JMIR Dermatology

Electronic, mobile, digital health approaches in cardiology and for cardiovascular health. Official partner journal of the European Congress on eCardiology and eHealth
Volume 4 (2021), Issue 1 ISSN: 2562-0959 Editor in Chief: Gunther Eysenbach, MD, MPH

Contents

Reviews

Google Trends in Dermatology: Scoping Review of the Literature (e27712)
Torunn Sivesind, Mindy Szeto, William Kim, Robert Dellavalle. 3

Does Wearing a Face Mask During the COVID-19 Pandemic Increase the Incidence of Dermatological Conditions in Health Care Workers? Narrative Literature Review (e22789)
Robyn-Jenia Wilcha. 146

Original Papers

Development of an mHealth App for Patients With Psoriasis Undergoing Biological Treatment: Participatory Design Study (e26673)
Bettina Trettin, Dorthe Danbjørg, Flemming Andersen, Steven Feldman, Hanne Agerskov. 13

A Sun Safety Pilot Program Using a Tanning Myths–Focused Video Contest for Utah Adolescents: Cross-sectional Analysis (e20192)
Amanda Truong, Brayden Forbes, Mingyuan Zhang, Molly McFadden, Stephanie Klein. 24

Association Between State Indoor Tanning Legislation and Google Search Trends Data in the United States From 2006 to 2019: Time-Series Analysis (e26707)
Carolyn Heckman, Yong Lin, Mary Riley, Yaqun Wang, Trishnee Bhurosy, Anna Mitarotondo, Baichen Xu, Jerod Stapleton. 33

Analysis of Keywords Used in Internet Searches for Melanoma Information: Observational Study (e25720)
Japbani Nanda, Jennifer Hay, Michael Marchetti. 39

Assessing Sunscreen Protection Using UV Photography: Descriptive Study (e24653)
Caitlin Horsham, Helen Ford, Jeremy Herbert, Alexander Wall, Sebastian Walpole, Elke Hacker. 46

Factors Contributing to Diagnostic Discordance Between Store-and-Forward Teledermatology Consultations and In-Person Visits: Case Series (e24820)
Michelle Lee, Robert Stavert. 57

Evaluating the Experiences of New and Existing Teledermatology Patients During the COVID-19 Pandemic: Cross-sectional Survey Study (e25999)
Judy Hamad, Amy Fox, Maria Kammire, Alison Hollis, Saif Khairat. 74

XSL•FO
RenderX

Patient Factors Associated with Interest in Teledermatology: Cross-sectional Survey (e21555)
Maham Ghani, Colin Adler, Howa Yeung. 83

Content in YouTube Videos for Rosacea: Cross-sectional Study (e24517)
Corey Basch, Priscila Laforet, Grace Hillyer, Erica Seidel, Christie Jaime. 94

Public Interest in a Potentially Harmful, Non–Evidence-Based "Wellness" Practice: Cross-Sectional Analysis of Perineum Sunning (e24124)
Ryan Ottwell, Micah Hartwell, Tracy Beswick, Taylor Rogers, Heather Ivy, Marcus Goodman, Matt Vassar. 100

Instagram Content Addressing Pruritic Urticarial Papules and Plaques of Pregnancy: Observational Study (e26200)
Ashley Payton, Benjamin Woo. 107

Risks and Benefits of Using Social Media in Dermatology: Cross-sectional Questionnaire Study (e24737)
Moshe Bressler, Eugene Grudnikoff, Yaakov Bressler, Rebecca Tamez, John Zampella. 114

Tetrahydrocannabinol and Skin Cancer: Analysis of YouTube Videos (e26564)
Andrina Mamo, Mindy Szeto, Roya Mirhossaini, Andrew Fortugno, Robert Dellavalle. 123

Tanning Misinformation Posted by Businesses on Social Media and Related Perceptions of Adolescent and Young Adult White Non-Hispanic Women: Mixed Methods Study (e25661)
Megan Moreno, Marina Jenkins, DeAnn Lazovich. 128

Nonprescription Products of Internet Retailers for the Prevention and Management of Herpes Zoster and Postherpetic Neuralgia: Analysis of Consumer Reviews on Amazon (e24971)
Pengyi Zhu, Benjamin Woo. 138

Corrigenda and Addenda

Correction: Association Between State Indoor Tanning Legislation and Google Search Trends Data in the United States From 2006 to 2019: Time-Series Analysis (e29516)
Carolyn Heckman, Yong Lin, Mary Riley, Yaqun Wang, Trishnee Bhurosy, Anna Mitarotondo, Baichen Xu, Jerod Stapleton. 92

XSL•FO
RenderX

Review

Google Trends in Dermatology: Scoping Review of the Literature

Torunn Elise Sivesind[1], MD; Mindy D Szeto[1], MS; William Kim[2], MA; Robert Paul Dellavalle[1,3], MD, MSPH, PhD

[1]Department of Dermatology, University of Colorado School of Medicine, Aurora, CO, United States
[2]University of Colorado School of Medicine, Aurora, CO, United States
[3]Dermatology Service, Rocky Mountain Regional VA Medical Center, Aurora, CO, United States

Corresponding Author:
Robert Paul Dellavalle, MD, MSPH, PhD
Department of Dermatology
University of Colorado School of Medicine
1665 Aurora Ct
Aurora, CO, 80045
United States
Phone: 1 720 857 5562
Fax: 1 720 723 7876
Email: robert.dellavalle@cuanschutz.edu

Abstract

Background: Google Trends is a powerful online database and analytics tool of popular Google search queries over time and has the potential to inform medical practice and priorities.

Objective: This review aimed to survey Google Trends literature in dermatology and elucidate its current roles and relationships with the field.

Methods: A literature search was performed using PubMed to access and review relevant dermatology-related Google Trends studies published within the last 5 years.

Results: Current research utilizing Google Trends data provides insight related to skin cancer, pruritus, cosmetic procedures, and COVID-19. We also found that dermatology is presently the highest-searched medical specialty—among 15 medical and surgical specialties as well as general practitioners. Google searches related to dermatology demonstrate a seasonal nature for various skin conditions and sun-related topics, depending on a region's inherent climate and hemi-sphere. In addition, celebrity social media and other viral posts have been found to potentiate Google searches about dermatology and drive public interest.

Conclusions: A limited number of relevant studies may have been omitted by the simplified search strategy of this study, as well as by restriction to English language articles and articles indexed in the PubMed database. This could be expanded upon in a secondary systematic review. Future re-search is warranted to better understand how Google Trends can be utilized to improve the quality of clinic visits, drive public health campaigns, and detect disease clusters in real time.

(JMIR Dermatol 2021;4(1):e27712) doi:10.2196/27712

KEYWORDS

Google Trends; search trends; internet; infodemiology; infoveillance; search terms; dermatology; skin cancer; databases

Introduction

Google Trends is an online database and analytics tool provided by Google (Google LLC, Mountain View, CA) that reports the relative popularity of a particular search term on Google compared to the peak number of Google searches related to that term over a certain period of time [1,2]. A search volume index (SVI) between 0 to 100 is then generated [2,3], reflecting trends and peak popularity for the term over a given timespan. Data are normalized by Google Trends such that ratios are created, which relate the search volume of an individual search term to the aggregate search volume for all queries, for a given geographic location and time range. These ratios are then proportionally transformed to a scale of 0 to 100 based on a search term's relative magnitude compared to all searches [2,4].

It is also possible to find the true search volume (rather than relative volume) by using the Google Keyword Planner [4], which allows one to assess a particular term for its total number of Google searches over a specified timeframe in a specific location. Patterns and changes in topic popularity may be examined via investigating different time periods or different locations after separately downloading each result and then

XSL•FO
RenderX

comparing these side-by-side. In a similar manner, it is also possible to compare the relative popularity of topics by conducting separate searches utilizing different search terms.

Recently, many medical specialties, including dermatology, have started using Google Trends data to better understand population interest in various topics, such as sunscreen, sunburn, skin cancer, and melanoma [1]. Knowledge gained from Google Trends has the potential to guide public health interventions, improve patient education, and tailor health care to patient concerns. Google Trends data are of particular interest to the field of dermatology; in a 2018 study, Ransohoff and Sarin [5] found that, among medical specialists and general practitioners, the most frequently searched physicians were dermatologists.

This study was undertaken to provide a scoping [6] preliminary review of literature in the field of dermatology that highlights the use of Google Trends, to elucidate the current relationship between dermatology and Google Trends, describe limitations of its use, and guide future directions for research and application to patient care.

Methods

A literature review was performed using the PubMed database to tabulate the total number of Google Trends studies from 2016 to 2020. To isolate the relevant dermatology-related publications, the following search string was utilized on August 4, 2020, resulting in 53 articles for initial screening: ((((“Dermatology”[Mesh]) OR “Skin Diseases”[Mesh]) OR “Cosmetic Techniques”[Mesh]) OR “Cosmeceuticals”[Mesh]) AND (google trends AND (y_5[Filter])). The search term “y_5” was included to filter articles published within the last 5 years (2016-2020). Screening of title and abstract for these articles was performed independently by 2 authors with education and experience in dermatology (TS, WK), and of these, 26 were ultimately chosen for inclusion in this review after determination of relevance.

Results

The total number of Google Trends publications over the last 5 years, along with the dermatology-related subset of 26 articles screened is displayed and tabulated by year in Multimedia Appendix 1.

Summary information for the 26 dermatology-specific articles included in this review is captured in Table 1.

XSL•FO
RenderX

Table 1. Summary of dermatology-related Google Trends publications (2016-2020) included in the review.

Topic and article citation	Google Trends location(s) analyzed	Key findings
Skin-related topics of public interest		
Ransohoff JD, Sarin KY. Referred by Google: mining Google Trends data to identify patterns in and correlates to searches for dermatological concerns and providers. Br J Dermatol; 2018 [5]	US, UK, South Africa, Singapore, worldwide	During the study window (September 2011-September 2016), searches originating in the United States revealed that dermatology is the most frequently searched medical specialty, followed by psychiatry and ophthalmology. This correlates with the proportion of self-referred patients, not with overall volume of visits. Countries in the southern hemisphere, such as South Africa, demonstrate a reversed seasonal search trend for dermatologists compared to countries in the northern hemisphere. Countries without distinct seasons, such as Singapore, had no seasonal variation in searches.
Hopkins ZH, Secrest AM. An international comparison of Google searches for sunscreen, sunburn, skin cancer, and melanoma: Current trends and public health implications. Photodermatol Photoimmunol Photomed; 2019 [1]	US, UK, Canada, Australia, New Zealand	From January 1, 2004 to December 31, 2017, sunscreen and sunburn had the highest intraterm correlation, with both searches rising. Searches for skin cancer and melanoma decreased during the study window for all countries except New Zealand and the United Kingdom. Countries with rising rates of melanoma displayed higher searches for all terms. Recommended online skin cancer prevention campaigns use the search terms “sunburn” and “sunscreen.”
Seidl S, Schuster B, Rüth M, Biedermann T, Zink A. What do Germans want to know about skin cancer? A nationwide Google search analysis from 2013 to 2017. J Med Internet Res; 2018 [7]	Germany	From November 2013 to October 2017, the highest volume search terms related to nonmelanoma skin cancer and melanoma included “skin cancer,” “white skin cancer,” “basalioma,” and “melanoma.” The most-searched anatomic area of nonmelanoma skin cancer was ““nose” and for melanoma, “nails.” This suggested that this information can be utilized to focus educational campaigns.
Callaghan DJ. Use of Google Trends to examine interest in Mohs micrographic surgery: 2004 to 2016. Dermatol Surg; 2018 [8]	US	During the study window (2004-2016), there was a rise in searches for “Mohs surgery,” positively correlated with a rise in the SVI[a] for “basal cell carcinoma” and “squamous cell carcinoma,” but without a similar correlation for “melanoma” or “skin cancer.”
Huang X, Baade P, Youlden DR, Youl PH, Hu W, Kimlin MG. Google as a cancer control tool in Queensland. BMC Cancer; 2017 [9]	Australia	Increases in the monthly ASR[b] for breast cancer, melanoma, and prostate cancer were significantly correlated with increases in monthly SVIs. Colorectal cancer did not show this significant correlation. However, the predictive powder of SVIs to account for ASR variances was different for each cancer type, suggesting that more research is needed for internet search–based cancer surveillance.
Zink A, Schuster B, Rüth M, Pereira MP, Philipp-Dormston WG, Biedermann T, Ständer S. Medical needs and major complaints related to pruritus in Germany: a 4-year retrospective analysis using Google AdWords Keyword Planner. J Eur Acad Dermatol Venereol; 2019 [10]	Germany	During the study window (June 2013-April 2017), the most searched German language Google terms on the topic of pruritus included “atopic eczema,” the lay term for psoriasis; “Schuppenflechte”; and “psoriasis.” A seasonal trend was noted, with the lowest searches for pruritus occurring in the summer.
Motosko C, Zakhem G, Ho R, Saadeh P, Hazen A. Using Google to trend patient interest in botulinum toxin and hyaluronic acid fillers. J Drugs Dermatol; 2018 [11]	US	Search volume for queries related to neuromodulators and hyaluronic acid–based fillers was positively correlated with the number of procedures performed in the same year and year prior.
Wang S, Manudhane A, Ezaldein HH, Scott JF. A review of the FDA's 510(k) approvals process for electromagnetic devices used in body contouring. J Dermatolog Treat; 2019 [12]	US	Google Trends SVI for the term “Emsculpt” grew during 2018, reaching a peak in July.
Seth D, Wang S, Ezaldein HH, Merati M, Scott JF. Over-the-counter light therapy for acne: a cross-sectional retrospective analysis. Dermatol Online J; 2019 [13]	US	During the study window (2010-2018), SVI for “acne light therapy mask” peaked in 2016.

XSL•FO
RenderX

Topic and article citation	Google Trends location(s) analyzed	Key findings
Dey M, Zhao SS. COVID-19 and Kawasaki disease: an analysis using Google Trends. Clin Rheumatol; 2020 [14]	Worldwide	Searches for "Kawasaki disease" rose sharply in April 2020; "Kawasaki disease" SVI was highest in Europe, possibly reflecting pediatric manifestation of COVID-19 in European populations. This suggests the use of Google Trends to detect disease clusters in real time.
Seasonality of searches		
Kardeş S. Seasonal variation in the internet searches for psoriasis. Arch Dermatol Res; 2019 [15]	US, UK, Canada, Ireland, Australia, New Zealand	Public interest in psoriasis-related information shows seasonal variability, with interest peaking in late winter and early spring.
Zink A, Schuster B, Rüth M, Pereira MP, Philipp-Dormston WG, Biedermann T, Ständer S. Medical needs and major complaints related to pruritus in Germany: a 4-year retrospective analysis using Google AdWords Keyword Planner. J Eur Acad Dermatol Venereol; 2019 [10]	Germany	During the study window (June 2013-April 2017), the most searched German language Google terms on the topic of pruritus included "atopic eczema," the lay term for psoriasis" "Schuppenflechte"; and "psoriasis." A seasonal trend was noted, with the lowest searches for pruritus occurring in the summer.
Tizek L, Schielein M, Rüth M, Ständer S, Pereira MP, Eberlein B, Biedermann T, Zink A. Influence of Climate on Google Internet Searches for Pruritus Across 16 German Cities: Retrospective Analysis. J Med Internet Res; 2019 [16]	Germany	Between August 2014 and July 2018, "pruritis" and "anal pruritis" were the most searched terms for the topic of pruritis, with more searches related to chronic than to acute pruritis. Temperature had a larger effect on searches than particle matter, humidity, and sunshine duration, with a peak in searches during winter.
Kirchberger MC, Kirchberger LF, Eigentler TK, Reinhard R, Berking C, Schuler G, Heinzerling L, Heppt MV. Interest in tanning beds and sunscreen in German-speaking countries. J Dtsch Dermatol Ges; 2017 [17]	Germany, Austria, Switzerland	During the study window (2004-2016), worldwide searches for sunscreen increased, while tanning bed searches decreased. Conversely, for German-speaking countries, there were more searches for tanning beds than for sunscreen. More education regarding prevention of UV[c] damage is needed for those residing in German-speaking countries.
Toosi B, Kalia S. Seasonal and geographic patterns in tanning using real-time data from Google Trends. JAMA Dermatol; 2016 [18]	Canada, US, Australia	Public interest in tanning salons and tanning beds has been declining since 2010 in Canada and since 2012 in the United States and Australia. Interest in tanning is seasonal — highest in March in the northern hemisphere, highest in September in the southern hemisphere.
Ransohoff JD, Sarin KY. Referred by Google: mining Google Trends data to identify patterns in and correlates to searches for dermatological concerns and providers. Br J Dermatol; 2018 [5]	US, UK, South Africa, Singapore, worldwide	During the study window (September 2011-September 2016), searches originating in the United States revealed that dermatology is the most frequently searched medical specialty, followed by psychiatry and ophthalmology. This correlates with the proportion of self-referred patients, not with overall volume of visits. Countries in the southern hemisphere, such as South Africa, demonstrate a reversed seasonal search trend for dermatologists compared to countries in the northern hemisphere. Countries without distinct seasons, such as Singapore, were found to have no seasonal variation in searches.
Kluger N. Insights into worldwide interest in tattoos using Google Trends. Dermatology; 2019 [19]	Worldwide	Public interest in tattoos increased steadily during the study window (January 2004-December 2018). Interest in tattoos demonstrates a seasonal pattern, peaking in the summer months.
Celaj S, Deng J, Murphy BL, Kundu RV. Analysis of population inquiry on practices for ultraviolet radiation protection. Dermatol Online J; 2017 [20]	US	During the study window (2004-2015), "broad spectrum sunscreen" SVI was highest in June and lowest in winter. After an FDA[d] announcement in 2011 regarding broad spectrum sunscreen labeling, the SVI for "broad spectrum sunscreen" increased. The "sunblock" and "sunscreen" SVIs were highest in June and lowest in December but were not affected by the FDA 2011 announcement. This suggests that Google Trends can be utilized to monitor campaigns or public health policy changes similar to the 2011 FDA announcement.

XSL•FO
RenderX

Topic and article citation	Google Trends location(s) analyzed	Key findings
Kluger N, Bouchard LJ. A comparative study of Google Search trends for melanoma, breast cancer and prostate cancer in Finland. Dermatology; 2019 [21]	Finland-based; included data from Belgium, Italy, Portugal, and Sweden	Compared public interest in melanoma to breast and prostate cancer, using Google Trends (January 1, 2010-January 1, 2019). The "melanoma" SVI was maximal in early summer. SVI peaks for the terms related to breast and prostate cancer were positively correlated with awareness campaigns for those diseases. This suggests a second public health campaign for melanoma awareness should be timed during winter (lowest public interest period).
Xu S, Thyssen JP, Paller AS, Silverberg JI. Eczema, atopic dermatitis, or atopic eczema: analysis of global search engine trends. Dermatitis; 2017 [22]	English, Russian, Japanese, Turkish, German (specified languages searched)	From 2014 to 2016, searches for eczema increased, while "atopic dermatitis" and "atopic eczema" searches remained stable. Authors recommended the universal use of "atopic dermatitis" rather than "eczema" due to the term's ambiguous nature. Seasonal climate changes were associated with flares of severity for atopic dermatitis and corresponded with search trends.
Hsiang EY, Semenov YR, Aguh C, Kwatra SG. Seasonality of hair loss: a time series analysis of Google Trends data 2004-2016. Br J Dermatol; 2018 [3]	8 English-speaking countries (did not specify)	SVI for terms related to hair loss demonstrated seasonality, with peaks in summer and autumn. This suggests symptoms of hair loss are greatest in summer and autumn.
Social media's impact on searches		
Ward B, Ward M, Paskhover B. Google Trends as a resource for informing plastic surgery marketing decisions. Aesthetic Plast Surg; 2018 [23]	US	Highly publicized plastic surgery events and celebrity social media posts have a significant impact on search volume for related topics.
Noar SM, Leas E, Althouse BM, Dredze M, Kelley D, Ayers JW. Can a selfie promote public engagement with skin cancer? Prev Med; 2018 [24]	US	Searches related to skin cancer, skin cancer prevention, and tanning increased during the period May 13-17, 2005, after a cancer selfie Facebook post went viral. This suggests that public health practitioners can utilize Google Trends to build on viral posts in real time to potentiate positive health benefits.
Limitations and strengths of Google Trends		
Martinez-Lopez A, Ruiz-Villaverde R, Molina-Leyva A. Google search trends in psoriasis: a pilot evaluation of global population interests. J Eur Acad Dermatol Venereol; 2018 [25]	Worldwide	This was a pilot study to assess primary topics of interest to those with psoriasis. The search term with the most growth during the period 2004-2016 was "kim kardashian psoriasis."
Kluger N. Tattoo side effects worldwide: a Google Trends-based time series analysis. Acta Dermatovenerol Alp Pannonica Adriat; 2019 [26]	Worldwide	SVI for tattoo-related symptoms increased during the study window (January 1, 2004-December 31, 2018).
Corazza M, Amendolagine G, Musmeci D, Forconi R, Borghi A. Sometimes even Dr Google is wrong: An unusual contact dermatitis caused by benzoyl peroxide. Contact Dermatitis; 2018 [27]	Italy	The study compared SVI for 3 chronic diseases to searches for "dermatitis," noting that only "diabetes" was searched more frequently than "dermatitis." This demonstrates likelihood of self-diagnosis of dermatitis via the internet. Search volume for the medication Benzac peaked in autumn and winter, aligning with seasonal acne flares.
Hessam S, Salem J, Bechara FG, Haferkamp A, Heidenreich A, Paffenholz P, Sand M, Tsaur I, Borgmann H. Hidradenitis suppurativa gains increasing interest on World Wide Web: a source for patient information? Int J Dermatol; 2017 [28]	Worldwide	Search queries related to HS[e] have risen over the last decade. HS-related website analysis demonstrates a need for improvement in quality and readability to raise disease awareness and allow earlier patient presentation for undiagnosed patients.
Lospinoso DJ, Lospinoso JA, Miletta NR. The impact of ultraviolet radiation on sunburn-related search activity. Dermatol Online J; 2017 [29]	US	A strong positive association between the UV index and SVI for sunburn-related terms was demonstrated. This suggests tracking search terms for sun protective measures as an indication of public awareness and efficacy of public health programs.

[a]SVI: search volume index.

[b]ASR: age-standardized incidence rate.

[c]UV: ultraviolet.

[d]FDA: Food and Drug Administration.

[e]HS: hidradenitis suppurativa.

XSL•FO
RenderX

Discussion

Skin-Related Topics of Public Interest

Notably, dermatology was reported by Ransohoff and Sarin [5] to be the most searched medical specialty in a comparative study of 15 medical specialties. To compare relative specialist popularity using Google Trends data, the study [5] used the search term "physician," to enable all specialist search terms to be normalized to the SVI of this term (the most popular term) and thus enabled an accurate comparison across all 15 physician specialties. However, the study by Ransohoff and Sarin [5] also found that, despite being the most searched specialty, dermatology ranked sixth in number of clinic visits per specialty and revealed that dermatologists had one of the highest percentages of self-referred patients. The authors concluded that the high rate of dermatology Google searches correlates with the proportion of self-referred patients rather than the number of clinic visits, and therefore, changes in online search volume may better reflect how patients initiate care with dermatologists rather than demonstrate real-time vacillations in clinic volume [5].

Several papers also describe the use of Google Trends to gather information about user searches related to skin cancer and skin cancer prevention. Google Trends searches for "sunscreen" and "sunburn" are growing in the United States, United Kingdom, Canada, Australia, and New Zealand [1]. Conversely, searches for "skin cancer" and "melanoma" are declining for one or both terms in the United States, Canada, and Australia [1].

In Germany, the most searched term in the skin cancer–related category was "forms of skin cancer," followed by "skin alterations" [7]. Seidl et al [7] also noted that the most searched anatomic locations of melanoma were "nails" and "eyes," while for nonmelanoma skin cancer, the most searched locations were "nose" and "face." A 2018 study [8] of US-based Google searches discovered that the search terms "Mohs surgery," "basal cell carcinoma," and "squamous cell carcinoma" rose during the years 2004 to 2016. This finding aligns with a rise in the use of Mohs micrographic surgery during this time, according to reports from Medicare and the National Ambulatory Medical Survey [8].

A study by Huang et al [9] using data from the Queensland Cancer Registry from January 2006 to December 2012 reported that increases in the monthly age-standardized incidence rates (ASR) for melanoma correlated with increases in the monthly SVI for search terms "skin cancer" and "melanoma." Additionally, through use of a multiple linear regression model, Huang et al [9] reported that the predictive power of the "skin cancer" SVI to explain variance in melanoma ASR was 17.9%, noting that the search term "skin cancer" includes both melanoma and keratinocyte carcinomas and thus may better predict rates of melanoma than the specific search term "melanoma," since online users may not be able to distinguish different skin cancer types when performing Google searches.

Google Trends has also been utilized to study pruritus. According to a 2019 study conducted in Germany by Zink et al [10] that utilized the Google Keywords Planner to determine search volume, it was discovered that for German language Google searches regarding pruritus, the most searched terms included "atopic eczema" (24.3%), the common term for psoriasis, "Schuppenflechte" (17.8%), "psoriasis" (13.4%), and the German word for pruritus, "Juckreiz" (2.9%).

Gauging public interest in certain cosmetic procedures and treatments is another application of Google Trends data. A 2018 study by Motosko et al [11] found that the number of procedures employing botulinum toxin and/or hyaluronic acid–derived fillers correlated significantly with the search volume for related search terms over the period spanning 2005 to 2016, while Wang et al [12] noted search volume expansion for "Emsculpt," a body contouring technique, during 2018. Similarly, a study by Seth et al [13] reported an increase in the search term "acne light therapy mask" in 2016, reflecting a parallel increase in public interest in light-emitting diode therapy for inflammatory acne.

Of particular interest given the currently evolving pandemic, a 2020 study by Dey and Zhao [14] examined the relationship between COVID-19 and Kawasaki disease using Google Trends data. The study found that the search frequencies of Kawasaki disease in 2019 and 2020 were similar until April 2020, when reports of a Kawasaki-like disease in children with COVID-19 emerged. From February to May 2019, searches for Kawasaki disease were highest in Indonesia, the Philippines, and Malaysia — regions where the disease is more commonly found. However, from February to May 2020, searches for Kawasaki disease were highest in France, Switzerland, and Italy, a finding that reflects our current knowledge of the multisystem inflammatory syndrome in children (MIS-C), associated with COVID-19 and aligning with MIS-C clusters in Europe during this time [22,30]. While popularity of search terms may be confounded by news or social media–driven popularity, Dey and Zhao [14] noted that the association revealed through Google Trends data could highlight its potential future utility in identifying real-time disease clusters.

Seasonality of Searches

Google searches related to dermatology demonstrate a seasonal nature for several skin diseases. A 2019 study by Kardeş [15] found that searches for "psoriasis" were elevated in the late winter and early spring and were lower in the late summer and early fall, with statistically significant results from the United Kingdom, Canada, Ireland, Australia, and New Zealand and noted a trend toward seasonal variation in US-based searches.

In Germany, Google searches for "pruritus" were lowest in the summer [10] and highest in the winter [16]. Additionally, "tanning bed" was searched most in March and May, while "sunscreen" search volume was highest in June [17]. Toosi and Kalia [18] reported that public interest in tanning for Canada and the United States was highest in March and for Australia, was highest in September. Countries in the southern hemisphere, such as South Africa, demonstrate a reversed seasonal search trend compared to countries in the northern hemisphere; countries without distinct seasons, such as Singapore, were found to have no seasonal variation in searches [5]. According to Kluger [19], the term "tattoo" was searched most during the summer and least during winter: Searches for the term "tattoo"

XSL•FO
RenderX

are highest from July to August in the northern hemisphere and reach a peak in January for regions in the southern hemisphere. Interestingly, Kluger [26] found that searches for symptoms of tattoo-related complications, such as pruritus and induration, rose during the period 2004 through 2018 inclusive — however, interpretation of these results is difficult, as the search volume increase could reflect either a real increase in tattoo side effects or be secondary to rising popularity of tattoos [26].

Search patterns for sunscreen in the United States have shown similar seasonal trends [20]. A US-based study found the search terms "skin cancer" and "tanning" were highest in the early summer months, while "sunburn" was highest in the late summer; the monthly timing of these trends was noted to be reversed in countries of the southern hemisphere, such as South Africa [5]. "Melanoma" was found to have the highest searches in the early summer months of either hemisphere [5,21].

In a study of worldwide Google Trends data spanning 5 languages, 4 of these demonstrated peaks in SVI for the term "eczema" in line with seasonal climate changes that are associated with flares of severity for atopic dermatitis, speaking to both the seasonality of searches and to the widespread usage of "eczema" as a synonym for atopic dermatitis [31]. Hsiang et al [3] studied "hair loss" search volume, with data from the top 4 most populous countries of both hemispheres and observed the highest SVI occurred in the summer and autumn, with the lowest search volume corresponding to the spring. The authors noted these results suggest a correlative relationship between hair loss and seasonality and that hair loss is greatest in the summer and autumn. This is in line with other studies that have noted the percentage of telogen phase hairs peaks in the late summer, with a smaller peak in the spring, and therefore, maximal hair loss occurs at the end of summer and during the fall [32].

Social Media's Impact on Searches

Social media has been found to influence dermatology-related search volume on Google. A 2018 study by Ward et al [23] found that the average interest level of fillers increased by 30.31 points (relative to a maximum SVI of 100) in the time period after Kylie Jenner stated that she underwent lip augmentation with Juvederm in April 2015, compared to searches conducted in the period prior (January 2004 through March 2015). Additionally, a study by Noar et al [24] noted that after a highly graphic skin cancer selfie went viral on Facebook, all search queries for skin cancer, skin cancer prevention, and tanning significantly increased, with May 13, 14, and 15 of 2017 being the 6th, 8th, and 40th most searched days for skin cancer since the inception of Google Trends on January 1, 2004.

Limitations and Strengths of Google Trends

The main limitation of utilizing Google Trends to accurately assess public interest in a certain dermatologic topic is that it relies on the ability to access the internet, which is variable [25,26]. Individuals who are of lower socioeconomic status and educational background may not have access to a computer or smart device through which they can use Google. Additionally, individuals who are of older age may choose not to use a computer and thus would not use Google. As a result, certain groups of individuals who may be at higher risk for particular dermatologic conditions may not use Google and are omitted from Google Trends. This would imply that the dermatologic interests of people in older age groups or lower socioeconomic status may not be accurately or fully represented in Google Trends data, which could bias the information it presents and limits extrapolation to the broader population.

Thus, while Google Trends is a powerful tool for assessing the public's dermatologic interest, it is important to consider which populations are unequally represented with this instrument and find other tools to fill these gaps. While Google accounts for approximately 91% of the market share of online searches worldwide (according to available data from January 2021), it is vital to note that search engines other than Google may be utilized, along with specific health information websites; therefore, analysis of a variety of search engines could potentially capture a more complete picture of current trends in skin-related topics of public interest.

Nevertheless, Google Trends may be a useful tool for dermatologists to gauge areas of skin concern and topics of interest, as patients may perform searches on Google for questions they are not comfortable asking their dermatologists in a clinic visit [11]. Additionally, the increasing use of Google to search skin diseases may highlight the increased prevalence of self-diagnosis and self-treatment [27,28]. Therefore, it could be useful for professional medical organizations to take note of which skin diseases and dermatology-related terms are most often searched and to notify individual dermatologists, who could then dedicate additional time to patient education, reaffirm facts, and dispel misconceptions and misinformation.

One potential public health benefit of Google Trends would be to focus on highly searched terms in order to guide and drive health campaigns. For example, in 2019, Hopkins and Secrest [1] recommended online skin cancer prevention campaigns to focus on the search terms "sunburn" and "sunscreen" as these 2 terms have demonstrated increasing search frequency from 2004 to 2016. These public health campaigns can be specifically tailored to complement and make the most of current public interest [7]. Frequency of searched terms can serve as a proxy for public awareness and speak to the efficacy of public health programs [29].

Another possible use of Google Trends is for dermatologists to quickly detect the presence of viral social media content related to dermatology, such as the skin cancer selfie that went viral on Facebook in 2017, and to then engage with the online public and utilize this viral content to strengthen public health campaigns [24]. Lastly, as the study by Dey and Zhao [14] of COVID-10 and Kawasaki-like disease illustrates, Google Trends has the potential to be utilized in identifying disease clusters in real time, meriting further research to better understand how dermatology may leverage this tool in early identification of public health concerns in the future.

Limitations of This Scoping Review

Limitations of this review article include its simplified search strategy, which included only English language publications, restriction to the PubMed database, and lack of previous studies

XSL•FO
RenderX

examining Google Trends and dermatology. Google Trends is a relatively new tool (2006 conception), and therefore, not many dermatology publications highlight the use of Google Trends in dermatology. For example, in 2020, there was only 1 dermatology Google Trends publication out of 174 total publications discussing Google Trends, as illustrated in Multimedia Appendix 1. This highlights the gap in prior literature on the intersection of these 2 topics, which weakens the conclusions we can generate from existing research. While we lay the groundwork with this survey and scoping review of related literature [6], in order to better assess the utility of Google Trends in dermatology, further research in this area is required.

Summary

Review of the literature illustrates that assessment of Google Trends data related to dermatology has been studied, with topics including skin cancer, pruritus, cosmetic procedures, social media, clinic visits, and the associated Kawasaki-like disease of COVID-19 (MIS-C). Additionally, a seasonal nature of search terms has been widely reported in the literature, varying according to hemisphere. The main limitation of Google Trends as a research tool is access to and use of the internet. Further research is needed to better understand how this search tool can be utilized to improve the quality of clinic visits, drive public health campaigns, and detect disease clusters in real time.

Conflicts of Interest

RD is a Joint Coordinating Editor for Cochrane Skin, Editor in Chief of JMIR Dermatology, a dermatology section editor for UpToDate, a Social Media Editor for the Journal of the American Academy of Dermatology (JAAD), and a Podcast Editor for the Journal of Investigative Dermatology (JID). He is a coordinating editor representative on Cochrane Council. TS is a section editor for JMIR Dermatology. RD receives editorial stipends (JAAD, JID), royalties (UpToDate), and expense reimbursement from Cochrane Skin. TS receives fellowship funding from the Pfizer Global Medical Grant (58858477) Dermatology Fellowship 2020 (principal investigator: RD) and serves on the Medical Advisory Board of Antedotum Inc.

RD receives editorial stipends (JAAD, JID), royalties (UpToDate), and expense reimbursement from Cochrane Skin. TS receives fellowship funding from the Pfizer Global Medical Grant (58858477) Dermatology Fellowship 2020 (principal investigator: RD) and serves on the Medical Advisory Board of Antedotum Inc.

Multimedia Appendix 1
Number of dermatology-related publications compared to the total number of Google Trends publications by year (2016-2020). [PNG File , 77 KB - derma_v4i1e27712_app1.png]

References

1. Hopkins ZH, Secrest AM. An international comparison of Google searches for sunscreen, sunburn, skin cancer, and melanoma: Current trends and public health implications. Photodermatol Photoimmunol Photomed 2019 Mar;35(2):87-92. [doi: 10.1111/phpp.12425] [Medline: 30198586]
2. Google L. FAQ about Google Trends data: how is google trends data normalized? Trends Help. URL: https://support.google.com/trends/answer/4365533?hl=en&ref_topic=6248052 [accessed 2021-05-08] [WebCite Cache ID 73eSYBJXk]
3. Hsiang EY, Semenov YR, Aguh C, Kwatra SG. Seasonality of hair loss: a time series analysis of Google Trends data 2004-2016. Br J Dermatol 2018 Apr;178(4):978-979. [doi: 10.1111/bjd.16075] [Medline: 29048738]
4. Churick N. How to Use Google Trends for Keyword Research: 7 Effective Ways. ahrefs blog. 2019 Dec 30. URL: https://ahrefs.com/blog/how-to-use-google-trends-for-keyword-research/ [accessed 2021-05-08]
5. Ransohoff JD, Sarin KY. Referred by Google: mining Google Trends data to identify patterns in and correlates to searches for dermatological concerns and providers. Br J Dermatol 2018 Mar;178(3):794-795. [doi: 10.1111/bjd.15491] [Medline: 28338220]
6. Munn Z, Peters MDJ, Stern C, Tufanaru C, McArthur A, Aromataris E. Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. BMC Med Res Methodol 2018 Nov 19;18(1):143 [FREE Full text] [doi: 10.1186/s12874-018-0611-x] [Medline: 30453902]
7. Seidl S, Schuster B, Rüth M, Biedermann T, Zink A. What Do Germans Want to Know About Skin Cancer? A Nationwide Google Search Analysis From 2013 to 2017. J Med Internet Res 2018 May 02;20(5):e10327 [FREE Full text] [doi: 10.2196/10327] [Medline: 29698213]
8. Callaghan DJ. Use of Google Trends to Examine Interest in Mohs Micrographic Surgery: 2004 to 2016. Dermatol Surg 2018 Feb;44(2):186-192. [doi: 10.1097/DSS.0000000000001270] [Medline: 28930787]
9. Huang X, Baade P, Youlden DR, Youl PH, Hu W, Kimlin MG. Google as a cancer control tool in Queensland. BMC Cancer 2017 Dec 04;17(1):816 [FREE Full text] [doi: 10.1186/s12885-017-3828-x] [Medline: 29202718]
10. Zink A, Schuster B, Rüth M, Pereira MP, Philipp-Dormston WG, Biedermann T, et al. Medical needs and major complaints related to pruritus in Germany: a 4-year retrospective analysis using Google AdWords Keyword Planner. J Eur Acad Dermatol Venereol 2019 Jan;33(1):151-156. [doi: 10.1111/jdv.15200] [Medline: 30067284]
11. Motosko C, Zakhem G, Ho R, Saadeh P, Hazen A. Using Google to Trend Patient Interest in Botulinum Toxin and Hyaluronic Acid Fillers. J Drugs Dermatol 2018 Nov 01;17(11):1245-1246. [Medline: 30500150]

XSL•FO
RenderX

12. Wang S, Manudhane A, Ezaldein HH, Scott JF. A review of the FDA's 510(k) approvals process for electromagnetic devices used in body contouring. J Dermatolog Treat 2019 Nov;30(7):727-729. [doi: 10.1080/09546634.2019.1566589] [Medline: 30614316]
13. Seth D, Wang S, Ezaldein HH, Merati M, Scott JF. Over-the-counter light therapy for acne: a cross-sectional retrospective analysis. Dermatol Online J 2019 Jan 15;25(1):13030. [Medline: 30710908]
14. Dey M, Zhao SS. COVID-19 and Kawasaki disease: an analysis using Google Trends. Clin Rheumatol 2020 Aug;39(8):2483-2484 [FREE Full text] [doi: 10.1007/s10067-020-05231-z] [Medline: 32557254]
15. Kardeş S. Seasonal variation in the internet searches for psoriasis. Arch Dermatol Res 2019 Aug;311(6):461-467. [doi: 10.1007/s00403-019-01921-0] [Medline: 31025101]
16. Tizek L, Schielein M, Rüth M, Ständer S, Pereira MP, Eberlein B, et al. Influence of Climate on Google Internet Searches for Pruritus Across 16 German Cities: Retrospective Analysis. J Med Internet Res 2019 Jul 12;21(7):e13739 [FREE Full text] [doi: 10.2196/13739] [Medline: 31301128]
17. Kirchberger MC, Kirchberger LF, Eigentler TK, Reinhard R, Berking C, Schuler G, et al. Interest in tanning beds and sunscreen in German-speaking countries. J Dtsch Dermatol Ges 2017 Dec;15(12):1192-1198. [doi: 10.1111/ddg.13380] [Medline: 29148618]
18. Toosi B, Kalia S. Seasonal and Geographic Patterns in Tanning Using Real-Time Data From Google Trends. JAMA Dermatol 2016 Feb;152(2):215-217. [doi: 10.1001/jamadermatol.2015.3008] [Medline: 26719968]
19. Kluger N. Insights into Worldwide Interest in Tattoos Using Google Trends. Dermatology 2019;235(3):240-242 [FREE Full text] [doi: 10.1159/000496986] [Medline: 30826808]
20. Celaj S, Deng J, Murphy BL, Kundu RV. Analysis of population inquiry on practices for ultraviolet radiation protection. Dermatol Online J 2017 Oct 15;23(10):13030 [FREE Full text] [Medline: 29469800]
21. Kluger N, Bouchard LJ. A Comparative Study of Google Search Trends for Melanoma, Breast Cancer and Prostate Cancer in Finland. Dermatology 2019;235(4):346-347 [FREE Full text] [doi: 10.1159/000498987] [Medline: 30999301]
22. Toubiana J, Poirault C, Corsia A, Bajolle F, Fourgeaud J, Angoulvant F, et al. Kawasaki-like multisystem inflammatory syndrome in children during the covid-19 pandemic in Paris, France: prospective observational study. BMJ 2020 Jun 03;369:m2094 [FREE Full text] [doi: 10.1136/bmj.m2094] [Medline: 32493739]
23. Ward B, Ward M, Paskhover B. Google Trends as a Resource for Informing Plastic Surgery Marketing Decisions. Aesthetic Plast Surg 2018 Apr;42(2):598-602. [doi: 10.1007/s00266-017-1019-4] [Medline: 29218476]
24. Noar SM, Leas E, Althouse BM, Dredze M, Kelley D, Ayers JW. Can a selfie promote public engagement with skin cancer? Prev Med 2018 Jun;111:280-283. [doi: 10.1016/j.ypmed.2017.10.038] [Medline: 29109014]
25. Martinez-Lopez A, Ruiz-Villaverde R, Molina-Leyva A. Google search trends in psoriasis: a pilot evaluation of global population interests. J Eur Acad Dermatol Venereol 2018 Oct;32(10):e370-e372. [doi: 10.1111/jdv.14944] [Medline: 29573479]
26. Kluger N. Tattoo side effects worldwide: a Google Trends-based time series analysis. Acta Dermatovenerol Alp Pannonica Adriat 2019 Sep;28(3):125-127 [FREE Full text] [Medline: 31545390]
27. Corazza M, Amendolagine G, Musmeci D, Forconi R, Borghi A. Sometimes even Dr Google is wrong: An unusual contact dermatitis caused by benzoyl peroxide. Contact Dermatitis 2018 Dec;79(6):380-381. [doi: 10.1111/cod.13086] [Medline: 30079477]
28. Hessam S, Salem J, Bechara FG, Haferkamp A, Heidenreich A, Paffenholz P, et al. Hidradenitis suppurativa gains increasing interest on World Wide Web: a source for patient information? Int J Dermatol 2017 Jul;56(7):726-732. [doi: 10.1111/ijd.13601] [Medline: 28321845]
29. Lospinoso DJ, Lospinoso JA, Miletta NR. The impact of ultraviolet radiation on sunburn-related search activity. Dermatol Online J 2017 Aug 15;23(8):13030 [FREE Full text] [Medline: 29469736]
30. Bautista-Rodriguez C, Sanchez-de-Toledo J, Clark BC, Herberg J, Bajolle F, Randanne PC, et al. Multisystem Inflammatory Syndrome in Children: An International Survey. Pediatrics 2021 Feb;147(2):e2020024554. [doi: 10.1542/peds.2020-024554] [Medline: 33234669]
31. Xu S, Thyssen JP, Paller AS, Silverberg JI. Eczema, Atopic Dermatitis, or Atopic Eczema: Analysis of Global Search Engine Trends. Dermatitis 2017;28(4):276-279. [doi: 10.1097/DER.0000000000000273] [Medline: 28722692]
32. Kunz M, Seifert B, Trüeb RM. Seasonality of hair shedding in healthy women complaining of hair loss. Dermatology 2009;219(2):105-110. [doi: 10.1159/000216832] [Medline: 19407435]

Abbreviations

ASR: age-standardized incidence rate
MIS-C: multisystem inflammatory syndrome in children
SVI: search volume index

XSL•FO
RenderX

Edited by G Eysenbach; submitted 03.02.21; peer-reviewed by S Kardes, J Solomon, C Ellis; comments to author 03.03.21; revised version received 27.04.21; accepted 29.04.21; published 25.05.21.

Please cite as:
Sivesind TE, Szeto MD, Kim W, Dellavalle RP
Google Trends in Dermatology: Scoping Review of the Literature
JMIR Dermatol 2021;4(1):e27712
URL: https://derma.jmir.org/2021/1/e27712
doi:10.2196/27712
PMID:

©Torunn Elise Sivesind, Mindy D Szeto, William Kim, Robert Paul Dellavalle. Originally published in JMIR Dermatology (http://derma.jmir.org), 25.05.2021. This is an open-access article distributed under the terms of the Creative Commons Attribution License (https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work, first published in JMIR Dermatology Research, is properly cited. The complete bibliographic information, a link to the original publication on http://derma.jmir.org, as well as this copyright and license information must be included.

XSL•FO
RenderX

Original Paper

Development of an mHealth App for Patients With Psoriasis Undergoing Biological Treatment: Participatory Design Study

Bettina Trettin[1,2,3], RN, MSc; Dorthe Boe Danbjørg[3], RN, MSc, PhD; Flemming Andersen[3,4,5], PhD, MD; Steven Feldman[6], PhD, Prof Dr, MD; Hanne Agerskov[3,7], RN, MSc, PhD

[1]Centre for Innovative Medical Technology, Odense University Hospital, Odense, Denmark
[2]Department of Dermatology and Allergy Centre, Odense University Hospital, Odense, Denmark
[3]Department of Clinical Research, University of Southern Denmark, Odense, Denmark
[4]Private Hospital Molholm, Vejle, Denmark
[5]Department of Dermatology, Aalborg University Hospital, Aalborg, Denmark
[6]Center for Dermatology Research, Wake Forest School of Medicine, Winston-Salem, NC, United States
[7]Department of Nephrology, Odense University Hospital, Odense, Denmark

Corresponding Author:
Bettina Trettin, RN, MSc
Centre for Innovative Medical Technology
Odense University Hospital
Kløvervænget 8C, entrance 101, 3rd fl
Odense, 5000
Denmark
Phone: 45 5164 0948
Email: bettina.trettin@rsyd.dk

Abstract

Background: In Denmark, patients with psoriasis undergoing biological treatment have regular follow-ups, typically every 3 months. This may pose a challenge for patients who live far away from the hospital. Mobile health (mHealth) is a promising and reliable tool for the long-term management of patients with psoriasis undergoing biological treatment because the disease course can be properly monitored. Despite recent developments in mHealth, the full potential of teledermatology remains to be tapped by newer, more attractive forms of services focused on patients' needs.

Objective: This study aims to design and develop an mHealth app to support the self-management of patients with psoriasis using a participatory design.

Methods: Using participatory design, we conducted 1 future workshop, 4 mock-up workshops, and 1 prototype test with patients and health care professionals to co-design a prototype. The process was iterative to ensure that all stakeholders would provide input into the design and outcome; this approach enabled continuous revision of the prototype until an acceptable solution was agreed upon. Data were analyzed according to the steps—plan, act, observe, and reflect—in the methodology of participatory design.

Results: Health care professionals and patients emphasized the importance of a more patient-centered approach, focusing on the communication and maintenance of relationships. Patients perceived consultations to be impersonal and repetitive and wanted the opportunity to contribute to the agenda while attending a consultation. Patients also stated they would prefer not to attend visits in person every 3 months. On the basis of these findings, we designed an mHealth app that could replace in-person visits and support patients at in-person visits. Video consultations, self-monitoring, and registration of patient-reported outcome data were embedded in the app.

Conclusions: Using participatory design facilitated mutual learning and democratic processes that gave end users a significant influence over the solution. Despite the advantages of using participatory design in developing mHealth solutions, organizational conditions may still represent a barrier to the optimization of solutions.

(JMIR Dermatol 2021;4(1):e26673) doi:10.2196/26673

KEYWORDS

mHealth; psoriasis; biologics; participatory design; teledermatology; mobile phone

XSL•FO
RenderX

Introduction

Background

Psoriasis is a chronic, complex inflammatory disease that requires long-term management. In Denmark, patients with psoriasis receiving biological treatment have in-person follow-ups every 3 months. Patients are frustrated by these quarterly mandatory checkups and do not always benefit from consultations, which they experience as time consuming and rigidly structured, in a way that is not targeted to patients' individual needs [1,2]. Hence, this may present an opportunity to improve the current clinical practice.

The application of telemedicine in dermatology is referred to as teledermatology (TD). TD has the potential to transform health care delivery to better meet patients' needs [3]. TD improves access to specialist care, diagnostic accuracy, and treatment adherence while also reducing costs [4]. Attempts have been made within TD to develop *mobile* solutions, also referred to as mobile health (mHealth), using new-generation smartphones. Mobile TD has been used to treat patients with acute and chronic skin diseases [5-7]. Mobile TD may help in optimizing psoriasis treatment [8] and has been accepted by both patients and health care professionals (HCPs). It reduces in-person visits and augments person-centered care [9]. Mobile TD could be a promising tool for the long-term management of patients with psoriasis on systemic treatment (eg, biologics), where the disease course can be properly monitored and medication side effects can be detected earlier [10].

A TD solution is as effective as the in-person management of patients with psoriasis, as assessed by objective clinical outcomes [11]. TD can increase access to specialized care and reduce commuting and in-office waiting times [12]. Patients and HCPs acknowledge the benefits of telemedicine solutions; however, there are still several barriers to TD (eg, economic factors, reliability, availability, and reluctance to use it) that need to be addressed [13]. Another challenge in implementing telemedicine [14] is the limited understanding of the requirements for optimal clinical effectiveness [15]. The full potential of TD remains to be tapped by newer, more attractive forms of services that closely focus on patients' needs [16]. One method to develop a TD solution adapted to patients' and HCPs' requirements is to use participatory design (PD). In PD, the focus is on designing and developing a technology that forecasts the possibilities of future technology before the solution is developed [17]. Mutual learning is the core element of PD. Through participation, the intention is to equalize the power between end users and designers by sharing knowledge. Researchers and designers need in-depth knowledge about end users' needs and daily lives, whereas end users need knowledge about technical aspects and possibilities, together with clinical opportunities and limitations. This approach reflects the democratic aspects of PD, as it offers end users a voice in the design and development of a technology that will affect patients' daily life and HCPs' current clinical practice.

Objective

The aim of this study is to design and develop a patient-centered TD solution based on patients' and HCPs' needs. This paper describes the design and development of an mHealth app and the involvement of patients, HCPs, researchers, and information technology (IT) designers in a PD study.

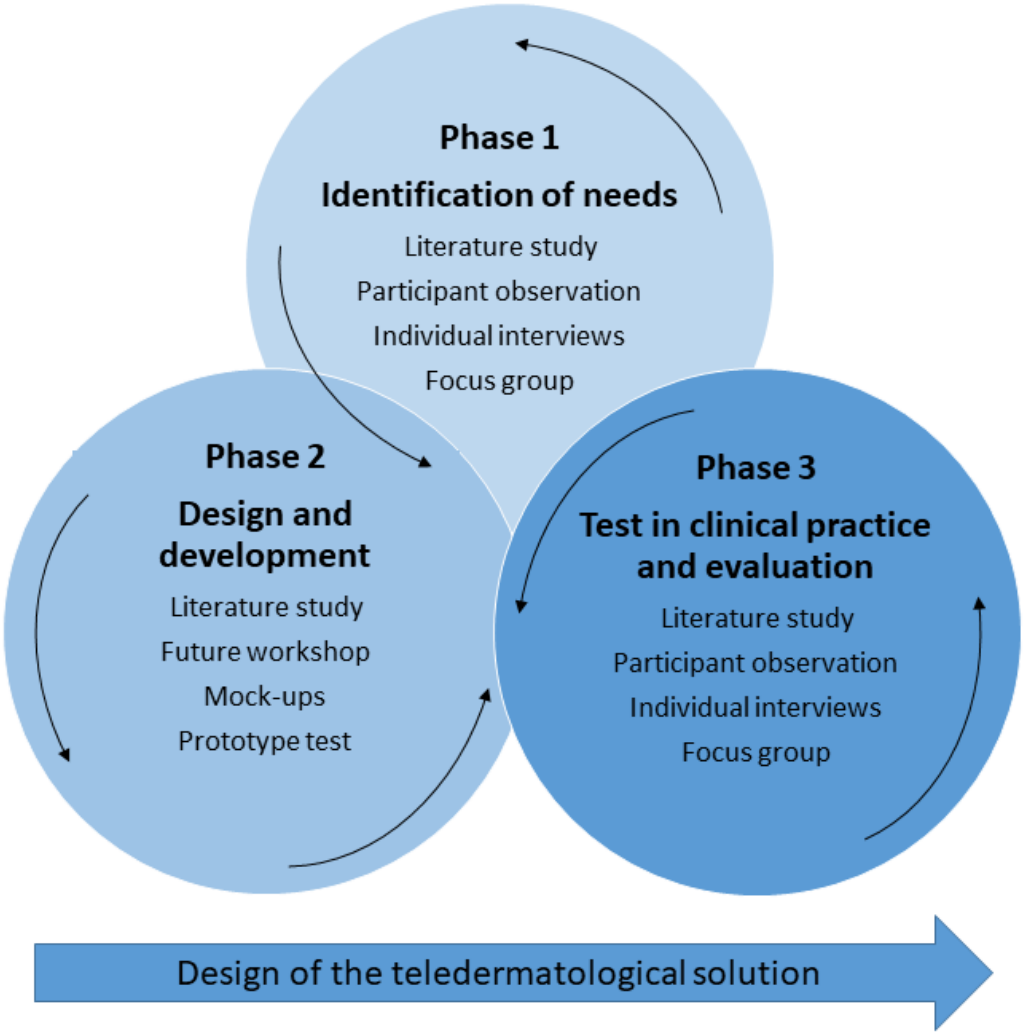
Methods

Overview

The PD study was conducted in 3 phases [18]. In phase 1, we identified end users' needs by exploring their experiences. We used ethnographic methods to explore patients' everyday life experiences with the disease and the HCPs' experiences of clinical practice. Previous studies have reported the results from phase 1 [1,2]. In phase 2, we designed and developed a telemedicine solution to meet the needs identified in phase 1. In phase 3, we tested the prototypes in clinical practice. All phases were conducted as iterative processes throughout the study (Figure 1). Literature studies were conducted continuously in all phases to broaden our understanding of the emerging findings [19]. This paper reports reflections on phase 2 and describes and critically discusses the iterative process of the design and development of an mHealth app. In this paper, the terms high- and low-fidelity prototypes are used to visualize the design process. Design fidelity refers to the level of detail and functionality of a prototype. Low-fidelity prototypes are often created using no technology but instead a drawing, which enables the collection and analysis of feedback in the early stages of the design phase. High-fidelity prototypes are highly functional, interactive, and close to the final product [20].

XSL•FO
RenderX

Figure 1. The three phases in the teledermatology solution design and development.



Setting

The study was conducted at an outpatient clinic of a university hospital in Denmark. Workshops and prototype testing were conducted between April and December 2019. We conducted several workshops: (1) 1 future workshop in which ideas were generated based on the needs assessment of phase 1; (2) 2 mock-up workshops with patients to discuss the initial prototype; (3) 2 mock-up workshops with HCPs to discuss the initial prototype and patients' suggestions and corrections; and (4) 1 prototype test, where the initial prototype was tested in a real-life setting. At the time of data collection, patients were obliged to attend quarterly follow-ups to receive their biological medication, in accordance with national health policies.

Participants

Participants in the workshops included nurses (n=9) and physicians (n=4) with several years of experience in dermatology as well as the care and management of patients with psoriasis undergoing biological treatment. Participants' characteristics and overview of attendance are shown in Table 1. The same patients (n=3) participated in all the workshops. The patient participants were familiar with the first author, as they had contributed to their experiences of living with psoriasis in phase 1 of this study, and gave their consent to be contacted for further participation in the study. Patients were contacted by phone. In addition, a medical secretary, an IT designer, and a research team also participated. The research team consisted of a senior researcher within dermatology; a senior researcher within PD; a senior researcher within qualitative research; and the first author, who was the project leader.

XSL•FO
RenderX

Table 1. Participants' characteristics and attendance at the workshops and prototype test (N=23).

Participants and characteristics	Overview of attendance		
	Future workshop	Mock-up workshop	Prototype test
Nurse, f[a], >3 years' experience	✓	✓	
Nurse, f, >6 years' experience	✓	✓	✓
Nurse, f, >2 years' experience	✓	✓	✓
Nurse, f, >4 years' experience	✓		
Nurse, f, >13 years' experience	✓	✓	✓
Nurse, f, >3 years' experience	✓		
Nurse, f, >7 years' experience		✓	✓
Nurse, f, >3 years' experience			✓
Nurse, f, >8 years' experience			✓
Doctor, m[b], >20 years' experience	✓		
Doctor, m, >5 years' experience			✓
Doctor, f, >10 years' experience		✓	
Doctor, f, >8 years' experience			✓
Doctor, f, >5 years' experience			✓
Medical secretary, f, >15 years' experience			✓
Patient, f, aged 54 years; moderate to severe psoriasis for 31 years	✓	✓	
Patient, f, aged 28 years; moderate to severe psoriasis for 13 years	✓	✓	
Patient, m, aged 36 years; moderate to severe psoriasis for 18 years	✓	✓	✓
Information technology designer, m	✓	✓	✓
Researcher, f, experienced in participatory design	✓		✓
Researcher, m, experienced in psoriasis	✓		✓
Researcher, f, experienced in qualitative research	✓		✓
Researcher, f, PhD student	✓	✓	✓

[a]f: female.

[b]m: male.

Data Collection and Analysis

Before the workshops and prototype testing, a detailed script describing the various steps and responsibilities was prepared and delivered to the research team and IT designers. The script included the aim of the workshops and the introduction to group exercises and plenary discussions. The study data comprised recorded transcripts from the future workshop and photographs, along with a number of written notes from all participants. Field notes taken at each mock-up workshop and the content of the discussions and suggestions for designing a prototype at the workshops were summarized in a document. Suggestions from the patients and HCPs were added to the low-fidelity prototype and served as data. During the prototype testing, all participants were given observational guides to observe and note during the test. The observational guide asked the participants to observe and note both the patients' preparation before a consultation and the interaction during the consultation. These field notes served as data along with photographs and written field notes from one of the researchers (HA).

The analysis of the data material from the workshops and prototype test was inspired by the PD approach. The steps plan, act, observe, and reflect were followed in the data analysis in an iterative process [18]. It was not possible to plan or predict the number of iterations required to develop the final prototype. Each workshop was planned by the research group based on how the previous workshop had transpired. After each workshop, the research team shared their reflections as a part of the data analysis. On the basis of this process, the next step in the design and development phase was planned, thus facilitating mutual learning through shared experiences and perspectives. As member checking is a natural part of the PD process, participants were presented with findings from the previous activity, thus allowing them to comment on and contribute to the findings and further development of the prototype. Reporting was guided by the Consolidated Criteria for Reporting Qualitative Studies [21].

Future Workshop

A 2-hour future workshop was conducted to identify new approaches in clinical practice through a joint critique of the

XSL•FO
RenderX

existing approach [22]. The future workshop comprised 3 phases: phase 1, a critique phase; phase 2, a vision phase; and phase 3, a reality phase. In the critique phase, participants were informed about the aim of the workshop and then presented with findings from ethnographic field studies [1]. Selected findings were available in writing, together with photographs of the consultations taken during the participant observation from phase 1. The participants were then divided into 2 groups and encouraged to select the critique findings that they considered most suitable. They were also encouraged to write down additional critiques. Notes were written on post-it labels and placed on posters. Each phase of the future workshop had its own poster. In groups, they were asked to prioritize and select which points of critique they would proceed with. In the second phase of the future workshop, the vision phase, the participants were asked to convert the critique into positive ideas by asking "What if...?" They were asked to be creative and use their thoughts, visions, and dreams and to discuss categories and select the most important and significant topics. In the third phase, the reality phase, participants were asked to come up with ideas by asking "We do that by..." to create more specific and clear strategies to realize the visions. The words "What if...?" and "We do that by..." were printed on cards for the participants to fill out. The workshop was audio-recorded and further documented using notes and photos.

Mock-up Workshops

The research group created a low-fidelity prototype, and several mock-up workshops were conducted to explore its content and detail it further. At the mock-up workshops, the aim was to further design the solution based on the results of the future workshop. The solution was an app to empower the patients. It aimed to give them the opportunity to prepare ahead of follow-up consultations and allow for video consultations. Due to organizational circumstances, it was not possible for patients and HCPs to meet at the workshops. Therefore, they were conducted iteratively with HCPs and patients separately to achieve a continuous feedback and ensure the true emancipation of PD. The various features of the app were presented to the participants, and suggestions and critiques were written down on a poster.

Prototype Test

A high-fidelity prototype was developed based on the results from the previous workshops. As this prototype also allowed for video consultations and for patients to fill out 2 questionnaires before consultations, a prototype test was required. The 2-hour prototype test was conducted at the outpatient clinic, in the usual consultation rooms, to ensure that the setting was a realistic environment. The aim was to ensure a continued co-design with users and to test the technology. First, the participants were introduced to the prototype. They were then asked to play out a follow-up consultation based on the completed questionnaires. The set-up was planned so that it was as close to reality as possible. For this reason, doctors, nurses, and patients represented themselves. The remaining participants were equipped with observational guides and asked to make notes and write down questions, suggestions, and reflections during the consultation. Two consultations were performed simultaneously. Subsequently, the video consultations were conducted. Again, each participant represented themselves in their usual role in clinical practice, apart from one HCP, who acted as a patient, as only one patient showed up. This HCP is referred to as a patient in the following *Results* section. One video consultation was conducted during a plenary session. Those who did not participate in the consultations were asked to fill out the observational guides. The process was documented by field notes from all participants as well as photos taken by the research group. The prototype test was finalized with an evaluation of all the participants.

Ethics

All participants received oral and written information about the study, in accordance with the applicable ethical rules [23], and gave their written consent. The Danish Data Protection Agency (2012-58-0018) approved the study.

Results

Future Workshop

The most common suggestion for change in clinical practice was the inclusion of a more patient-centered approach. In this approach, patients would be given the opportunity to contribute to the agenda of the consultations, which were perceived as being impersonal and repetitive. Patients expressed that they wanted to have a say in what would be discussed, rather than "just answering the same questions over and over again.":

> *I know you have to inform about smoking, but don't say it to me every time. There must be some information missing in your IT system, or something.* [Patient]

Patients also requested flexibility and that they would not have to attend in person every 3 months. General information regarding psoriasis and comorbidities was considered important. However, even though participants were asked about their weights or smoking habits, no strategies for how to improve, for example, lifestyle behavior, were proffered. Both patients and HCPs emphasized that the future care and management of patients with psoriasis should focus on communication and mutual relations:

> *Up here, I haven't had a regular nurse, so I actually have no relationship with anyone.* [Patient]

Another significant issue for patients was the lack of continuity in meeting HCPs. One patient pointed out that she had been a patient at the outpatient clinic for 8 years but always met new medical doctors at consultations. The workshop further revealed that not all patients were offered the same services, for example, an appointment with a dietitian. These services or opportunities should be made visible and offered equally to all patients. This would give them the opportunity to discuss, for example, their nutrition habits with the HCP. In the reality phase of the future workshop, participants proposed that some of the abovementioned items could be offered in video consultations and prepared at home ahead of consultations:

> *What if maybe we only need to see them physically twice a year?* [Nurse]

XSL•FO
RenderX

> *What if the patient was given the opportunity in advance to fill in a form from home electronically [about] some areas they would like to talk about. Then you could run the consultation based on that.* [Nurse]

Patients also questioned having to attend in-person to collect their medication. The findings from the future workshop were depicted in a drawing, whose purpose was to serve as a design artifact for further elaboration at the mock-up workshops (for the English version, see Multimedia Appendix 1).

Mock-up Workshops

On the basis of the results from the future workshop, it was decided to design an app for patients with psoriasis undergoing biological treatment, with the intention of meeting their needs and requests related to daily life with psoriasis and follow-up visits. HCPs acknowledged this move as a possible and appropriate solution. A low-fidelity prototype (for the English version, see Multimedia Appendix 2) was designed, and features and possible content were discussed with patients, HCPs, and an IT designer. Patients pointed out the importance of using the *good stories* to communicate knowledge and information about disease and treatment and that written knowledge and information should highlight that "you can have a good life with psoriasis.":

> *I think it is insanely important that patients are also told that you can actually have or get a good life with psoriasis, it gives, like, hope.* [Patient]

The low-fidelity prototype included the registration of patient data, such as the self-monitoring of blood pressure, pulse, and weight. The Dermatology Quality of Life Questionnaire (DLQI) was embedded in the app. Normally, these measurements are taken at all in-person consultations. The low-fidelity prototype would make it possible for patients to complete the DLQI at home and register their patient data, meaning that this information would be automatically digitally received at the hospital. The HCPs discussed the importance of integrating the opportunity for patients to prepare ahead of consultations and that the main focus of consultations would be what is important to the patients. An existing questionnaire developed by the nurses was presented, evaluated, and adjusted by 5 new patients who did not participate in the workshops. This was done to ensure that it was also comprehensible for patients not involved in the design process. The questionnaire called preparation before consultation gave the patients several topics that could be discussed at their next consultation, including a free-text space for questions or comments. A feature in the app called preparation before consultation was designed, and the questionnaires and patient data were gathered to help patients prepare before a consultation. Furthermore, HCPs requested the development of a medication function that would allow them to order, distribute, and track patients' medication, using a track and trace feature. Likewise, patients requested a track and trace function of their medication.

Prototype Testing

On the basis of the suggestions, corrections, and further development, a high-fidelity prototype app called *Psoriasis* was designed (for the English version, see the Multimedia Appendix 3). It was based on an existing platform at the university hospital called *My Hospital*. *My hospital* is a digital platform developed to facilitate communication between the hospital and patients and is integrated in the patients' personal electronic medical records. For prototype testing in December 2019, *Psoriasis* was activated in a real-life setting. In testing the preparation feature, patients were asked to fill out the self-monitoring data, the DLQI questionnaire, and the preparation before consultation questionnaire before attending a face-to-face consultation. The HCPs were instructed on how to conduct a consultation based on the feature data and responses. There was an overall agreement that whenever the questionnaire preparation before consultation was used during the consultations, it changed the content of and approach to the consultations in a positive way, by focusing on the patients' needs and requests:

> *The doctor refers to a form on which the patient has noted sadness—and they talk about it. The doctor asks what the patient has been done about it and the patient says he has started seeing a psychologist. The nurse enters the dialogue and confirms the patient's problems (has known the patient for several years). Eye contact is maintained throughout.* [Field note]

However, for HCPs, it was challenging to change their practice and not return to their previous routines and questions:

> *The doctor asks direct questions about psoriasis and treatment. They talk back and forth about the treatment and the doctor asks, "Do you have any side effects?" To which the patient replies, "No, I have a bit on my scalp." They talk about possible treatment. The patient refers to the form and the doctor asks: "Where?" The doctor finds it and addresses what has been ticked.* [Field note]

One patient mentioned including a question about travel plans, as this is important due to traveling with biological medication.

In testing the video function, patients and HCPs were instructed as described above. For the video test, we used an iPad (Apple Inc) and a regular workstation in the outpatient clinic. Patients used their own devices. The functionality was good for both sound and picture. Patients were positive and expressed the personal advantages of video consultations. However, they suggested providing a guide in the app regarding how to initiate video consultations. Some HCPs were more reluctant and emphasized the need to meet and get to know patients before offering a video consultation because observing reactions, signs, and nonverbal communication was found to be challenging. Despite this, they acknowledged the patients' perspectives.

Final Design

HCPs and patients (including those who did not attend the prototype test) were asked to comment on the interface, usability, and content of the high-fidelity prototype. Small adjustments were made based on these comments, for example, the inclusion of more pictures to visualize the different types of psoriasis and a podcast on living with psoriasis (Table 2).

XSL•FO
RenderX

Table 2. Overview of the features in the app based on the identified needs.

Identified needs	Features in the app	Potential impact
Information about psoriasis and treatment	Knowledge database contains information about • Psoriasis • What psoriasis looks like • Comorbidities • Medications • Video recording of how to inject oneself • Video recording of emollient treatment	To support patients with psoriasis by providing them with knowledge
Information about biological treatment	Knowledge database contains information about • Biological treatment • Biosimilar treatment • Decision on treatment start • Addressing patients' fear of discontinuance	To support patients and include them in the process of receiving biologics and encourage them in addressing their concerns
Information about living with psoriasis	Knowledge database contains information about • Diet, exercise, smoking, alcohol, and stress • Being together with others • A podcast about living with psoriasis	To provide patients with information about lifestyle-related issues and addressing psychological aspects
Preparation before attending a consultation	Information to prepare the patients before attending a consultation, including patient data • DLQI[a] questionnaire and the questionnaire "prepare before consultation" • Self-monitoring of blood pressure, pulse, weight, and urine • Free-text space	To support patients in self-management, preparation before a consultation, and contributing to the agenda
Reducing in-person consultations	• Video consultations for Android and IOS • Guidance on how to attend a video consultation • Messages to the Department of Dermatology to address nonurgent questions • Information about where to pick up the biological treatment (link to map)	To support communication between the patients and HCPs[b] and provide care and management based on the patients' everyday life perspectives

[a]DLQI: Dermatology Quality of Life Questionnaire.

[b]HCP: health care professional.

Discussion

Principal Findings

In this study, an mHealth app for patients with psoriasis undergoing biological treatment was designed, adjusted, and tested through a PD process in close collaboration with patients, HCPs, IT designers, and fellow researchers. The future workshop revealed that users' needs could be met by an app. Its use could replace in-person follow-up visits; it can be used at in-person visits and can facilitate person-centered care. The iterative process enabled us to continuously revise, redesign, and test the app until a solution that reflected the needs of the end users emerged. This highlights the importance of using PD, in which users, designers, and researchers collaborate in the design and development of new health care services. The use of PD and thus the importance of user participation and democratic processes in the medical field have been acknowledged for many years [24].

mHealth interventions have been widely used in the management of chronic conditions [25-27] and have the potential to successfully support the process. However, the use of interdisciplinary team–based approaches in the process of designing and developing mHealth solutions is essential, given that it facilitates an understanding of the context in which the solution will be used by patients and HCPs and ensures that the solution is compatible with patients' needs and clinical demands [28].

For this study, we established a team that represented patients and stakeholders from all levels within the field, that is, the management of patients with psoriasis undergoing biological treatment. Thus, they were all familiar with the health care context and daily life with psoriasis. However, the prototype test revealed that HCPs were somewhat reluctant to use video consultations, as they were concerned about not being able to observe the patients' nonverbal communication. Conversely, the patients experienced video consultations as suitable and convenient. This highlights not only the important democratic aspects of PD but also the shift of power dynamics in the PD process [29]. Giving patients a voice as to how they prefer the management of their condition in daily life provides HCPs with new insights and understanding, and this mutual understanding may have had a significant impact on the acceptability and implementation of the app in this study.

XSL•FO
RenderX

Likewise, the future workshop contributed to mutual learning, as it revealed that usual consultations were perceived as impersonal and repetitive. In addition, it emerged that patients would actually like to *have a say* in what to discuss and have the chance to contribute to the agenda for follow-up visits. Future workshops emphasize critique, learning, teamwork, democracy, and empowerment, which make them suitable for use in PD [22]. Future workshops were developed by Jungk [22], who believed that utopian and fantasy-based ideas and strategies for the future could be created through critique. Being creative is naturally accompanied by open mindedness; however, in practice, mental blocks often occur, thus hindering creative thinking [30]. The use of "What if..." and "We do that by..." cards in our future workshop supported the participants in being creative and share their ideas and visions for their future consultations. The use of this tool and technique engaged the participants in telling, making, and enacting [31]. Despite striving for the true emancipation and engagement of all end users, not all of the needs and requests of the end users could be met. The design and development of a technological medication delivery system have failed. Biological medication and its management are highly regulated, as this is an expensive medication that is prescribed free of charge for patients. For this reason, it was not possible to prescribe the existing web-based system in the region of Southern Denmark. However, an agreement was made among local hospitals in the region. In the future, the biological medicine will be sent to the hospital closest to the patient for distribution. The prescription and ordering of medication would continue to be made as usual on paper, which made it impossible to deliver push messages to patients when their medication had arrived. This was presented to the participants at the mock-up workshops, followed by an explanation of the existing technology and policy practices regarding biological medicine. Kyhn [32] argues that by providing end users with details about the structure and content of the emerging system, we support them in developing an understanding of the opportunities and limitations that go beyond the present interface. Therefore, mutual learning can be fostered, as we develop a shared understanding of the practice and potentials.

While engaging in a PD project, user activities are often creative and experimental, involving all stakeholders [17]. As, in our study, it was not possible for both patients and HCPs to attend a mock-up workshop at the same time, we decided to conduct several small mock-up workshops in iterative processes. The reason for this was to ensure that all stakeholders would *have a say* in the design and could influence the outcome, thereby staying true to one of the core elements of PD. Expanding the creativity in the PD process itself, for example, conducting *one-to-one* workshops, may be acceptable and may still facilitate empowerment among patients and HCPs [33].

This study was a small, single-center study connected to a clinical setting, which may put transferability in question. However, this is not an uncommon setting for qualitative research. In addition, the design process was based on findings from previous qualitative field and interview studies, thus including experiences and perspectives from other groups of patients with psoriasis and experienced HCPs. A limitation of this study was that only one patient was included in the prototype test. All 3 patients were invited, but 2 of them canceled a few hours before the test. Limited user participation is a known practical limitation in PD [34]; however, because the patients were a part of the other workshops and had planned for the mHealth solution to be tested in clinical practice, we decided to conduct the prototype test. Again, creativity and readjustment were necessary, and a HCP acted as a patient during the prototype test. To overcome this barrier, the mHealth solution was tested further in clinical practice, but it will be reported in a separate paper.

Conclusions

Results from the future workshop, mock-up workshops, and the prototype test, based on findings from ethnographic field studies, led to the design of an app for patients with psoriasis receiving biological treatment. By using PD that facilitated mutual learning and democratic processes, end users exerted a significant impact on the solution, given that it was customized to both clinical practice and end users' needs. The app provided both HCPs and patients the opportunity to facilitate a new approach in clinical practice. Despite the advantages of using PD in the development of mHealth solutions, organizational factors may still represent a barrier to the most desirable solution.

Acknowledgments

Funding for this project was provided by The University of Southern Denmark, Odense University Hospital, Kirsten Wehnerts og Robert Wehnerts Fond, and Novartis (grant DK1809880731). The authors would like to thank all the participants for their time, creativity, and effort throughout this project.

Conflicts of Interest

SF receives research, speaking and/or consulting support from Arcutis, Dermavant, Galderma, GSK/Stiefel, Almirall, Alvotech, Leo Pharma, BMS, Boehringer Ingelheim, Mylan, Celgene, Pfizer, Ortho Dermatology, Abbvie, Samsung, Janssen, Lilly, Menlo, Helsinn, Arena, Forte, Merck, Novartis, Regeneron, Sanofi, Novan, Qurient, National Biological Corporation, Caremark, Advance Medical, Sun Pharma, Suncare Research, Informa, UpToDate and National Psoriasis Foundation. He also consults for others through Guidepoint Global, Gerson Lehrman and other consulting organizations. SF is also the founder and majority owner of www.DrScore.com, and the founder and part owner of Causa Research, a company dedicated to enhancing patients' adherence to treatment. The other authors declare no conflicts of interest.

XSL•FO
RenderX

Multimedia Appendix 1
Findings from the future workshop presented as a design artifact.
[PNG File , 2157 KB - derma_v4i1e26673_app1.png]

Multimedia Appendix 2
Example of the paper prototype design artifact.
[PNG File , 1300 KB - derma_v4i1e26673_app2.png]

Multimedia Appendix 3
High-fidelity prototype used at the prototype test.
[PNG File , 173 KB - derma_v4i1e26673_app3.png]

References

1. Trettin B, Feldman SR, Andersen F, Danbjørg DB, Agerskov H. A changed life: the life experiences of patients with psoriasis receiving biological treatment. Br J Dermatol 2020 Sep;183(3):516-523. [doi: 10.1111/bjd.18876] [Medline: 31953845]
2. Trettin B, Feldman S, Andersen F, Danbjørg DB, Agerskov H. Improving management of psoriasis patients receiving biological treatment: a qualitative approach. Nurs Open 2021 Jan 01:745 [FREE Full text] [doi: 10.1002/nop2.745] [Medline: 33385301]
3. Finch TL, Mort M, Mair FS, May CR. Future patients? Telehealthcare, roles and responsibilities. Health Soc Care Community 2008 Jan;16(1):86-95. [doi: 10.1111/j.1365-2524.2007.00726.x] [Medline: 18181818]
4. Bashshur RL, Shannon GW, Tejasvi T, Kvedar JC, Gates M. The empirical foundations of teledermatology: a review of the research evidence. Telemed J E Health 2015 Dec;21(12):953-979 [FREE Full text] [doi: 10.1089/tmj.2015.0146] [Medline: 26394022]
5. Massone C, Lozzi GP, Wurm E, Hofmann-Wellenhof R, Schoellnast R, Zalaudek I, et al. Cellular phones in clinical teledermatology. Arch Dermatol 2005 Oct;141(10):1319-1320. [doi: 10.1001/archderm.141.10.1319] [Medline: 16230577]
6. Ebner C, Wurm EM, Binder B, Kittler H, Lozzi GP, Massone C, et al. Mobile teledermatology: a feasibility study of 58 subjects using mobile phones. J Telemed Telecare 2008;14(1):2-7. [doi: 10.1258/jtt.2007.070302] [Medline: 18318921]
7. Schreier G, Hayn D, Kastner P, Koller S, Salmhofer W, Hofmann-Wellenhof R. A mobile-phone based teledermatology system to support self-management of patients suffering from psoriasis. Annu Int Conf IEEE Eng Med Biol Soc 2008;2008:5338-5341. [doi: 10.1109/IEMBS.2008.4650420] [Medline: 19163923]
8. Hayn D, Koller S, Hofmann-Wellenhof R, Salmhofer W, Kastner P, Schreier G. Mobile phone-based teledermatologic compliance management - preliminary results of the TELECOMP study. Stud Health Technol Inform 2009;150:468-472. [Medline: 19745356]
9. Frühauf J, Schwantzer G, Ambros-Rudolph CM, Weger W, Ahlgrimm-Siess V, Salmhofer W, et al. Pilot study on the acceptance of mobile teledermatology for the home monitoring of high-need patients with psoriasis. Australas J Dermatol 2012 Feb;53(1):41-46. [doi: 10.1111/j.1440-0960.2011.00852.x] [Medline: 22309330]
10. Koller S, Hofmann-Wellenhof R, Hayn D, Weger W, Kastner P, Schreier G, et al. Teledermatological monitoring of psoriasis patients on biologic therapy. Acta Derm Venereol 2011 Oct;91(6):680-685 [FREE Full text] [doi: 10.2340/00015555-1148] [Medline: 21879250]
11. Armstrong AW, Chambers CJ, Maverakis E, Cheng MY, Dunnick CA, Chren M, et al. Effectiveness of online vs in-person care for adults with psoriasis: a randomized clinical trial. JAMA Netw Open 2018 Oct 05;1(6):e183062 [FREE Full text] [doi: 10.1001/jamanetworkopen.2018.3062] [Medline: 30646223]
12. Ford AR, Gibbons CM, Torres J, Kornmehl HA, Singh S, Young PM, et al. Access to dermatological care with an innovative online model for psoriasis management: results from a randomized controlled trial. Telemed J E Health 2019 Jul;25(7):619-627 [FREE Full text] [doi: 10.1089/tmj.2018.0160] [Medline: 30222518]
13. Ariens LF, Schussler-Raymakers FM, Frima C, Flinterman A, Hamminga E, Arents BW, et al. Barriers and facilitators to ehealth use in daily practice: perspectives of patients and professionals in dermatology. J Med Internet Res 2017 Sep 05;19(9):e300 [FREE Full text] [doi: 10.2196/jmir.7512] [Medline: 28874336]
14. Jennett P, Yeo M, Pauls M, Graham J. Organizational readiness for telemedicine: implications for success and failure. J Telemed Telecare 2003 Dec 02;9 Suppl 2(2_suppl):27-30. [doi: 10.1258/135763303322596183] [Medline: 14728753]
15. Armfield NR, Edirippulige SK, Bradford N, Smith AC. Telemedicine-is the cart being put before the horse? Med J Aust 2014 May 19;200(9):530-533. [doi: 10.5694/mja13.11101] [Medline: 24835716]
16. Greis C, Meier Zürcher C, Djamei V, Moser A, Lautenschlager S, Navarini AA. Unmet digital health service needs in dermatology patients. J Dermatolog Treat 2018 Nov;29(7):643-647. [doi: 10.1080/09546634.2018.1441488] [Medline: 29455570]

XSL•FO
RenderX

17. Clemensen J, Larsen SB, Kyng M, Kirkevold M. Participatory design in health sciences: using cooperative experimental methods in developing health services and computer technology. Qual Health Res 2007 Jan;17(1):122-130. [doi: 10.1177/1049732306293664] [Medline: 17170250]
18. Clemensen J, Rothmann MJ, Smith AC, Caffery LJ, Danbjorg DB. Participatory design methods in telemedicine research. J Telemed Telecare 2016 Jan 01. [doi: 10.1177/1357633X16686747] [Medline: 28027678]
19. Clemensen J. Pervasive healthcare: home treatment of patients with diabetic foot ulcers. 2006. URL: https://tinyurl.com/5bm2cheu [accessed 2021-04-24]
20. Rudd J, Stern K, Isensee S. Low vs. high-fidelity prototyping debate. interactions 1996 Jan 02;3(1):76-85. [doi: 10.1145/223500.223514]
21. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. Int J Qual Health Care 2007 Dec 16;19(6):349-357. [doi: 10.1093/intqhc/mzm042] [Medline: 17872937]
22. Jungk R, Müllert N, Institute for Social Inventions. Future Workshops : How to Create Desirable Futures. London: Institute for Social Inventions; 1987:1-126.
23. World Medical Association. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. J Am Med Assoc 2013 Nov 27;310(20):2191-2194. [doi: 10.1001/jama.2013.281053] [Medline: 24141714]
24. Palmer VJ, Weavell W, Callander R, Piper D, Richard L, Maher L, et al. The Participatory Zeitgeist: an explanatory theoretical model of change in an era of coproduction and codesign in healthcare improvement. Med Humanit 2019 Sep;45(3):247-257 [FREE Full text] [doi: 10.1136/medhum-2017-011398] [Medline: 29954854]
25. Lim S, Kang SM, Shin H, Lee HJ, Won Yoon J, Yu SH, et al. Improved glycemic control without hypoglycemia in elderly diabetic patients using the ubiquitous healthcare service, a new medical information system. Diabetes Care 2011 Feb 26;34(2):308-313 [FREE Full text] [doi: 10.2337/dc10-1447] [Medline: 21270188]
26. Nguyen HQ, Wolpin S, Chiang KC, Cuenco D, Carrieri-Kohlman V. Exercise and symptom monitoring with a mobile device. AMIA Annu Symp Proc 2006:1047 [FREE Full text] [Medline: 17238666]
27. Bellamy N, Wilson C, Hendrikz J, Whitehouse SL, Patel B, Dennison S, EDC Study Group. Osteoarthritis Index delivered by mobile phone (m-WOMAC) is valid, reliable, and responsive. J Clin Epidemiol 2011 Feb;64(2):182-190. [doi: 10.1016/j.jclinepi.2010.03.013] [Medline: 20609562]
28. Matthew-Maich N, Harris L, Ploeg J, Markle-Reid M, Valaitis R, Ibrahim S, et al. Designing, implementing, and evaluating mobile health technologies for managing chronic conditions in older adults: a scoping review. JMIR Mhealth Uhealth 2016 Jun 09;4(2):e29 [FREE Full text] [doi: 10.2196/mhealth.5127] [Medline: 27282195]
29. Bratteteig T, Bødker K, Dittrich Y, Mogensen PH, Simonsen J. Methods: organising principles and general guidelines for Participatory Design projects. In: Routledge International Handbook of Participatory Design. Milton, UK: Routledge; 2013:137-164.
30. Troxler P, Kuhnt B. Future workshops - the unthinkable and how to make it happen. Hands-On Knowledge Co-Creation and Sharing: Practical Methods and Techniques. 2007. URL: https://surfsharekit.nl/objectstore/515a2c91-e9e6-4bd8-acfe-d7431a8f13e0 [accessed 2021-04-24]
31. Brandt E, Binder T, Sanders E. Tools and techniques: ways to engage telling, making and enacting. In: Routledge International Handbook of Participatory Design. Milton, UK: Routledge; 2013:145-181.
32. Kyng M. Making representations work. Commun ACM 1995 Sep;38(9):46-55. [doi: 10.1145/223248.223261]
33. Jensen CM, Overgaard S, Wiil UK, Smith AC, Clemensen J. Bridging the gap: a user-driven study on new ways to support self-care and empowerment for patients with hip fracture. SAGE Open Med 2018 Sep 07;6 [FREE Full text] [doi: 10.1177/2050312118799121] [Medline: 30210796]
34. Spinuzzi C. The methodology of participatory design. Technical Communication. 2005. URL: https://repositories.lib.utexas.edu/bitstream/handle/2152/28277/SpinuzziTheMethodologyOfParticipatoryDesign.pdf [accessed 2021-04-24]

Abbreviations

DLQI: Dermatology Quality of Life Questionnaire
HCP: health care professional
IT: information technology
mHealth: mobile health
PD: participatory design
TD: teledermatology

XSL•FO
RenderX

Edited by G Eysenbach; submitted 21.12.20; peer-reviewed by B Arents, E Wang; comments to author 05.02.21; revised version received 11.02.21; accepted 17.04.21; published 10.05.21.

Please cite as:
Trettin B, Danbjørg DB, Andersen F, Feldman S, Agerskov H
Development of an mHealth App for Patients With Psoriasis Undergoing Biological Treatment: Participatory Design Study
JMIR Dermatol 2021;4(1):e26673
URL: https://derma.jmir.org/2021/1/e26673
doi:10.2196/26673
PMID:

©Bettina Trettin, Dorthe Boe Danbjørg, Flemming Andersen, Steven Feldman, Hanne Agerskov. Originally published in JMIR Dermatology (http://derma.jmir.org), 10.05.2021. This is an open-access article distributed under the terms of the Creative Commons Attribution License (https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work, first published in JMIR Dermatology Research, is properly cited. The complete bibliographic information, a link to the original publication on http://derma.jmir.org, as well as this copyright and license information must be included.

XSL•FO
RenderX

Original Paper

A Sun Safety Pilot Program Using a Tanning Myths–Focused Video Contest for Utah Adolescents: Cross-sectional Analysis

Amanda Truong[1], PhD; Brayden Forbes[2], MD; Mingyuan Zhang[3], MSc; Molly McFadden[4], MSc; Stephanie Klein[5], MD

[1]Department of Oncological Sciences, University of Utah, Salt Lake City, UT, United States
[2]Division of Dermatology, University of Arizona, Tucson, AZ, United States
[3]Department of Population Health Sciences, University of Utah, Salt Lake City, UT, United States
[4]Department of Internal Medicine, University of Utah, Salt Lake City, UT, United States
[5]Department of Dermatology, University of Utah, Salt Lake City, UT, United States

Corresponding Author:
Stephanie Klein, MD
Department of Dermatology
University of Utah
30 N 1900 E
Salt Lake City, UT,
United States
Phone: 1 801 581 6465
Email: stephanie.klein@hsc.utah.edu

Abstract

Background: Adolescents are susceptible to excessive ultraviolet exposure due to intentional tanning, outdoor lifestyles, and poor sunscreen adherence. As skin cancer incidence continues to rise in the United States, effective and focused interventions are needed to encourage photoprotective behaviors.

Objective: This study seeks to determine poor photoprotective behavior risk factors in adolescents residing in Utah and whether video contest participants have increased sun-protective knowledge and intentions.

Methods: In this cross-sectional study, we surveyed Utah high school students (n=20) who participated in a tanning myths-themed public service announcement video contest. A control cohort of students who did not participate in the video contest were also surveyed (n=89). Demographics, sun exposure history, intentions to tan, and intentions to use sunscreen were documented. Knowledge of tanning myths was assessed with a 7-question sun safety quiz.

Results: The survey response rate was 93.2% (109/117). Two-thirds reported at least one sunburn, and 47.7% (52/109) reported intentional tanning within the past 2 years. Higher tanning intentions were associated with a personal ($P<.001$), family ($P=.001$), and peer ($P<.001$) history of tanning. Video contest participants had higher sun safety quiz scores ($P<.001$) and higher sunscreen use intentions ($P=.01$), but did not have decreased tanning intentions ($P=.47$) compared to non–video contest participants. Hispanic and Black students were less likely to participate in the video contest ($P<.001$ and $P=.04$, respectively). In a comparison of White students to students of color, there were no differences in sun exposure history, but students of color had lower sun safety knowledge ($P=.01$) and lower sunscreen use intention ($P=.02$).

Conclusions: Sun safety educational disparities exist, and targeted efforts are needed to encourage photoprotective behaviors in high-risk populations. Our findings suggest that video contest participation may encourage sunscreen use and sun protection awareness.

(JMIR Dermatol 2021;4(1):e20192) doi:10.2196/20192

KEYWORDS

prevention; sun protection; questionnaire; photoprotection; experiential learning; teenager; safety; pilot; video; cross-sectional; adolescent; young adult; behavior; risk; knowledge; intention

XSL•FO
RenderX

Introduction

Background

The incidence of skin cancer has been increasing for the past several decades in the United States [1-3]. The state of Utah has one of the nation's highest skin cancer incidence rates and the highest rate of incidence and death of melanoma, the deadliest type of skin cancer [4]. It has been well established that ultraviolet exposure is a modifiable risk factor for melanoma and nonmelanoma skin cancers [5]. Because adolescents are generally exposed to high amounts of UV radiation from intentional tanning, they are an important target population for skin cancer prevention programming [6].

The most efficacious sun protection programs have been shown to involve children and include active individual participation [7]. Building on this concept, while specifically addressing an adolescent population, we designed and sponsored an annual statewide contest running from 2015 to 2018, in which Utah teenagers voluntarily created 1-minute public service announcement) videos debunking tanning myths. Between 3 and 10 finalists and their families attended a celebratory event at the University of Utah Department of Dermatology each year where their public service announcement videos were viewed, students' achievements were recognized, and the importance of sun-protective behaviors, particularly in Utah, was stressed.

In this study, a cohort of adolescents from high schools who participated in the video contest and a cohort of adolescents from the same high schools who did not participate were electronically surveyed about tanning intentions on sun-protective behaviors and understanding of tanning myths. We sought to identify the demographics and risk factors associated with increased tanning intentions and decreased sunscreen use intentions. We hypothesized that video contest participants would have increased sun-protective intentions and knowledge compared to those who did not participate in the video contest.

Methods

Recruitment

This study was approved by the institutional review board at the University of Utah (institutional review board no. 00085420). In June 2018, all students (n=22) who participated in the video contest between 2015 and 2018 were emailed an anonymous closed survey eliciting demographic information, sun exposure history prior to video contest participation, and the intention to tan or use sunscreen in the future. A 7-question true-or-false knowledge quiz consisting of 5 tanning myths (false) and 2 skin cancer facts (true) was also included. The score was calculated from the quiz to evaluate the tanning myths knowledge of participants by assigning 1 point for each correct answer. A convenience sample of 95 non–video contest participants attending the same high schools were invited to complete the same electronic survey. These participants were recruited at tabling events during 3 lunch time hours and were asked to complete anonymous surveys on tablets or laptop computers provided by the research team. Participants in both groups were given a US $5 gift card or a candy bar for completing the survey.

Statistical Analysis

Tanning intentions were calculated based on participant responses for questions asking likelihood to tan in the future. High tanning intentions corresponded to responses "very likely" or "extremely likely". Medium tanning intentions corresponded to "moderately likely" or "slightly likely" responses, and low tanning intentions corresponded to a "not likely" response. For sunscreen use intentions, answers for likelihood to use sunscreen in the future included "always" or "most of the time" for high intentions, "sometimes" and "rarely" for medium intentions, and "never" for low intentions.

For participant characteristics, we report descriptive statistics as medians (IQR) or frequencies (percentages). To assess the efficacy of the video contest and evaluate the factors associated with knowledge of tanning myths and tanning intentions, we used chi-square tests for categorical variables and Wilcoxon rank sum tests for continuous variables. If numbers were sparse, Fisher exact tests were performed for categorical variables, and the exact version of the Wilcoxon rank sum tests were performed for continuous variables. To compare race demographics, each was compared to the total of each category (ie, White vs. people of color, Hispanic vs. non-Hispanic etc). Results were considered statistically significant if the 2-sided *P* values were less than .05. All tests were performed using R studio version 1.0.143.

Results

In total, 109 participants completed the survey (20 video contest participants and 89 non–video contest participants), with a survey response rate of 93.2% (109/117). Approximately half of the survey respondents were male. Self-identified race included White (51/109, 46.8%), Hispanic (36/109, 33.0%), Asian or Pacific islander (18/109, 16.5%), Black or African American (16/109, 14.7%), Native American (2/109, 1.8%), and other (8/109, 7.3%). Furthermore, 39.4% (43/109) of respondents reported having 1 sunburn in the past 2 years, and 26.6% (29/109) reported having at least two or more sunburns in the past 2 years. Almost half (52/109) had a history of intentional tanning, 22.9% (25/109) had family members that tan, 45.9% (50/109) had friends who tan, and 26.6% (29/109) had a family history of skin cancer. In the comparison of video contest and non–video contest participants, White students were more likely to participate in the video contest ($P<.001$), whereas Hispanic and Black students were less likely to participate in the video contest ($P<.001$ and $P=.04$, respectively; Table 1).

XSL•FO
RenderX

Table 1. Participant demographics and tanning history comparing video contest (n=20) and non–video contest (n=89) participants.

Characteristic		Video contest participant		*P* value
	All participants (N=109)	Yes (n=20)	No (n=89)	
Gender, n (%)				.85
Male	62 (56.9)	11 (55)	51 (57)	
Female	47 (43.1)	9 (45)	38 (43)	
Race[a], n (%)				
White	51 (46.8)	17 (85)	34 (38)	*<.001*[b]
Hispanic	36 (33.0)	0 (0)	36 (40)	*<001*[b]
Black/African American	16 (14.7)	0 (0)	16 (18)	*.04*[bc]
Native American/American Indian	2 (1.8)	0 (0)	2 (2)	>.99[c]
Asian/Pacific Islander	18 (16.5)	4 (20)	14 (16)	.74[c]
Other	8 (7.3)	0 (0)	8 (9)	.35[c]
Sunburn in the past 2 years, n (%)				.81
More than once	29 (26.6)	5 (25)	24 (27)	
Once	43 (39.5)	7 (35)	36 (40)	
None	37 (33.9)	8 (40)	29 (33)	
Personal history of tanning, n (%)				.79
Yes	52 (47.7)	9 (45)	43 (48)	
No	57 (52.3)	11 (55)	46 (52)	
Family members that tan, n (%)				.39[a]
Yes	25 (22.9)	6 (30)	19 (21)	
No	84 (77.1)	14 (70)	70 (79)	
Friends that tan, n (%)				.68
Yes	50 (45.9)	10 (50)	40 (45)	
No	59 (54.1)	10 (50)	49 (55)	
Family history of skin cancer, n (%)				.13
Yes	29 (26.6)	8 (40)	21 (27)	
No	80 (73.4)	12 (60)	68 (76)	
Sun safety education in class, n (%)				.46
Yes	54 (49.5)	8 (40)	46 (52)	
No	55 (50.5)	12 (60)	43 (48)	

[a]For race, participants were allowed to pick more than one response.

[b]Italics indicate value is statistically significant.

[c]Fisher exact test was used.

Although knowledge of skin cancer facts did not differ between video contest and non–video contest participants (*P*=.14 and *P*=.11, respectively), video contest participants were more likely to correctly identify 2 tanning myths: “A base tan protects you against getting a sunburn” (*P*=.02) and “There is no need for sun protection on cloudy or cold days” (*P*=.04; Table 2). Overall, video contest participants had a higher total knowledge quiz score compared to non–video contest participants (*P*<.001; Table 3). Furthermore, quiz scores were not significantly different when students who had prior sun safety classroom education, a history of tanning, or gender or family history of skin cancer were compared to those who did not, but higher quiz scores were associated with high sunscreen intentions (*P*=.01; Tables 3 and 4).

XSL•FO
RenderX

Table 2. Number of participants answering knowledge quiz questions correctly comparing video contest (n=20) and non–video contest (n=89) participants. Skin cancer facts were used as control questions.

Quiz items by correct answers	Video contest participant		*P* value
	Yes (n=20)	No (n=89)	
Tanning myth (false), n (%)			
A "base tan" protects you against getting a sunburn	19 (95)	62 (70)	*.02*[a]
Tanning beds are a safe way to tan	20 (100)	75 (84)	.07
There is no need for sun protection on cloudy or cold days	20 (100)	72 (81)	*.04*[a]
A fake (spray-on or lotion) tan will protect me from the sun	20 (100)	76 (85)	.12
Only old people get skin cancer	20 (100)	80 (90)	.21
Skin cancer fact (true) , n (%)			
Utah has one of the highest rates of skin cancer in the country	13 (65)	41 (46)	.14
Skin cancer is the most common type of cancer	17 (85)	57 (64)	.11

[a]Italics indicate value is statistically significant.

Table 3. Analysis of median tanning myths and skin cancer facts quiz scores (maximum score 7).

Variable	Score, median (IQR)	*P* value
Video contest participation		*<0.001*[ab]
Yes (n=20)	7 (6-7)	
No (n=89)	5 (4-6)	
Sun safety class education		0.82
Yes (n=54)	6 (5-6)	
No (n=55)	6 (5-6.5)	
History of tanning		0.29
Yes (n=52)	6 (5-6)	
No (n=57)	5 (4-6)	
Gender		0.16[a]
Male (n=62)	6 (4.2-6)	
Female (n=47)	6 (5-7)	
Race		
White only (n=40)	6 (6-7)	*<0.001*[ab]
People of color (n=69)	5 (4-6)	
Family history of skin cancer		0.34[a]
Yes (n=29)	6 (5-7)	
No (n=80)	6 (5-6)	

[a]Exact version of Wilcoxon rank sum test used.
[b]Italics indicate value is statistically significant.

XSL•FO
RenderX

Table 4. Variables associated with future intentions of sunscreen use and tanning.

Variable	Sunscreen use intention			*P* value	Tanning intention			*P* value
	High	Medium	Low		High	Medium	Low	
Video contest participation, n (%)				*0.01* [ab]				.47[a]
Yes (n=20)	15 (75)	5 (25)	0 (0)		2 (10)	7 (35)	11 (55)	
No (n=89)	36 (40)	39 (44)	14 (16)		20 (22)	25 (28)	44 (49)	
Knowledge score, n (%)				*0.01* [ab]				.46
≥5 (n=85)	46 (54)	31 (36)	8 (9)		15 (18)	26 (31)	44 (52)	
<5 (n=24)	5 (21)	13 (54)	6 (25)		7 (29)	6 (25)	11 (46)	
Sun safety class education, n (%)				0.21				.69
Yes (n=54)	23 (43)	26 (48)	5 (9)		12 (22)	17 (31)	25 (46)	
No (n=55)	28 (51)	18 (33)	9 (16)		10 (18)	15 (27)	30 (55)	
History of tanning, n (%)				0.09				*<0.001*[ab]
Yes (n=52)	25 (48)	24 (46)	3 (6)		18 (35)	18 (35)	16 (31)	
No (n=57)	26 (46)	20 (35)	11 (19)		4 (7)	14 (25)	39 (68)	
Peer tanning, n (%)				0.15				*<0.001*[ab]
Yes (n=50)	28 (56)	18 (36)	4 (8)		20 (40)	14 (28)	16 (32)	
No (n=59)	23 (39)	26 (44)	10 (17)		2 (3)	18 (31)	39 (66)	
Family member tanning, n (%)				0.78[a]				*.001* [b]
Yes (n=25)	12 (48)	11 (44)	2 (8)		10 (40)	10 (40)	5 (20)	
No (n=84)	39 (46)	33 (39)	12 (14)		12 (14)	22 (26)	50 (60)	
Gender, n (%)				0.7				.96
Male (n=62)	27 (44)	26 (42)	9 (15)		12 (19)	18 (29)	32 (52)	
Female (n=47)	24 (51)	18 (38)	5 (11)		10 (21)	14 (30)	23 (49)	
Race, n (%)				*0.002* [b]				.98
White (n=39)	25 (64)	14 (36)	0 (0)		8 (21)	11 (28)	20 (51)	
People of color (n=70)	26 (37)	30 (43)	14 (20)		14 (20)	21 (30)	35 (30)	
Family history of skin cancer, n (%)				0.32[a]				.42
Yes (n=29)	17 (59)	10 (34)	2 (7)		8 (28)	9 (31)	12 (41)	
No (n=80)	34 (42)	34 (42)	12 (15)		14 (18)	23 (29)	43 (54)	

[a]Fisher exact test was used.

[b]Italics indicate value is statistically significant.

Analysis of all survey respondents revealed that tanning intentions were significantly higher for those with a history of tanning (*P*<.001), those who have friends that tan (*P*<.001), and those with family members who tan (*P*=.001). Future intentions to use sunscreen were higher in video contest participants (*P*=.01) and White students (*P*=.002; Table 4). In addition, White students had higher average knowledge quiz scores compared to students who did not self-identify as only White (*P*<.001; Table 3).

A subsequent analysis of non–video contest participants comparing White students and students of color found no statistical differences in tanning intentions, having family members who tan, having friends who tan, a family history of skin cancer, or a personal history of sunburn. However, students of color had lower tanning myth knowledge scores (*P*=.01) and reported lower intention to use sunscreen in the future (*P*=.02; Table 5).

XSL•FO
RenderX

Table 5. Evaluation of tanning knowledge, history, and intentions of non–video contest participants comparing White students (n=23) to students of color (n=66).

Variable	Total (N=89)	White (n=23)	People of color (n=66)	*P* value
Sun safety knowledge, median (IQR)				
	5 (4-6)	6 (5.5-6)	5 (4-6)	*.01*[ab]
Personal tanning history, n (%)				.16
Yes	43 (48)	14 (61)	29 (44)	
No	46 (52)	9 (39)	37 (56)	
Family tanning history, n (%)				>.99[a]
Yes	19 (21)	5 (22)	14 (21)	
No	70 (79)	18 (78)	52 (79)	
Peer tanning history, n (%)				.08
Yes	40 (45)	14 (61)	26 (39)	
No	49 (55)	9 (39)	40 (61)	
Family history of skin cancer, n (%)				.14
Yes	21 (24)	8 (35)	13 (20)	
No	68 (76)	15 (65)	53 (80)	
Sunburn in the past 2 years, n (%)				.28
More than once	24 (27)	9 (39)	15 (23)	
Once	36 (40)	7 (30)	29 (44)	
None	29 (33)	7 (30)	22 (33)	
Sunscreen use intention, n (%)				*.02* [bc]
High	36 (40)	13 (57)	23 (35)	
Medium	39 (44)	10 (43)	29 (44)	
Low	14 (16)	0 (0)	14 (21)	
Tanning intention, n (%)				.89[c]
High	20 (22)	6 (26)	14 (21)	
Medium	25 (28)	6 (26)	19 (29)	
Low	44 (49)	11 (48)	33 (50)	

[a]Exact version of Wilcoxon rank sum test was used.

[b]Italics indicate value is statistically significant.

[c]Fisher exact test was used.

Discussion

In summary, our study confirms a high percentage of intentional tanning and poor sun-protective behaviors in our adolescent population. In a comparison of those who did and did not participate in a tanning myths–focused video contest, video contest participants had higher sun safety knowledge and higher intentions to use sunscreen, but did not show significant differences in tanning intentions compared to non–video contest participants. In addition, although the video contest was open to all Utah high school students, we had no Black or Hispanic students participate. A subsequent analysis found that students of color had lower sun safety knowledge scores and lower sunscreen use intentions despite having similar sun exposure and tanning histories compared to White students.

We and others have previously shown that sun-protective behaviors decrease as children age [8-10]. Our current study confirms the critical need for continued sun-protective interventions in Utah's adolescent population: two-thirds had at least one sunburn within the past 2 years and nearly half reported intentional outdoor tanning within the past 2 years. Adolescents who report having family members who purposefully tan have displayed similar behavior [11,12]. Congruently, those who have parental encouragement to practice sun-protective behaviors are significantly more likely to practice them [9,13]. Our study confirms this pattern and another that identifies peer tanning as an important psychosocial factor influencing adolescent tanning behavior [6,14,15]. Interventions focused on parental and peer influence may be beneficial for this population.

XSL•FO
RenderX

Traditional classroom lectures have been shown to be ineffective in promoting photoprotective behavior changes [16-18]. In our cohort, there was no difference in sun safety knowledge or sunscreen and tanning intentions between those that had sun safety education in school versus those that did not. However, our video contest participants were more likely to identify tanning myths resulting in unintentional sun exposure, indicating, “A base tan protects you against getting a sunburn” and “There is no need for sun protection on cloudy or cold days”. Video contest participants also reported increased sunscreen use intentions, although they did not have decreased tanning intentions compared to non–video contest participants. Because preintervention knowledge scores were not assessed, we could not determine whether video contest participants had higher baseline knowledge of tanning myths compared to non–video contest participants. Nevertheless, our findings suggest that although skin cancer prevention may be of importance for video contest participants, as implicated by increased sunscreen use intention, the desire to have tanned skin persists. This is in concordance with recent studies that used individualized appearance-based approaches, such as ultraviolet photography and age-enhancing software to promote photoprotective behaviors [10,19-22]. Thus, future studies evaluating experiential learning methods, such as the video contest described herein, in conjunction with an appearance-based model, may show promise with this population.

Of note, adolescent members of underrepresented racial minority groups did not participate in our video contest. Although skin cancer is indeed far less common in people of color, its incidence is rising, and those diagnosed face a poorer prognosis than do White individuals [23]. Poor prognosis is thought to be caused by delay in treatment, which can result from skin cancer misconceptions and socioeconomic factors influencing access of care in people of color, as well as lack of skin cancer education directed towards this population and their providers [24-27]. These factors may also contribute to the lack of participation in our video contest. In particular, students were asked to use their own recording devices, which may discourage those from resource-limited households. Indeed, adolescents who are people of color in our study had both lower tanning myth knowledge scores and decreased sunscreen use intention. However, our findings did not show differences in tanning history, sunburn history, or family history of skin cancer between White students and students of color. These findings underlie the need for targeted skin cancer prevention education that is community- or family-centered for adolescents who are people of color [28-30].

Our study has several limitations including the small sample size surveyed, which reduces the power of our conclusions and renders them ungeneralizable to the adolescent population as a whole. Furthermore, we cannot comment on the efficacy of the video contest in improving knowledge because preintervention tanning knowledge was not assessed in the video contest participants. The video contest may inherently possess a selection bias for those who have a greater understanding of sun safety or access to video recording devices. Thus, the contest may be unappealing to those who are less informed about sun safety or who are less familiar with video production. Follow-up studies are needed to assess retention of sun-protective knowledge and behaviors long term.

In conclusion, adolescents are at high risk for poor sun-protective behaviors. Participating in a public service announcement video contest may promote sunscreen use, but does not reduce tanning intentions. Our findings highlight the need for targeted photoprotective interventions, specifically for those who report high-risk tanning intentions and also those who are people of color.

Acknowledgments

AT is supported by a National Institutes of Health grant (no. F30CA235964). This investigation was supported by the University of Utah Study Design and Biostatistics Center, with funding in part from the National Center for Research Resources and the National Center for Advancing Translational Sciences, National Institutes of Health (grant no. 8UL1TR000105, formerly no. UL1RR025764).

Conflicts of Interest

None declared.

References

1. Lomas A, Leonardi - Bee J, Bath - Hextall F. A systematic review of worldwide incidence of nonmelanoma skin cancer. British Journal of Dermatology 2012 Apr 23;166(5):1069-1080. [doi: 10.1111/j.1365-2133.2012.10830.x]
2. Leiter U, Keim U, Garbe C. Epidemiology of skin cancer: update 2019. Adv Exp Med Biol 2020;1268:123-139. [doi: 10.1007/978-3-030-46227-7_6] [Medline: 32918216]
3. Holman DM, Freeman MB, Shoemaker ML. Trends in melanoma incidence among non-Hispanic whites in the United States, 2005 to 2014. JAMA Dermatol 2018 Mar 01;154(3):361-362 [FREE Full text] [doi: 10.1001/jamadermatol.2017.5541] [Medline: 29387875]
4. U.S. cancer statistics data visualizations tool. Centers for Disease Control and Prevention. 2018 Nov 01. URL: https://www.cdc.gov/cancer/uscs/dataviz/index.htm [accessed 2019-06-19]

XSL•FO
RenderX

5. El Ghissassi F, Baan R, Straif K, Grosse Y, Secretan B, Bouvard V, WHO International Agency for Research on Cancer Monograph Working Group. A review of human carcinogens--part D: radiation. Lancet Oncol 2009 Aug;10(8):751-752. [doi: 10.1016/s1470-2045(09)70213-x] [Medline: 19655431]
6. Holman DM, Watson M. Correlates of intentional tanning among adolescents in the United States: a systematic review of the literature. J Adolesc Health 2013 May;52(5 Suppl):S52-S59 [FREE Full text] [doi: 10.1016/j.jadohealth.2012.09.021] [Medline: 23601612]
7. Stoebner-Delbarre A, Defez C, Borrel E, Sancho-Garnier H, Sancho-Garnier H, Guillot B. Programmes de prévention des cancers cutanés. Annales de Dermatologie et de Vénéréologie 2005 Sep;132(8-9):641-647. [doi: 10.1016/s0151-9638(05)79411-4] [Medline: 16230913]
8. Görig T, Diehl K, Greinert R, Breitbart E, Schneider S. Prevalence of sun-protective behaviour and intentional sun tanning in German adolescents and adults: results of a nationwide telephone survey. J Eur Acad Dermatol Venereol 2018 Feb;32(2):225-235. [doi: 10.1111/jdv.14376] [Medline: 28573745]
9. Ackermann S, Vuadens A, Levi F, Bulliard J. Sun protective behaviour and sunburn prevalence in primary and secondary schoolchildren in western Switzerland. Swiss Med Wkly 2016;146:w14370 [FREE Full text] [doi: 10.4414/smw.2016.14370] [Medline: 27878788]
10. Weight AB, Forbes BR, Whittier SA, Truong A, Klein SZ. Investigating skin age analysis to reduce tanning intentions among adolescents: A pilot study. Pediatr Dermatol 2018 Dec 05;36(1):50-52. [doi: 10.1111/pde.13734]
11. Cokkinides VE, Weinstock MA, O'Connell MC, Thun MJ. Use of indoor tanning sunlamps by US youth, ages 11-18 years, and by their parent or guardian caregivers: prevalence and correlates. Pediatrics 2002 Jun;109(6):1124-1130. [doi: 10.1542/peds.109.6.1124] [Medline: 12042553]
12. Hoerster KD, Mayer JA, Woodruff SI, Malcarne V, Roesch SC, Clapp E. The influence of parents and peers on adolescent indoor tanning behavior: findings from a multi-city sample. J Am Acad Dermatol 2007 Dec;57(6):990-997 [FREE Full text] [doi: 10.1016/j.jaad.2007.06.007] [Medline: 17658194]
13. Miller KA, Huh J, Unger JB, Richardson JL, Allen MW, Peng DH, et al. Patterns of sun protective behaviors among Hispanic children in a skin cancer prevention intervention. Prev Med 2015 Dec;81:303-308 [FREE Full text] [doi: 10.1016/j.ypmed.2015.09.027] [Medline: 26436682]
14. Falzone AE, Brindis CD, Chren M, Junn A, Pagoto S, Wehner M, et al. Teens, tweets, and tanning beds: rethinking the use of social media for skin cancer prevention. Am J Prev Med 2017 Sep;53(3S1):S86-S94 [FREE Full text] [doi: 10.1016/j.amepre.2017.04.027] [Medline: 28818251]
15. Stapleton J, Turrisi R, Hillhouse J. Peer crowd identification and indoor artificial UV tanning behavioral tendencies. J Health Psychol 2008 Oct;13(7):940-945 [FREE Full text] [doi: 10.1177/1359105308095068] [Medline: 18809645]
16. Day AK, Wilson CJ, Hutchinson AD, Roberts RM. The role of skin cancer knowledge in sun-related behaviours: a systematic review. J Health Psychol 2014 Sep;19(9):1143-1162. [doi: 10.1177/1359105313485483] [Medline: 23682066]
17. Geller AC, Shamban J, O'Riordan DL, Slygh C, Kinney JP, Rosenberg S. Raising sun protection and early detection awareness among Florida high schoolers. Pediatr Dermatol 2005;22(2):112-118. [doi: 10.1111/j.1525-1470.2005.22204.x] [Medline: 15804297]
18. Miller KA, Langholz BM, Ly T, Harris SC, Richardson JL, Peng DH, et al. SunSmart: evaluation of a pilot school-based sun protection intervention in Hispanic early adolescents. Health Educ Res 2015 Jun;30(3):371-379 [FREE Full text] [doi: 10.1093/her/cyv011] [Medline: 25801103]
19. Dodd LJ, Forshaw MJ. Assessing the efficacy of appearance-focused interventions to prevent skin cancer: a systematic review of the literature. Health Psychology Review 2010 Sep;4(2):93-111. [doi: 10.1080/17437199.2010.485393]
20. Hillhouse J, Turrisi R, Scaglione NM, Cleveland MJ, Baker K, Florence LC. A web-based intervention to reduce indoor tanning motivations in adolescents: a randomized controlled trial. Prev Sci 2017 Feb;18(2):131-140 [FREE Full text] [doi: 10.1007/s11121-016-0698-4] [Medline: 27549602]
21. Brinker TJ, Heckl M, Gatzka M, Heppt MV, Resende Rodrigues H, Schneider S, et al. A skin cancer prevention facial-aging mobile app for secondary schools in Brazil: appearance-focused interventional study. JMIR Mhealth Uhealth 2018 Mar 09;6(3):e60 [FREE Full text] [doi: 10.2196/mhealth.9794] [Medline: 29523502]
22. Brinker TJ, Klode J, Esser S, Schadendorf D. Facial-aging app availability in waiting rooms as a potential opportunity for skin cancer prevention. JAMA Dermatol 2018 Sep 01;154(9):1085-1086 [FREE Full text] [doi: 10.1001/jamadermatol.2018.1907] [Medline: 30046805]
23. Gloster HM, Neal K. Skin cancer in skin of color. J Am Acad Dermatol 2006 Nov;55(5):741-60; quiz 761. [doi: 10.1016/j.jaad.2005.08.063] [Medline: 17052479]
24. Agbai ON, Buster K, Sanchez M, Hernandez C, Kundu RV, Chiu M, et al. Skin cancer and photoprotection in people of color: a review and recommendations for physicians and the public. J Am Acad Dermatol 2014 Apr;70(4):748-762. [doi: 10.1016/j.jaad.2013.11.038] [Medline: 24485530]
25. Buchanan Lunsford N, Berktold J, Holman DM, Stein K, Prempeh A, Yerkes A. Skin cancer knowledge, awareness, beliefs and preventive behaviors among black and hispanic men and women. Prev Med Rep 2018 Dec;12:203-209 [FREE Full text] [doi: 10.1016/j.pmedr.2018.09.017] [Medline: 30364862]

XSL•FO
RenderX

26. Ma F, Collado-Mesa F, Hu S, Kirsner RS. Skin cancer awareness and sun protection behaviors in white Hispanic and white non-Hispanic high school students in Miami, Florida. Arch Dermatol 2007 Aug;143(8):983-988. [doi: 10.1001/archderm.143.8.983] [Medline: 17709656]
27. Coups EJ, Stapleton JL, Hudson SV, Medina-Forrester A, Natale-Pereira A, Goydos JS. Sun protection and exposure behaviors among Hispanic adults in the United States: differences according to acculturation and among Hispanic subgroups. BMC Public Health 2012 Nov 15;12:985 [FREE Full text] [doi: 10.1186/1471-2458-12-985] [Medline: 23153104]
28. Kumar V, Kumar A, Ghosh AK, Samphel R, Yadav R, Yeung D, et al. Enculturating science: Community-centric design of behavior change interactions for accelerating health impact. Semin Perinatol 2015 Aug;39(5):393-415. [doi: 10.1053/j.semperi.2015.06.010] [Medline: 26215599]
29. Alsop K, Thorne H, Sandhu S, Hamilton A, Mintoff C, Christie E, Melbourne Melanoma Project, Australian Ovarian Cancer Study Group (AOCS), Kathleen Cuningham Foundation Consortium for Research into Familial Breast Cancer (kConFab), et al. A community-based model of rapid autopsy in end-stage cancer patients. Nat Biotechnol 2016 Oct;34(10):1010-1014. [doi: 10.1038/nbt.3674] [Medline: 27617737]
30. Dadlani C, Orlow S. Planning for a brighter future: a review of sun protection and barriers to behavioral change in children and adolescents. Dermatol Online J 2008 Sep 15;14(9):1 [FREE Full text] [Medline: 19061583]

Edited by G Eysenbach; submitted 15.05.20; peer-reviewed by M Zafar, U Rabbani; comments to author 30.08.20; revised version received 15.10.20; accepted 23.03.21; published 09.04.21.

Please cite as:
Truong A, Forbes B, Zhang M, McFadden M, Klein S
A Sun Safety Pilot Program Using a Tanning Myths–Focused Video Contest for Utah Adolescents: Cross-sectional Analysis
JMIR Dermatol 2021;4(1):e20192
URL: https://derma.jmir.org/2021/1/e20192
doi:10.2196/20192
PMID:

©Amanda Truong, Brayden Forbes, Mingyuan Zhang, Molly McFadden, Stephanie Klein. Originally published in JMIR Dermatology (http://derma.jmir.org), 09.04.2021. This is an open-access article distributed under the terms of the Creative Commons Attribution License (https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work, first published in JMIR Dermatology Research, is properly cited. The complete bibliographic information, a link to the original publication on http://derma.jmir.org, as well as this copyright and license information must be included.

XSL•FO
RenderX

Original Paper

Association Between State Indoor Tanning Legislation and Google Search Trends Data in the United States From 2006 to 2019: Time-Series Analysis

Carolyn Heckman[1], PhD; Yong Lin[1], PhD; Mary Riley[2], MPH; Yaqun Wang[1], PhD; Trishnee Bhurosy[1], PhD; Anna Mitarotondo[1], BA; Baichen Xu[1], MS; Jerod Stapleton[3], PhD

[1]Rutgers Cancer Institute of New Jersey, New Brunswick, NJ, United States
[2]Medtronic, Denver, CO, United States
[3]University of Kentucky, Lexington, KY, United States

Corresponding Author:
Carolyn Heckman, PhD
Rutgers Cancer Institute of New Jersey
195 Little Albany St
New Brunswick, NJ, 08901
United States
Phone: 1 7322358830
Email: ch842@rutgers.edu

Related Article:

This is a corrected version. See correction statement: https://derma.jmir.org/2021/1/e29516

Abstract

Background: Exposure to ultraviolet radiation from the sun or indoor tanning is the cause of most skin cancers. Although indoor tanning has decreased in recent years, it remains most common among adolescents and young adults, whose skin is particularly vulnerable to long-term damage. US states have adopted several types of legislation to attempt to minimize indoor tanning among minors: a ban on indoor tanning among all minors, a partial minor ban by age (eg, <14 years), or the requirement of parental consent or accompaniment for tanning. Currently, only 6 US states have no indoor tanning legislation for minors.

Objective: This study investigated whether internet searches (as an indicator of interest) related to indoor tanning varied across US states by the type of indoor tanning legislation, using data from Google Trends from 2006 to 2019.

Methods: We conducted a time-series analysis of Google Trends data on indoor tanning from 2006 to 2019 by US state. Time-series linear regression models were generated to assess the Google Trends data over time by the type of indoor tanning legislation.

Results: We found that indoor tanning search rates decreased significantly for all 50 states and the District of Columbia over time ($P<.01$). The searches peaked in 2012 when indoor tanning received marked attention (eg, indoor tanning was banned for all minors by the first state—California). The reduction in search rates was more marked for states with a complete ban among minors compared to those with less restrictive types of legislation.

Conclusions: Our findings are consistent with those of other studies on the association between indoor tanning regulations and attitudinal and behavioral trends related to indoor tanning. The main limitation of the study is that raw search data were not available for more precise analysis. With changes in interest and norms, indoor tanning and skin cancer risk among young people may change. Future studies should continue to determine the impact of such public health policies in order to inform policy efforts and minimize risks to public health.

(JMIR Dermatol 2021;4(1):e26707) doi:10.2196/26707

KEYWORDS

adolescents; dermatology; Google Trends; indoor tanning; internet; policy; prevention; skin cancer; skin cancer prevention; tanning; trend; time series; web-based health information; young adult; youth

XSL•FO
RenderX

Introduction

Ultraviolet radiation from the sun or indoor tanning is the cause of most skin cancers [1]. Although indoor tanning has decreased in recent years, it remains most common among adolescents and young adults [2,3], whose skin is particularly vulnerable to long-term damage [1]. US states have adopted several types of legislation to minimize indoor tanning among minors: a ban on indoor tanning among all minors, a partial minor ban by age (eg, <14 years), or the requirement of parental consent or accompaniment during indoor tanning. Currently, only 6 US states (Alaska, Colorado, Iowa, Montana, New Mexico, and South Dakota) have no indoor tanning legislation for minors [4]. The increase in indoor tanning restrictions may explain reductions in the number of indoor tanning providers, consumer spending on indoor tanning [5], and past-year indoor tanning among girls (24.1% in 2009 and 9.5% in 2015) and boys (5.7% in 2009 and 3.3% in 2015) attending high school and young adults aged 18-34 years (14% in 2007 and 4% in 2018) in the United States in recent years [3,6]. More stringent regulations have been associated with greater reductions in indoor tanning behavior and have been estimated to have a greater impact on melanoma incidence, mortality, and cost [7-10].

Internet search trends indicate public interest in a topic and are associated with actual health-related events such as influenza and COVID-19 outbreaks [11,12], medication use [13,14], melanoma mortality rates [15], and tobacco- and alcohol-related policy changes [16,17]. This study investigated whether internet searches (as an indicator of interest) related to indoor tanning varied across US states by the type of indoor tanning legislation, using free, publicly available data from Google Trends from 2006 to 2019. We hypothesized that the reduction in search rates over time would be associated with stricter indoor tanning regulations (eg, a ban on indoor tanning among all minors).

Methods

Data were downloaded from Google Trends [18]; these data reflect how many searches have been conducted on a specified topic relative to the total number of searches on Google within the selected time frame and geographic location. Search volume indices range from 0 (no searches) to 100 (peak number of searches). We selected the topic “indoor tanning,” which includes related search terms (eg, “tanning bed”). The indoor tanning time series consists of search volume indices from January 2006 to October 2019 for each state, along with the District of Columbia, and the United States as a whole. Google Trends data were available for 2004 and 2005, but state data were not sufficient for analysis.

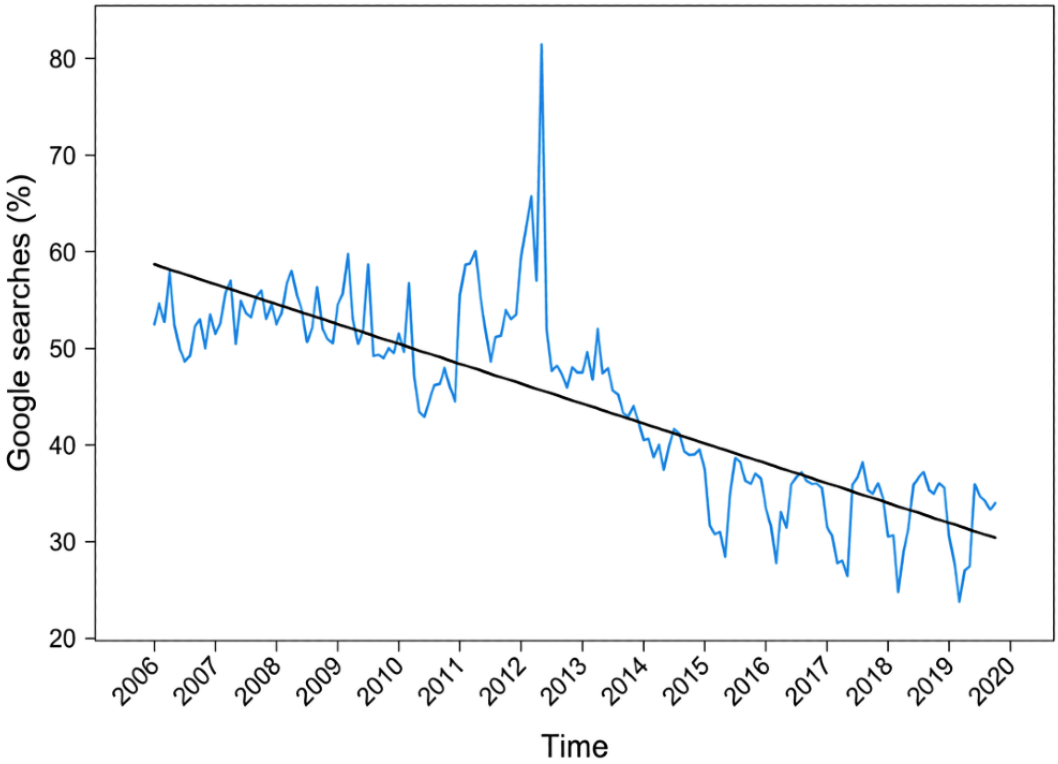
In order to study longitudinal trends, seasonal effects were first excluded from the time series, since indoor tanning is most popular during spring in many parts of the United States [19]. We fitted 2 linear models for each state to evaluate the Google Trends data on indoor tanning and their association with the legislation type (a ban of all minors [n=22], a partial ban [n=10], requirement of parental consent [n=13], and no legislation [n=6] as of October 2019) as documented by the National Conference of State Legislatures [4]. Model 1 is a change-point model with the date of legislation enactment as the change point and as an outlier, since we observed an additional peak for some states on the date of legislation enactment. The first legislation was enacted in Wisconsin in 1991 (a partial ban), and the latest legislation included in the analyses were those enacted in Maine and Maryland (complete bans) in September and October of 2019, respectively. Model 2 is a model without any change points. To account for the correlations among adjacent time points in both models, an autoregressive moving average error structure was used. The fitted slopes (change rates) for all states in both models were calculated. The association between legislation type and the fitted slopes was assessed using a heterogenous variance model owing to unequal variations in slopes among legislation types. For Model 1, the difference in slope before and after the date of legislation enactment was first evaluated to determine whether Model 2 was sufficient for comparisons among legislation types. For multiple comparisons, P values were adjusted on the basis of the Tukey method for multiplicity adjustment. A P value less than .05 was considered significant. Statistical analyses were conducted using R (version 4.0.1, The R Foundation) [20] and SAS (version 9.4, The SAS Institute) [21].

Results

Figure 1 shows the trend in Google searches related to indoor tanning for the United States overall with the fitted regression line for the no-change-point model. The slope (change rate for tanning search trends) decreased over time. When individual states (Multimedia Appendix 1) were grouped by legislation type, the decreasing slope rates differed. These decreasing rates were greater for states that imposed a ban on all minors than for states with other types of legislation. We calculated P values to compare slopes before and after the date of legislation enactment, based on change-point Model 1, for states that imposed a minor ban. Before multiplicity adjustment, P values were significant for only the District of Columbia (2015), Delaware (2015), and Nebraska (2014) (P=.02-.04). After multiplicity adjustment, all these P values were not significant (P≥.44). In addition, the slope differences before and after the enactment of the legislation by legislation type were not significant (P=.84). Hence, we only compared the legislation types in accordance with Model 2.

XSL•FO
RenderX

Figure 1. Google Trends data for the United States with fitted regression lines. Blue line: time series data after excluding seasonal effects, black line: Model 2 without change points.



As indicated in Model 2, the legislation type was significantly associated with a reduction in search rates (slopes) (*P*=.01). Table 1 shows the results of pairwise comparisons in the reduction in search rates by legislation type. We found that the reduction in the indoor tanning search trend was more marked for states that imposed a ban on all minors (0.6% per month smaller search volume) than for those that imposed a partial ban (*P*=.009, adjusted *P*=.04). Furthermore, this rate reduction was more marked for states that imposed a ban on all minors (0.5% per month smaller search volume) than for those that required parental consent (*P*=.005, adjusted *P*=.02). Moreover, this rate reduction was more marked for states that imposed a ban on all minors (0.2% per month smaller search volume) than for those with no legislation; these values were borderline significant before adjustment but did not significantly differ after multiplicity adjustment (*P*=.08, adjusted *P*=.28). The rate reduction was more marked for states with no legislation than for those requiring parental consent and those that imposed a partial ban, but these values did not significantly differ after multiplicity adjustment (adjusted *P*≥.22). Finally, rate reductions between states requiring parental consent and those that imposed a partial ban did not significantly differ (*P*=.22, adjusted *P*=.98).

Table 1. Pairwise comparisons of Google Trends search data by legislation type.

Comparisons	Rate difference (SE)	*P* value[a]	Adjusted *P* value[b]
States that banned all minors vs states that required parental consent	–0.60 (0.22)	*.009*	*.04*
States that banned all minors vs states that imposed a partial ban	–0.51 (0.17)	*.005*	*.02*
States that banned all minors vs states with no legislation	–0.27 (0.13)	.08	.28
States with no legislation vs states that required parental consent	–0.34 (0.20)	.07	.27
States with no legislation vs states that imposed a partial ban	–0.24 (0.14)	.06	.22
States that required parental consent vs states that imposed a partial ban	0.09 (0.22)	.70	.98

[a]Significant *P* values are italicized.

[b]Values are based on Tukey-Kramer adjustment.

Discussion

Principal Findings

Studies have previously analyzed Google Trends data related to tanning, skin protection, skin cancer, and other health-related issues, along with tanning trends by season, geographic location, and population demographics of US states [15,19,22-24]. However, to our knowledge, no previous studies have explored an association between Google search rates and indoor tanning–related legislation. This study shows that indoor tanning search rates decreased significantly for all 50 US states and the District of Columbia over time. We observed a peak in 2012

XSL•FO
RenderX

when indoor tanning received increased media attention. For example, in 2012, along with the release of the final season of the television show Jersey Shore (catchphrase: "Gym, Tan, Laundry"), Patricia Krentcil from New Jersey was accused of bringing her fair-skinned, red-headed, 5-year-old daughter to tanning salons with her, and indoor tanning was banned for all minors by the first state—California.

The reduction in the Google search rate was more marked for states that imposed bans among all minors than for those with a less restrictive legislation. Considering the limitations of Google Trends data and the wide variation in the timing of legislation across US states, there are several potential explanations for these findings. For example, restrictive regulations may influence interest in tanning, as evidenced by internet search trends, or decreased interest in tanning may facilitate the enactment of more restrictive policies. These associations may also be better accounted for by other unmeasured factors (eg, increasing outdoor temperatures over time). It is not surprising that we observed no significant difference in search trends for states that imposed partial bans and those that require parental consent or accompaniment, since both types of policies are partial restrictions. However, it is difficult to explain the lack of a significant difference in the trends for states with no legislation and those with other types of legislation. Perhaps search trends for states with no legislation are more likely to be similar to the nationwide media trends if state and local media attention is limited.

Strengths and Limitations

The strengths of this study include its longitudinal analysis of a nationwide data set based on millions of Google searches. A key limitation of the study is that raw search data were not available for more precise analyses. The data are anonymized; hence, we are unaware of the demographics or other characteristics of the searchers, including (for example) what proportion of searchers are youth or adults or are for, against, or neutral toward indoor tanning. The data are limited to the 90% of people in the United States who use the internet [25] and the 88.1% of internet searches conducted on Google [26], which tends to be more representative of people aged under 45 years, compared to other search engines such as Bing or Yahoo [27]. Arora et al [28] have previously reviewed the potential opportunities and limitations of Google Trends data for use in health and health policy research.

Conclusions

In the context of other relevant data, Google Trends data may provide novel insights into health- and health policy–related trends. Longitudinal Google search trends are associated with the type of indoor tanning legislation. As interest in tanning and norms change, indoor tanning and the skin cancer risk among young people may also change [3]. Future studies should continue to investigate the impact of such public health policies to inform policy efforts and minimize the public health risk.

Acknowledgments

This study was funded in part by the National Cancer Institute (P30CA072720).

Conflicts of Interest

Author MR is an employee of Medtronic Inc. The other authors have no conflicts to declare.

Multimedia Appendix 1
Google search trends with fitted regression lines (Black line: simple linear regression; Red line: Change-point linear regression; Blue line: Time series data after removing seasonal effect).
[DOCX File , 465 KB - derma_v4i1e26707_app1.docx]

References

1. Gandini S, Doré JF, Autier P, Greinert R, Boniol M. Epidemiological evidence of carcinogenicity of sunbed use and of efficacy of preventive measures. J Eur Acad Dermatol Venereol 2019 Mar;33 Suppl 2:57-62. [doi: 10.1111/jdv.15320] [Medline: 30811691]
2. Guy GP, Watson M, Seidenberg AB, Hartman AM, Holman DM, Perna F. Trends in indoor tanning and its association with sunburn among US adults. J Am Acad Dermatol 2017 Jun;76(6):1191-1193 [FREE Full text] [doi: 10.1016/j.jaad.2017.01.022] [Medline: 28522044]
3. Qin J, Holman DM, Jones SE, Berkowitz Z, Guy GP. State Indoor Tanning Laws and Prevalence of Indoor Tanning Among US High School Students, 2009-2015. Am J Public Health 2018 Jul;108(7):951-956. [doi: 10.2105/AJPH.2018.304414] [Medline: 29771612]
4. Indoor Tanning Restrictions for Minors: A State-By-State Comparison. National Conference of State Legislatures. 2020 Dec 11. URL: https://www.ncsl.org/research/health/indoor-tanning-restrictions.aspx [accessed 2021-03-08]
5. Jayakumar KL, Lipoff JB. Tax Collections and Spending as a Potential Measure of Health Policy Association With Indoor Tanning, 2011-2016. JAMA Dermatol 2018 May 01;154(5):613-614 [FREE Full text] [doi: 10.1001/jamadermatol.2018.0161] [Medline: 29641804]
6. Bowers JM, Geller AC, Schofield E, Li Y, Hay JL. Indoor Tanning Trends Among US Adults, 2007-2018. Am J Public Health 2020 Jun;110(6):823-828. [doi: 10.2105/AJPH.2020.305605] [Medline: 32298165]

XSL•FO
RenderX

7. Gordon LG, Rodriguez-Acevedo AJ, Køster B, Guy GP, Sinclair C, Van Deventer E, et al. Association of Indoor Tanning Regulations With Health and Economic Outcomes in North America and Europe. JAMA Dermatol 2020 Apr 01;156(4):401-410 [FREE Full text] [doi: 10.1001/jamadermatol.2020.0001] [Medline: 32074257]
8. Guy GP, Berkowitz Z, Jones SE, Olsen EO, Miyamoto JN, Michael SL, et al. State indoor tanning laws and adolescent indoor tanning. Am J Public Health 2014 Apr;104(4):e69-e74. [doi: 10.2105/AJPH.2013.301850] [Medline: 24524515]
9. Reimann J, McWhirter JE, Cimino A, Papadopoulos A, Dewey C. Impact of legislation on youth indoor tanning behaviour: A systematic review. Prev Med 2019 Jun;123:299-307. [doi: 10.1016/j.ypmed.2019.03.041] [Medline: 30940571]
10. Rodriguez-Acevedo AJ, Green AC, Sinclair C, van Deventer E, Gordon LG. Indoor tanning prevalence after the International Agency for Research on Cancer statement on carcinogenicity of artificial tanning devices: systematic review and meta-analysis. Br J Dermatol 2020 Apr;182(4):849-859. [doi: 10.1111/bjd.18412] [Medline: 31381131]
11. Ayyoubzadeh SM, Ayyoubzadeh SM, Zahedi H, Ahmadi M, R Niakan Kalhori S. Predicting COVID-19 Incidence Through Analysis of Google Trends Data in Iran: Data Mining and Deep Learning Pilot Study. JMIR Public Health Surveill 2020 Apr 14;6(2):e18828 [FREE Full text] [doi: 10.2196/18828] [Medline: 32234709]
12. Ginsberg J, Mohebbi MH, Patel RS, Brammer L, Smolinski MS, Brilliant L. Detecting influenza epidemics using search engine query data. Nature 2009 Feb 19;457(7232):1012-1014. [doi: 10.1038/nature07634] [Medline: 19020500]
13. Crowson MG, Schulz K, Tucci DL. National Utilization and Forecasting of Ototopical Antibiotics: Medicaid Data Versus "Dr. Google". Otol Neurotol 2016 Sep;37(8):1049-1054. [doi: 10.1097/MAO.0000000000001115] [Medline: 27348390]
14. Schuster NM, Rogers MAM, McMahon LF. Using search engine query data to track pharmaceutical utilization: a study of statins. Am J Manag Care 2010 Aug;16(8):e215-e219 [FREE Full text] [Medline: 20690788]
15. Bloom R, Amber KT, Hu S, Kirsner R. Google Search Trends and Skin Cancer: Evaluating the US Population's Interest in Skin Cancer and Its Association With Melanoma Outcomes. JAMA Dermatol 2015 Aug;151(8):903-905. [doi: 10.1001/jamadermatol.2015.1216] [Medline: 26061357]
16. Ghosh A, E-Roub F, Krishnan NC, Choudhury S, Basu A. Can google trends search inform us about the population response and public health impact of abrupt change in alcohol policy? A case study from India during the covid-19 pandemic. Int J Drug Policy 2021 Jan;87:102984 [FREE Full text] [doi: 10.1016/j.drugpo.2020.102984] [Medline: 33091762]
17. Troelstra SA, Bosdriesz JR, de Boer MR, Kunst AE. Effect of Tobacco Control Policies on Information Seeking for Smoking Cessation in the Netherlands: A Google Trends Study. PLoS One 2016;11(2):e0148489 [FREE Full text] [doi: 10.1371/journal.pone.0148489] [Medline: 26849567]
18. Google Trends. URL: https://trends.google.com/trends/geo=US [accessed 2021-03-04]
19. Toosi B, Kalia S. Seasonal and Geographic Patterns in Tanning Using Real-Time Data From Google Trends. JAMA Dermatol 2016 Feb;152(2):215-217. [doi: 10.1001/jamadermatol.2015.3008] [Medline: 26719968]
20. The R Project for Statistical Computing. The R Foundation. URL: http://www.r-project.org/ [accessed 2021-03-25]
21. SAS Institute Inc. URL: http://www.sas.com/ [accessed 2021-03-25]
22. Callaghan DJ. Use of Google Trends to Examine Interest in Mohs Micrographic Surgery: 2004 to 2016. Dermatol Surg 2018 Feb;44(2):186-192. [doi: 10.1097/DSS.0000000000001270] [Medline: 28930787]
23. Kwan Z, Yong SS, Robinson S. Analysis of Internet searches using Google Trends to measure interest in sun protection and skin cancer in selected South-East Asian populations. Photodermatol Photoimmunol Photomed 2020 Mar;36(2):83-89. [doi: 10.1111/phpp.12510] [Medline: 31508854]
24. Seth D, Gittleman H, Barnholtz-Sloan J, Bordeaux JS. Association of Socioeconomic and Geographic Factors With Google Trends for Tanning and Sunscreen. Dermatol Surg 2018 Feb;44(2):236-240. [doi: 10.1097/DSS.0000000000001324] [Medline: 28902024]
25. Internet/Broadband Fact Sheet. Pew Research Center. 2019 Jun 12. URL: https://www.pewresearch.org/internet/fact-sheet/internet-broadband/ [accessed 2021-03-04]
26. Search engine market share United States of America. StatCounter. URL: https://gs.statcounter.com/search-engine-market-share/all/united-states-of-america [accessed 2021-03-04]
27. Sentance R. How different age demographics search the internet. UserZoom. URL: https://www.userzoom.com/ux-library/what-are-the-differences-in-how-age-demographics-search/ [accessed 2021-03-04]
28. Arora VS, McKee M, Stuckler D. Google Trends: Opportunities and limitations in health and health policy research. Health Policy 2019 Mar;123(3):338-341. [doi: 10.1016/j.healthpol.2019.01.001] [Medline: 30660346]

XSL•FO
RenderX

Edited by M Focsa; submitted 22.12.20; peer-reviewed by J Sapp, C Mavrot; comments to author 11.01.21; revised version received 08.03.21; accepted 15.03.21; published 09.04.21.

Please cite as:
Heckman C, Lin Y, Riley M, Wang Y, Bhurosy T, Mitarotondo A, Xu B, Stapleton J
Association Between State Indoor Tanning Legislation and Google Search Trends Data in the United States From 2006 to 2019: Time-Series Analysis
JMIR Dermatol 2021;4(1):e26707
URL: https://derma.jmir.org/2021/1/e26707
doi:10.2196/26707
PMID:

©Carolyn Heckman, Yong Lin, Mary Riley, Yaqun Wang, Trishnee Bhurosy, Anna Mitarotondo, Baichen Xu, Jerod Stapleton. Originally published in JMIR Dermatology (http://derma.jmir.org), 09.04.2021. This is an open-access article distributed under the terms of the Creative Commons Attribution License (https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work, first published in JMIR Dermatology Research, is properly cited. The complete bibliographic information, a link to the original publication on http://derma.jmir.org, as well as this copyright and license information must be included.

XSL•FO
RenderX

Original Paper

Analysis of Keywords Used in Internet Searches for Melanoma Information: Observational Study

Japbani K Nanda[1], BS; Jennifer L Hay[2], PhD; Michael A Marchetti[1], MD

[1]Dermatology Service, Department of Medicine, Memorial Sloan Kettering Cancer Center, New York, NY, United States

[2]Department of Psychiatry and Behavioral Sciences, Memorial Sloan Kettering Cancer Center, New York, NY, United States

Corresponding Author:
Michael A Marchetti, MD
Dermatology Service
Department of Medicine
Memorial Sloan Kettering Cancer Center
530 E 74th St
New York, NY, 10021
United States
Phone: 1 646 888 6016
Fax: 1 646 227 7274
Email: marchetm@mskcc.org

Abstract

Background: The internet is an accessible resource for health care information and is often used by patients to learn about melanoma. The keywords that are used in internet searches can reflect internet users' interest in specific topics and the public's awareness of health-related issues.

Objective: This study aims to describe the most frequently used keywords, questions, and corresponding websites in internet searches for melanoma.

Methods: This is an observational study using data retrieved from Google Trends, Alexa Internet, SEMrush, Ahrefs, and SE Ranking for the keywords "melanoma" and "skin cancer."

Results: Average search interest as per Google Trends was greater for the keyword "skin cancer" than for the keyword "melanoma." Searches for the top 25 keywords in 3 databases resulted in 34 unique melanoma keywords and 33 unique skin cancer keywords. Melanoma keywords were most frequently related to clinicopathologic classification (n=11, 32%), and skin cancer keywords were most frequently about diagnosis (n=14, 42%). Questions about the prognosis of melanoma appeared most frequently among the most popular melanoma questions, but general questions or questions about the diagnosis of melanoma contributed the greatest proportion of searches by search volume. Skin cancer question searches were most commonly about diagnosis. The highest proportion of searches for popular melanoma and skin cancer keywords most frequently sent traffic to websites from nonprofit organizations and media companies, respectively.

Conclusions: We identified common keywords, questions, and websites used to access information about melanoma on the internet. These data may help health care providers and public health professionals when educating and counseling patients and the public about skin cancer.

(JMIR Dermatol 2021;4(1):e25720) doi:10.2196/25720

KEYWORDS

internet; melanoma; skin cancer; health information; search; keyword; question; website; cost-per-click

Introduction

In 2017, there were an estimated 1.2 million people living with invasive melanoma in the United States [1]. People may choose from a number of information sources to learn about melanoma, including the internet. In 2019, 90% of US adults used the internet, and 72% reported that they looked for medical or health information for themselves using a smartphone, computer, or other electronic means [2,3]. Although 95% of patients with melanoma at the University of Michigan reported that their physician provided sufficient information, 83% still looked to the internet for more information about melanoma [4]. Younger

XSL•FO
RenderX

respondents, females, those with a higher level of education, and those diagnosed with melanoma were found to be more likely to search the internet for information about their diagnosis [4]. Although the majority of patients described their use of the internet as a positive experience, one-third of patients with melanoma have reported higher anxiety after internet use [4].

Researchers have previously studied trends in internet searches related to skin cancer. Using Google Trends, Bloom et al [5] found that internet searches for the terms "melanoma" and "skin cancer" in the United States increased each summer from 2010 to 2014. The peak for skin cancer searches occurred in May, which is skin cancer awareness month, suggesting a possible association with outreach programs [6]. German studies of Google search volume spanning 2013-2018 found that the most frequently used keywords for internet searches related to skin cancer were "skin cancer," "white skin cancer," "basalioma," and "melanoma" [7,8]. Internet users searched for information about skin cancer types, identification, and skin changes [8]. The variety of search terms and questions used by internet users and the resulting websites accessed for information related to melanoma are not well characterized, particularly in the United States. Given the widespread use of the internet for health information broadly and skin cancer information specifically, our objective is to describe the keywords and questions used in melanoma internet searches. We also seek to identify the most frequently accessed websites for corresponding keyword searches.

Methods

Databases

This study was exempt from Institutional Review Board review because the data were publicly available. Data were obtained from multiple online databases: Google Trends [9], Alexa Internet [10], SEMrush [11], Ahrefs (URL Rating and Ahrefs Top) [12], and SE Ranking [13]. Google Trends provides keyword search interest data. Alexa, SEMrush, Ahrefs, and SE Ranking provide keyword or website analysis tools. Data from Alexa originates from the use of one of more than 25,000 browser extensions by millions of global internet users and from sites that install an Alexa script and permit Alexa to measure site traffic [14,15]. SEMrush uses third-party data providers to collect Google's search results for the 500 million most popular keywords and collects information about websites in the top 100 positions [16]. Ahrefs uses independently obtained data across 10 different search engines (ie, does not use output from Alexa, Google, etc), processes clickstream data, and has the world's largest third-party search query database [17,18]. SE Ranking is a cloud-based search engine optimization and marketing tool that tracks real-time website rankings for major search engines [19]. Data were extracted from databases on June 21, 2020, and analyzed using descriptive statistics.

Keyword Search Interest and Search Volume

We defined a keyword as a term that is entered into a search engine (like Google), which subsequently lists websites on a results page. As internet users may initially search for information about melanoma with a more general term such as skin cancer, we performed searches and analyses for both melanoma and skin cancer. To determine search term interest (ranging from 0 to 100), we extracted US and worldwide web search data using Google Trends' term comparison functionality to compare the terms "melanoma" and "skin cancer." Search interest at a given time is presented relative to the peak popularity for a search term, which is indicated by a score of 100. We also recorded average monthly keyword search volumes over a 12-month period using SEMrush and Ahrefs.

Keyword Popularity and Search Volume Analysis

We extracted the 25 most popular keywords related to melanoma and skin cancer searches using Alexa, SEMrush, and Ahrefs. For keywords that appeared in the first 25 consecutively listed keywords for one database but not another, the corresponding ranking in each database was recorded, if available. In Alexa, we determined the website with the highest share of voice for the keyword "melanoma." Share of voice refers to the proportion of searches made for a keyword that result in traffic receipt by a specific website. Within the "Keyword Clusters" tool for organic keywords, we selected the melanoma cluster and ranked keywords by popularity (ranging from 0 to 100), which is updated monthly and indicates the relative frequency of searches for that keyword. In SEMrush, we searched for "melanoma" in the "Keyword Magic Tool" (US database) using the exact match filter, sorted by average monthly volume of searches during a 1-year period. In Ahrefs, we searched for "melanoma" in the "Keywords explorer" (Google, US database) using the phrase match filter, sorted by average monthly volume of searches. This process was similarly performed for the keyword "skin cancer" using Alexa, SEMrush, and Ahrefs. Keywords were classified into one of eight categories: general, diagnosis, clinicopathologic classification, etiology, prognosis, treatment, prevention, or screening.

Keyword Advertising and Associated Websites

Keyword cost-per-click (CPC; USD) was recorded, if available, using SEMrush (based on Google Ads) and Ahrefs (based on multiple search engines). CPC is the average price paid by advertisers when their advertisement is clicked on in the results for that keyword. We recorded Alexa's indicator of paid competition (ranging from 0 to 100), which is updated monthly and reflects the amount of advertisements that appear on major search engines for a searched keyword. We recorded the websites with the highest keyword share of voice per Alexa for each popular keyword. The organizations associated with popular websites were classified as nonprofit, media company, government, charity, or medical practice [20-35].

Melanoma and Skin Cancer–Related Questions

The first 25 consecutively listed search questions related to melanoma and skin cancer were recorded using SEMrush's "Keyword Magic Tool" (US database) and Ahrefs's "Keywords explorer" (Google, US database). In SEMrush, questions were identified using the exact match filter and ranked based on average monthly volume of searches during a 1-year period. In Ahrefs, questions were ranked based on the average monthly volume of searches. Questions were classified into the same categories as keywords (previously mentioned).

XSL•FO
RenderX

Popular Websites for Highest Ranked Melanoma and Skin Cancer Keywords

For the single most popular melanoma and skin cancer keywords, we used Alexa, Ahrefs, and SE Ranking to determine the 10 websites that received the highest share of voice of organic traffic or were the highest ranked. Alexa provided the websites with the highest share of voice during the prior 6 months. In Ahrefs, the websites were ranked by monthly estimated search traffic (Google, US). SE Ranking provided websites ranked on data from April 2020 (Google, US). For websites that appeared in the top 10 for one database and not another, the corresponding ranking for that website in each database was noted if available.

Results

Search Interest and Search Volume

"Skin cancer" was more frequently used than "melanoma" as a search term per Google Trends. From January 2004 to June 2020, average search term interest in the United States was 62 (min-max: 39-100) for "skin cancer" and 49 (min-max: 32-76) for "melanoma." In June 2020 specifically, search term interest was 71 for "skin cancer" and 48 for "melanoma." Worldwide, "skin cancer" was also more frequently used than "melanoma" (data not shown). The average US monthly search volume for the keyword "melanoma" was 246,000 (SEMrush) and 243,000 (Ahrefs); global estimates were 585,500 (SEMrush) and 644,000 (Ahrefs). The average US monthly search volume for the keyword "skin cancer" was 301,000 (SEMrush) and 190,000 (Ahrefs); global estimates were 547,300 (SEMrush) and 356,000 (Ahrefs).

Popular Keywords

There were 34 unique keywords among the top 25 melanoma-related keywords in Alexa, SEMrush, and Ahrefs (Multimedia Appendix 1, Table S1). Keywords that appeared in the top 10 of all 3 databases were "melanoma," "malignant melanoma," "ocular melanoma," "metastatic melanoma," "melanoma symptoms," "melanoma cancer," "nodular melanoma," and "melanoma pictures." Keywords were most frequently related to melanoma clinicopathologic classification (n=11, 32%). There were 33 unique keywords among the top 25 skin cancer–related keywords in Alexa, SEMrush, and Ahrefs (Multimedia Appendix 1, Table S2). Keywords that appeared in the top 10 of all 3 databases were "skin cancer," "skin cancer types," "skin cancer pictures," "what does skin cancer look like," "skin cancer symptoms," "skin cancer images," and "signs of skin cancer." Keywords were most frequently related to skin cancer diagnosis (n=14, 42%).

Keyword Advertising and Commonly Accessed Websites

Using advertising competition data (paid competition and CPC) from multiple databases for the most popular keywords and questions in internet searches for melanoma and skin cancer, the keyword or question associated with the highest or one of the highest indicators of advertising competition (in the case of a tie) was related to treatment in 7 out of 10 cases. The keyword or question associated with the lowest indicator of advertising competition was related to diagnosis in 8 out of 10 cases.

A total of 11 unique websites had the highest share of voice per Alexa for the 34 melanoma keywords, and cancer.org (nonprofit; n=10, 29%) was the most frequent (Multimedia Appendix 1, Table S1). A total of 5 unique websites had the highest share of voice for the 33 skin cancer keywords, and webmd.com (media company; n=18, 55%) was the most frequent (Multimedia Appendix 1, Table S2).

Popular Question Searches

The top 25 question searches about melanoma are shown in Multimedia Appendix 1, Table S3. Questions related to melanoma that appeared in the top 5 of SEMrush or Ahrefs were "what is melanoma," "what does melanoma look like," "does melanoma itch," "what causes melanoma," "what is melanoma cancer," "what is the first sign of melanoma," "what does early signs of melanoma look like," and "where does melanoma spread to first." Among the top 25 melanoma questions, the most frequent category was prognosis (16/50, 32%). Per SEMrush, general melanoma questions contributed the greatest proportion of searches by search volume (14,440/33,400, 43.2%). Per Ahrefs, questions about the diagnosis of melanoma contributed the greatest proportion of searches by search volume (16,200/41,100, 39.4%).

The top 25 question searches about skin cancer are shown in Multimedia Appendix 1, Table S4. Questions in the top 5 were "what does skin cancer look like," "does skin cancer itch," "is skin cancer itchy," "can you die from skin cancer," "is skin cancer deadly," "how serious is basal cell skin cancer," "what is skin cancer," "what do the early stages of skin cancer look like," and "what causes skin cancer." Among the top 25 skin cancer questions, the most frequent category was diagnosis (27/50, 54%). Per SEMrush and Ahrefs, questions about diagnosis contributed the greatest proportion of searches by search volume (63,700/82,040, 77.6% and 30,400/43,400, 70.0%, respectively).

Popular Websites for Highest Ranked Keywords

The 5 most popular or highest ranked websites for the keyword "melanoma" in Alexa, Ahrefs, and SE Ranking were skincancer.org (nonprofit), cancer.org (nonprofit), wikipedia.org (nonprofit), medicalnewstoday.com (media company), and mayoclinic.org (nonprofit). The 5 most popular or highest ranked websites for the keyword "skin cancer" were webmd.com (media company), skincancer.org (nonprofit), cancer.org (nonprofit), mayoclinic.org (nonprofit), and medicinenet.com (media company; Multimedia Appendix 1, Table S5).

Discussion

Principal Findings

Herein, we described the volume of searches, popular keyword search strategies, and popular websites accessed for information about melanoma and skin cancer on the internet. The most popular melanoma and skin cancer keywords were related to clinicopathologic classification and diagnosis, respectively. Queries about diagnosis often pertained to images, signs, or

XSL•FO
RenderX

symptoms of skin cancer, suggesting a greater need for publicly available high-quality images of skin cancer. Our findings suggest that internet users are interested in online resources to learn about skin cancer diagnosis. This may also reflect awareness of the importance of skin cancer detection. Similarly, an analysis of internet search terms related to skin cancer in Germany found that keyword searches were often related to skin cancer identification via images or symptoms [7]. We also found that keyword searches related to prevention were uncommon. This may represent a need for increased awareness about the importance of primary prevention. Alternatively, this may suggest that the public already has adequate knowledge about preventative measures or that different, less technical terms are used, which were not captured in our study design.

With regard to searched questions, interest was directed toward melanoma prognosis, general information about melanoma, diagnosis of melanoma, and diagnosis of skin cancer. This may reflect internet users' concerns regarding prognosis and the importance of prognostic and staging information in the determination of treatment options for melanoma. These findings further support the need for online resources with information about the detection of melanoma and skin cancer. Keyword searches related to treatment were less common for both melanoma and skin cancer. Our findings parallel the results of a German study that investigated topics of interest in internet searches related to melanoma and nonmelanoma skin cancer [8]. The study found that searches related to the treatment of skin cancer were made less frequently, while searches related to the forms of skin cancer were more common [8].

Our findings based on CPC data suggest that there is greater advertising competition for keywords related to the treatment of skin cancer than for the diagnosis of skin cancer. Nonprofit or charity-associated websites comprised 71% (24/34) and 36% (12/33) of the websites with the highest share of voice for popular melanoma and skin cancer keywords, respectively. Although cancer.org, a website of the nonprofit American Cancer Society [33], most frequently received traffic from the highest proportion of searches made for popular melanoma keywords, the highest proportion of searches for the great majority of popular skin cancer keywords sent traffic to webmd.com (WebMD LLC), which is a consumer health information brand under media company Internet Brands [31,32]. The type of website that receives a high share of traffic from internet searches may be affected by the specificity of a given keyword search as determined by the topic of interest, topic complexity, or the chosen keyword vocabulary. This is important to note because the quality and readability of health information can vary between websites associated with media companies, governmental organizations, and nonprofit groups [36-39].

An internet search for health information can affect treatment plans and serve as a topic of discussion between patients and health care providers. The majority (71%) of Canadian patients with melanoma found that information from the internet affected their decisions regarding treatment [40]. Most found the internet to be useful, albeit difficult to understand to various degrees [40]. Websites resulting from "melanoma" searches in 2017 demonstrated variability in quality and available content, as well as a higher than recommended reading level [41]. Therefore, physicians continue to play an important role by encouraging patients to discuss the findings of their internet searches for health information and addressing potential misinformation from online sources. Health care providers should be prepared to address questions or concerns that arise from patients' health-related internet searches and guide patients toward reliable online sources of information. In this way, patients can better serve as active participants and advocates for their own health.

Limitations

Our study is limited by its observational design using retrospective data and an inability to comment on the proportion of internet searches made by patients with or survivors of skin cancer or internet users at high risk for skin cancer. Nonetheless, our use of multiple keyword and website analysis services allowed us to evaluate the most popular keywords and websites accessed by the public. It is possible that internet users who searched for melanoma keywords may have been diagnosed with melanoma and sought to learn more about their diagnosis, while those who performed searches for skin cancer information may have been looking for general skin cancer information. A survey of 31 patients with melanoma found that 96% used the internet to acquire information about melanoma treatment [40]. Bloom et al [5] found a positive correlation between skin cancer search volume index and increased mortality due to melanoma, postulating that this may have been due to a higher volume of searches performed by individuals with advanced melanoma or others who were indirectly affected. Future research would be invaluable to study associations between the characteristics of internet users and specific keyword internet searches. Our study is also limited to analysis of the data as reported by keyword databases. Internet users can choose to learn about specific topics of interest or enhance their understanding of a given topic by directly clicking on links within an accessed webpage instead of performing a keyword search. Although keywords related to prevention were uncommon in our study, internet users may perform searches related to prevention using other keywords. For example, searches for sunburn prevention or sunscreen are relevant for skin cancer prevention but do not contain the keywords "melanoma" or "skin cancer."

Conclusions

Skin cancer is a public health issue that was highlighted in the US Surgeon General's call for preventative action [42]. As a highly accessible resource, the internet is a valuable educational tool for skin cancer. Our study sheds light on internet users' interests and awareness of topics related to melanoma and skin cancer. Our findings suggest that efforts should be made to ensure that the public has access to high quality information to address general concerns about melanoma and other interests related to the clinicopathologic classification, prognosis, and diagnosis of melanoma, as well as the diagnosis of skin cancer in general. This may also be an opportunity for public health professionals and clinicians to emphasize the importance of sun protective measures and skin cancer prevention. Public health professionals can create educational materials and initiate campaigns that effectively address topics of interest as expressed

XSL•FO
RenderX

in internet searches while using keyword analysis to improve access to high quality resources. By understanding topics of interest, popular search queries, and frequently accessed websites for health information, clinicians can better prepare themselves to offer options for preferred information sources or critically evaluate the quality of online content accessed by patients. Familiarity with the types of skin cancer–related information that are of interest to the public and the most frequently accessed internet sources for this information may assist health care providers and public health professionals as they counsel and educate patients and the public on skin cancer.

Acknowledgments

This research is funded in part by a grant from the National Cancer Institute/National Institutes of Health (P30-CA008748).

Conflicts of Interest

None declared.

Multimedia Appendix 1
Corresponding tables.
[DOCX File , 42 KB - derma_v4i1e25720_app1.docx]

References

1. Howlader N, Noone AM, Krapcho M, Miller D, Brest A, Yu M, et al. SEER Cancer Statistics Review 1975-2017. Surveillance, Epidemiology, and End Results Program. Bethesda, MD: National Cancer Institute; 2020 Apr. URL: https://seer.cancer.gov/csr/1975_2017/ [accessed 2020-07-08]
2. Internet/broadband fact sheet. Pew Research Center. URL: https://www.pewresearch.org/internet/fact-sheet/internet-broadband/ [accessed 2020-06-08]
3. In the past 12 months, have you used a computer, smartphone, or other electronic means to look for health or medical information for yourself? Health Information National Trends Survey. URL: https://hints.cancer.gov/view-questions-topics/question-details.aspx?PK_Cycle=12&qid=1606 [accessed 2020-07-11]
4. Ludgate MW, Sabel MS, Fullen DR, Frohm ML, Lee JS, Couper MP, et al. Internet use and anxiety in people with melanoma and nonmelanoma skin cancer. Dermatol Surg 2011 Sep;37(9):1252-1259. [doi: 10.1111/j.1524-4725.2011.02124.x] [Medline: 22988988]
5. Bloom R, Amber KT, Hu S, Kirsner R. Google search trends and skin cancer: evaluating the US population's interest in skin cancer and its association with melanoma outcomes. JAMA Dermatol 2015 Aug;151(8):903-905. [doi: 10.1001/jamadermatol.2015.1216] [Medline: 26061357]
6. Kantor J. Association of Google search volume index peaks for skin cancer with skin cancer awareness month. JAMA Dermatol 2016 Jan;152(1):113. [doi: 10.1001/jamadermatol.2015.3814] [Medline: 26762257]
7. Tizek L, Schielein MC, Rüth M, Szeimies RM, Philipp-Dormston WG, Braun SA, et al. Interest in skin cancer in urban populations: a retrospective analysis of Google search terms in nine large German cities. Acta Derm Venereol 2019 Jul 01;99(9):797-804 [FREE Full text] [doi: 10.2340/00015555-3214] [Medline: 31073622]
8. Seidl S, Schuster B, Rüth M, Biedermann T, Zink A. What do Germans want to know about skin cancer? A nationwide Google search analysis from 2013 to 2017. J Med Internet Res 2018 May 02;20(5):e10327 [FREE Full text] [doi: 10.2196/10327] [Medline: 29698213]
9. Google Trends. URL: https://trends.google.com/trends/?geo=US [accessed 2020-06-21]
10. Alexa. URL: https://www.alexa.com/ [accessed 2020-06-21]
11. Semrush. URL: https://www.semrush.com/ [accessed 2020-06-21]
12. Ahrefs. URL: https://ahrefs.com/ [accessed 2020-06-21]
13. SE Ranking. URL: https://seranking.com/ [accessed 2020-06-21]
14. Yesbeck J. Your top questions about Alexa data and ranks, answered. Alexa Blog. URL: https://blog.alexa.com/top-questions-about-alexa-answered/ [accessed 2020-07-11]
15. How do I get my site's metrics Certified? Alexa. URL: https://support.alexa.com/hc/en-us/articles/200450354-How-do-I-get-my-site-s-metrics-Certified- [accessed 2020-07-11]
16. Where does Semrush data come from? Semrush. URL: https://www.semrush.com/kb/998-where-does-semrush-data-come-from [accessed 2020-07-11]
17. Ahrefs by the numbers. Ahrefs. URL: https://ahrefs.com/big-data [accessed 2020-07-11]
18. Helen. Where do you get the data from? Ahrefs. URL: https://help.ahrefs.com/en/articles/78119-where-do-you-get-the-data-from [accessed 2020-07-11]
19. Getting started. SE Ranking. URL: https://help.seranking.com/getting-started/ [accessed 2020-07-11]
20. The Skin Cancer Foundation. URL: https://www.skincancer.org/ [accessed 2020-07-02]

XSL•FO
RenderX

21. Frequently asked questions. Mayo Clinic. URL: https://www.mayoclinic.org/giving-to-mayo-clinic/contact-us/frequently-asked-questions [accessed 2020-07-02]
22. You're on a journey to health and wellness. And we're right there with you. Healthline. URL: https://www.healthline.com/about#mission [accessed 2020-07-02]
23. Wikipedia. URL: https://www.wikipedia.org/ [accessed 2020-07-02]
24. About this website. National Cancer Institute. URL: https://www.cancer.gov/about-website [accessed 2020-07-02]
25. Frequently asked questions. DermNet NZ. URL: https://dermnetnz.org/faq/ [accessed 2020-07-02]
26. Why have a skin cancer check? Bondi Junction Skin Cancer Clinic. URL: https://www.skincancer.net.au/why-have-a-skin-check [accessed 2020-07-02]
27. Vision, mission and core values. Texas Oncology. URL: https://www.texasoncology.com/who-we-are/who-is-texas-oncology/vision-mission-core-values [accessed 2020-07-02]
28. About Dotdash. Verywell Health. URL: https://www.verywellhealth.com/about-us#AboutDotdash [accessed 2020-07-02]
29. Our story. Cancer Treatment Centers of America. URL: https://www.cancercenter.com/community/about-us/our-story [accessed 2020-07-02]
30. Academy values. American Academy of Dermatology Association. URL: https://www.aad.org/employment [accessed 2020-07-02]
31. Our business. WebMD. URL: https://www.webmd.com/corporate/our-business [accessed 2020-07-01]
32. Internet Brands. URL: https://www.internetbrands.com/ [accessed 2020-07-02]
33. Facts about the American Cancer Society. American Cancer Society. URL: https://www.cancer.org/about-us/who-we-are/fact-sheet.html [accessed 2020-07-01]
34. About us. MedicineNet. URL: https://www.medicinenet.com/script/main/art.asp?articlekey=12510 [accessed 2020-07-11]
35. About Medical News Today. Medical News Today. URL: https://www.medicalnewstoday.com/about [accessed 2020-07-11]
36. Promislow S, Walker JR, Taheri M, Bernstein CN. How well does the internet answer patients' questions about inflammatory bowel disease? Can J Gastroenterol 2010 Nov;24(11):671-677 [FREE Full text] [doi: 10.1155/2010/957264] [Medline: 21157582]
37. Pusz MD, Brietzke SE. How good is Google? The quality of otolaryngology information on the internet. Otolaryngol Head Neck Surg 2012 Sep;147(3):462-465. [doi: 10.1177/0194599812447733] [Medline: 22597577]
38. Laplante-Lévesque A, Brännström KJ, Andersson G, Lunner T. Quality and readability of English-language internet information for adults with hearing impairment and their significant others. Int J Audiol 2012 Aug;51(8):618-626. [doi: 10.3109/14992027.2012.684406] [Medline: 22731921]
39. Storino A, Castillo-Angeles M, Watkins AA, Vargas C, Mancias JD, Bullock A, et al. Assessing the accuracy and readability of online health information for patients with pancreatic cancer. JAMA Surg 2016 Sep 01;151(9):831-837. [doi: 10.1001/jamasurg.2016.0730] [Medline: 27144966]
40. Hamilton SN, Scali EP, Yu I, Gusnowski E, Ingledew PA. Sifting through it all: characterizing melanoma patients' utilization of the internet as an information source. J Cancer Educ 2015 Sep;30(3):580-584. [doi: 10.1007/s13187-014-0711-1] [Medline: 25077770]
41. Alshaikh EA, Almedimigh AF, Alruwaili AM, Almajnoni AH, Alhajiahmed A, Almalki TS, et al. Patient-focused online resources for melanoma: highly variable content and quality. J Cancer Educ 2019 Aug;34(4):775-781. [doi: 10.1007/s13187-018-1372-2] [Medline: 29732480]
42. US Department of Health and Human Services. The Surgeon General's call to action to prevent skin cancer. HHS.gov. Washington, DC: US Dept of Health and Human Services, Office of the Surgeon General; 2014. URL: https://www.hhs.gov/sites/default/files/call-to-action-prevent-skin-cancer.pdf [accessed 2020-04-13]

Abbreviations

CPC: cost-per-click

Edited by G Eysenbach; submitted 12.11.20; peer-reviewed by L Tizek, M van Eenbergen; comments to author 05.01.21; revised version received 13.03.21; accepted 14.04.21; published 18.05.21.

Please cite as:
Nanda JK, Hay JL, Marchetti MA
Analysis of Keywords Used in Internet Searches for Melanoma Information: Observational Study
JMIR Dermatol 2021;4(1):e25720
URL: https://derma.jmir.org/2021/1/e25720
doi:10.2196/25720
PMID:

XSL•FO
RenderX

©Japbani K Nanda, Jennifer L Hay, Michael A Marchetti. Originally published in JMIR Dermatology (http://derma.jmir.org), 18.05.2021. This is an open-access article distributed under the terms of the Creative Commons Attribution License (https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work, first published in JMIR Dermatology Research, is properly cited. The complete bibliographic information, a link to the original publication on http://derma.jmir.org, as well as this copyright and license information must be included.

XSL•FO
RenderX

Original Paper

Assessing Sunscreen Protection Using UV Photography: Descriptive Study

Caitlin Horsham[1], MSc; Helen Ford[1], MSc; Jeremy Herbert[2], PhD; Alexander Wall[2], GradDip(IndDus); Sebastian Walpole[3], PhD; Elke Hacker[1], PhD

[1]School of Public Health and Social Work, Queensland University of Technology, Brisbane, Australia

[2]Designworks Group Pty Ltd, Brisbane, Australia

[3]Genetics & Population Health Division, QIMR Berghofer, Brisbane, Australia

Corresponding Author:
Elke Hacker, PhD
School of Public Health and Social Work
Queensland University of Technology
60 Musk Avenue
Kelvin Grove
Brisbane, 4059
Australia
Phone: 61 731389674
Email: elke.hacker@qut.edu.au

Abstract

Background: Photography using a UV transmitting filter allows UV light to pass and can be used to illuminate UV blocking lotions such as sunscreens.

Objective: The aim of this study is to compare currently available UV photography cameras and assess whether these devices can be used as visualization tools for adequate coverage of sun protection lotions.

Methods: This study was conducted in 3 parts: in phase 1, 3 different UV cameras were tested; in phase 2, we explored whether UV photography could work on a range of sun protection products; and in phase 3, a UV webcam was developed and was field-tested in a beach setting. In phase 1, volunteers were recruited, and researchers applied 3 sun protection products (ranging from sun protection factor [SPF] 15 to 50+) to the participants' faces and arms. UV photography was performed using 3 UV cameras, and the subsequent images were compared. In phase 2, volunteers were recruited and asked to apply their own SPF products to their faces in their usual manner. UV photographs were collected in the morning and afternoon to assess whether the coverage remained over time. Qualitative interviews were conducted to assess the participants' level of satisfaction with the UV image. In phase 3, a small portable UV webcam was designed using a plug-and-play approach to enable the viewing of UV images on a larger screen. The developed webcam was deployed at a public beach setting for use by the public for 7 days.

Results: The 3 UV camera systems tested during phase 1 identified the application of a range of sun protection lotions of SPF 15 to 50+. The sensitivity of the UV camera devices was shown to be adequate, with SPF-containing products applied at concentrations of 2 and 1 mg/cm^2 clearly visible and SPF-containing products applied at a concentration of 0.4 mg/cm^2 having lower levels of coverage. Participants in phase 2 reported high satisfaction with the UV photography images, with 83% (29/35) of participants likely to use UV photography in the future. During phase 2, it was noted that many participants used tinted SPF-containing cosmetics, and several tinted products were further tested. However, it was observed that UV photography could not identify the areas missed for all tinted products. During phase 3, the electrical components of the UV webcam remained operational, and the camera was used 233 times by the public during field-testing.

Conclusions: In this study, we found that UV photography could identify the areas missed by sun protection lotions with chemical filters, and participants were engaged with personalized feedback.

Trial Registration: Australian New Zealand Clinical Trials Registry (ANZCTR) ACTRN12619000975190; http://www.anzctr.org.au/Trial/Registration/TrialReview.aspx?id=377089 ; Australian New Zealand Clinical Trials Registry (ANZCTR) ACTRN12619000145101; https://www.anzctr.org.au/Trial/Registration/TrialReview.aspx?id=376672.

(JMIR Dermatol 2021;4(1):e24653) doi:10.2196/24653

XSL•FO
RenderX

KEYWORDS

skin neoplasms; melanoma; health promotion; public health; preventive medicine; sunburn; sunscreening agents; UV photography; mobile phone

Introduction

Background

Reflected UV photography provides a unique method of assessing sunscreen application. A camera using a UV transmitting filter allows UV radiation to pass but absorbs or blocks visible and infrared light. The subject is illuminated by either UV emitting lamps or sunlight, and a photo is taken, which then highlights the areas where sunscreens have been applied. Sunscreen application followed by UV photography is a potential method to objectively measure the visibility of sunscreen on the skin [1]. Pratt et al [2] have shown that UV photography can detect commonly missed areas during sunscreen application on the face, with participants missing the eyelids and the medial canthal area around the eyes. Molecular analysis of normal eyelids has also shown that over a quarter of cells carry mutations that exhibit characteristic signatures of UV light exposure [3]. The eyebrow and eyelid have also been reported as high-risk anatomical sites for locally destructive basal cell carcinoma skin cancers [4].

Skin cancer is estimated to account for more cases diagnosed than all other cancers combined in Australia, costing over Aus $800 million (US $622 million) to treat each year [5-7]. Sunlight or UV radiation is the main risk factor for skin cancers, and sunburn remains highly prevalent in the northern Australian state of Queensland, with 49% of adults and 45% of children sunburnt in the previous 12 months [8]. Of the children who were sunburnt in the past 12 months, 69% were most recently sunburnt during a water-based activity [8]. These findings are concerning and highlight the importance of adequate sunscreen coverage and reapplication when participating in water-based activities. Regular sunscreen application has been shown to reduce the incidence of squamous cell carcinoma and melanoma [9,10] and block the harmful molecular effects of UV radiation on skin cells in vivo [11].

Barriers reported to sunscreen application include concerns over sunscreen esthetics and tactile properties, including a sticky or greasy texture, feeling hot or sweaty, perception that sunscreens cause acne or skin irritation, and dislike of sunscreen appearance [12]. Many cosmetic products are secondary sunscreens with a sun protection factor (SPF) that offers convenience and improved texture and appearance. In Australia, the industry-accepted SPF standard tests primary sunscreens as well as secondary sunscreen products, which are applied at a thickness of 2 mg/cm^2 and rated for SPF from 0 to 50+. For SPF products to be effective, adequate quantities of the product need to be applied with an appropriate frequency of reapplication. There are 2 types of sun protection formulations: (1) physical filters such as titanium dioxide or zinc oxide, which act by scattering sunlight from the skin surface, or (2) chemical filters that transform the energy from the sun into molecular conformational changes [13]. Physical filters cannot be detected with UV photography, and only lotions with chemical filters can be visualized. In addition, some cosmetic products are tinted and contain both chemical and physical filters in their formulations. The physical filters within these products may limit their ability to be visualized. Tinted SPF cosmetics contain a temporary color or pigmentation and can include products such as foundations, lipsticks, and eye shadows.

Objectives

The purpose of this study was to compare UV photography cameras and assess whether these devices can be used as visualization tools for adequate coverage of a range of SPF lotions commonly applied to the face, including sunscreens, moisturizers, and cosmetics.

Methods

This study was conducted in 3 parts: phase 1 was laboratory testing, which involved testing different UV cameras and SPF product coverage; phase 2 was determining whether UV photography could visualize a range of sun protection products self-applied by individuals; and phase 3 was developing a UV webcam and field-testing the device in a public beach setting.

Phase 1: Laboratory Testing of UV Cameras

Commercially available UV cameras were purchased using the purchasing protocol, which involved searching the internet using the terms “UV camera,” “sunscreen detector,” and “sunscreen camera.” A total of 3 devices were identified and purchased for delivery to Australia. The cameras of 2 devices, the Sunscreenr (Vocelight LLC) and Nurugo SPF (Nurugo), attach to Android smartphones and are used in combination with an app. The third device used a digital single-lens reflex (DSLR) camera (Model D5300, Nikon) fitted with a Baader Venus filter (Model Baader Planetarium U-Filter 2“, Ultraviolet, ZWL 350 nm).

Participants were eligible to participate if they were aged 18 years or above and were available to attend the university campus. Participants were excluded if they had allergies or were sensitive to sunscreen. The sample size calculation for phase 1 was based on the recommendations from the industry-accepted Sunscreen Standard (AS/NZS 2604:2012), which sets a minimum sample size of 10 participants to assess each sun protection product. Participants were recruited through university email and social media posts. Participants completed a demographic survey and removed any skin care or makeup products from their face and arms using isopropanol wipes and paper towels. Images of the treatment sites (face and forearms where SPF lotions were applied) were captured using the DSLR UV camera and normal photography before any lotions were applied. This was to ensure that there were no SPF lotions on the skin before treatment. The treatment areas were marked by the researchers using plastic cutout rectangles (4×2.5 cm) on the participants’ face and both forearms. Each SPF lotion was randomly assigned to a treatment site and applied at concentrations of 2, 1, and 0.4 mg/cm^2 (Figure S1 in Multimedia Appendix 1). The SPF lotions used included (1) sunscreen SPF

XSL•FO
RenderX

50+ (Cancer Council Ultra; active ingredients: homosalate 100 mg/g, octyl salicylate 50 mg/g, butyl methoxydibenzoylmethane 30 mg/g, and octocrylene 80 mg/g), (2) moisturizer secondary sunscreen SPF 50+ (SunSense Moisturizer; active ingredients: bemotrizinol 2%, methylene bis-benzotriazolyl tetramethylbutylphenol 2.5%, and octyl salicylate 5.0%), and (3) moisturizer secondary sunscreen SPF 15+ (Neutrogena Moisturizer; active ingredients: butyl methoxydibenzoylmethane, ethylhexyl methoxycinnamate, ethylhexyl salicylate, and phenylbenzimidazole sulfonic acid). Only SPF lotion products with chemical sunscreen filters were used, as zinc oxide and titanium dioxide cannot be visualized with UV photography. Images were captured immediately after SPF product application (baseline timepoint) and 20 minutes post application (follow-up timepoint) using the 3 UV cameras purchased. UV images of the participants' faces (front, left side, and right side) as well as both forearms were taken at each timepoint.

Image analysis was performed using Image J (National Institutes of Health) [14], and the scale-to-pixel measurement was assigned using the treatment area (4×2.5 cm), with the rectangle tool used to define the region of interest. Image thresholds were set, and the percentage of area with dark pixels (SPF lotion present) were compared with the percentage of area with light pixels (no SPF lotion present) to calculate the percentage of coverage.

Phase 2: Testing UV Photography Using a Range of Sun Protection Products

Part 2a: Observational Study

An observational study was conducted to assess the application of sun protection products of indoor workers. To be eligible, participants had to be aged 18 years or above, a current indoor worker, routinely use products with SPF on their face, and available to visit the researchers to attend both morning and afternoon photo sessions on the same day. Participants were recruited through email, social media, and the Queensland University of Technology workplace health and safety programs. Participants provided consent, completed a baseline questionnaire, and were asked to apply their own SPF products to their face in their usual manner before attending the study visit. To assess if the coverage remained over time, participants were imaged in the morning and then again in the afternoon, with a gap of at least 4 hours between timepoints. A total of 3 UV images of the participants' faces (front, left side, and right side) were taken at each timepoint. Images were captured indoors using a white background and standard lighting, with participants sitting on a stool at a set distance from the camera, and an artificial UV light source (Nurugo) was used for UV illumination. In the afternoon, participants were shown their UV images, and an in-person interview was conducted. During the interview, participants were asked about their level of satisfaction with their UV photography images. The interview questions are listed in Table S1 in Multimedia Appendix 1.

To assess the difference in coverage between the morning and afternoon photo sessions, an automated image analysis method was developed to objectively detect, segment, and quantify the areas of the face within the UV images that were not adequately covered by SPF lotions. Volocity 3D image analysis software (PerkinElmer) was used. A scale-to-pixel measurement was assigned to each image using the ID sticker (19×24 mm), the region of interest tool was imposed, and the find object tool was used to find the percentage of area with dark pixels (SPF lotion present) and compared this with the percentage of area with light pixels (no SPF lotion present). The segmented areas included the nose, cheeks, forehead, and medial canthal area, which were then scored as "yes, adequately protected" or "no, not adequately protected."

Part 2b: Testing Tinted SPF Lotions

Many SPF lotions used by participants in the observational study were tinted products that combined a colored base with SPF protection. Commonly used tinted sun protection products by participants in the observational study were purchased by the researchers for further laboratory testing in 1 volunteer. The 5 products used included (1) Fit Me SPF 18 liquid foundation (*Maybelline*; *active ingredients: octinoxate 7%*), (2) Lasting Radiance SPF 28 liquid foundation (*Rimmel*; *active ingredients: octinoxate*), (3) SkinActive beauty balm (BB) cream SPF 15 (*Garnier*; *active ingredients: octinoxate*), (4) BB cream SPF 15 (*Olay*; *active ingredients: octisalate* and *avobenzone*), and (5) SkinActive BB cream SPF 50+ (*La Roche-Posay*; *active ingredients: homosalate 6.0% w/w, octyl salicylate 5.0% w/w, butyl methoxydibenzoylmethane 5.0% w/w, octocrylene 5.0% w/w, ethylhexyl triazone 4.0% w/w, bemotrizinol 3.0% w/w, drometrizole trisiloxane 3.0% w/w, ecamsule 0.99% w/w,* and *titanium dioxide 0.83% w/w*). The volunteer provided informed consent, completed a demographic survey, and was asked to visit the researchers at the university. At the study visit, the volunteer was asked to remove any skin care or makeup products using isopropanol wipes and then rinse the area using running water and a paper towel. A UV image and normal photography image were taken from the treatment site before application to ensure that no lotions remained on the skin. The participants and research staff were blinded to the brand and SPF strength of the lotion. Lotions were applied to participants' forearms to compare the 5 products at 2, 1, 0.4, and 0.2 mg/cm^2 concentrations each to a 4×2.5 cm area of skin. Tinted sun protection products 4 and 5 were further evaluated at lower concentrations on the face, with applications of 1, 0.6, 0.4, and 0.2 mg/cm^2. Data collection included images captured immediately after application using both the DSLR UV camera and a normal camera (Nikon).

Phases 1 and 2 of the study were approved by the Human Research Ethics Committee of the Queensland University of Technology (number 1800001263) and prospectively registered with the Australian and New Zealand Clinical Trials Register (ACTRN12619000975190; ACTRN12619000145101). The sample size calculation for the phase 2 observational study was based on the recommendations from Lancaster et al [15] of 30 participants, which is widely used in feasibility testing studies.

XSL•FO
RenderX

Phase 3: Development, Safety, and Field-Testing of a UV Webcam

Development

A UV webcam on a large screen was developed for use at public events, which could be used by the public with contactless operation. The UV webcam was developed using a UV transmitting filter (Edmund Optics) and an M12 lens (ArduCam) connected to a printed circuit board for processing electronics and housed within a plastic molding with a 365-nm UV light-emitting diode light source. A high-definition multimedia interface output cable was used to display the image, and a commercially available pressure sensor mat (Radio Parts Pty Ltd) was connected via a custom data acquisition system to report the pressure-sensitive switch information in real time over a USB connection. The pressure sensor mat allowed use data to be collected and stored data locally on a microSD card. The UV webcam functioned with contactless operation and only required the users to stand on the mat for the image to be displayed on the screen. The UV webcam was designed to be plugged into any monitor or display screen with a high-definition multimedia interface connection point and display the image using a plug-and-play approach without requiring any software or an internet connection.

Observational Testing

To check whether the UV webcam was connecting and recording use data from the pressure sensor mat correctly, observational testing was performed in Brisbane, Australia (approximate latitude 27°S, 153°E). A total of 2 volunteers (90 kg and 60 kg) stood on the pressure sensor mat and used the UV camera 10 times, and the time-stamped data collected by the device were then compared with observational data.

Safety Testing

The temperature of the UV webcam device after 2 and 4 hours of continuous operation was recorded using an infrared handheld thermometer (ThermaTwin TN410LCE Infrared Thermometer). The UV radiation emitted by the UV light source was measured using a UV intensity meter (Solar Light Co, model PMA2100) fitted with a digital sensor (Solar Light Co, model PMA2101). The detector head of the sensor was positioned at a distance where a person's face would be placed during use.

Field-Testing

A field study was conducted from November 21 to 27, 2020, in spring in Australia. The UV webcam was deployed to Surfers Paradise beach in Queensland, Australia (approximate latitude 28.0°S, 153.4°E). The UV webcam was placed near the beach entry on the esplanade in a high-traffic area accessed by the public. The UV webcam was deployed at the start of the day until the end of daylight hours, and free SPF 50+ chemical sunscreen was available next to the UV webcam through a touchless automatic dispenser system (Danger Sun Overhead). End users could provide optional feedback if desired using the contact email and phone number provided next to the UV webcam. The deployment of the UV webcam was to assess the functionality and not human subjects' research; therefore, we obtained an institutional ethics review board exemption from the Human Research Ethics Committee of the Queensland University of Technology for this phase of the study.

Weather measurements were collected during the field study. Temperature data were recorded in degrees Celsius for the daily minimum and maximum as well as for observations at 9 AM and 3 PM each day. The temperature data were captured by the Bureau of Meteorology weather station (no.: 040764; Gold Coast Seaway, latitude 28°S, 153°E). The UV radiation data were captured by the Australian Radiation Protection and Nuclear Safety Agency detector (Gold Coast, latitude 28°S, 153°E), with the standard erythemal dose (SED) calculated with daily summaries and hourly observations recorded at 10 AM and noon.

Results

Phase 1: Laboratory Testing of UV Cameras

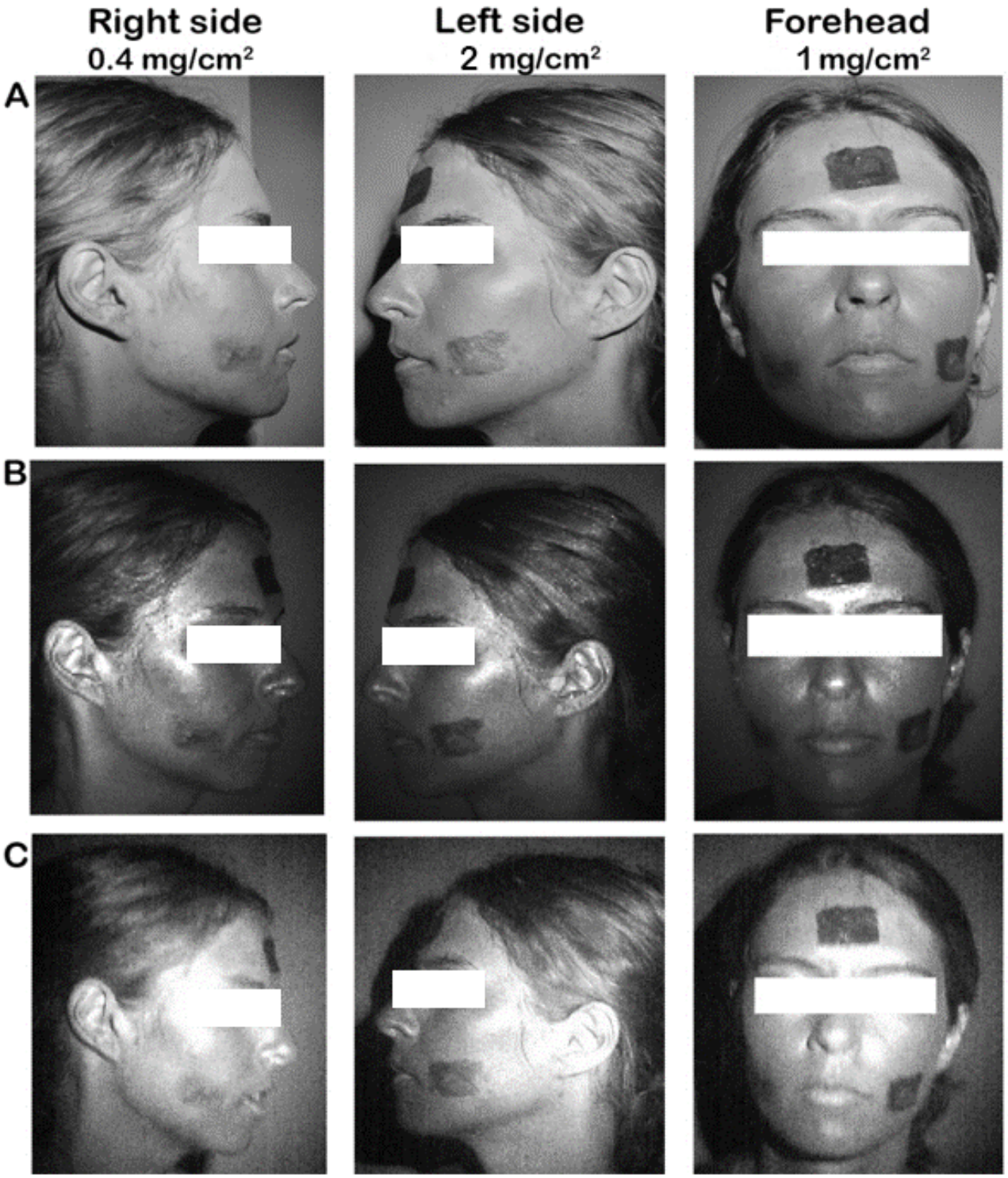
A total of 10 participants enrolled and completed the laboratory testing phase. The participants were mostly female (8/10, 80%), and 70% (7/10) of the participants had very fair or fair skin (Table S2 in Multimedia Appendix 1). All 3 UV cameras captured well-defined areas when the SPF lotions were applied at concentrations of 2 and 1 mg/cm^2. Figure 1 shows the areas where SPF lotions were applied to the participants' faces, with the dark areas indicating SPF lotions are present.

The quality of the image captured by the DSLR UV camera was the highest of the 3 UV cameras purchased, with an image size of 6000×4000 pixels and a resolution of 300 dpi (dots per inch). The image size captured by the Sunscreenr camera was 1716×1290 pixels at 72 dpi and by the Nurugo SPF camera was 480×640 pixels at 72 dpi. Both the Nurugo SPF and Sunscreenr cameras collected images that had sufficient image quality for an observer to view the images on the small screen of a smartphone.

With the 10 volunteers, the sensitivity of the UV camera devices was also tested using 3 SPF-containing lotions applied at concentrations of 2, 1, and 0.4 mg/cm^2 (Figure S2 in Multimedia Appendix 1). There was perfect agreement (100%) across the UV camera devices when the concentration of the SPF product was high (2 and 1 mg/cm^2; Table 1). The lower 0.4 mg/cm^2 application thickness had less coverage, but there was still strong agreement among the UV camera devices (Table 1).

XSL•FO
RenderX

Figure 1. Comparison of UV photography devices. (A) A digital single-lens reflex (DSLR) UV camera, (B) Nurugo sun protection factor (SPF) camera, and (C) Sunscreenr camera were used to capture images of a SPF 50+ lotion applied to a 4 cm×2.5 cm area at a set concentration on the right cheek (0.4 mg/cm^2), forehead (2 mg/cm^2), and left cheek (1 mg/cm^2).



XSL•FO
RenderX

Table 1. The percentage of coverage at each treatment site determined by 3 UV camera devices in 10 volunteers.

Sun protection product	DSLR[a] UV camera (n=10); % (SE)	Sunscreenr UV camera (n=10); % (SE)	Nurugo SPF[b] camera (n=10); % (SE)
Sunscreen SPF 50+ (mg/cm^2)			
2	100 (0)	100 (0)	100 (0)
1	100 (0)	100 (0)	100 (0)
0.4	72 (3.1)	72 (3.1)	73 (3.4)
Moisturizer SPF 50+ (mg/cm^2)			
2	100 (0)	100 (0)	100 (0)
1	100 (0)	100 (0)	100 (0)
0.4	69 (0.2)	68 (1.4)	69 (0.2)
Moisturizer SPF 15+ (mg/cm^2)			
2	100 (0)	100 (0)	100 (0)
1	100 (0)	100 (0)	100 (0)
0.4	69 (0.3)	68 (1.3)	69 (0.3)

[a]DSLR: digital single-lens reflex.

[b]SPF: sun protection factor.

Phase 2: Testing UV Photography Using a Range of Sun Protection Products

Part 2a: Observational Study

A total of 39 participants enrolled and completed the morning photo session, and 2 participants did not return for their afternoon photos. Furthermore, 2 participants wore products that contained only physical active ingredients and were excluded from further analysis (Figure S3 in Multimedia Appendix 1). Overall, 35 participants were included in the analysis.

The participants were mostly females (34/35, 97%), and 63% (22/35) of the participants had very fair or fair skin type (Table S2 in Multimedia Appendix 1). Just over half of the participants had applied 1 SPF-containing product (20/35, 57%), 34% (12/35) of the participants had applied 2 products, and 9% (3/35) of the participants had 3 or more products applied to their faces. The most used type of product was facial moisturizer (22/55, 40%), followed by liquid foundation (17/55, 31%), sunscreen (11/55, 20%), lip balm/lipstick (3/55, 5%), and powder foundation (2/55, 4%). Of the 55 facial products used by the participants, 25% (14/55) were SPF 50+, 53% (29/55) were SPF 15+, 4% (2/55) were below SPF 15, and 18% (10/55) had no SPF rating. A total of 66% (23/35) participants used one or more products that were tinted and contained chemical UV filters as well as varying quantities of titanium dioxide or zinc oxides.

Participants reported high satisfaction with the UV photography images, with 83% (29/35) of participants likely to use UV photography in the future to help guide the application of SPF products, whereas 80% (28/35) of participants would share their UV image with friends or family (Table S2 in Multimedia Appendix 1).

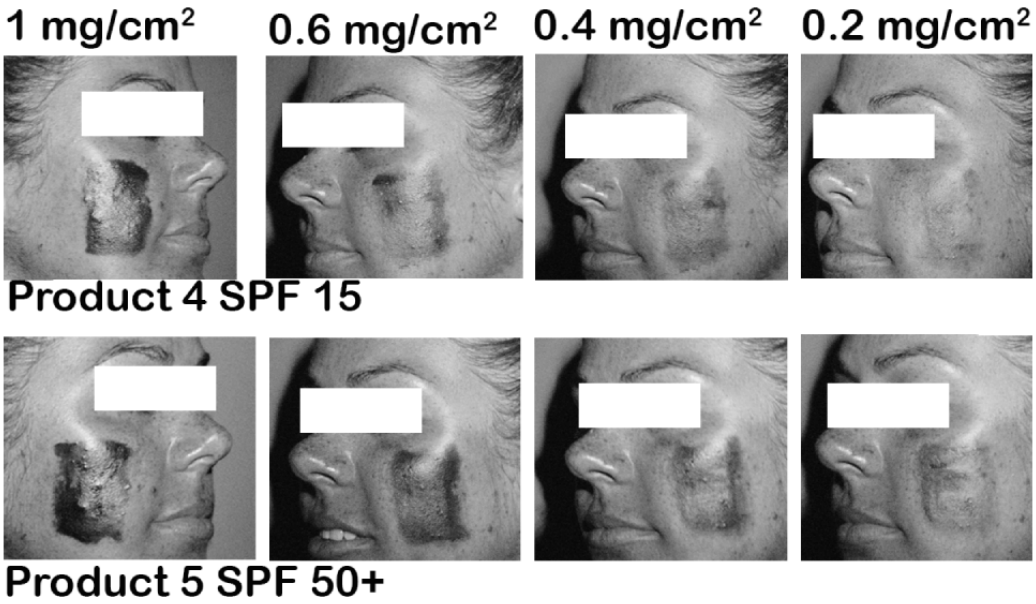
Participants' images captured in the morning showed good coverage of sun protection products on their nose (32/35, 91%), and 80% (28/35) of participants had their cheeks covered, and 71% (25/35) of the participants had their forehead protected. By the afternoon, the coverage of sun protection products had decreased, with only 74% (26/35) of the participants still having good coverage on their nose, 63% (22/35) having their cheeks protected, and 51% (18/35) having their forehead covered. On average, the morning and afternoon photos were taken 4 hours and 37 minutes apart. Commonly missed areas included the medial canthal area (across the eyes), which was missed by 37% (13/35) of the participants in the morning, and by the afternoon, 69% (24/35) of the participants had no sun protection in this area (Figure S4 in Multimedia Appendix 1).

Part 2b: Testing Tinted SPF Lotions

The level of coverage varied greatly between the 5 tinted products, regardless of SPF rating (Figure S5 in Multimedia Appendix 1). Overall, 3 out of the 5 tinted SPF products were barely visible or not visible using UV photography. A review of the product ingredient list revealed that all the 5 products tested listed chemical UV filters as well as varying quantities of titanium dioxide or zinc oxides. UV photography was shown not to be suitable for 3 of the tinted products, as the physical blockers titanium dioxide or zinc oxides may have affected the ability to capture UV images. However, 2 tinted sun protection products were visible using UV photography even at low concentrations. The level of coverage was still high for the SPF 50+ product, yielding a dark area at the treatment site even when applied at 0.2 mg/cm^2 (Figure 2). Although the SPF 15 product had adequate coverage at 1 mg/cm^2, the absorption of UV was reduced at the lower 0.6, 0.4, and 0.2 mg/cm^2 sites (Figure 2).

XSL•FO
RenderX

Figure 2. Tinted cosmetics and sun protection coverage using UV photography. The top panel shows product 4 applied to the cheek at concentrations of 1, 0.6, 0.4, and 0.2 mg/cm^2, and the bottom panel shows product 5 applied at the same concentrations. SPF: sun protection factor.

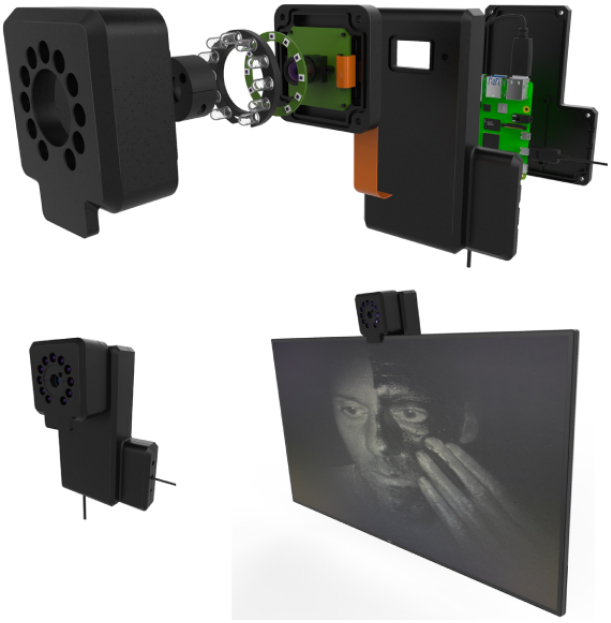


Phase 3: Development, Safety, and Field-Testing of a UV Webcam

Development

The prototype UV webcam was developed to provide personalized feedback about where improvements could be made for sunscreen application (Figure 3).

Figure 3. UV webcam device. The top panel shows the electrical components, which are housed within a plastic box (bottom left panel) and mounted on a monitor connected via a high-definition multimedia interface cable to display UV images (bottom right panel). The darker areas on the face show where sunscreen has been applied.



Observational Testing

The UV webcam was able to track use through a pressure-sensitive mat. Testing demonstrated perfect agreement with observed use and device-recorded use, with a κ value of 1.0, and the 95% CI range was 1.0-1.0 (Table 2).

XSL•FO
RenderX

Table 2. Agreement between observed use and UV webcam–recorded use (N=10).

Weight of person using UV webcam (kg)	UV webcam device–reported use, n (%)	
	Yes	No
90 (observed use=10)	10 (100)	0 (0)
60 (observed use=10)	10 (100)	0 (0)

Safety Testing

The prototype unit emits only UV-A irradiation and requires over 7 hours of continuous exposure to equal 15 minutes of midday sun light in Brisbane, Australia. During observational testing and field-testing, no eye or skin irritation was reported or observed using the UV webcam. The temperature of the UV webcam device after 2 and 4 hours of continuous operation was 37.1°C and 37.7°C, respectively.

Field-Testing

The UV webcam recorded data each day and was used 233 times during deployment at the beach location (Figure S6 in Multimedia Appendix 1). The UV radiation exposure level was consistently high, requiring sun protection each day during the field-testing, with daily SEDs ranging from 56 SEDs to 70 SEDs (Table S3 and Figure S7 in Multimedia Appendix 1). The UV index level was above 3 for over 5 hours each day during the field-testing, and no daytime rainfall was recorded (Table S3 in Multimedia Appendix 1). The average daily maximum temperature was 27.6°C (range 18.9-30) during field-testing (Table S3 in Multimedia Appendix 1).

No complaints, adverse events, or concerns were logged from users during the 7 days when the UV webcam was deployed. The UV webcam had sufficient power to function via a USB connection, and the display monitor required a 240-volt power supply.

Discussion

Principal Findings

Our study investigated the use of UV photography as a sun safety educational approach. A total of 3 UV camera systems were tested, and all devices identified the application of a range of SPF 15 to 50+ chemical sunscreens, moisturizers, and cosmetics. The sensitivity of the UV camera devices was shown to be adequate, with SPF-containing products applied at concentrations of 2 and 1 mg/cm^2 clearly visible and SPF-containing products applied at a concentration of 0.4 mg/cm^2 having lower levels of coverage. This study showed that participants were engaged with the personalized feedback approach of UV photography and that a UV webcam connected to a large monitor was used by beachgoers. However, we found that 3 out of the 5 tinted SPF products were not visible using UV photography because of the varying quantities of titanium dioxide and zinc oxides, which limit the sensitivity of UV photography. We recommend the use of UV photography for translucent sun protection lotions, including chemical sunscreens and moisturizers, and found that UV photography is less reliable for tinted products.

Sunscreens and SPF-containing moisturizers or cosmetics are commonly used for sun protection. In Australia, a cohort study of over 40,000 respondents reported that 40% regularly used sunscreen or cosmetics with SPF on their faces [16]. Young adults in a holiday beach setting reported high rates of daily sunscreen use (166/188, 88.3%), and most participants who reported being sunburnt also reported applying sunscreen [17]. Further data also suggest that both adults and children apply far less sunscreen than recommended, resulting in less protection [18,19]. The effectiveness of SPF-containing lotions depends on the application thickness, covering all sun-exposed skin, and regular reapplication [20]. In phase 2, we found that the SPF products had less coverage on the face by the afternoon compared with the morning photo session several hours earlier. Here, we showed that UV photography is a practical, well-liked method to visualize the need for sunscreen reapplication, with most participants indicating that they would use the technology again in the future. An estimated 7220 melanoma cases are attributed to sun exposure in Australia each year, and the effective use of sunscreen could reduce this burden, with health interventions using UV photography offering substantial opportunity for improvement [21].

Strategies to improve sunscreen application are important, as the belief that the whole face or body is protected following an application may increase UV exposure [22]. Previous research using UV photography has found that individuals do not apply sunscreen uniformly across the whole body [18]. A total of 52 participants were asked to apply sunscreen on their whole body, and researchers found that sunscreen application on the front side of the body was better than the back, and females covered their skin better than males [18]. UV photography may assist sunscreen application by providing personalized feedback on missed areas as well as revealing when reapplication is required.

We developed a UV webcam device and deployed it in a high UV environment and found that it was used by beachgoers during the weeklong field test. We chose a beach setting to deploy the UV webcam device because of the high rates of sunburn in these environments. In Queensland, 45% of children reported being sunburnt in the previous 12 months, and 69% of these sunburns happened during a water-based activity [8]. Future research could explore whether beachgoers improve their sunscreen application following personalized feedback from the UV webcam and explore the effect this technology may have on reducing sunburn. Previous research has shown that the benefits of ecological momentary health interventions, which influence behaviors within an environmental context, can improve willingness to change behavior [23].

In addition to visualizing sunscreen coverage, UV photographic imaging has also been shown to be a beneficial tool for assessing skin damage and promoting behavioral change by highlighting

XSL•FO
RenderX

the negative effects of the sun on an individual's appearance in sun bed users [24] and young adults [25,26]. To further engage the public, recent strategies by Cancer Council Western Australia have included UV camera imagery to raise awareness of sun damage [27]. UV photography is a valuable public health promotional tool, and it is also a convenient method for use in a research setting. Other methodologies to assess sunscreen application include tape stripping, swabbing of body sites, and laboratory processing of samples using fluorescence spectroscopy, which can be laborious and time-consuming.

A limitation of UV photography imaging is the use of SPF lotions containing physical blockers such as titanium dioxide or zinc oxide, which are not detected. Several tinted foundations use titanium dioxide as an ingredient but have additional chemical filters to reach the stated SPF rating; however, these combination cosmetic products did not perform well in testing, with 3 out of 5 products not being detected by UV photography. Limitations of this study include selection bias, as participants in the observational study were recruited using a convenience sample, and we did not use a random sampling method. Phase 1 and 2 participants were mainly female and therefore may not represent the general population. In phase 2, under the study conditions, participants might have been more cautious than real life and applied SPF lotions more carefully. In phase 3, we did not capture self-reported sunburns or behavioral changes from participants.

Conclusions

Reducing the number of Australians sunburnt each year forms a crucial part of sun safety initiatives, and improving the messaging on the quantity of sunscreen to apply to achieve sufficient coverage as well as commonly missed areas is essential. In this study, we tested a variety of UV cameras and found that UV photography could identify the application of SPF-containing chemical filter sunscreens and moisturizers as well as determine unprotected areas. We found that the participants were engaged with personalized UV photography feedback.

Acknowledgments

The authors would like to thank all the participants for their time. UV radiation measurements were provided by the Australian Radiation Protection and Nuclear Safety Agency UV network, and sunscreen was donated by Danger Sun Overhead during the field-testing phase. This study was funded by the Queensland Government Advance Queensland fund. The sponsors of the study had no role in the study design, collection, analysis, and interpretation of data; in the writing of this manuscript; and in the decision to submit the paper for publication. The corresponding author had full access to all data in the study and the final responsibility for the decision to submit for publication.

Authors' Contributions

EH contributed to conceptualization; funding acquisition; investigation; methodology; project administration; resources; data curation; formal analysis; supervision; visualization; and writing, reviewing, and editing the manuscript. CH contributed to project administration; investigation; formal analysis; and writing, reviewing, and editing the manuscript. HF contributed to the project administration, investigation, and review and editing of the manuscript. SW, JH, and AW contributed to the methodology, investigation, and review and editing of the manuscript.

Conflicts of Interest

HF, CH, SW, and EH state no conflicts of interest. JH and AW are employees of Designworks group.

Multimedia Appendix 1
Additional research and methods information.
[DOCX File , 2144 KB - derma_v4i1e24653_app1.docx]

References

1. Richer V, Kharazmi P, Lee TK, Kalia S, Lui H. Quantifying the visual appearance of sunscreens applied to the skin using indirect computer image colorimetry. Photodermatol Photoimmunol Photomed 2018 Mar;34(2):130-136. [doi: 10.1111/phpp.12361] [Medline: 29080360]
2. Pratt H, Hassanin K, Troughton LD, Czanner G, Zheng Y, McCormick AG, et al. UV imaging reveals facial areas that are prone to skin cancer are disproportionately missed during sunscreen application. PLoS One 2017;12(10):e0185297 [FREE Full text] [doi: 10.1371/journal.pone.0185297] [Medline: 28968413]
3. Martincorena I, Roshan A, Gerstung M, Ellis P, Van LP, McLaren S, et al. Tumor evolution. High burden and pervasive positive selection of somatic mutations in normal human skin. Science 2015 May 22;348(6237):880-886 [FREE Full text] [doi: 10.1126/science.aaa6806] [Medline: 25999502]
4. Baxter JM, Patel AN, Varma S. Facial basal cell carcinoma. Br Med J 2012 Aug 21;345:e5342. [doi: 10.1136/bmj.e5342] [Medline: 22915688]
5. Skin cancer in Australia. Australian Institute of Health and Welfare (AIHW). 2016. URL: https://www.aihw.gov.au/reports/cancer/skin-cancer-in-australia/ [accessed 2019-04-09]

XSL•FO
RenderX

6. Fransen M, Karahalios A, Sharma N, English DR, Giles GG, Sinclair RD. Non-melanoma skin cancer in Australia. Med J Aust 2012 Nov 19;197(10):565-568. [doi: 10.5694/mja12.10654] [Medline: 23163687]
7. Elliott TM, Whiteman DC, Olsen CM, Gordon LG. Estimated healthcare costs of melanoma in Australia over 3 years post-diagnosis. Appl Health Econ Health Policy 2017 Dec;15(6):805-816. [doi: 10.1007/s40258-017-0341-y] [Medline: 28756584]
8. The health of Queenslanders 2020. Report of the Chief Health Officer, Queensland. 2020. URL: https://www.health.qld.gov.au/__data/assets/pdf_file/0019/1011286/cho-report-2020-full.pdf [accessed 2020-12-15]
9. Green AC, Williams GM, Logan V, Strutton GM. Reduced melanoma after regular sunscreen use: randomized trial follow-up. J Clin Oncol 2011 Jan 20;29(3):257-263. [doi: 10.1200/JCO.2010.28.7078] [Medline: 21135266]
10. van der Pols JC, Williams GM, Pandeya N, Logan V, Green AC. Prolonged prevention of squamous cell carcinoma of the skin by regular sunscreen use. Cancer Epidemiol Biomarkers Prev 2006 Dec;15(12):2546-2548 [FREE Full text] [doi: 10.1158/1055-9965.EPI-06-0352] [Medline: 17132769]
11. Hacker E, Boyce Z, Kimlin MG, Wockner L, Pollak T, Vaartjes SA, et al. The effect of MC1R variants and sunscreen on the response of human melanocytes in vivo to ultraviolet radiation and implications for melanoma. Pigment Cell Melanoma Res 2013 Nov;26(6):835-844. [doi: 10.1111/pcmr.12157] [Medline: 23962207]
12. Wang SQ, Virmani P, Lim HW. Consumer acceptability and compliance: the next frontier in sunscreen innovation. Photodermatol Photoimmunol Photomed 2016 Jan;32(1):55-56. [doi: 10.1111/phpp.12211] [Medline: 26409211]
13. Dussert AS, Gooris E, Hemmerle J. Characterization of the mineral content of a physical sunscreen emulsion and its distribution onto human stratum corneum. Int J Cosmet Sci 1997 Jun;19(3):119-129. [doi: 10.1046/j.1467-2494.1997.171707.x] [Medline: 18507639]
14. Schneider CA, Rasband WS, Eliceiri KW. NIH Image to ImageJ: 25 years of image analysis. Nat Methods 2012 Jul;9(7):671-675 [FREE Full text] [doi: 10.1038/nmeth.2089] [Medline: 22930834]
15. Lancaster GA, Dodd S, Williamson PR. Design and analysis of pilot studies: recommendations for good practice. J Eval Clin Pract 2004 May;10(2):307-312. [doi: 10.1111/j.2002.384.doc.x] [Medline: 15189396]
16. Olsen CM, Thompson BS, Green AC, Neale RE, Whiteman DC, QSkin SunHealth Study Group. Sun protection and skin examination practices in a setting of high ambient solar radiation: a population-based cohort study. JAMA Dermatol 2015 Sep;151(9):982-990. [doi: 10.1001/jamadermatol.2015.0739] [Medline: 26039788]
17. Horsham C, Antrobus J, Olsen CM, Ford H, Abernethy D, Hacker E. Testing wearable UV sensors to improve sun protection in young adults at an outdoor festival: field study. JMIR Mhealth Uhealth 2020 Sep 16;8(9):e21243 [FREE Full text] [doi: 10.2196/21243] [Medline: 32936083]
18. Jovanovic Z, Schornstein T, Sutor A, Neufang G, Hagens R. Conventional sunscreen application does not lead to sufficient body coverage. Int J Cosmet Sci 2017 Oct;39(5):550-555. [doi: 10.1111/ics.12413] [Medline: 28699163]
19. Diaz A, Neale RE, Kimlin MG, Jones L, Janda M. The children and sunscreen study: a crossover trial investigating children's sunscreen application thickness and the influence of age and dispenser type. Arch Dermatol 2012 May;148(5):606-612. [doi: 10.1001/archdermatol.2011.2586] [Medline: 22250190]
20. Olsen CM, Wilson LF, Green AC, Biswas N, Loyalka J, Whiteman DC. Prevention of DNA damage in human skin by topical sunscreens. Photodermatol Photoimmunol Photomed 2017 May;33(3):135-142. [doi: 10.1111/phpp.12298] [Medline: 28165636]
21. Olsen CM, Wilson LF, Green AC, Bain CJ, Fritschi L, Neale RE, et al. Cancers in Australia attributable to exposure to solar ultraviolet radiation and prevented by regular sunscreen use. Aust N Z J Public Health 2015 Oct;39(5):471-476 [FREE Full text] [doi: 10.1111/1753-6405.12470] [Medline: 26437734]
22. O'Hara M, Horsham C, Koh U, Janda M. Unintended sunburn after sunscreen application: an exploratory study of sun protection. Health Promot J Austr 2019 Oct 20:533-539. [doi: 10.1002/hpja.301] [Medline: 31631453]
23. Heron KE, Smyth JM. Ecological momentary interventions: incorporating mobile technology into psychosocial and health behaviour treatments. Br J Health Psychol 2010 Feb;15(Pt 1):1-39 [FREE Full text] [doi: 10.1348/135910709X466063] [Medline: 19646331]
24. Gibbons FX, Gerrard M, Lane DJ, Mahler HI, Kulik JA. Using UV photography to reduce use of tanning booths: a test of cognitive mediation. Health Psychol 2005 Jul;24(4):358-363. [doi: 10.1037/0278-6133.24.4.358] [Medline: 16045371]
25. Mahler HI, Kulik JA, Gerrard M, Gibbons FX. Effects of photoaging information and UV photo on sun protection intentions and behaviours: a cross-regional comparison. Psychol Health 2013;28(9):1009-1031. [doi: 10.1080/08870446.2013.777966] [Medline: 23537173]
26. Mahler HI, Kulik JA, Harrell J, Correa A, Gibbons FX, Gerrard M. Effects of UV photographs, photoaging information, and use of sunless tanning lotion on sun protection behaviors. Arch Dermatol 2005 Mar;141(3):373-380. [doi: 10.1001/archderm.141.3.373] [Medline: 15781679]
27. Don't let the sun see your DNA!. Cancer Council Western Australia. 2019. URL: https://www.cancerwa.asn.au/articles/news-2019/dont-let-the-sun-see-your-dna/ [accessed 2020-12-15]

XSL•FO
RenderX

Abbreviations

BB: beauty balm
dpi: dots per inch
DSLR: digital single-lens reflex
SED: standard erythemal dose
SPF: sun protection factor

Edited by G Eysenbach; submitted 23.12.20; peer-reviewed by J Robinson, D Bowen; comments to author 07.03.21; revised version received 07.04.21; accepted 09.04.21; published 26.05.21.

Please cite as:
Horsham C, Ford H, Herbert J, Wall A, Walpole S, Hacker E
Assessing Sunscreen Protection Using UV Photography: Descriptive Study
JMIR Dermatol 2021;4(1):e24653
URL: https://derma.jmir.org/2021/1/e24653
doi:10.2196/24653
PMID:

©Caitlin Horsham, Helen Ford, Jeremy Herbert, Alexander Wall, Sebastian Walpole, Elke Hacker. Originally published in JMIR Dermatology (http://derma.jmir.org), 26.05.2021. This is an open-access article distributed under the terms of the Creative Commons Attribution License (https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work, first published in JMIR Dermatology Research, is properly cited. The complete bibliographic information, a link to the original publication on http://derma.jmir.org, as well as this copyright and license information must be included.

XSL•FO
RenderX

Original Paper

Factors Contributing to Diagnostic Discordance Between Store-and-Forward Teledermatology Consultations and In-Person Visits: Case Series

Michelle S Lee[1], BA; Robert Stavert[2], MD, MBA

[1]Harvard Medical School, Boston, MA, United States

[2]Department of Dermatology, Cambridge Health Alliance, Somerville, MA, United States

Corresponding Author:
Michelle S Lee, BA
Harvard Medical School
25 Shattuck Street
Boston, MA, 02115
United States
Phone: 1 4127217765
Email: michelle_lee3@hms.harvard.edu

Abstract

Background: Use of asynchronous store-and-forward (SAF) teledermatology can improve access to timely and cost-effective dermatologic care and has increased during the COVID-19 pandemic. Previous research has found high diagnostic concordance rates between SAF teledermatology and face-to-face clinical diagnosis, but to our knowledge, none have used specific cases to illustrate factors contributing to diagnostic discordance.

Objective: To identify and illustrate characteristics that may have contributed to diagnostic discordance between store-and-forward teledermatology and in-person clinical diagnosis in a series of patients.

Methods: We identified 7 cases of diagnostic discordance between teledermatology and in-person visits where the favored diagnosis of the in-person dermatologist was not included in the differential diagnosis formulated by the teledermatologist. Cases were identified from a previously published retrospective chart review of 340 SAF teledermatology consultations, which was previously performed at an academic community health care system in the greater Boston area, Massachusetts, from January 1, 2014, through December 31, 2017. Of 99 patients who completed an in-person dermatology appointment after their teledermatology consultation, 7 had diagnostic disagreement between the teledermatologist and in-person dermatologist where the diagnosis in the in-person consultation was not included in the differential diagnosis in the original teledermatology consult. These 7 cases were examined by 2 author reviewers to identify factors that may have contributed to diagnostic discordance.

Results: Factors contributing to diagnostic discordance between SAF teledermatology consultations and in-person visits included poor image quality, inadequate history or diagnostic workup, inability to evaluate textural characteristics, diagnostic uncertainty due to atypical presentations, and evolution in appearance of skin conditions over time.

Conclusions: We identified multiple factors that contributed to diagnostic discordance. Recognition and mitigation of these factors, when possible, may help to improve diagnostic accuracy and reduce the likelihood of misdiagnosis. Continuing education of referring providers and implementation of standardized guidelines for referrals may also be helpful in reducing the risk of misdiagnosis due to inherent limitations of teledermatology services.

(JMIR Dermatol 2021;4(1):e24820) doi:10.2196/24820

KEYWORDS

teledermatology; eHealth; dermatology; telemedicine; diagnosis

Introduction

Store-and-forward (SAF) teledermatology systems utilize asynchronous evaluation of clinical images and information to provide diagnostic and management guidance directly to patients or other health care providers. In contrast to real-time telemedicine such as video encounters, SAF encounters involve collecting clinical information from a referring provider to be sent electronically to another site or provider, often a specialist,

XSL•FO
RenderX

for review at a later time. SAF teledermatology platforms can increase access to dermatologic care, provide financial savings for patients and health systems, and provide a comparable quality of care to in-person evaluation for numerous dermatologic conditions [1-8]. Utilization of both synchronous video and asynchronous SAF telemedicine has increased significantly during the 2020 COVID-19 pandemic [9,10]. SAF teledermatology may play a particularly vital role in the provision of safe and efficient dermatologic care as it requires less resources and coordination to implement compared to live interactive teledermatology [11].

Evaluation of diagnostic concordance for patients who receive both a teledermatology and in-person consultation is one method of assessing the diagnostic quality of SAF teledermatology consultations. Complete diagnostic concordance occurs when the first diagnosis matches between the in-person dermatologist and teledermatologist [12-17]. Previous research has found 79%-94% concordance rates between teledermatology and face-to-face clinical diagnosis, with some variation based on factors including skin condition and whether or not dermatoscopy is utilized [12-17]. High rates of diagnostic concordance help to ensure that the diagnoses patients receive from SAF teledermatology platforms are comparable to those that patients would receive during an in-person encounter.

Although previously published work has examined rates and patterns of discordance [12-17], to our knowledge, none have previously used cases to identify and illustrate specific characteristics that may contribute to diagnostic discordance. We analyzed a series of 7 cases of diagnostic discordance, identifying contributing factors in hopes of identifying opportunities to improve teledermatology systems and mitigate potential risks that can occur from misdiagnosis.

Methods

Previously, a retrospective chart review of 340 SAF teledermatology consultations performed at our institution from January 1, 2014, through December 31, 2017, was conducted [18]. All SAF teledermatology cases were ordered alphabetically by patient's last name, and the first 340 cases were reviewed. Among these 340 teledermatology cases, there were 99 patients who also completed an in-person dermatology visit, and further chart review was performed to determine the level of management concordance between teledermatologist and in-person dermatologist, defined by five categories: (1) fully concordant, (2) partially concordant, (3) discordant, (4) unable to assess because treatment was not specified by the referring provider, and (5) treatment not specified by teledermatology provider and an in-person appointment is requested for further evaluation. The definition of diagnostic discordance for this study was based on previous literature, which has defined diagnostic concordance as complete agreement (where the first diagnosis matched between in-person dermatologist and teledermatologist), partial agreement (where diagnoses overlapped between in-person dermatologist and teledermatologist), and discordant (where diagnoses did not match between teledermatologist and in-person dermatologist) [18-20]. Analysis of the 99 patients with both teledermatology and in-person visits found that diagnoses in 76 (77%) encounters were fully concordant, 16 (16%) were partially concordant, and 7 (7%) were fully discordant. We further evaluated these 7 diagnostically discordant cases to identify factors contributing to diagnostic discordance. Both authors (MSL and RS) performed retrospective chart review of the cases and discussed causes of the diagnostic discordance to come to a consensus.

Images from the teledermatology consult were submitted by the referring provider and taken using the Epic Haiku mobile app (Epic Systems Corporation). The teledermatologist was different than the in-person dermatologist in all but the second case reviewed. This project was exempt from full review by our Institutional Review Board.

Results

Overview

A summary of the cases, teledermatology and in-person differential diagnoses, in-person diagnosis, and factors contributing to diagnostic discordance is provided in Table 1.

XSL•FO
RenderX

Table 1. Summary of cases and factors contributing to diagnostic discordance.

Case	Age (yrs) and gender	Telederm[a] differential diagnosis	Treatment after telederm visit	In-person differential diagnosis	In-person diagnosis (diagnostic test)	Contributing factors to diagnostic uncertainty
1	31, male	Superficial morphea, superficial dermatophyte infection, pityriasis rotunda, psoriasis, parapsoriasis, CTCL[b], Hansen	None	Confluent and reticulated papillomatosis of Gougerot and Carteaud, morphea, tinea corporis, and discoid erythrasma	Eczematous dermatitis (punch biopsy)	Image quality compromised by patient positioning and lighting leading to shine artifact; unusual morphology, presentation; lack of historical details provided
2	60, male	Sarcoid, mycobacterial, hypersensitivity, lichenoid reaction, pseudolymphoma, arthropod bite, folliculitis	Betamethasone dipropionate 0.05% cream twice a day	Tinea corporis, sarcoid, annular lichen planus	Tinea corporis (KOH prep[c] confirmed)	Image quality compromised by limited view of anatomic area; evolution of rash from time of telederm to time of in-person visit from papular to characteristic annular with scale
3	26, male	Impetigo, tinea faciei, Majocchi, contact dermatitis, rosacea	Empiric doxycycline 100 mg orally twice a day for 2 weeks, continue clotrimazole	VZV[d] reactivation (herpes zoster)	Herpes zoster (physical exam)	Limited single-image view made it more difficult to appreciate dermatomal distribution; lack of adequate testing including superficial bacterial culture and KOH prep; evolution of rash from telederm consult to time of in-person visit
4	63, male	Actinic keratoses, excoriated papulopustular rosacea, squamous cell carcinoma	None prescribed	Telangiectasias due to sun damage	Nonspecific telangiectasias due to sun damage (clinical diagnosis)	Inability to palpate lesion to determine textural characteristics; image artifact showing overlying scale; no dermatoscopic images taken during initial consultation
5	69, male	HSV[e], erythema multiforme, contact dermatitis, or pemphigus vulgaris, and paraneoplastic pemphigus	None prescribed	Allergic contact dermatitis vs actinic cheilitis	Lichenoid dermatitis (biopsy)	HSV/VZV viral culture would have been helpful when evaluating vesicles on mucosal surfaces; diagnostically challenging case; lack of historical details provided
6	41, male	HSV, LGV[f]	None prescribed	Condyloma acuminata	Epidermal inclusion cyst (biopsy)	Nonclassic presentation resulting in diagnostic uncertainty; viral and bacterial swab cultures would be helpful for initial consult; difficulty in distinguishing between vesicles, pustules, cysts via telederm
7	65, male	Unable to determine	None prescribed	Irritated seborrheic keratosis vs melanoma	BCC[g] (shave biopsy)	Dermatoscopic images were out of focus, and nondermatoscopic images were not included

[a]Telederm: teledermatology.
[b]CTCL: cutaneous T-cell lymphoma.
[c]KOH prep: potassium hydroxide preparation.
[d]VZV: varicella zoster virus.
[e]HSV: herpes simplex virus.
[f]LGV: lymphogranuloma venereum.
[g]BCC: basal cell carcinoma.

Case 1

A 31-year-old male presented to his primary care provider with a several-year history of well-circumscribed, hyperpigmented, nonpruritic, thin, scaly plaques with skin tightening on his back, trunk, and chest, as well as associated gynecomastia. The patient had tried applying moisturizing lotion without relief. Teledermatology consultation resulted in a broad differential diagnosis including superficial morphea, superficial dermatophyte infection, pityriasis rotunda, psoriasis, parapsoriasis, cutaneous T-cell lymphoma, and Hansen disease. The submitted images showed several sharply demarcated hyperpigmented thin plaques with overlying xerotic scale on the back as well as well-circumscribed tan thin plaques with overlying scale on the collar distribution of the neck and the upper chest (Figures 1 and 2). The teledermatologist noted that the image quality was limited by patient positioning and lighting, leading to shine artifact, and noted that further history about potential exposures and travel history would have been helpful, particularly to rule out Hansen disease. Due to the broad differential and no leading diagnosis, he was referred for an in-person consultation. His in-person exam revealed

XSL•FO
RenderX

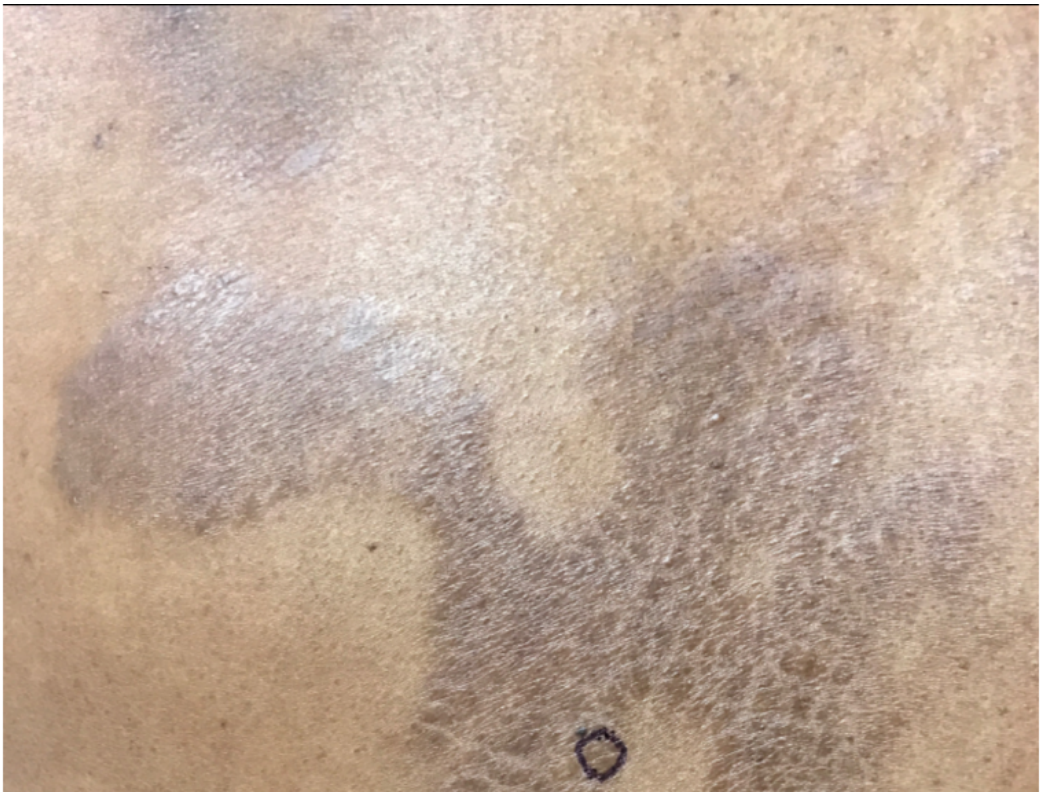
well-demarcated geographic hyperpigmented atrophic and wrinkly patches on the back (Figure 3) and the anterior bilateral shoulders, left flank, and upper arms, as well as gynecomastia. The differential diagnosis included confluent and reticulated papillomatosis of Gougerot-Carteaud, morphea, tinea corporis, and discoid erythrasma. A punch biopsy was performed, which revealed findings most consistent with an eczematous dermatitis. The patient was treated with triamcinolone 0.1% cream and did not return for scheduled follow-up appointments.

Figure 1. Case 1. Submitted teledermatology image showing patient's back with hyperkeratotic plaque and xerotic scale. Image quality compromised by patient positioning and lighting leading to shine artifact.

Figure 2. Case 1. Submitted teledermatology image showing patient's neck and clavicular region with hyperkeratotic plaque and xerotic scale. Image quality compromised by patient positioning and lighting leading to shine artifact.

XSL•FO
RenderX

Figure 3. Case 1. Image for in-person visit showing well-demarcated, geographic, hyperpigmented, atrophic, and wrinkly patches on the back.



Case 2

A 60-year-old man with 3 weeks of pruritic pink papules on the left forearm next to tattooed skin was referred to teledermatology. Submitted photos showed a 1-2 cm light pink patch containing three discrete 4-6 mm pink papules, and the differential diagnosis included sarcoidosis, atypical mycobacterial infection, hypersensitivity reaction, lichenoid reaction, and pseudolymphoma, as well as arthropod assault and folliculitis. The teledermatologist noted that image quality was compromised by the limited anatomic view provided (Figure 4). The patient was prescribed betamethasone dipropionate 0.05% cream twice daily for 2 weeks. In the office 3 weeks later, he was noted to have a pink-red annular plaque with overlying scale (Figure 5) that was suspicious for tinea corporis, which was confirmed with a potassium hydroxide preparation (KOH prep) showing hyphae. The patient was treated with topical ketoconazole 1% cream, and his rash resolved without recurrence.

XSL•FO
RenderX

Figure 4. Case 2. Submitted teledermatology image showing left forearm with 1-2 cm light pink patch containing three discrete 4-6 mm pink papules. Image quality compromised by limited anatomic view.

Figure 5. Case 2. In-office photo obtained from same patient, demonstrating left forearm with pink-red annular plaque with scale (tinea corporis).

Case 3

A 26-year-old male with a 3-day history of a round pink plaque on the left cheek, within which were papules and erosions, was referred to teledermatology. At the time of his referral, the referring provider had prescribed treatment of this plaque with topical clotrimazole. The patient reported that he had worn a mask and participated in paintball and jiujitsu a few days prior to presentation and that his lesions appeared shortly afterwards. He reported that the lesion started as a pimple or vesicle, and

XSL•FO
RenderX

then progressed into a plaque. A single submitted clinical image showed a limited view of the left cheek (Figure 6). The teledermatologist's differential diagnosis included impetigo, tinea faciei, Majocchi granuloma, and contact dermatitis. The teledermatologist advised the referring provider to obtain a superficial bacterial culture of the plaque, continue clotrimazole, and start empiric treatment with doxycycline if the patient was unable to return for the culture. The patient subsequently reported progression of his rash and was scheduled for an in-person visit with the dermatologist 1 week later. At that time, the initial lesions had crusted over, and new lesions on his left upper medial cheek, left nasal bridge, and left nasal ala in a dermatomal distribution were noted (Figure 7). A clinical diagnosis of herpes zoster was made, the patient was prescribed oral acyclovir, and the rash subsequently resolved.

Figure 6. Case 3. Limited view of the face from teledermatologist consult.

Figure 7. Case 3. Images from clinic 1 week later.

Case 4

A 63-year-old man was referred to teledermatology for evaluation of a 7-month history of an enlarging nasal lesion. The teledermatologist reviewed the image and described erythematous macules that appeared to have scale or crust on the nasal tip and ala (Figure 8). The differential diagnosis provided by the teledermatologist was dependent on textural characteristics and included actinic keratoses if the lesion was rough and excoriated papulopustular rosacea if the texture was not rough. The teledermatologist requested additional textural information. Due to the incomplete information on skin texture, the patient was referred for an in-person visit, where his exam revealed no overlying scale or roughness to suggest actinic keratosis and no features suggestive of squamous cell carcinoma. He denied a history of facial flushing or acneiform or pustular eruptions. He was clinically diagnosed with a telangiectasia, likely due to dermatoheliosis, and no further treatment was recommended.

XSL•FO
RenderX

Figure 8. Case 4. Submitted image to teledermatology showing erythematous macules with apparent scale or crust on the nasal tip and ala.

Case 5

A 69-year-old man with a 2-month history of blistering lips with skin peeling and pain unresponsive to Vaseline was referred to teledermatology. The submitted image showed a focal erosion with hemorrhagic crust and vesiculation (Figure 9), and the differential included herpes simplex virus (HSV), erythema multiforme, contact dermatitis, pemphigus vulgaris, and paraneoplastic pemphigus. The teledermatologist pointed out that the patient was not asked about history of similar eruptions, involvement of the oral mucosa, or associated symptoms including pain or burning, which would have aided the diagnosis. The consultant also recommended obtaining HSV/varicella zoster virus viral cultures and applying emollient, and the patient was scheduled for an in-office dermatology appointment. During the first in-person visit, the erosions and vesicles were resolving (Figure 10), and a bacterial culture was taken from a focal erosion which grew methicillin-resistant *Staphylococcus aureus*. He was treated with doxycycline and the fissure healed. The lip erosions subsequently recurred (Figure 11) and were biopsied, with pathology most consistent with a lichenoid dermatitis. He was treated with triamcinolone 0.1% cream and his symptoms resolved.

XSL•FO
RenderX

Figure 9. Case 5. Submitted teledermatology image of focal erosion with hemorrhagic crust and vesiculation on lips.

Figure 10. Case 5. Image from first in-person visit showing resolving vesicles and erosions.

XSL•FO
RenderX

Figure 11. Case 5. Image from second in-person visit, when biopsy was taken.

Case 6

A 41-year-old man with no known history of sexually transmitted infections was referred to teledermatology for 1 month of an unchanging nontender penile rash. He was in a monogamous relationship, and his female partner did not have a similar rash. Submitted images demonstrated a cluster of apparent deep-seated vesicles or pustules on the dorsal penile shaft (Figure 12) as well as documented 1.5-2 cm suprapubic lymphadenopathy. The teledermatologist noted difficulty in distinguishing between vesicles and pustules in the images and recommended obtaining a medication history as well as viral and bacterial swab culture for genital vesicles and pustules. The differential included infectious and inflammatory etiologies, including HSV, lymphogranuloma venereum, and a fixed drug eruption. The patient was scheduled for an in-person evaluation (Figure 13), during which a shave biopsy was obtained that demonstrated a foreign body giant cell reaction suggestive of a ruptured epidermal inclusion cyst.

XSL•FO
RenderX

Figure 12. Case 6. Submitted teledermatology image suggestive of vesicles versus pustules on the dorsal penile shaft.

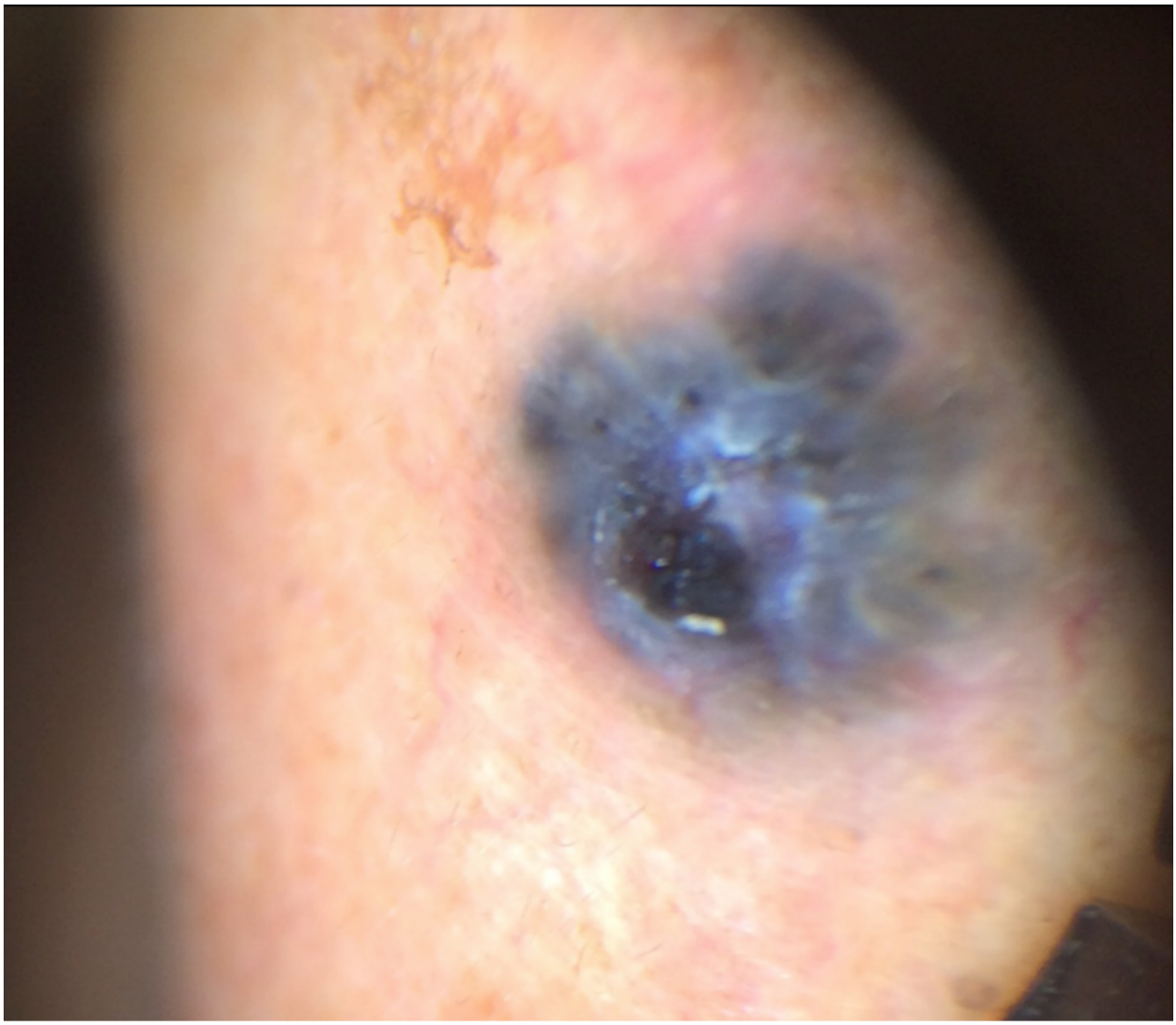
Figure 13. Case 6. Image from in-person visit.

XSL•FO
RenderX

Case 7

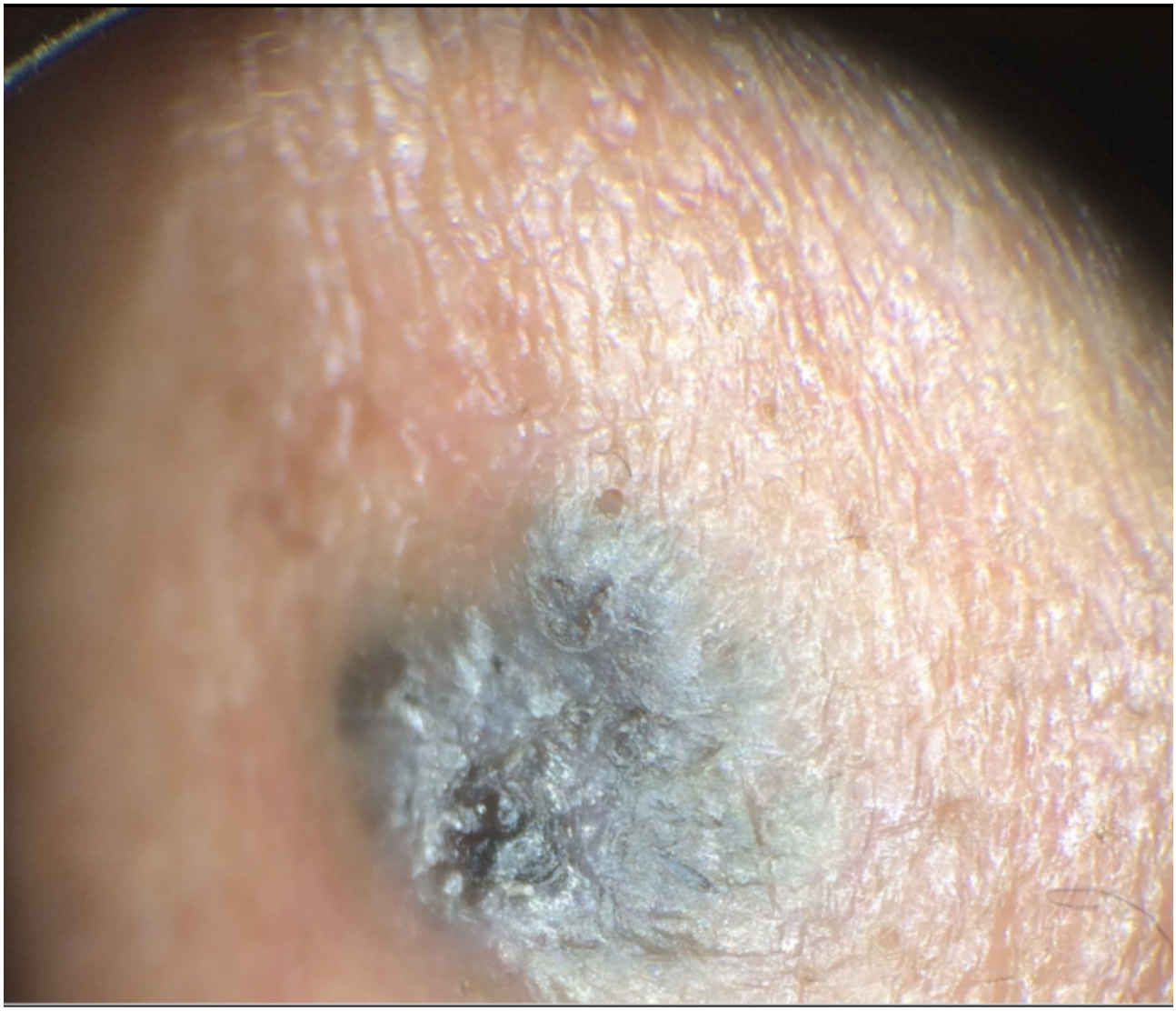
A 66-year-old man with a 1- to 2-year history of a hyperpigmented nasal papule was referred for teledermatology consultation. The teledermatologist noted that the two dermatoscopic images provided were poorly focused (Figures 14 and 15), and no gross images were submitted. Thus, the consultant was unable to provide a differential diagnosis with the provided clinical images, and the patient was referred for an in-person visit. During the in-office encounter, exam revealed a 5-6 mm black thin papule with a collarette of scale on the nasal bridge (Figure 16) with a differential of irritated seborrheic keratosis versus melanoma. A shave biopsy was performed of the lesion, which resulted in a diagnosis of pigmented basal cell carcinoma. The patient was referred for Mohs surgery.

Figure 14. Case 7. Submitted image to teledermatologist taken with dermoscopy.



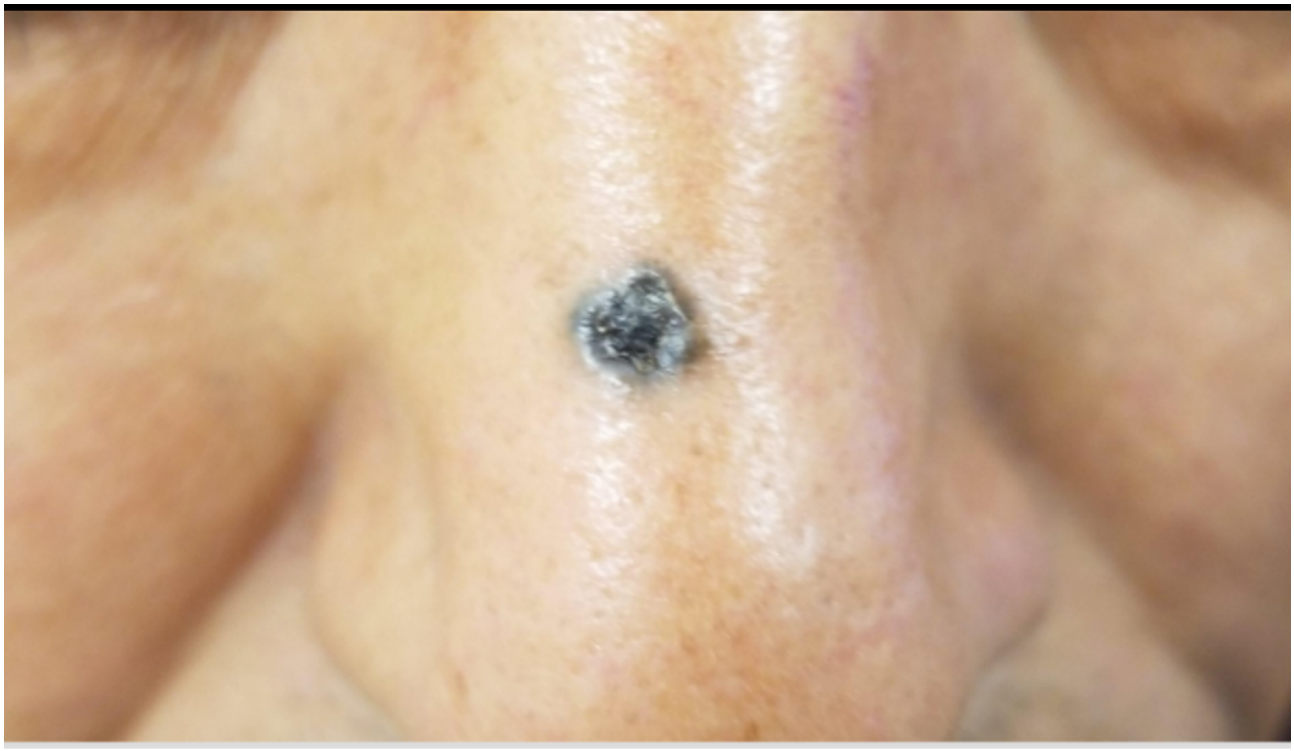
XSL•FO
RenderX

Figure 15. Case 7. Submitted image to teledermatologist taken with dermoscopy.



XSL•FO
RenderX

Figure 16. Case 7. In-person image showing 5-6 mm black thin papule with collarette of scale on the nasal bridge.



Discussion

Principal Results

From our case analysis, we identified multiple factors that likely contributed to diagnostic discordance between SAF teledermatology consultations and in-person visits in these cases. One contributing factor was poor image quality, including use of bright lighting creating shine artifact (case 1), submission of photos that showed partial views without showing the entire anatomic area involved (cases 1, 2, 3, and 7), and poorly focused images (case 7). These cases demonstrate the importance of education on appropriate image acquisition techniques. Following previously published best practices [21,22] and ongoing feedback to providers submitting photos may facilitate improved photo quality over time.

In some cases, additional clinical history or diagnostic tests provided by the referring clinician would have been helpful in narrowing the differential diagnosis. For example, diagnostic accuracy may have increased if the referring provider had performed bedside diagnostics such as superficial wound cultures, viral cultures, KOH preps (cases 2, 3, and 5), or dermoscopy (case 7). Use of dermoscopy has previously been shown to be a helpful tool in teledermatology programs, particularly in the evaluation of pigmented lesions [12]. Improved training of referring providers in using these diagnostic modalities may be helpful by providing clinical data to the dermatologist that leads to improved diagnostic accuracy. In addition, many cases illustrate the importance of a complete relevant medical history. For example, in case 6, a clinical history of similar vesicular eruptions, involvement of the oral mucosa, new exposures in the affected area, and associated pain or burning would have been helpful in differentiating between HSV, erythema multiforme, contact dermatitis, or pemphigus. Similarly, increased education for referring providers around questions relevant to certain dermatologic presentations (ie, asking about involvement of oral mucosa for bullous eruptions) would help them obtain an optimal history to aid in diagnosis.

Even with high-quality images, some morphologic characteristics may be difficult to appreciate with photos given visual limitations and inability to evaluate textural characteristics. For example, in case 4, palpation for detection of scale and induration may have helped the teledermatologist differentiate actinic damage from telangiectasias, and the teledermatologist interpreted the initial submitted image as a lesion with apparent overlying scale or crust, which was not seen in person. Case 6 also highlights that cystic, pustular, and vesicular structures can sometimes be difficult to distinguish from photos alone, depending on the angle and lighting of the photo taken. These cases highlight inherent diagnostic limitations of teledermatology services.

Finally, some factors such as atypical presentations and evolution of skin lesions over time were not specific to teledermatology and may have occurred in an initial in-person visit as well. For example, multiple cases remained diagnostically challenging even when patients were seen in person due to atypical presentations (cases 1, 5, and 6). Additionally, cases 2 and 3 highlight how morphology and distribution can evolve over time, leading to changes in suspected diagnosis. Teledermatology may have the highest utility for cases with typical presentations as unusual presentations may be difficult for teledermatologists to manage confidently without in-person evaluation and possible skin biopsy. Recognition of these limitations may also help with appropriate selection of patients more likely to benefit from an in-person encounter rather than a teledermatology visit. Even when patients can be managed with teledermatology, it is

XSL•FO
RenderX

important for patients and providers to maintain follow-up to ensure appropriate response to management and ongoing support if the patient's condition or morphology changes from the time of original teledermatology consultation.

Our study has important implications given that the use of asynchronous and other types of virtual care continues to rise [9,10], as incorrect diagnosis via teledermatology or lack of a timely referral for an in-person visit may have potential negative consequences for patients. For example, case 2 highlights how a teledermatologist's incorrect diagnosis and prescription of betamethasone for tinea corporis may have contributed to the progression of the rash, although the correct diagnosis also may not have been made at an initial in-person visit given its atypical presentation. In case 7, it was essential that a timely referral was made given the indeterminate images, which allowed the patient to receive a biopsy resulting in a diagnosis of pigmented basal cell carcinoma.

In order to improve the quality of SAF consultations and decrease rates of diagnostic discordance, we advocate for use of a standardized guide to help improve the quality of SAF teledermatology consults, including image quality and appropriate workup. In addition to guidelines already outlined by the American Telemedicine Association [21,22], our study highlights the need for guidelines for proper lighting, examples of dermoscopy images, relevant questions to ask in the patient history for certain morphologic presentations, and certain suggested diagnostic tests to perform before submitting a consult.

In addition, the educational value of SAF consults should continue to be emphasized to both referring and consulting providers in order to help improve the quality of consults and ensure the highest level of diagnostic accuracy. Referring providers' ability to obtain an optimal history and diagnostic testing will also likely improve with increased use of SAF teledermatology and iterative dialogue between providers about patients' medical management. For example, previous studies have highlighted the educational potential of SAF teledermatology systems on improving referring primary care provider knowledge of dermatologic care [23]. Teledermatologists should also be encouraged to engage in education with referring providers to ensure this ongoing learning process.

The strengths of our study include its in-depth analysis of specific cases and side-by-side comparison of teledermatology and in-person consults for the same patients. While several studies have been published on overall rates of diagnostic discordance, which have been estimated at around 39%-67% [12-17,19], none to our knowledge have presented a case-by-case analysis that illustrates and compares the teledermatology and in-person visits for the same patients.

Limitations

Some of the limitations of our study include that our sample size limits our ability to generalize across all cases of diagnostic concordance, although we intend for this to be a more in-depth study of fewer cases. In addition, only one teledermatologist reviewed each image submitted by the referring provider, which may introduce the possibility that diagnostic uncertainty may have been due to the individual teledermatologist's level of comfort with the diagnosis rather than the inherent limitations of teledermatology. The teledermatologist was also different than the in-person dermatologist in all but the second case, and thus some of the differences in experience and comfort level between the teledermatologists and in-person dermatologists may have contributed to the discordant diagnoses.

Conclusions

Collectively, these cases highlight factors that can contribute to diagnostic discordance between teledermatologist and in-person dermatologist and the importance of ensuring that teledermatology services are supported by readily available in-person visits when appropriate to achieve the correct diagnosis in these cases. We also highlight the importance of ongoing education of referring providers to ensure optimal history and diagnostic workup and improve quality of consultations and the development of standardized guidelines for submitting referrals.

Teledermatology can provide substantial benefits to patients, and recognition of its limitations and mitigation of the factors identified in these cases provide opportunities to improve the quality and diagnostic accuracy of SAF teledermatology services.

Conflicts of Interest

None declared.

References

1. Snoswell C, Finnane A, Janda M, Soyer HP, Whitty JA. Cost-effectiveness of Store-and-Forward Teledermatology: A Systematic Review. JAMA Dermatol 2016 Jun 01;152(6):702-708. [doi: 10.1001/jamadermatol.2016.0525] [Medline: 27074289]
2. Rajda J, Seraly MP, Fernandes J, Niejadlik K, Wei H, Fox K, et al. Impact of Direct to Consumer Store-and-Forward Teledermatology on Access to Care, Satisfaction, Utilization, and Costs in a Commercial Health Plan Population. Telemed J E Health 2018 Feb;24(2):166-169. [doi: 10.1089/tmj.2017.0078] [Medline: 28742431]
3. Datta SK, Warshaw EM, Edison KE, Kapur K, Thottapurathu L, Moritz TE, et al. Cost and Utility Analysis of a Store-and-Forward Teledermatology Referral System: A Randomized Clinical Trial. JAMA Dermatol 2015 Dec 01;151(12):1323-1329. [doi: 10.1001/jamadermatol.2015.2362] [Medline: 26375589]

XSL•FO
RenderX

4. Lasierra N, Alesanco A, Gilaberte Y, Magallón R, García J. Lessons learned after a three-year store and forward teledermatology experience using internet: Strengths and limitations. Int J Med Inform 2012 May;81(5):332-343. [doi: 10.1016/j.ijmedinf.2012.02.008] [Medline: 22425394]
5. Chuchu N. Teledermatology for diagnosing skin cancer in adults. Cochrane Database Syst Rev 2018;12. [doi: 10.1002/14651858.cd013193] [Medline: 30521686]
6. Finnane A, Dallest K, Janda M, Soyer HP. Teledermatology for the Diagnosis and Management of Skin Cancer: A Systematic Review. JAMA Dermatol 2017 Mar 01;153(3):319-327. [doi: 10.1001/jamadermatol.2016.4361] [Medline: 27926766]
7. Naka F, Lu J, Porto A, Villagra J, Wu ZH, Anderson D. Impact of dermatology eConsults on access to care and skin cancer screening in underserved populations: A model for teledermatology services in community health centers. J Am Acad Dermatol 2018 Feb;78(2):293-302. [doi: 10.1016/j.jaad.2017.09.017] [Medline: 29061478]
8. G Bianchi M, Santos A, Cordioli E. Benefits of Teledermatology for Geriatric Patients: Population-Based Cross-Sectional Study. J Med Internet Res 2020 Apr 21;22(4):e16700 [FREE Full text] [doi: 10.2196/16700] [Medline: 32314966]
9. Ramaswamy A, Yu M, Drangsholt S, Ng E, Culligan PJ, Schlegel PN, et al. Patient Satisfaction With Telemedicine During the COVID-19 Pandemic: Retrospective Cohort Study. J Med Internet Res 2020 Sep 09;22(9):e20786 [FREE Full text] [doi: 10.2196/20786] [Medline: 32810841]
10. Su MY, Das S. Expansion of asynchronous teledermatology during the COVID-19 pandemic. J Am Acad Dermatol 2020 Dec;83(6):e471-e472 [FREE Full text] [doi: 10.1016/j.jaad.2020.08.054] [Medline: 32822793]
11. Brinker TJ, Hekler A, von Kalle C, Schadendorf D, Esser S, Berking C, et al. Teledermatology: Comparison of Store-and-Forward Versus Live Interactive Video Conferencing. J Med Internet Res 2018 Oct 24;20(10):e11871 [FREE Full text] [doi: 10.2196/11871] [Medline: 30355564]
12. Piccolo D, Smolle J, Argenziano G, Wolf IH, Braun R, Cerroni L, et al. Teledermoscopy--results of a multicentre study on 43 pigmented skin lesions. J Telemed Telecare 2000;6(3):132-137. [doi: 10.1258/1357633001935202] [Medline: 10912329]
13. Warshaw EM, Hillman YJ, Greer NL, Hagel EM, MacDonald R, Rutks IR, et al. Teledermatology for diagnosis and management of skin conditions: a systematic review. J Am Acad Dermatol 2011 Apr;64(4):759-772. [doi: 10.1016/j.jaad.2010.08.026] [Medline: 21036419]
14. Warshaw EM, Gravely AA, Nelson DB. Reliability of store and forward teledermatology for skin neoplasms. J Am Acad Dermatol 2015 Mar;72(3):426-435. [doi: 10.1016/j.jaad.2014.11.001] [Medline: 25599624]
15. Warshaw EM, Gravely AA, Nelson DB. Accuracy of teledermatology/teledermoscopy and clinic-based dermatology for specific categories of skin neoplasms. J Am Acad Dermatol 2010 Aug;63(2):348-352. [doi: 10.1016/j.jaad.2009.10.037] [Medline: 20633809]
16. Piccolo D, Smolle J, Wolf IH, Peris K, Hofmann-Wellenhof R, Dell'Eva G, et al. Face-to-face diagnosis vs telediagnosis of pigmented skin tumors: a teledermoscopic study. Arch Dermatol 1999 Dec;135(12):1467-1471. [doi: 10.1001/archderm.135.12.1467] [Medline: 10606051]
17. Landow SM, Mateus A, Korgavkar K, Nightingale D, Weinstock MA. Teledermatology: key factors associated with reducing face-to-face dermatology visits. J Am Acad Dermatol 2014 Sep;71(3):570-576. [doi: 10.1016/j.jaad.2014.02.021] [Medline: 24704089]
18. Dobry A, Begaj T, Mengistu K, Sinha S, Droms R, Dunlap R, et al. Implementation and Impact of a Store-and-Forward Teledermatology Platform in an Urban Academic Safety-Net Health Care System. Telemed J E Health 2020 Jun 09. [doi: 10.1089/tmj.2020.0069] [Medline: 32522105]
19. Nelson CA, Takeshita J, Wanat KA, Bream KDW, Holmes JH, Koenig HC, et al. Impact of store-and-forward (SAF) teledermatology on outpatient dermatologic care: A prospective study in an underserved urban primary care setting. J Am Acad Dermatol 2016 Mar;74(3):484-90.e1. [doi: 10.1016/j.jaad.2015.09.058] [Medline: 26679528]
20. Barbieri JS, Nelson CA, James WD, Margolis DJ, Littman-Quinn R, Kovarik CL, et al. The reliability of teledermatology to triage inpatient dermatology consultations. JAMA Dermatol 2014 Apr;150(4):419-424. [doi: 10.1001/jamadermatol.2013.9517] [Medline: 24522374]
21. McKoy K, Norton S, Lappan C. Quick Guide to Store-Forward Teledermatology for Referring Providers.: ATA Teledermatology SIG; 2012. URL: http://teledermatology-society.org/wp-content/uploads/2013/08/quick-guide-to-store-forward-and-live-interactive-teledermatology-for-referring-providers.pdf [accessed 2021-01-29]
22. McKoy K, Antoniotti NM, Armstrong A, Bashshur R, Bernard J, Bernstein D, et al. Practice Guidelines for Teledermatology. Telemed J E Health 2016 Dec;22(12):981-990. [doi: 10.1089/tmj.2016.0137] [Medline: 27690203]
23. Mohan GC, Molina GE, Stavert R. Store and forward teledermatology improves dermatology knowledge among referring primary care providers: A survey-based cohort study. J Am Acad Dermatol 2018 Nov;79(5):960-961. [doi: 10.1016/j.jaad.2018.05.006] [Medline: 29753059]

Abbreviations

HSV: herpes simplex virus
KOH prep: potassium hydroxide preparation
SAF: store-and-forward

XSL•FO
RenderX

Edited by G Eysenbach; submitted 07.10.20; peer-reviewed by E Tensen, F Kaliyadan, F Blazer; comments to author 02.12.20; revised version received 26.01.21; accepted 29.01.21; published 25.02.21.

Please cite as:
Lee MS, Stavert R
Factors Contributing to Diagnostic Discordance Between Store-and-Forward Teledermatology Consultations and In-Person Visits: Case Series
JMIR Dermatol 2021;4(1):e24820
URL: https://derma.jmir.org/2021/1/e24820
doi:10.2196/24820
PMID:

©Michelle S Lee, Robert Stavert. Originally published in JMIR Dermatology (http://derma.jmir.org), 25.02.2021. This is an open-access article distributed under the terms of the Creative Commons Attribution License (https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work, first published in JMIR Dermatology Research, is properly cited. The complete bibliographic information, a link to the original publication on http://derma.jmir.org, as well as this copyright and license information must be included.

XSL•FO
RenderX

Original Paper

Evaluating the Experiences of New and Existing Teledermatology Patients During the COVID-19 Pandemic: Cross-sectional Survey Study

Judy Hamad[1], MPH; Amy Fox[1], MD; Maria Suzanne Kammire[1], BS; Alison Nancy Hollis[1], BS; Saif Khairat[2,3], MPH, PhD

[1]Department of Dermatology, School of Medicine, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States

[2]Carolina Health Informatics Program, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States

[3]Healthcare Systems, School of Nursing, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States

Corresponding Author:
Saif Khairat, MPH, PhD
Carolina Health Informatics Program
University of North Carolina at Chapel Hill
428 Carrington Hall
Chapel Hill, NC, 27514
United States
Phone: 1 9198435416
Email: saif@unc.edu

Abstract

Background: As teledermatology has been widely adopted during the COVID-19 pandemic, it is essential to examine patients' experiences and satisfaction with teledermatology.

Objective: We aimed to assess the teledermatology experiences of new and existing clinic patients in the context of the rapid shift toward teledermatology practices during the COVID-19 pandemic.

Methods: We conducted a cross-sectional study of 184 teledermatology patients who were assessed during the COVID-19 pandemic at a major southeastern medical center from May 13 to June 5, 2020. The primary outcome was patient satisfaction levels among new and existing patients. The secondary outcome was patients' willingness to use teledermatology in the future.

Results: Of the 288 teledermatology patients who were assessed during the study period, 184 (63.9%) completed the survey. Patients reported high overall satisfaction with teledermatology, with 86.4% (159/184) of participants reporting positive overall satisfaction and experiences with teledermatology. New patients had significantly higher Likert scores for overall satisfaction with teledermatology than those of follow-up patients (new patients: mean 4.70; existing patients: mean 4.43; P=.03). Overall, patients' satisfaction with teledermatology did not significantly differ based on age (P=.36), race and ethnicity (P=.46), education level (P=.11), residence (P=.74), or insurance status (P=.74). There were no significant differences in overall satisfaction between patients with and without prior telehealth experience (P=.53), between the video and telephone visit types (P=.17), and among platform types (P=.22). Prior telehealth experience was associated with higher odds of being willing to use telehealth in the future (odds ratio 2.39, 95% CI 1.31-4.35; P=.004).

Conclusions: This cross-sectional survey study demonstrates that during the rapid expansion of teledermatology, new clinic patients had significantly higher scores for overall satisfaction with their teledermatology experience compared to those of established clinic patients (P=.03). Prior telehealth experience was associated with higher odds of being willing to use teledermatology in the future. Overall, teledermatology expansion was met with high levels of patient satisfaction during the COVID-19 pandemic.

(JMIR Dermatol 2021;4(1):e25999) doi:10.2196/25999

KEYWORDS

teledermatology; telehealth; patient satisfaction; patient-centered outcomes; COVID-19; dermatology; implementation; virtual health; digital health; cross-sectional

XSL•FO
RenderX

Introduction

With the rapid shift toward converting office-based dermatology clinics into web-based clinics during the COVID-19 pandemic [1,2], teledermatology has been increasingly used in clinical practice and has been a common subject of scientific literature in the past year [3]. Prior to the continuation of widespread teledermatology implementation, it is imperative that dermatologists examine patients' experiences with teledermatology. The exchange of information through video, audio, and imagery has made it possible for dermatologists to visualize, diagnose, and communicate with patients throughout the pandemic. This rapid evolution has also resulted in the recognition of web-based services by most health insurance organizations [4,5] and the recording of telemedicine encounters in electronic health records. These changes will allow teledermatology to remain a prominent communication method in the future of the field.

Patients' experiences likely differ based on patient-provider relationships and whether patients are new clinic patients or established clinic patients. Although some studies have reported high patient satisfaction after the use of teledermatology for new referrals or consults [6-9], to our knowledge there are no studies that examine new and existing patients' satisfaction with teledermatology. Our objective was to assess new and existing patients' satisfaction with teledermatology in the context of the COVID-19 pandemic–related rapid shift toward teledermatology practices.

Methods

Study Design

We conducted a cross-sectional study of teledermatology patients' satisfaction during the COVID-19 pandemic at a major southeastern medical center. The rationale for this quality improvement initiative was to characterize patients' experiences with teledermatology in order to improve our delivery of this mode of care. We reported this study per the Standards for Quality Improvement Report Excellence 2.0 guidelines [10]. This study was exempt from institutional review board approval due to its quality improvement objectives.

Study Materials and Participants

Eligible participants were new and existing patients who attended teledermatology visits for acute and chronic conditions. Patients were invited to complete a postvisit survey, which was a voluntary survey that was adapted from a validated telehealth satisfaction study [11]. We recorded survey responses by using the web-based survey tool Qualtrics. We piloted the survey among 22 patients and made iterative survey changes based on patients' and service providers' feedback. We included responses from the piloted survey in the analysis, as there were minimal survey changes. We administered the survey from May 13 to June 5, 2020, to the patients of 8 dermatologists who delivered adult and pediatric teledermatology services. All patients who used adult and pediatric teledermatology services during the study period were eligible for inclusion in this study; however, the parents or guardians of pediatric patients completed the survey.

Survey Questions

The survey instrument was adapted from the Telehealth Satisfaction Scale and modified by a telehealth domain expert so that the survey met the needs of this study. The survey consisted of 25 questions that addressed demographics, visit characteristics, and satisfaction measures (Multimedia Appendix 1). Patients reported whether they were new or existing patients of the clinic, whether they were telehealth-experienced patients or telehealth-naïve patients (no prior telehealth experience), and whether they were willing to use telehealth in the future (answered "yes" or "no"). Patients rated their satisfaction with 12 items on a Likert scale (1=poor; 2=fair; 3=good; 4=very good; 5=excellent). Satisfaction-related items included patients' overall satisfaction with teledermatology, patient-related outcomes (personal comfort with teledermatology, the ease of using teledermatology, and respect for patients' privacy), the voice and visual quality of the visit, time characteristics (the length of wait time and the length of time with the service provider), and service provider–related outcomes (treatment explanations, thoroughness, and the courtesy of the provider).

Outcomes

The primary outcome was satisfaction levels among new and existing patients. The secondary outcome was patients' willingness to use teledermatology in the future.

Statistical Analysis

Satisfaction ratings of very good and excellent were considered positive ratings. Continuous measures were reported as means with SDs. Categorical variables were reported as numbers and percentages. Fisher exact tests were used for categorical variables, and *t* tests and one-way analysis of covariance tests were used to determine differences in the means of continuous variables. Univariable logistic regression was conducted to identify predictors of willingness to use teledermatology in the future. Statistical analyses were performed using Stata 16 (StataCorp LLC). A P value of <.05 was considered statistically significant.

Results

Study Population Characteristics

Of the 288 teledermatology patients assessed, 184 (63.9%) completed the survey (Table 1). The mean age of participants was 37.8 years, and 72.8% (134/184) of participants were females. Most teledermatology visits were conducted for existing patients (123/184; 66.8%) and telehealth-naïve patients (107/184; 58.2%). Most respondents were White (114/184; 62.0%) and had a Bachelor's degree or other higher education degree (92/184; 50%). The majority of the respondents were privately insured (109/184; 59.2%), a large subset of patients had public insurance (69/184; 37.5%), and a minority of patients were uninsured (6/184; 3.3%).

XSL•FO
RenderX

Table 1. Participants' characteristics (N=184).

Characteristic	Value
Age (years), mean (SD)	37.8 (18.3)
Sex, n (%)	
Male	50 (27.2)
Female	134 (72.8)
Race, n (%)	
White	114 (62)
Black/African American	44 (23.9)
Hispanic/Latino	12 (6.5)
Asian/Pacific Islander	10 (5.4)
Other	4 (2.2)
Education level, n (%)	
Less than high school	21 (11.4)
High school or equivalent	32 (17.4)
Some college	28 (15.2)
Associate degree	11 (6)
Bachelor's degree	46 (25)
Graduate, doctorate, or professional degree	46 (25)
Residence, n (%)	
Urban	47 (25.5)
Suburban	87 (47.3)
Rural	50 (27.2)
Unique patient zip codes reached, n	84
Insurance status, n (%)	
Uninsured	6 (3.3)
Private insurance	109 (59.2)
Medicare, Medicaid, or Tricare	69 (37.5)
Impairments, n (%)	
Visual	29 (15.8)
Auditory	5 (2.7)
Both	3 (1.6)
None	147 (79.9)
Patient type, n (%)	
New	61 (33.1)
Existing	123 (66.8)
Prior telehealth experience, n (%)	
Yes (telehealth-experienced patient)	77 (41.8)
No (telehealth-naïve patient)	107 (58.2)
Visit type, n (%)	
Video	171 (92.9)
Telephone	13 (7.1)

XSL•FO
RenderX

Patient-Reported Satisfaction

Patients reported high overall satisfaction with teledermatology (Figure 1), with 86.4% (159/184) of participants reporting a positive teledermatology experience. New patients had significantly higher Likert scores for overall satisfaction with teledermatology than those of follow-up patients (new patients: mean 4.70; follow-up patients: mean 4.43; *P*=.03). Patients' satisfaction with teledermatology did not significantly differ based on age (*P*=.36), race and ethnicity (*P*=.46), education level (*P*=.11), residence (*P*=.74), or insurance status (*P*=.74). There were no significant differences in overall satisfaction between patients with and without prior telehealth experience (*P*=.53) and between the video and telephone visit types (*P*=.17). In terms of all of the satisfaction measures, new patients reported higher satisfaction scores compared to those reported by existing patients; however, these differences were not statistically significant (Figure 2).

Figure 1. Patient-centered satisfaction outcomes following the completion of teledermatology visits.

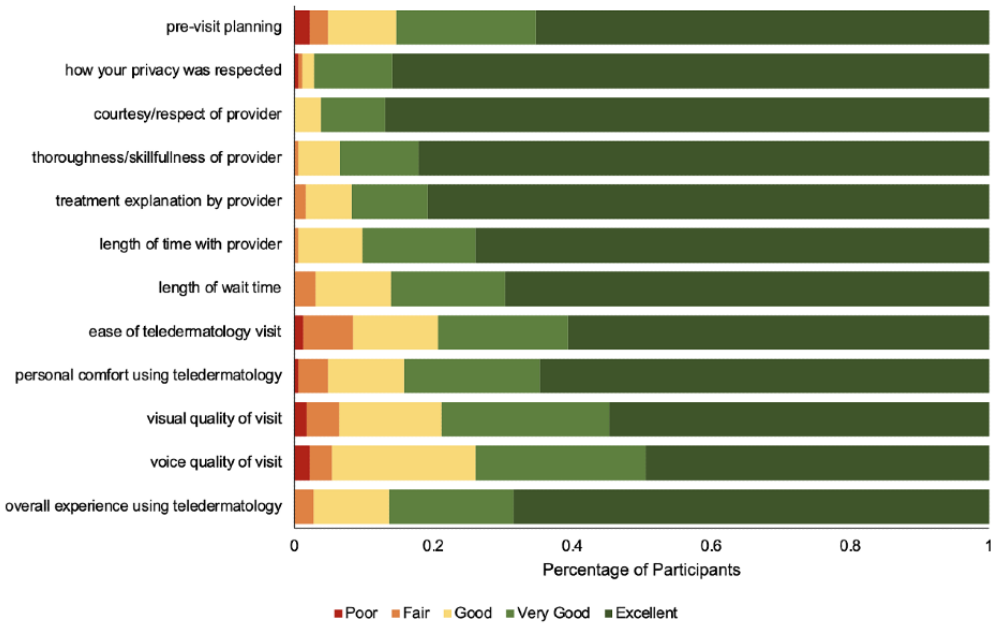
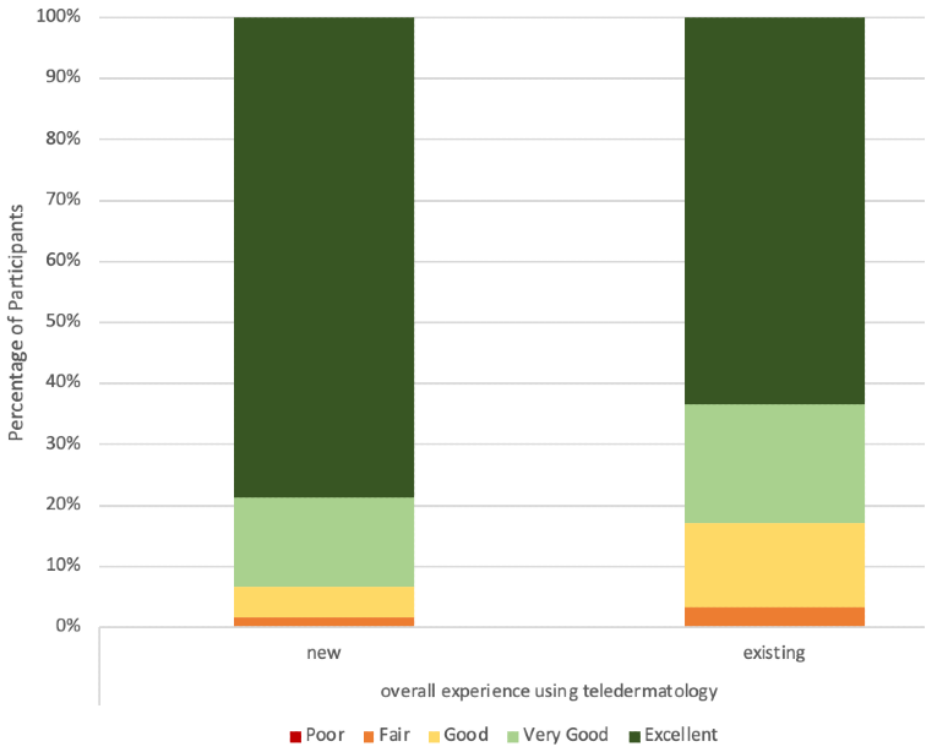


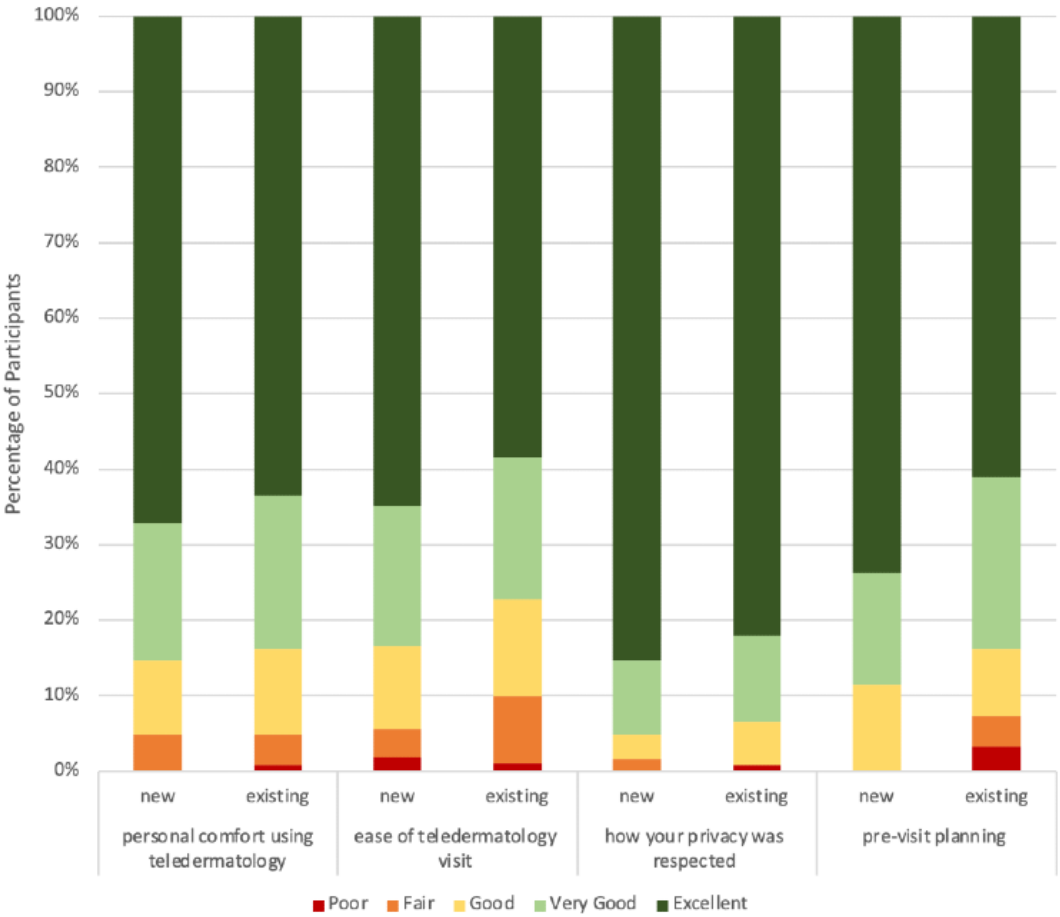
Figure 2. New and follow-up patients' overall satisfaction with teledermatology.



XSL•FO
RenderX

Patients' personal comfort with using telehealth and the ease of using telehealth were similar between new and follow-up patients (Figure 3). Participants reported high satisfaction with the privacy of telehealth visits, with 85.2% (52/61) of new patients and 82% (100/122) of follow-up patients rating their satisfaction as "excellent" (Figure 3). Patients' satisfaction with previsit planning was different between the two groups (*P*=.15); follow-up patients reported lower levels of satisfaction (excellent: 75/123, 61%; very good: 28/123, 22.8%; good: 11/123, 8.9%; fair: 5/123, 4.1%; poor: 4/123, 3.3%), while new patients reported slightly higher levels of satisfaction with the teledermatology process (excellent: 45/61, 73.7%; very good: 9/61, 14.8%; good: 7/61, 11.5%; fair and poor: 0/61, 0%; Figure 3). Participants' overall satisfaction with the voice quality of visits was low, and follow-up patients' satisfaction with voice quality was lower than new patients' satisfaction. Patients' satisfaction with visual quality was slightly higher than their satisfaction with voice quality and similar between follow-up patients and new patients. The length of wait time, length of time with the service provider, and provider-related satisfaction were highly rated among participants.

Figure 3. New and follow-up patients' satisfaction with the following patient-related outcomes: comfort, ease, privacy, and previsit planning experiences.



Willingness to Use Teledermatology in the Future

Our univariable logistic regression showed that prior telehealth experience was associated with higher odds of being willing to use teledermatology in the future (odds ratio [OR] 2.39, 95% CI 1.31-4.35; *P*=.004). Age, sex, race, education, residence, and insurance status were not associated with significant odds of preferring teledermatology (Table 2). Compared to new patients, existing patients had nonsignificantly higher odds of using of telehealth in the future (OR 1.46, 95% CI 0.79-2.72; *P*=.23).

XSL•FO
RenderX

Table 2. Univariate logistic regression results for predicting patient's willingness to use teledermatology in the future.

Predictor	Preferred telehealth, odds ratio (95% CI)	*P* value
Age (years)		
<18	Referent	N/A[a]
18-34	1.51 (0.54-4.24)	.44
35-64	1.14 (0.40-3.25)	.80
≥65	0.42 (0.11-1.55)	.11
Sex		
Female	Referent	N/A
Male	1.16 (0.61-2.23)	.65
Race		
White	Referent	N/A
Black/African American	1.19 (0.59-2.39)	.62
Other	1.19 (0.51-2.80)	.69
Education level		
Less than high school	Referent	N/A
High school or equivalent	0.62 (0.21-1.89)	.40
Some college	0.43 (0.13-1.38)	.16
Associate degree	0.20 (0.03-1.17)	.08
Bachelor's degree	1.41 (0.50-4.01)	.51
Graduate, doctorate, or professional degree	0.99 (0.35-2.79)	.99
Residence		
Rural	Referent	N/A
Suburban	1.23 (0.61-2.48)	.56
Urban	1.57 (0.70-3.50)	.70
Insurance status		
Medicare, Medicaid, or Tricare	Referent	N/A
Private insurance	1.2 (0.66-2.20)	.55
Uninsured	0.61 (0.11-3.57)	.59
Patient type		
New	Referent	N/A
Follow-up	1.46 (0.79-2.72)	.23
Prior telehealth experience		
No	Referent	N/A
Yes	2.39 (1.31-4.35)	.004

[a]N/A: not applicable.

Discussion

Principal Findings

We conducted an evaluation of teledermatology implementation as a response to the COVID-19 crisis. Although there is a limited number of prior teledermatology studies that evaluate patients' satisfaction, this study found that patients' satisfaction was high across numerous key measures. We found that 97.3% (179/184) of patients reported a positive overall experience with teledermatology (ratings of good, very good, or excellent). These findings are consistent with those of prior teledermatology studies in related literature [7-9]. Additionally, we found that patients' overall satisfaction with telehealth did not vary significantly based on patients' demographic characteristics, locations of residence, education, or insurance status.

Our results demonstrated that new patients had significantly higher overall scores for satisfaction with teledermatology than those of existing patients (*P*=.03). Furthermore, new patients

XSL•FO
RenderX

reported higher satisfaction for all satisfaction metrics. This may be due to the fact that new patients did not have prior in-person experiences with the dermatologist that they were seeing; therefore, they could not compare different teledermatology experiences. Furthermore, existing patients may have been more inclined to compare their teledermatology visit to those they experienced in person. This high satisfaction among new patients could also be related to the fact that we reached out to geographically diverse patients across 84 zip codes who were enthusiastic about having increased access to dermatology services.

Interestingly, over half of our participants (107/184, 58.2%) never used telehealth services prior to their teledermatology visit during the COVID-19 pandemic. In an Italian study of teledermatology patients of an acne center that was conducted during the COVID-19 pandemic, patients reported favorable experiences, and 92% of patients appreciated their visits [12]. This was similar to our study. However, the Italian study's patient population entirely consisted of existing patients. In contrast, we observed various conditions among the new and existing patients, especially among telehealth-naïve patients. We found that prior telehealth experience was associated with a willingness to use teledermatology in the future. The increasing awareness of telehealth benefits, such as time and cost savings, among patients with no telehealth experience may help mitigate people's resistance to future telehealth use [13]. Additionally, because people compare prior in-person visits to teledermatology visits, our patients may have considered in-person visits to be more thorough than video visits. The deployment of teledermatology during our study period likely reflected the broader use of telehealth for conditions other than those that would be present after the COVID-19 pandemic and the need for disease-specific scheduling algorithms, which can ensure that the telehealth modality suits the target condition. However, the overall satisfaction of both new and follow-up patients was extremely positive, and the expansion of teledermatology services seemed to be well received by patients.

The impacts of the national health crisis have undoubtedly influenced patients' perception of care and have likely influenced patients' willingness to engage in teledermatology in a way that is unprecedented in prior studies. We suspect that at least a portion of the highly positive responses to teledermatology visits from our surveyed patients was due to teledermatology providing patients with the ability to avoid high-risk settings and continue to practice social distancing by staying at their homes [14]. In addition, many patients travel long distances to be seen by specialists at the clinic and are pleased to save time, money, and energy by not having to physically appear at clinics. It is for these reasons that the amplification of the role of telehealth has been regarded as a silver lining or "bright spot" of the pandemic [15-18]. Although the Centers for Medicare & Medicaid Services have provided payment parity for telehealth visits and service providers can bill patients for telehealth visits at the same rates as in-person visit rates, patients have likely saved money by taking less time off of work and not having to consider gas costs for trips to clinics.

Limitations

The findings of our research are limited by the nature of our study. First, this study reported findings from a single cross-sectional sample of patients who were treated by 8 participating dermatologists. Although patients were recruited consecutively at the end of telehealth visits, several patients did not stay on the phone or video call to immediately complete the survey. It is possible that patients who did not complete the survey had characteristics that considerably differed from the characteristics of those who did complete the survey, given that we had a nonresponse rate of 36%. Participants in this study were more likely to be White; educated; insured; and, on average, younger than the general population. Although we did not find statistical differences in satisfaction based on the many demographic characteristics we analyzed, it is possible that a larger sample size would have resulted in the observation of important differences in satisfaction. One study reported a potential disparity—the decreased amount of video visit use among older adults [19]. This highlighted the following key questions: (1) which populations do or do not have access to telehealth, and (2) how does this impact disparities in care? Second, this study took place at a single dermatology department at an academic institution. Thus, we cannot generalize our results to the larger dermatology patient population. Third, we did not collect information regarding diagnosis; it is plausible that patients' satisfaction with telehealth may differ based on dermatologic conditions that require more or less complicated management. Finally, we observed a ceiling effect in our data. Since satisfaction scores were rated on a Likert scale of 1-5, the ratings tended to be grouped at the higher end of the scale. This ceiling effect likely resulted in less variability among the data and limited our ability to test associations or build multivariable regression models.

Conclusion

We report that the rapid expansion of teledermatology resulted in new patients reporting higher satisfaction with their teledermatology experiences compared to the satisfaction of existing patients of the clinic. Prior telehealth experience was associated with higher odds of being willing to use teledermatology in the future. The rapid adoption of teledermatology during the study period was met with high overall levels of patient satisfaction during the COVID-19 pandemic. The deployment of teledermatology during our study period likely reflected the broader use of telehealth for conditions other than those that would be present after the COVID-19 pandemic and highlighted the need for disease-specific scheduling algorithms, which can ensure that the telehealth modality suits the target condition.

XSL•FO
RenderX

Authors' Contributions

JH was responsible for data collection and analysis. AF was the domain expert who assisted with the study design and data collection. ANH was responsible for manuscript preparation. MSK was responsible for manuscript preparation and data analysis. SK was responsible for study design and analysis.

Conflicts of Interest

None declared.

Multimedia Appendix 1
Teledermatology patient satisfaction survey tool.
[PDF File (Adobe PDF File), 13 KB - derma_v4i1e25999_app1.pdf]

References

1. Perkins S, Cohen JM, Nelson CA, Bunick CG. Teledermatology in the era of COVID-19: Experience of an academic department of dermatology. J Am Acad Dermatol 2020 Jul;83(1):e43-e44 [FREE Full text] [doi: 10.1016/j.jaad.2020.04.048] [Medline: 32305442]
2. Price KN, Thiede R, Shi VY, Curiel-Lewandrowski C. Strategic dermatology clinical operations during the coronavirus disease 2019 (COVID-19) pandemic. J Am Acad Dermatol 2020 Jun;82(6):e207-e209 [FREE Full text] [doi: 10.1016/j.jaad.2020.03.089] [Medline: 32277972]
3. Doraiswamy S, Abraham A, Mamtani R, Cheema S. Use of telehealth during the COVID-19 pandemic: Scoping review. J Med Internet Res 2020 Dec 01;22(12):e24087. [doi: 10.2196/24087] [Medline: 33147166]
4. Medicare telemedicine health care provider fact sheet. Centers for Medicare & Medicaid Services. URL: https://www.cms.gov/newsroom/fact-sheets/medicare-telemedicine-health-care-provider-fact-sheet [accessed 2021-04-28]
5. Notification of enforcement discretion for telehealth remote communications during the COVID-19 nationwide public health emergency. Health & Human Services Health Information Privacy. URL: https://www.hhs.gov/hipaa/for-professionals/special-topics/emergency-preparedness/notification-enforcement-discretion-telehealth/index.html [accessed 2021-04-28]
6. Marchell R, Locatis C, Burgess G, Maisiak R, Liu W, Ackerman M. Patient and provider satisfaction with teledermatology. Telemed J E Health 2017 Aug;23(8):684-690 [FREE Full text] [doi: 10.1089/tmj.2016.0192] [Medline: 28375822]
7. Mounessa JS, Chapman S, Braunberger T, Qin R, Lipoff JB, Dellavalle RP, et al. A systematic review of satisfaction with teledermatology. J Telemed Telecare 2018 May;24(4):263-270. [doi: 10.1177/1357633X17696587] [Medline: 28350281]
8. Mair F, Whitten P. Systematic review of studies of patient satisfaction with telemedicine. BMJ 2000 Jun 03;320(7248):1517-1520 [FREE Full text] [doi: 10.1136/bmj.320.7248.1517] [Medline: 10834899]
9. Hills Z, Khairat S. Teledermatology: Using collaborative technologies to enhance public health awareness. 2014 Presented at: 2014 International Conference on Collaboration Technologies and Systems (CTS); May 19-23, 2014; Minneapolis, MN, USA. [doi: 10.1109/cts.2014.6867599]
10. Ogrinc G, Davies L, Goodman D, Batalden P, Davidoff F, Stevens D. SQUIRE 2.0 (Standards for QUality Improvement Reporting Excellence): revised publication guidelines from a detailed consensus process. BMJ Qual Saf 2016 Dec;25(12):986-992 [FREE Full text] [doi: 10.1136/bmjqs-2015-004411] [Medline: 26369893]
11. Morgan DG, Kosteniuk J, Stewart N, O'Connell ME, Karunanayake C, Beever R. The telehealth satisfaction scale: reliability, validity, and satisfaction with telehealth in a rural memory clinic population. Telemed J E Health 2014 Nov;20(11):997-1003 [FREE Full text] [doi: 10.1089/tmj.2014.0002] [Medline: 25272141]
12. Ruggiero A, Megna M, Annunziata MC, Abategiovanni L, Scalvenzi M, Tajani A, et al. Teledermatology for acne during COVID-19: high patients' satisfaction in spite of the emergency. J Eur Acad Dermatol Venereol 2020 Nov;34(11):e662-e663 [FREE Full text] [doi: 10.1111/jdv.16746] [Medline: 32534472]
13. Al Quran HA, Khader YS, Ellauzi ZM, Shdaifat A. Effect of real-time teledermatology on diagnosis, treatment and clinical improvement. J Telemed Telecare 2015 Mar;21(2):93-99. [doi: 10.1177/1357633X14566572] [Medline: 25589469]
14. Fisk M, Livingstone A, Pit SW. Telehealth in the context of COVID-19: Changing perspectives in Australia, the United Kingdom, and the United States. J Med Internet Res 2020 Jun 09;22(6):e19264 [FREE Full text] [doi: 10.2196/19264] [Medline: 32463377]
15. Sharma A, Jindal V, Singla P, Goldust M, Mhatre M. Will teledermatology be the silver lining during and after COVID-19? Dermatol Ther 2020 Jul;33(4):e13643 [FREE Full text] [doi: 10.1111/dth.13643] [Medline: 32441373]
16. Olayiwola JN, Magaña C, Harmon A, Nair S, Esposito E, Harsh C, et al. Telehealth as a bright spot of the COVID-19 pandemic: Recommendations from the virtual frontlines ("Frontweb"). JMIR Public Health Surveill 2020 Jun 25;6(2):e19045 [FREE Full text] [doi: 10.2196/19045] [Medline: 32479413]
17. Khairat S, Haithcoat T, Liu S, Zaman T, Edson B, Gianforcaro R, et al. Advancing health equity and access using telemedicine: a geospatial assessment. J Am Med Inform Assoc 2019 Aug 01;26(8-9):796-805 [FREE Full text] [doi: 10.1093/jamia/ocz108] [Medline: 31340022]

XSL•FO
RenderX

18. Khairat S, Lin X, Liu S, Man Z, Zaman T, Edson B, et al. Evaluation of patient experience during virtual and in-person urgent care visits: Time and cost analysis. J Patient Exp 2021 Jan 12;8:1-8 [FREE Full text] [doi: 10.1177/2374373520981487]
19. Schifeling CH, Shanbhag P, Johnson A, Atwater RC, Koljack C, Parnes BL, et al. Disparities in video and telephone visits among older adults during the COVID-19 pandemic: Cross-sectional analysis. JMIR Aging 2020 Nov 10;3(2):e23176 [FREE Full text] [doi: 10.2196/23176] [Medline: 33048821]

Abbreviations

OR: odds ratio

Edited by G Eysenbach; submitted 24.11.20; peer-reviewed by J op den Buijs, F Gomez; comments to author 12.01.21; revised version received 21.01.21; accepted 17.04.21; published 05.05.21.

Please cite as:
Hamad J, Fox A, Kammire MS, Hollis AN, Khairat S
Evaluating the Experiences of New and Existing Teledermatology Patients During the COVID-19 Pandemic: Cross-sectional Survey Study
JMIR Dermatol 2021;4(1):e25999
URL: https://derma.jmir.org/2021/1/e25999
doi:10.2196/25999
PMID:34028471

©Judy Hamad, Amy Fox, Maria Suzanne Kammire, Alison Nancy Hollis, Saif Khairat. Originally published in JMIR Dermatology (http://derma.jmir.org), 05.05.2021. This is an open-access article distributed under the terms of the Creative Commons Attribution License (https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work, first published in JMIR Dermatology Research, is properly cited. The complete bibliographic information, a link to the original publication on http://derma.jmir.org, as well as this copyright and license information must be included.

XSL•FO
RenderX

Original Paper

Patient Factors Associated with Interest in Teledermatology: Cross-sectional Survey

Maham Ghani[1*], BSc; Colin Adler[2*], MPH; Howa Yeung[2,3], MD, MSc

[1]City University of New York School of Medicine, City University of New York, New york, NY, United States
[2]Department of Dermatology, Emory University School of Medicine, Emory University, Atlanta, GA, United States
[3]Regional Telehealth Service, Veterans Affairs Veterans Integrated Service Network 7, Decatur, GA, United States
[*]these authors contributed equally

Corresponding Author:
Howa Yeung, MD, MSc
Department of Dermatology, Emory University School of Medicine
Emory University
1525 Clifton Rd NE Suite 100
Atlanta, GA, 30322
United States
Phone: 1 (404) 727 9838
Email: howa.yeung@emory.edu

Abstract

Background: Teledermatology is a conduit for patients communicating with dermatologists on the internet, which bypasses in-person visits. It holds promise to address access needs for dermatologic care; however, the interest in using teledermatology is unknown in underserved populations with potential barriers to the use of health care technology.

Objective: This study aimed to characterize the association between demographic characteristics with interest in exchanging digital images or videos of skin lesions with health care providers electronically.

Methods: We examined data from the Health Information National Trends Survey (HINTS) 4 cycle 4 (2014) of the National Cancer Institute. HINTS is a cross-sectional, nationally representative household survey conducted annually, which collects information on demographics, perceptions and use of health information, and provides information on how cancer risks are perceived. HINTS 4 cycle 4 had a sample of 3677 participants. We examined the outcome to the question, “how interested are you in exchanging digital images or videos (eg, photos of skin lesions) with a health care provider electronically?” We dichotomized the outcome by a high level of interest (responding with “very”) and those who did not have a high level of interest (responding with “somewhat,” “a little,” or “not at all”) in exchanging images or videos. We used a multivariable logistic regression model developed through backwards selection, with all final covariates associated with varying levels of teledermatology use at $P<.05$. Sensitivity analysis was performed by changing the outcome dichotomy to model those who were “not at all” interested. Two-sided tests were performed with $P<.05$ considered significant.

Results: Among 3447 respondents, 888 (weighted prevalence=26.2%) were “very” interested in participating in teledermatology. A higher interest in using teledermatology was associated with a younger age, higher educational attainment, higher household income, internet usage, type of mobile device ownership, history of electronic medical information exchange with a clinician within the past 12 months, and high level of trust in web-based information on cancer (for all, $P<.01$), but not with the female gender, race or ethnicity, health insurance status, or having a regular medical provider.

Conclusions: Modifiable access barriers to teledermatology adoption include trust, experience with teledermatology, and use of health apps. Teledermatology program implementation should address these specific factors within the digital divide to promote equitable access to care across diverse patient populations.

(JMIR Dermatol 2021;4(1):e21555) doi:10.2196/21555

KEYWORDS

digital divide; e-health literacy; Internet; modifiable behaviors; teledermatology

XSL•FO
RenderX

Introduction

Teledermatology is a conduit for patients communicating with dermatologists on the internet, which bypasses in-person visits. It can occur through a live videoconferencing or by sending photographs for asynchronous review [1]. Patients may work with their general practitioners (GP) to contact a dermatologist via telehealth, or they can initiate the interaction themselves directly [2]. With evolving technology, camera phones can click photographs of sufficient quality to meet teledermatology standards, with potential for broad patient adoption without facilitation from an intermediary GP [2]. Implementation of teledermatology has recently been accelerated during the 2020 COVID-19 pandemic [3].

Teledermatology has the ability to increase medical care access to diverse populations at reduced costs and wait times [1,4]. High levels of concordance in diagnosis have been noted between teledermatology and in-person consultations [5]. However, there remains a knowledge gap in the characteristics of patients who use teledermatology. Previous studies suggest that demographics such as young age, high income, and high educational status are correlated with increased eHealth literacy, which refers to the ability to search, obtain, and understand web-based health information [6], as well as increased health app usage [7] and communication with physicians on the internet [8]. However, these studies did not explore the factors that influence patient interest in participating specifically in teledermatology.

Consideration of the identified characteristics of individuals who are less interested in using teledermatology in the context of the digital divide has implications for health equity as teledermatology expands. The digital divide encompasses a broad range of variables that contribute to the gap in the ability to access and use digital devices [9]. The exchange of images or videos distinguishes teledermatology from the more general telemedicine. Exchanging images requires more advanced technologic skills, with particular attention to be paid to aspects pertaining to image quality such as focus, lighting, and background [10]. Teledermatology requires a minimal bandwidth to adequately participate in videoconferencing [10]. Identifying the images of the patient may pose a potential vulnerability and require substantial patient trust in the technological platform.

In this study, we aimed to determine sociodemographic correlates with patient interest in exchanging images and videos electronically with health care providers in the nationally representative Health Information National Trends Survey (HINTS) of the National Cancer Institute. We hypothesized that teledermatology adoption by various subpopulations may be mediated by differential levels of access to and interest in exchanging images and videos with their health care providers.

Methods

Study Sample

We examined data from HINTS 4 cycle 4 (2014) of the National Cancer Institute. HINTS is a cross-sectional, nationally representative household survey conducted annually, which collects information on demographics and the perceptions and use of health information, and provides information on how cancer risks are perceived. HINTS 4 cycle 4 had a sample of 3677 participants. Data from 2014 were used because the outcome of interest, “How interested are you in exchanging digital images or video (eg, photos of skin lesions) with a health care provider electronically?” was only available in this cycle. Details about HINTS data collection, including weighting methodologies, is described elsewhere. The institutional review board of Emory University exempted this study from review.

Sociodemographic and Health Behavior Correlates

The covariates include sociodemographic variables as well as access and use of the internet such as the following: self-reported gender, age, education, race and ethnicity, annual household income level, seeing a health professional regularly, having health insurance, using the internet, using electronic devices to share medical information with a health professional, and using various devices (if any) with or without health apps on them. The survey question on devices was, “please indicate if you have one of the following electronic devices: tablet, smartphone, cellphone, etc.” The responses were as follows: “(1) tablet computer like an iPad, Samsung, Galaxy Tab, Motorola Xoom, or Kindle Fire, only; (2) smartphone such as an iPhone, Android phone, Blackberry device, or a Windows phone; (3) basic cellphone only; and (4) multiple devices listed.” The survey question regarding health apps contained on one’s electronic device was, “on your tablet or smartphone, do you have any software apps related to health?” The answer choices were as follows: “yes,” “no,” and “don’t know.” These 2 questions were combined to generate 1 variable to specify the type of electronic device a participant owned and if there were health apps installed on that device.

We also assessed cancer information–seeking behavior, including, but not limited to, skin cancer. Cancer-related covariates included the following: seeking cancer information, trusting web-based information on cancer, and using the internet to obtain cancer-related information for oneself in the past 12 months.

Outcome: Interest in Using Teledermatology

The primary outcome was defined by the following question: “how interested are you in exchanging information like digital images or video (eg, photos of skin lesions) with a health care provider electronically?” We dichotomized the outcome by a high level of interest (responding with “very”) and those who did not have a high level of interest (responding with “somewhat,” “a little,” or “not at all”) in exchanging images and videos with health care providers.

Statistical Analysis

Statistical analyses were conducted using SAS (version 9.4, SAS Institute). Nationally representative prevalence estimates were obtained using jackknife replicate weights that accounted for the complex survey design. For bivariate analyses, the associations between specific sociodemographic groups and interest in sharing photographs or videos were assessed using unconditional logistic regression. We used complete cases

XSL•FO
RenderX

analysis for logistic regression owing to the low proportion of missing data (6%). A multivariable logistic regression model was developed through backwards selection, with all final covariates associated with varying levels of teledermatology use at $P<.05$. Furthermore, sensitivity analysis was performed by changing the outcome dichotomy to model those who were "not at all" interested. Two-sided tests were performed with $P<.05$ indicating statistical significance.

Results

The response rate of HINTS 4 cycle 4 was 34%. In total, 3677 respondents fully completed 3529 surveys and partially completed 148 surveys. Demographic characteristics of survey respondents by the level of their interest in teledermatology are summarized in Table 1. A total of 888 of 3447 (weighted prevalence=26.2%) participants were very interested, 784 (22.8%) were somewhat interested, 515 (16.2%) were a little interested, and 1260 (34.8%) were not at all interested.

As shown in Table 1, the socioeconomic demographic characteristics associated with high levels of interest in sharing photographs or videos were the female gender ($P=.02$), young age ($P<.001$), high levels of education ($P=.001$), high annual household income range ($P<.001$), having a regular medical provider ($P=.02$), trusting web-based information on cancer ($P<.001$), using the internet ($P<.001$), sharing medical information with medical providers ($P<.001$), and having multiple electronic devices, including smartphones and tablets, with health apps (for both $P<.001$).

Multivariable modeling in Table 2 shows that trust in web-based information on cancer (odds ratio [OR] 1.9, 95% CI 1.3-2.8) is associated with high levels of interest in exchanging images.

Sharing medical information electronically with a health care professional (OR 2.1, 95% CI 1.5-2.9) is associated with high levels of interest in exchanging images (Table 2). Sensitivity analysis revealed that individuals who reported no interest in exchanging images were less likely to have shared medical information electronically with a health care professional (OR 0.3, 95% CI 0.2-0.4).

Having multiple devices with health apps (OR 2.6, 95% CI 1.5-4.6) is associated with high levels of interest in exchanging images (Table 2). Sensitivity analysis revealed that individuals reporting no interest in exchanging images were less likely to own multiple devices with health apps (OR 0.3, 95% CI 0.2-0.5), own multiple devices without health apps (OR 0.5, 95% CI 0.3-0.7), own a tablet device without health apps (OR 0.6, 95% CI 0.4-0.9), own a smartphone with health apps (OR 0.4, 95% CI 0.2-0.8), and own a smartphone without health apps (OR 0.5, 95% CI 0.3-0.7).

Age, gender, annual household income, education, having a regular medical provider, internet usage, having health insurance, and trusting web-based information on cancer were not significant predictors of a high level of interest in teledermatology after adjusting for the aforementioned variables.

XSL•FO
RenderX

Table 1. Patient factors associated with high levels of interest in exchanging digital images (eg, photographs of skin lesions) with a health care provider electronically.

Factors	Very interested (n=888), n (weighted %)	Not at all interested (n=2559), n (weighted %)	Total participants	*P* value
Gender				.02
Male	322 (25.1[a])	1018 (74.9)	1340	
Female	557 (27.7)	1495 (72.3)	2052	
Unknown	9 (9.2)	46 (90.8)	55	
Age (years)				<.001
18-34	153 (30.0)	310 (70.0)	463	
35-49	243 (32.2)	474 (67.8)	717	
50-64	295 (22.3)	876 (77.7)	1171	
≥65	166 (16.1)	780 (83.9)	946	
Unknown	31 (19.0)	119 (81.0)	150	
Education				.001
High school or below	56 (19.0)	200 (81.0)	256	
High School	126 (21.7)	479 (78.3)	605	
Some college degree	256 (24.4)	788 (75.6)	1044	
College or higher	424 (31.7)	994 (68.3)	1418	
Unknown	26 (18.8)	98 (81.2)	124	
Race and ethnicity				.61
Hispanic	143 (29.3)	343 (70.7)	486	
Non-Hispanic White	445 (24.6)	1447 (75.4)	1892	
Non-Hispanic Black	152 (30.4)	361 (69.9)	513	
Other	63 (28.8)	166 (71.2)	229	
Unknown	85 (25.9)	242 (74.1)	327	
Income range				<.001
<US $20,000	157 (24.8)	537 (75.2)	694	
US $20,000-$34,999	109 (22.2)	348 (77.8)	457	
US $35,000-$49,999	118 (24.2)	347 (75.8)	465	
US $50,000-$74,999	132 (26.5)	396 (73.5)	528	
≥US $75,000	321 (33.0)	643 (67.0)	964	
Unknown	51 (11.1)	288 (88.9)	339	
Having a regular medical provider				.02
Yes	627 (27.7)	1783 (72.3)	2410	
No	260 (23.7)	760 (76.3)	1020	
Unknown	1 (2.1)	16 (97.9)	17	
Having health insurance				.15
Yes	773 (25.7)	2263 (74.3)	3036	
No	113 (29.7)	284 (70.3)	397	
Unknown	2 (9.7)	12 (90.3)	14	
Trust in web-based information on cancer				<.001
A lot	231 (38.4)	407 (61.6)	638	
Not a lot	620 (23.8)	1997 (76.2)	2617	

XSL•FO
RenderX

Factors	Very interested (n=888), n (weighted %)	Not at all interested (n=2559), n (weighted %)	Total participants	*P* value
Unknown	37 (20.8)	155 (79.2)	192	
Using the internet				<.001
Yes	767 (27.5)	1977 (72.5)	2744	
No	117 (17.8)	580 (82.2)	697	
Unknown	4 (85.7)	2 (14.3)	6	
Owning electronic devices and using health apps				<.001
Multiple devices with health apps	220 (40.9)	292 (59.1)	512	
Multiple devices without health apps	187 (25.0)	508 (75.0)	693	
Tablet device with health apps	14 (30.6)	51 (69.4)	65	
Tablet device without health apps	68 (25.4)	213 (74.6)	281	
Smartphone with health apps	73 (34.4)	150 (65.6)	223	
Smartphone without health apps	142 (23.4)	421 (76.6)	563	
Basic cellphone	117 (15.2)	631 (84.8)	748	
None	42 (11.0)	249 (89.0)	291	
Unknown	25 (43.7)	44 (56.3)	69	
Sharing medical information with health care providers				<.001
Yes	371 (39.6)	572 (60.4)	943	
No	507 (20.9)	1954 (79.1)	2461	
Unknown	10 (13.9)	33 (86.1)	43	

[a]Weighted percentage to adjust for the nonresponse bias.

XSL•FO
RenderX

Table 2. Multivariable analysis of interest levels in exchanging digital images (eg, photographs of skin lesions) with a health care provider electronically.

Characteristics	Very interested		Not at all interested	
	Odds Ratio (95% CI)	*P* value	Odds ratio (95% CI)	*P* value
Gender	N/A[a]	.51		.20
Male	Ref[b]		Ref	
Female	1.1 (0.8-1.7)		1.2 (0.9-1.6)	
Age (years)		.06		.10
18-34	Ref		Ref	
35-49	1.2 (0.8-1.9)		0.9 (0.7-1.4)	
50-64	0.8 (0.5-1.2)		1.3 (0.9-1.8)	
≥65	0.7 (0.4-1.2)		1.5 (1.0-2.1)	
Trusting web-based information on cancer		.002		.80
Yes	1.9 (1.3-2.8)		0.9 (0.7-1.3)	
No	Ref		Ref	
Sharing medical information with health care providers		<.001		<.001
Yes	2.1 (1.5-2.9)		0.3 (0.2-0.4)	
No	Ref		Ref	
Owning devices with or without health apps		<.001		<.001
Multiple devices with health apps	2.6 (1.5-4.6)		0.3 (0.2-0.5)	
Multiple devices without health apps	1.5 (0.8-2.7)		0.5 (0.3-0.7)	
Tablet device with health apps	1.7 (0.6-4.5)		0.9 (0.3-2.6)	
Tablet device without health apps	1.6 (0.8-3.3)		0.6 (0.4-0.9)	
Smartphone with health apps	2.0 (0.9-4.0)		0.4 (0.2-0.8)	
Smartphone without health apps	1.3 (0.7-2.4)		0.5 (0.3-0.7)	
Basic cellphone	Ref		Ref	
None	0.7 (0.3-1.4)		1.5 (1.0-2.1)	

[a]N/A: not applicable.

[b]Ref: Reference group for comparison.

Discussion

Principal Findings

High levels of interest in using teledermatology were associated with modifiable behaviors such as the use of devices with health apps, trust in web-based information on cancer, and prior experiences in exchanging health information with physicians on the internet. Sociodemographic factors such as young age, female gender, high education, and high household income were not associated with an increased interest in exchanging images of skin lesions with health care providers after adjusting for these modifiable variables. Future implementation of teledermatology should address these identified factors within the digital divide to provide equitable access to care across diverse patient populations.

Access to devices and how they are used are aspects of the digital divide, which can be adjusted. Physical access to the internet was found to be the most significant predictor of web-based patient-provider communication [9]. Once access is established, usage becomes the rate-limiting factor, which depends on the ability to retrieve and search for information on the internet and to use mobile health apps [11,12]. Users of mobile health apps are more likely to exhibit health-promoting behaviors than those who own similar devices but do not use health apps [11]. A potential barrier to the use of health apps is privacy concerns with inputting personal data into digital devices. Digital health information requires high levels of eHealth literacy to effect action [13]. Mobile device and health app usage is associated with characteristics previously linked to increased eHealth literacy, such as young age, higher education, and high income [7,14]. However, unlike age, education, and income, access and usage of devices can be modified to enhance teledermatology implementation.

Trust in web-based information on cancer can be directed to mediate interest in teledermatology usage. Trust is a necessary antecedent to the development of eHealth literacy and engagement with health information [15,16]. Trust in web-based health information is associated with higher education and the

XSL•FO
RenderX

disclosure of health information on the internet, which are factors linked to eHealth literacy [17]. Even among groups with increased eHealth literacy, young individuals have higher trust in web-based health care services than their older counterparts [18]. Patient trust in a telemedicine service can be broken down into their trust in the organization, treatment, care professional, and technology [19]. Increased trust in the telehealth service can be gained when patients are referred by other health care professionals [20]. Moreover, face-to-face interactions with the provider prior to a web-based consultation also increases patient trust [21]. The provider should ensure that patient concerns are being addressed as this will increase trust in the telehealth provider and the treatment plan [21].

Prior experience in exchanging health information on the internet is an adjustable factor that can be targeted to increase interest in exchanging digital images. Lack of knowledge and experience with web-based patient-provider communication is found to impede its use [9], while prior experience with sharing medical information electronically is associated with higher interest in exchanging digital images with providers [15]. As patients expand their experiences with digital technology within and outside of the health care context, patients will have the opportunity to develop trust in teledermatology services [19].

Teledermatology interventions are implemented and expanded across populations to bridge the digital divide [22]. For example, the US Department of Veteran Affairs has expanded the reach of teledermatology by loaning electronic devices to veterans and provided training in using the devices so that veterans can more easily connect with the existing telehealth networks [23]. They have also attempted to evaluate the effectiveness of these measures through a survey on patient satisfaction with teledermatology use and its contributory factors [24]. Our study found that factors malleable to influence—use of health apps, trust, and experience—are barriers that can be mediated to increase the reach, adoption, and effectiveness of teledermatology.

Limitations

There were some limitations to this study. The cross-sectional nature of the HINTS data precluded the establishment of causal relationships between the usage, trust, and prior experience in using health apps and the interest in teledermatology. The measured outcome was available only in HINTS 4 cycle 4 (2014); more recent data were not available to address the study question. All survey responses were self-reported and subject to information bias. We could not exclude residual confounding variables from additional unmeasured or unexamined variables. We were unable to distinguish the history of skin cancer from that of other cancers when controlling for covariates related to information-seeking behaviors associated with cancer. Interest in exchanging images on the internet might differ if the patient worked with GPs to send images to a teledermatology service or if the service is directly patient-initiated, and this aspect should be examined in future studies. Future studies should explore how well patients and GPs follow teledermatology guidelines on taking adequate images. We were unable to assess if interests in teledermatology translated directly to teledermatology usage or adherence to recommendations from teledermatology services.

Conclusions

In conclusion, modifiable access barriers to teledermatology adoption included experience with exchanging health information on the internet, trust in web-based information on cancer, and the use of mobile health apps. Future implementation of teledermatology should address these identified factors within the digital divide to provide equitable access to care across diverse patient populations.

Acknowledgments

This study was supported in part by the Dermatology Foundation and the National Institute of Arthritis and Musculoskeletal and Skin Diseases (L30 AR076081) (HY). The content of this manuscript is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health or the Department of Veterans Affairs.

Conflicts of Interest

HY previously received an honorarium from Syneos Health.

References

1. Coates SJ, Kvedar J, Granstein RD. Teledermatology: from historical perspective to emerging techniques of the modern era: part I: History, rationale, and current practice. J Am Acad Dermatol 2015 Apr;72(4):563-574. [doi: 10.1016/j.jaad.2014.07.061] [Medline: 25773407]
2. Walocko FM, Tejasvi T. Teledermatology Applications in Skin Cancer Diagnosis. Dermatol Clin 2017 Oct;35(4):559-563. [doi: 10.1016/j.det.2017.06.002] [Medline: 28886813]
3. Hollander JE, Carr BG. Virtually Perfect? Telemedicine for Covid-19. N Engl J Med 2020 Mar 11;382(18):1679-1681. [doi: 10.1056/NEJMp2003539] [Medline: 32160451]
4. Uscher-Pines L, Malsberger R, Burgette L, Mulcahy A, Mehrotra A. Effect of Teledermatology on Access to Dermatology Care Among Medicaid Enrollees. JAMA Dermatol 2016 Aug 01;152(8):905-912. [doi: 10.1001/jamadermatol.2016.0938] [Medline: 27144986]

XSL•FO
RenderX

5. Bashshur RL, Shannon GW, Tejasvi T, Kvedar JC, Gates M. The Empirical Foundations of Teledermatology: A Review of the Research Evidence. Telemed J E Health 2015 Dec;21(12):953-979 [FREE Full text] [doi: 10.1089/tmj.2015.0146] [Medline: 26394022]
6. Kontos E, Blake KD, Chou WS, Prestin A. Predictors of eHealth usage: insights on the digital divide from the Health Information National Trends Survey 2012. J Med Internet Res 2014 Jul 16;16(7):e172 [FREE Full text] [doi: 10.2196/jmir.3117] [Medline: 25048379]
7. Carroll JK, Moorhead A, Bond R, LeBlanc WG, Petrella RJ, Fiscella K. Who Uses Mobile Phone Health Apps and Does Use Matter? A Secondary Data Analytics Approach. J Med Internet Res 2017 Apr 19;19(4):e125 [FREE Full text] [doi: 10.2196/jmir.5604] [Medline: 28428170]
8. Graham AL, Amato MS. Twelve Million Smokers Look Online for Smoking Cessation Help Annually: Health Information National Trends Survey Data, 2005-2017. Nicotine Tob Res 2019 Jan 04;21(2):249-252 [FREE Full text] [doi: 10.1093/ntr/nty043] [Medline: 29660037]
9. Jiang S, Street RL. Factors Influencing Communication with Doctors via the Internet: A Cross-Sectional Analysis of 2014 HINTS Survey. Health Commun 2017 Feb;32(2):180-188. [doi: 10.1080/10410236.2015.1110867] [Medline: 27196037]
10. McKoy K, Antoniotti NM, Armstrong A, Bashshur R, Bernard J, Bernstein D, et al. Practice Guidelines for Teledermatology. Telemed J E Health 2016 Dec;22(12):981-990. [doi: 10.1089/tmj.2016.0137] [Medline: 27690203]
11. Mahmood A, Kedia S, Wyant DK, Ahn S, Bhuyan SS. Use of mobile health applications for health-promoting behavior among individuals with chronic medical conditions. Digit Health 2019;5:2055207619882181 [FREE Full text] [doi: 10.1177/2055207619882181] [Medline: 31656632]
12. Connolly KK, Crosby ME. Examining e-Health literacy and the digital divide in an underserved population in Hawai'i. Hawaii J Med Public Health 2014 Feb;73(2):44-48 [FREE Full text] [Medline: 24567867]
13. Cosco TD, Firth J, Vahia I, Sixsmith A, Torous J. Mobilizing mHealth Data Collection in Older Adults: Challenges and Opportunities. JMIR Aging 2019 Mar 19;2(1):e10019 [FREE Full text] [doi: 10.2196/10019] [Medline: 31518253]
14. Tennant B, Stellefson M, Dodd V, Chaney B, Chaney D, Paige S, et al. eHealth literacy and Web 2.0 health information seeking behaviors among baby boomers and older adults. J Med Internet Res 2015 Mar 17;17(3):e70. [doi: 10.2196/jmir.3992] [Medline: 25783036]
15. Serrano KJ, Yu M, Riley WT, Patel V, Hughes P, Marchesini K, et al. Willingness to Exchange Health Information via Mobile Devices: Findings From a Population-Based Survey. Ann Fam Med 2016;14(1):34-40 [FREE Full text] [doi: 10.1370/afm.1888] [Medline: 26755781]
16. Strekalova YA. When Trust Is Not Enough: A Serial Mediation Model Explaining the Effect of Race Identity, eHealth Information Efficacy, and Information Behavior on Intention to Participate in Clinical Research. Health Educ Behav 2018 Dec;45(6):1036-1042 [FREE Full text] [doi: 10.1177/1090198118757822] [Medline: 29478354]
17. AlGhamdi KM, Moussa NA. Internet use by the public to search for health-related information. Int J Med Inform 2012 Jun;81(6):363-373. [doi: 10.1016/j.ijmedinf.2011.12.004] [Medline: 22217800]
18. Paige SR, Krieger JL, Stellefson ML. The Influence of eHealth Literacy on Perceived Trust in Online Health Communication Channels and Sources. J Health Commun 2017 Jan;22(1):53-65 [FREE Full text] [doi: 10.1080/10810730.2016.1250846] [Medline: 28001489]
19. Velsen LV, Tabak M, Hermens H. Measuring patient trust in telemedicine services: Development of a survey instrument and its validation for an anticoagulation web-service. Int J Med Inform 2017 Jan 01;97:52-58. [doi: 10.1016/j.ijmedinf.2016.09.009] [Medline: 27919395]
20. Van Velsen L, Wildevuur S, Flierman I, Van Schooten B, Tabak M, Hermens H. Trust in telemedicine portals for rehabilitation care: an exploratory focus group study with patients and healthcare professionals. BMC Med Inform Decis Mak 2016 Jan 27;16:11 [FREE Full text] [doi: 10.1186/s12911-016-0250-2] [Medline: 26818611]
21. Almathami HKY, Win KT, Vlahu-Gjorgievska E. Barriers and Facilitators That Influence Telemedicine-Based, Real-Time, Online Consultation at Patients' Homes: Systematic Literature Review. J Med Internet Res 2020 Feb 20;22(2):e16407 [FREE Full text] [doi: 10.2196/16407] [Medline: 32130131]
22. Peracca S, Jackson G, Weinstock M, Oh D. Implementation of Teledermatology: Theory and Practice. Curr Derm Rep 2019 May 2;8(2):35-45. [doi: 10.1007/s13671-019-0252-2]
23. At Home. US Department of Veterans Affairs. 2016. URL: https://telehealth.va.gov/type/home [accessed 2019-12-23]
24. Baranowski MLH, Balakrishnan V, Chen SC. Patient Satisfaction with the Veteran's Administration Teledermatology Service. J Am Acad Dermatol 2019 Jan 28. [doi: 10.1016/j.jaad.2019.01.036] [Medline: 30703451]

Abbreviations

GP: general practitioner
HINTS: Health Information National Trends Survey

XSL•FO
RenderX

Edited by G Eysenbach; submitted 17.06.20; peer-reviewed by H Mehdizadeh, F Kaliyadan; comments to author 08.07.20; revised version received 09.08.20; accepted 17.04.21; published 10.05.21.

Please cite as:
Ghani M, Adler C, Yeung H
Patient Factors Associated with Interest in Teledermatology: Cross-sectional Survey
JMIR Dermatol 2021;4(1):e21555
URL: https://derma.jmir.org/2021/1/e21555
doi:10.2196/21555
PMID:

©Maham Ghani, Colin Adler, Howa Yeung. Originally published in JMIR Dermatology (http://derma.jmir.org), 10.05.2021. This is an open-access article distributed under the terms of the Creative Commons Attribution License (https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work, first published in JMIR Dermatology Research, is properly cited. The complete bibliographic information, a link to the original publication on http://derma.jmir.org, as well as this copyright and license information must be included.

XSL•FO
RenderX

Corrigenda and Addenda

Correction: Association Between State Indoor Tanning Legislation and Google Search Trends Data in the United States From 2006 to 2019: Time-Series Analysis

Carolyn Heckman[1], PhD; Yong Lin[1], PhD; Mary Riley[2], MPH; Yaqun Wang[1], PhD; Trishnee Bhurosy[1], PhD; Anna Mitarotondo[1], BA; Baichen Xu[1], MS; Jerod Stapleton[3], PhD

[1]Rutgers Cancer Institute of New Jersey, New Brunswick, NJ, United States

[2]Medtronic, Denver, CO, United States

[3]University of Kentucky, Lexington, KY, United States

Corresponding Author:
Carolyn Heckman, PhD
Rutgers Cancer Institute of New Jersey
195 Little Albany St
New Brunswick, NJ, 08901
United States
Phone: 1 7322358830
Email: ch842@rutgers.edu

Related Article:

Correction of: https://derma.jmir.org/2021/1/e26707

(JMIR Dermatol 2021;4(1):e29516) doi:10.2196/29516

In "Association Between State Indoor Tanning Legislation and Google Search Trends Data in the United States From 2006 to 2019: Time-Series Analysis" (JMIR Dermatol 2021;4(1):e26707) the authors noted two errors.

Due to a system error, the name of one author, Trishnee Bhurosy, was replaced with the name of another author on the paper, Jerod Stapleton. In the originally published paper, the order of authors was listed as follows:

Carolyn Heckman; Yong Lin; Mary Riley; Yaqun Wang; Jerod Stapleton; Anna Mitarotondo; Baichen Xu; Jerod Stapleton

This has been corrected to:

Carolyn Heckman; Yong Lin; Mary Riley; Yaqun Wang; Trishnee Bhurosy; Anna Mitarotondo; Baichen Xu; Jerod Stapleton

In the originally published paper, the ORCID of author Trishnee Bhurosy was incorrectly published as follows:

Trishnee Bhurosy: 0000-0002-8501-1483

This has been corrected to:

Trishnee Bhurosy: 0000-0003-2603-2839

The correction will appear in the online version of the paper on the JMIR Publications website on April 14, 2021, together with the publication of this correction notice. Because this was made after submission to PubMed, PubMed Central, and other full-text repositories, the corrected article has also been resubmitted to those repositories.

Submitted 09.04.21; this is a non–peer-reviewed article;accepted 09.04.21; published 14.04.21.

Please cite as:
Heckman C, Lin Y, Riley M, Wang Y, Bhurosy T, Mitarotondo A, Xu B, Stapleton J
Correction: Association Between State Indoor Tanning Legislation and Google Search Trends Data in the United States From 2006 to 2019: Time-Series Analysis
JMIR Dermatol 2021;4(1):e29516
URL: https://derma.jmir.org/2021/1/e29516
doi:10.2196/29516
PMID:

XSL•FO
RenderX

©Carolyn Heckman, Yong Lin, Mary Riley, Yaqun Wang, Trishnee Bhurosy, Anna Mitarotondo, Baichen Xu, Jerod Stapleton. Originally published in JMIR Dermatology (http://derma.jmir.org), 14.04.2021. This is an open-access article distributed under the terms of the Creative Commons Attribution License (https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work, first published in JMIR Dermatology Research, is properly cited. The complete bibliographic information, a link to the original publication on http://derma.jmir.org, as well as this copyright and license information must be included.

XSL•FO
RenderX

Original Paper

Content in YouTube Videos for Rosacea: Cross-sectional Study

Corey H Basch[1], MPH, EdD; Priscila E Laforet[2], MPH; Grace C Hillyer[3], MPH, EdD; Erica J Seidel[4], PsyD; Christie Jaime[1], MS

[1]Department of Public Health, William Paterson University, Wayne, NJ, United States
[2]Division of Hematology/Oncology, Department of Medicine, Columbia University Irving Medical Center, New York, NY, United States
[3]Department of Epidemiology, Mailman School of Public Health, Columbia University, New York, NY, United States
[4]Department of Student Life/Counseling Center, Borough of Manhattan Community College, New York, NY, United States

Corresponding Author:
Corey H Basch, MPH, EdD
Department of Public Health
William Paterson University
300 Pompton Rd
Wayne, NJ, 07470
United States
Phone: 1 973 720 2603
Email: baschc@wpunj.edu

Abstract

Background: Rosacea is an inflammatory skin disease that is chronic in nature. In addition to the physical symptoms, there are substantial quality of life issues that patients with rosacea experience, largely due to the visible nature in which rosacea manifests.

Objective: The purpose of this study was to describe the content related to rosacea in highly viewed English- and Spanish-language videos on YouTube.

Methods: We coded identifying information for each video and categories including characteristics of rosacea, clinical solutions, and alternative solutions. The 100 YouTube videos examined were viewed 18.5 million times between 2006 and 2020, and 57.3% (10,652,665/18,592,742) of these views were of consumer videos.

Results: Videos posted by consumers more often promoted or were trying to sell a product or procedure (32/55, 58% of consumers vs 10/31, 32% of medical professionals and 4/14, 29% of television, internet, news, or entertainment sources; P=.03) and more frequently mentioned the use of makeup or other ways to cover up rosacea (30/55, 55% of consumers vs 6/31, 19% of medical professionals and 2/14, 14% of television, internet, news, or entertainment sources; P<.001). Videos sourced from medical professionals more often mentioned medication (17/31, 55%) than videos uploaded by consumers (14/55, 25%) or TV, internet, news, or entertainment sources (3/14, 21%) (P=.01).

Conclusions: Given that rosacea is experienced differently for each person, consumer advice that works for one individual may not work for another. There is a need for reliable videos on rosacea to emphasize this and clarify misconceptions.

(JMIR Dermatol 2021;4(1):e24517) doi:10.2196/24517

KEYWORDS

rosacea; YouTube; social media; skin disease; skin; chronic; dermatology

Introduction

Rosacea is an inflammatory skin disease that is chronic in nature [1]. The cause of rosacea is unknown and the pathophysiology is inadequately comprehended [1]. Current statistics indicate that this is a prevalent problem, with an estimated 416 million adults affected [2] worldwide and an estimated 16 million individuals with rosacea in the United States [3]. Recent research has led to improved understanding of the common triggers and symptomology of this widely experienced issue. Triggers of rosacea include genetic and environmental factors [1], and patients are often encouraged to monitor environmental triggers closely to avoid the onset of symptoms.

The most commonly identifiable symptom of rosacea includes redness or flushing in the face, but the range of symptoms can be variable and are broken down into subtypes. The American Academy of Dermatology has identified 4 subtypes: (1) subtype 1, which is characterized by visible redness, flushing, and blood

XSL•FO
RenderX

vessels; (2) subtype 2, in which acne-like breakouts are common; (3) subtype 3, which is rare and involves thickening skin that can result in rhinophyma, a thickened and bulbous nose; and (4) subtype 4, which affects the eyes with issues ranging from burning and stinging to the development of cysts [4]. It is possible to experience more than one subtype at a time. Naturally, because subtypes are varied and may overlap, treatments are dependent upon related symptoms and patient experiences [5]. These treatments include but are not limited to topical therapies [6-9], antibiotics [10], laser and pulsed light therapies [11-15], and reconstructive surgery [16,17].

In addition to the physical symptoms, there are substantial quality of life issues that patients with rosacea experience, largely due to the visible nature in which rosacea manifests [4]. Much has been written and researched about the medical aspects of rosacea, such as causes, prognosis, and treatment, but the psychological impact of the condition is infrequently discussed and of great importance to those with this condition. With limited ability to control triggers and the lack of a cure, patients are challenged with a lifelong chronic condition that alters their facial appearance, which often impacts their self-esteem and quality of life, especially when the rosacea is severe [18-21].

Current research suggests that 90% of Americans use the internet [22], and many consumers search the web for information related to their health. YouTube is a highly popular medium for sharing information through videos, with an estimated 2 billion unique users [23]. Studies of YouTube are prevalent on a variety of health issues and issues concerning the skin specifically [24-27]. The purpose of this study was to describe the content related to rosacea in highly viewed English- and Spanish-language videos on YouTube.

Methods

The 100 videos with the most views on YouTube were identified using the keyword “rosacea” on May 31, 2020, and were recorded and coded. Videos in English and Spanish were included in the study. Six videos were not reviewed, as they were in a language other than English or Spanish, and they were replaced with the next 6 videos in English or Spanish.

Metadata were identified for each video, including the URL, source of video upload (consumer, medical professional, television- or internet-based news, or entertainment television), number of views, length of video in minutes and seconds, date of upload, language in which the video was recorded, and whether the video featured a medical doctor. A fact sheet from the American Academy of Dermatology was used to create coding categories for content [4]. Categories included characteristics of rosacea, clinical solutions, and alternative solutions.

Characteristics of rosacea included a general description of the condition, triggers and flare-ups of rosacea, the fact that rosacea is more common among women, and the impact of rosacea on the quality of life, such as feelings of frustration, embarrassment, worry, low self-esteem, anxiety, and depression. Mentions by subtype were noted. Specific details of the symptom subtype are noted below. Clinical solutions included mentions of surgery for thickened skin, laser treatment, medication, measures to protect against the sun, a potential cure, and the promotion of products or procedures. Skin care tips and mentions of makeup to cover the skin were included in the alternative solutions category. Responses were coded as “yes” or “no” for whether the video mentioned each of the above characteristics or solutions.

Frequencies and percentages of all categorical variables were calculated, and means, standard deviations, and ranges were determined for the number of views and video length. Video source was recoded as consumer, medical professional, or combined television-based news and entertainment television. Chi-square tests and analysis of variance were used to assess possible associations between video source and the characteristics and content of the videos. Authors EJS and CJ each coded half the videos and then coded a random 10% subset to ascertain interrater reliability. Using Cohen κ (κ=0.92), interrater reliability was shown to be excellent. Because human subjects were not involved in this study, this protocol was not reviewed by an institutional review board, per the policies at William Paterson University and Columbia University.

Results

The 100 YouTube videos examined were viewed 18.5 million times between 2006 and 2020, and 57.3% (10,652,665/18,592,742) of these views were of consumer videos (Table 1).

XSL•FO
RenderX

Table 1. Characteristics of YouTube videos (N=100) about rosacea by video upload source.

Characteristic	Total (N=100)	Consumer (n=55)	Medical professional (n=31)	Television- or internet-based news and entertainment television (n=14)	*P* value
Video characteristics					
Views, n (%)	18,592,742 (100)	10,652,665 (57.3)	5,527,057 (29.2)	2,513,020 (13.5)	N/A[a]
Views, mean (SD)	185,927 (205,020)	193,685 (205,962)	175,066 (210,611)	179,501 (202,362)	.45
Views, range	33,076-1,407,672	40,254-1,407,672	42,443-1,003,575	33,076-782,574	N/A
Video length (min), mean (SD)	10.53 (8.92)	11.45 (8.60)	9.20 (7.53)	9.93 (12.60)	.42
Video length (min), range	0.82-46.17	0.83-46.17	0.82-25.93	1.60-43.32	N/A
Video upload date, n (%)					.15
2006-2010	6 (6.0)	3 (5.5)	2 (6.5)	1 (7.1)	
2011-2015	35 (35.0)	16 (29.1)	10 (32.3)	9 (64.3)	
2016-2020	59 (59.0)	26 (47.3)	19 (61.3)	4 (28.6)	
Language of video, n (%)					.03
English	78 (78.0)	40 (72.7)	29 (93.5)	9 (64.3)	
Spanish	22 (22.0)	15 (27.3)	2 (6.5)	5 (35.7)	
Features a medical professional, n (%)	33 (33.0)	1 (1.8)	27 (87.1)	5 (35.7)	<.001
Characteristics of rosacea, n (%)					
Included general description of rosacea	65 (65.0)	31 (56.4)	22 (71.0)	12 (85.7)	.09
Mentions triggers and flare-ups	52 (52.0)	23 (41.8)	19 (61.3)	10 (71.4)	.07
Mentions rosacea is more common in women	9 (9.0)	5 (9.1)	1 (3.2)	3 (21.4)	.14
Mentions impact on quality of life	30 (30.0)	19 (34.5)	7 (22.6)	4 (28.6)	.51
Mentions subtype 1 signs and symptoms[b]	65 (65.0)	31 (56.4)	22 (71.0)	12 (85.7)	.09
Mentions subtype 2 signs and symptoms[c]	65 (65.0)	30 (54.5)	23 (74.2)	12 (85.7)	.04
Mentions subtype 3 signs and symptoms[d]	33 (33.0)	12 (21.8)	14 (45.2)	7 (50.0)	.03
Mentions subtype 4 signs and symptoms[e]	14 (14.0)	6 (10.9)	3 (9.7)	5 (35.7)	.04
Clinical solutions, n (%)					
Mentions surgery for thickened skin	3 (3.0)	1 (1.8)	0 (0.0)	2 (14.3)	.03
Mentions laser treatment	22 (22.0)	8 (14.5)	11 (35.5)	3 (21.4)	.08
Mentions medication	34 (34.0)	14 (25.5)	17 (54.8)	3 (21.4)	.01
Mentions sun protection	40 (40.0)	17 (30.9)	18 (58.1)	5 (35.7)	.05
Mentions a cure	8 (8.0)	5 (9.1)	1 (3.2)	2 (14.3)	.41
Promotes or sells a product or procedure	46 (46.0)	32 (58.2)	10 (32.3)	4 (28.6)	.03
Alternative solutions, n (%)					
Promotes an alternative treatment	31 (31.0)	17 (30.9)	8 (25.8)	6 (42.9)	.52
Mentions skin care tips	54 (54.0)	32 (58.2)	17 (54.8)	5 (35.7)	.32
Mentions makeup or other ways to cover up rosacea	38 (38.0)	30 (54.5)	6 (19.4)	2 (14.3)	<.001

[a]N/A: not applicable.

[b]Subtype 1 signs and symptoms: flushing and redness, particularly in the center of the face; visible broken blood vessels and spider veins; skin that is swollen, very sensitive, or may sting and burn; rough, dry, or scaling skin; and skin that tends to flush or blush easily.

[c]Subtype 2 signs and symptoms: acne-like breakouts that tend to come and go and are found in the areas where the skin is very red, oily skin or skin that is very sensitive or may sting and burn, visible broken blood vessels and spider veins, and plaques with raised patches of skin.

XSL•FO
RenderX

[d]Subtype 3 signs and symptoms: bumpy skin or skin that begins to thicken, particularly on the nose, chin, forehead, cheeks, and ears; visible broken blood vessels and spider veins; oily skin; and large pores.

[e]Subtype 4 signs and symptoms: rosacea in the eyes where the eyes appear watery or bloodshot, feel gritty, burn or sting, itch, or are dry and sensitive to light; blurry or decreased vision; and visible broken blood vessels or a cyst on the eyelid.

The mean number of views was 185,927 (SD 205,020), and the mean length of the videos was 10.53 minutes (SD 8.92 minutes). Most videos were uploaded between 2016 and 2020 (59/100, 59.0%), recorded in English (78/100, 78.0%), and did not feature a medical professional (67/100, 67.0%).

Consumer videos less often mentioned signs and symptoms of subtypes 2 and 3 (subtype 2: 30/55, 55% of consumers vs 23/31, 74% of medical professionals and 12/14, 86% of television or internet; P=.04; subtype 3: 12/55, 22% of consumers vs 14/31, 45% of medical professionals and 7/14, 50% of television or internet; P=.03). Videos posted by consumers, however, more often promoted or were trying to sell a product or procedure (32/55, 58% of consumers vs 10/31, 32% of medical professionals and 4/14, 29% of television, internet, news, or entertainment; P=.03) and more frequently mentioned the use of makeup or other ways to cover up rosacea (30/55, 55% of consumers vs 6/31, 19% of medical professionals and 2/14, 14% of television, internet, news, or entertainment; P<.001). Videos sourced from medical professionals more often mentioned medication (17/31, 55%) than videos uploaded by consumers (14/55, 25%) or television, internet, news, or entertainment sources (3/14, 21%) (P=.01). Videos uploaded from a television, internet, news, or entertainment source more often mentioned subtype 4 (5/14, 36% vs 6/55, 11% of consumers and 3/31, 10% of medical professionals; P=.04) and surgical treatments for thickened skin (2/14, 14%) compared with consumer (1/55, 2%) and medical professional (0/0, 0%) videos (P=.03).

Discussion

To our knowledge, this is the first study to examine the content of both English and Spanish rosacea videos on YouTube. The majority of the 100 most popular rosacea YouTube videos were uploaded by consumers. Thus, medical professionals should be aware that consumer opinions and thoughts on rosacea are accessed more often than professional materials. The type of information presented in the videos analyzed also varied depending on the source. Videos sourced from medical professionals were most likely to mention information on medication and the use of sun protection as treatments for rosacea, while videos sourced from consumers were most likely to mention information on alternative treatments like the use of makeup to cover up rosacea. Research indicates that cosmetics can exacerbate rosacea [28-30], and as such, the prevalent makeup tutorials related to covering rosacea could be promoting products that cause flares. In addition, rather than focusing on avoiding triggers, this content focused on hiding symptoms.

Within the context of the connection between self-esteem and body image [31], research is delving further into rosacea's social and emotional fallout. Patients may avoid social situations, retreat from relationships, or think negatively about themselves as a result of their symptoms. An increase in symptoms of depression and anxiety related to the severity of the rosacea have been reported [19]. Women are more likely to be diagnosed with rosacea, exacerbating the gaps in self-esteem that already exist between men and women [32], suggesting that, for women, a holistic approach to treating the condition may be warranted to affect both the psychological and physical manifestations of the disease [33].

Further, the videos sourced from consumers were also found to be the most likely to include information to sell a product. This discovery highlights that consumers may have various underlying motivations to upload videos on rosacea, such as commercial sponsorship, which might result in the communication of misinformation to increase sales of a sponsored product to treat rosacea. Analysis of the videos revealed that the accuracy and reliability of the information found in the videos varied greatly. This is best highlighted by the videos that included information on a cure despite the fact that there is no cure for rosacea. The findings of this study are similar to a prior study of rosacea on a variety of internet sources, including YouTube videos, which concluded that internet sources could contain peer-generated content that was harmful or misleading [34].

This study has limitations that warrant mention. The cross-sectional design indicates that data were only collected at one point in time, and given the fact that content on the internet is in flux, the most popular videos could change over time. Additionally, this study only included videos in English and Spanish despite videos being available in an array of languages. Further, there is no way to delineate who viewed each video and the reason they did so. Therefore, the study strictly offers insight on the content and coverage of information in the widely viewed videos on YouTube.

Nonetheless, this study offers insight into the content available on YouTube about rosacea. Given that rosacea is experienced differently for each person, consumer advice that works for one individual may not work for another. There is a need for reliable videos on rosacea to emphasize this and clarify misconceptions. Further study is needed on the accuracy and reliability of information on rosacea in videos sourced by consumers, as well as on the factors that influence consumers to create and upload videos on rosacea for YouTube.

Conflicts of Interest

None declared.

References

XSL•FO
RenderX

1. Buddenkotte J, Steinhoff M. Recent advances in understanding and managing rosacea. F1000Res 2018;7:1885 [FREE Full text] [doi: 10.12688/f1000research.16537.1] [Medline: 30631431]
2. Gether L, Overgaard L, Egeberg A, Thyssen J. Incidence and prevalence of rosacea: a systematic review and meta-analysis. Br J Dermatol 2018 Aug;179(2):282-289. [doi: 10.1111/bjd.16481] [Medline: 29478264]
3. National Rosacea Society. Rosacea now estmated to affect at least 16 million Americans. Rosacea Review. 2010. URL: https://www.rosacea.org/rosacea-review/2010/winter/rosacea-now-estimated-to-affect-at-least-16-million-americans [accessed 2020-09-15]
4. Rosacea: signs and symptoms. American Academy of Dermatology Association. 2020. URL: https://www.aad.org/public/diseases/rosacea/what-is/symptoms [accessed 2020-09-21]
5. Johnson SM, Berg A, Barr C. Managing Rosacea in the Clinic: From Pathophysiology to Treatment-A Review of the Literature. J Clin Aesthet Dermatol 2020 Apr;13(Suppl 4):S17-S22 [FREE Full text] [Medline: 32802248]
6. Stein L, Kircik L, Fowler J, Tan J, Draelos Z, Fleischer A, et al. Efficacy and safety of ivermectin 1% cream in treatment of papulopustular rosacea: results of two randomized, double-blind, vehicle-controlled pivotal studies. J Drugs Dermatol 2014 Mar;13(3):316-323. [Medline: 24595578]
7. Taieb A, Khemis A, Ruzicka T, Barańska-Rybak W, Berth-Jones J, Schauber J, Ivermectin Phase III Study Group. Maintenance of remission following successful treatment of papulopustular rosacea with ivermectin 1% cream vs. metronidazole 0.75% cream: 36-week extension of the ATTRACT randomized study. J Eur Acad Dermatol Venereol 2016 May;30(5):829-836. [doi: 10.1111/jdv.13537] [Medline: 26691278]
8. Fowler J, Jarratt M, Moore A, Meadows K, Pollack A, Steinhoff M, Brimonidine Phase II Study Group. Once-daily topical brimonidine tartrate gel 0·5% is a novel treatment for moderate to severe facial erythema of rosacea: results of two multicentre, randomized and vehicle-controlled studies. Br J Dermatol 2012 Mar;166(3):633-641 [FREE Full text] [doi: 10.1111/j.1365-2133.2011.10716.x] [Medline: 22050040]
9. Del Rosso JQ. Topical a-Agonist Therapy for Persistent Facial Erythema of Rosacea and the Addition of Oxmetazoline to the Treatment Armamentarium: Where Are We Now? J Clin Aesthet Dermatol 2017 Jul;10(7):28-32 [FREE Full text] [Medline: 29104721]
10. Del Rosso JQ, Leyden JJ, Thiboutot D, Webster GF. Antibiotic use in acne vulgaris and rosacea: clinical considerations and resistance issues of significance to dermatologists. Cutis 2008 Aug;82(2 Suppl 2):5-12. [Medline: 18924545]
11. Al-Niaimi F, Glagoleva E, Araviiskaia E. Pulsed dye laser followed by intradermal botulinum toxin type-A in the treatment of rosacea-associated erythema and flushing. Dermatol Ther 2020 Nov;33(6):e13976. [doi: 10.1111/dth.13976] [Medline: 32633449]
12. Papageorgiou P, Clayton W, Norwood S, Chopra S, Rustin M. Treatment of rosacea with intense pulsed light: significant improvement and long-lasting results. Br J Dermatol 2008 Sep;159(3):628-632. [doi: 10.1111/j.1365-2133.2008.08702.x] [Medline: 18565174]
13. Larson AA, Goldman MP. Recalcitrant rosacea successfully treated with multiplexed pulsed dye laser. J Drugs Dermatol 2007 Aug;6(8):843-845. [Medline: 17763618]
14. Tirico M, Jensen D, Green C, Ross E. Short pulse intense pulsed light versus pulsed dye laser for the treatment of facial redness. J Cosmet Laser Ther 2020 Mar 17;22(2):60-64. [doi: 10.1080/14764172.2020.1717540] [Medline: 32041440]
15. Kawana S, Ochiai H, Tachihara R. Objective evaluation of the effect of intense pulsed light on rosacea and solar lentigines by spectrophotometric analysis of skin color. Dermatol Surg 2007 Apr;33(4):449-454. [doi: 10.1111/j.1524-4725.2007.33092.x] [Medline: 17430379]
16. Saad M, Matteucci P. A very severe case of rhinophyma requiring a three-stage reconstruction with a forehead flap. Ann R Coll Surg Engl 2020 Oct;102(8):e219-e222. [doi: 10.1308/rcsann.2020.0164] [Medline: 32808811]
17. Kang JK, Lee JS, Choi JH, Shin MS, Yun BM. Surgical treatment of rhinophyma using an ordinary bur. Arch Craniofac Surg 2020 Aug;21(4):264-267 [FREE Full text] [doi: 10.7181/acfs.2020.00199] [Medline: 32867419]
18. Baldwin HE, Harper J, Baradaran S, Patel V. Erythema of Rosacea Affects Health-Related Quality of Life: Results of a Survey Conducted in Collaboration with the National Rosacea Society. Dermatol Ther (Heidelb) 2019 Dec;9(4):725-734 [FREE Full text] [doi: 10.1007/s13555-019-00322-5] [Medline: 31512178]
19. Egeberg A, Hansen PR, Gislason GH, Thyssen JP. Patients with Rosacea Have Increased Risk of Depression and Anxiety Disorders: A Danish Nationwide Cohort Study. Dermatology 2016;232(2):208-213. [doi: 10.1159/000444082] [Medline: 26954304]
20. Bewley A, Fowler J, Schöfer H, Kerrouche N, Rives V. Erythema of Rosacea Impairs Health-Related Quality of Life: Results of a Meta-analysis. Dermatol Ther (Heidelb) 2016 Jun;6(2):237-247 [FREE Full text] [doi: 10.1007/s13555-016-0106-9] [Medline: 26983751]
21. Bewley A, Fowler J, Schöfer H, Kerrouche N, Rives V. Erythema of Rosacea Impairs Health-Related Quality of Life: Results of a Meta-analysis. Dermatol Ther (Heidelb) 2016 Jun;6(2):237-247 [FREE Full text] [doi: 10.1007/s13555-016-0106-9] [Medline: 26983751]
22. Anderson M, Perrin A, Jiang J, Kumar M. 10% of Americans don't use the internet. Who are they? Pew Research Center. 2019 Apr 22. URL: https://www.pewresearch.org/fact-tank/2019/04/22/some-americans-dont-use-the-internet-who-are-they/ [accessed 2020-09-16]

XSL•FO
RenderX

23. YouTube for Press. YouTube. URL: https://www.youtube.com/about/press/ [accessed 2020-08-23]
24. Basch CH, Basch CE, Hillyer GC, Reeves R. YouTube Videos Related to Skin Cancer: A Missed Opportunity for Cancer Prevention and Control. JMIR Cancer 2015 Mar 02;1(1):e1 [FREE Full text] [doi: 10.2196/cancer.4204] [Medline: 28410167]
25. Basch CH, Brown AA, Fullwood MD, Clark A, Fung IC, Yin J. YouTube as a source of information on skin bleaching: a content analysis. Clin Exp Dermatol 2018 Jun;43(4):399-403. [doi: 10.1111/ced.13335] [Medline: 29265426]
26. Li W, Ma JE, Chan AA, Lee DJ, Smogorzewski J. Hidradenitis suppurativa through the lens of YouTube: a cross-sectional analysis [online ahead of print]. J Am Acad Dermatol 2020 Jun 06. [doi: 10.1016/j.jaad.2020.05.148] [Medline: 32522514]
27. St Claire KM, Rietcheck H, Patel R, Dunnick C, Dellavalle R. Dermatology on YouTube - an update and analysis of new trends. Dermatol Online J 2018 Dec 15;24(12):13030 [FREE Full text] [Medline: 30677792]
28. Mandal A. Rosacea and cosmetics (make-up). News Medical and Life Sciences. 2019. URL: https://www.news-medical.net/health/Rosacea-and-Cosmetics-(Make-Up).aspx#:~:text=Rosacea%20sufferers%20tend%20to%20have,and%20stinging%20of%20the%20face [accessed 2020-09-21]
29. Jappe U, Schnuch A, Uter W. Rosacea and contact allergy to cosmetics and topical medicaments--retrospective analysis of multicentre surveillance data 1995-2002. Contact Dermatitis 2005 Feb;52(2):96-101. [doi: 10.1111/j.0105-1873.2005.00514.x] [Medline: 15725288]
30. Diepgen T, Weisshaar E. Contact dermatitis: epidemiology and frequent sensitizers to cosmetics. J Eur Acad Dermatol Venereol 2007 Sep;21(Suppl 2):9-13. [doi: 10.1111/j.1468-3083.2007.02381.x] [Medline: 17716286]
31. Clay D, Vignoles VL, Dittmar H. Body Image and Self-Esteem Among Adolescent Girls: Testing the Influence of Sociocultural Factors. J Res Adolescence 2005 Nov;15(4):451-477. [doi: 10.1111/j.1532-7795.2005.00107.x]
32. Stapleton P, Crighton GJ, Carter B, Pidgeon A. Self-esteem and body image in females: The mediating role of self-compassion and appearance contingent self-worth. Humanistic Psychol 2017 Sep;45(3):238-257. [doi: 10.1037/hum0000059]
33. Huynh TT. Burden of Disease: The Psychosocial Impact of Rosacea on a Patient's Quality of Life. Am Health Drug Benefits 2013 Jul;6(6):348-354 [FREE Full text] [Medline: 24991368]
34. Riddoch LH. It takes one to know one: exploring patient dialogue on rosacea web-based platforms and their potential for significant harm. J Dermatolog Treat 2019 Feb;30(1):52-62. [doi: 10.1080/09546634.2018.1468067] [Medline: 29676186]

Edited by G Eysenbach; submitted 22.09.20; peer-reviewed by P Kumar, P Pan; comments to author 30.10.20; revised version received 31.10.20; accepted 15.01.21; published 10.02.21.

Please cite as:
Basch CH, Laforet PE, Hillyer GC, Seidel EJ, Jaime C
Content in YouTube Videos for Rosacea: Cross-sectional Study
JMIR Dermatol 2021;4(1):e24517
URL: http://derma.jmir.org/2021/1/e24517/
doi:10.2196/24517
PMID:

©Corey H Basch, Priscila E Laforet, Grace C Hillyer, Erica J Seidel, Christie Jaime. Originally published in JMIR Dermatology (http://derma.jmir.org), 10.02.2021. This is an open-access article distributed under the terms of the Creative Commons Attribution License (https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work, first published in JMIR Dermatology Research, is properly cited. The complete bibliographic information, a link to the original publication on http://derma.jmir.org, as well as this copyright and license information must be included.

XSL•FO
RenderX

Original Paper

Public Interest in a Potentially Harmful, Non–Evidence-Based "Wellness" Practice: Cross-Sectional Analysis of Perineum Sunning

Ryan Ottwell[1*], BS; Micah Hartwell[1*], PhD; Tracy Beswick[2*], MD, PhD; Taylor Calli Rogers[1*], BS; Heather Ivy[3*], DO; Marcus Goodman[4*], DO; Matt Vassar[1], PhD

[1]Oklahoma State University Center for Health Sciences, Tulsa, OK, United States
[2]Center for Dermatology, Tulsa, OK, United States
[3]Philadelphia College of Osteopathic Medicine, Roswell, GA, United States
[4]Goodman Dermatology, Roswell, GA, United States
[*]these authors contributed equally

Corresponding Author:
Ryan Ottwell, BS
Oklahoma State University Center for Health Sciences
1111 W 17th Street
Tulsa, OK, 74017
United States
Phone: 1 918 582 1972
Email: ryan.ottwell@okstate.edu

Abstract

Background: Perineum sunning/tanning is a potentially harmful yet popular new health trend cultivated by a viral social media post, famous public figures, and subsequent media coverage.

Objective: Our primary objective is to evaluate public interest in perineum sunning/tanning.

Methods: Using an observational study design, we extracted data from Google Trends for the terms "perineum sunning," "perineum tanning," "Metaphysical Meagan," and "Josh Brolin"; and Twitter (via SproutSocial) for "perineum sunning" and "perineum tanning" from November 1, 2019, to December 31, 2019. UberSuggest was used to investigate monthly search volumes and user engagement. We used data from Google Trends and Twitter to construct autoregressive integrated moving average (ARIMA) models to forecast public interest in perineum sunning and perineum tanning had the post on social media never occurred. Next, we performed an integral function to calculate the cumulative increase in "perineum tanning" from the day after the post occurred to the end of the year as the area between the forecasted values and the actual values. Using Welch *t* tests, we compared forecasted and actual values for "perineum sunning" and "perineum tanning" using Twitter and Google Trends data over 1-, 2-, and 4-week periods after the social media post to determine if the increased volumes were statistically significant over time. Lastly, we monitored Google Trends for "perineum sunning" and "perineum tanning" through September 30, 2020, to capture trends during the summer months.

Results: Before the Instagram post went viral, there was no search interest in perineum sunning. ARIMA modeling for perineum tanning forecasted no increase in searches (0.00) if the post had not gone viral, while actual interest conveyed a relative cumulative increase of 919.00% from the day the post went viral through December 31, 2020. The term "perineum sunning" was mentioned on average 804 (SD 766.1) times daily for this 7-day period, which was also significantly higher than predicted ($P \leq .03$), totaling 5628 tweets for these 7 days. The increased volume of tweets and relative search interest from Google Trends remained significantly higher for both terms over the 1-, 2-, and 4-week intervals. User engagement showed that nearly 50% of people who searched for "perineum sunning" were likely to click a returned link for more information. Continued observance of search interest in perineum sunning demonstrated interest spikes in the summer months, June and July 2020.

Conclusions: Google Trends and Twitter data demonstrated that one social media post claiming non–evidence-based health benefits of regular sun exposure—without the use of sunscreen—generated significant public interest. Medical journals, dermatologists, and other health care professionals are obligated to educate and correct public misperceptions about viral wellness trends such as perineum sunning.

XSL•FO
RenderX

(JMIR Dermatol 2021;4(1):e24124) doi:10.2196/24124

KEYWORDS

general dermatology; perineum sunning; perineum tanning; skin neoplasm; public health; social media; infodemiology; public interest; Google Trends; Twitter

Introduction

Social media may positively affect health behaviors or propagate potentially harmful health information [1,2]. On October 21, 2019, posts on the social media platform Instagram boasted that perineum sunning would improve focus, augment hormonal regulation, increase libido, regulate circadian rhythm, and enhance health and longevity. These posts claimed that only 30 seconds of perineum sunning was equivalent to one day's worth of sun exposure while also recommending against sunscreen use when perineum sunning [3]. The original post went viral in late November via Twitter, and again in December after well-known actor Josh Brolin received media coverage for the severe sunburn to his anogenital area after attempting perineum sunning.

Given the high potential for sunburns and cutaneous cancers resulting from this practice, our primary objective was to investigate the effects of social media and news coverage of perineum sunning on public interest by examining internet search volume, trends, and engagement, using publicly available data. A more informed understanding of the influence of social media on public search interest in potentially harmful practices like perineum sunning may assist dermatologists and medical journals when developing social media strategies to directly combat medical misinformation.

Methods

Google Trends [4] was used to collect daily relative search interest from November 1, 2019, to December 31, 2019, for "perineum sunning," "perineum tanning," "Metaphysical Meagan" (the Instagram user who published the original post), and "Josh Brolin" (who appeared in news stories on December 3, 2019, after getting a severe sunburn while performing this practice). Search interest from Google Trends is provided as a relative measure of total searches from 0-100 estimated from the highest peak within a given time frame. To explore public interest beyond Google Trends, we performed keyword searches for "perineum sunning" and "perineum tanning" occurring on Twitter via SproutSocial [5], a social media analytics platform. We also used UberSuggest [6] to collect monthly internet search volumes and user engagement (defined as a person clicking on the links returned from the search) for the terms "perineum sunning" and "perineum tanning."

Using Google Trends and Twitter data, we constructed autoregressive integrated moving average (ARIMA) models to forecast predicted values of relative search interest and tweets for the terms "perineum sunning" and "perineum tanning" from November 25, 2019, to the end of the year if the post on social media had not occurred. Next, we calculated the average number of tweets and Google Trends relative search interest for the terms "perineum sunning" and "perineum tanning," and using Welch's *t* tests, compared them to their respective forecasted values over 1-, 2-, and 4-week periods after the social media post to assess if the increased volumes were statistically significant over time. Using an integral function, we calculated the cumulative area between the forecasted baseline and the actual relative search interest data to provide the relative increased search interest through December 31, 2019, for "perineum sunning" from Google Trends. Lastly, Google Trends was monitored for the terms "perineum sunning" and "perineum tanning" through September 30, 2020, to capture public interest trends during the summer months. All analyses were conducted in R, version 3.2.1 (The R Foundation).

Results

Relative search interest for the four search terms through the end of 2019 are compared in Figure 1.

Based on the first 24 days of November, the ARIMA model forecasted that no interest (0.0) would have arisen in "perineum sunning" for the rest of the year if the social media post had not happened.

Relative search interest for perineum sunning and perineum tanning peaked the day after the social media post went viral. Keyword usage on Twitter showed that tweets significantly increased the day following the post with an increase of 2064 (95% CI 2054-2074) tweets over the predicted value (1) for perineum sunning. For the first 7 days after the post went viral, actual search interest for perineum sunning and perineum tanning were on average 42% (SD 33.0) and 43.6% (SD 35.9) higher than predicted, respectively. Additionally, the term "perineum sunning" was mentioned on average 804 (SD 766.1) times daily for this 7-day period, which was also significantly higher than predicted ($P \leq .03$), totaling 5628 tweets for these 7 days. The increased volume of tweets and relative search interest from Google Trends remained significantly higher for both terms over the 1-, 2-, and 4-week intervals (Table 1).

XSL•FO
RenderX

Figure 1. Google Trends analysis of the terms "perineum sunning," "perineum tanning," "Metaphysical Meagan," and "Josh Brolin," from November 1 to December 31, 2019.

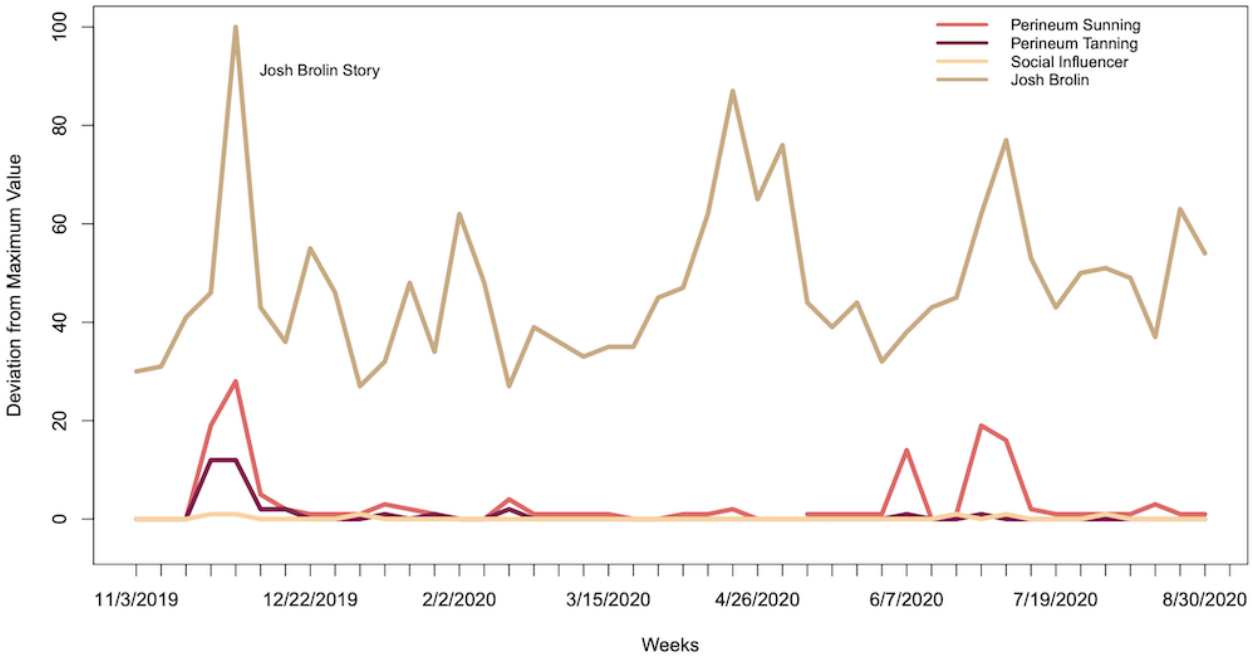


Table 1. Differences of means between actual and forecasted data from 1, 2, and 4 weeks after the social media post.

Search term	7 days			14 days			28 days		
	Forecast, mean (SD)	Actual, mean (SD)	*t* test (*df*=6); *P* value	Forecast, mean (SD)	Actual, mean (SD)	*t* test (*df*=13); *P* value	Forecast, mean (SD)	Actual, mean (SD)	*t* test (*df*=27); *P* value
Google Trends									
Perineum sunning[a] (%)	0 (0)	42.0 (33.0)	–4.2; .001	0 (0)	37.3 (32.4)	–4.3; <.001	0 (0)	21.2 (27.9)	–4.0; <.001
Perineum tanning[a] (%)	0 (0)	43.6 (35.9)	–3.2; .02	0 (0)	49.2 (31.3)	–5.9; <.001	0 (0)	30.6 (29.2)	–5.5; <.001
Twitter									
Perineum sunning[b]	2.8 (7.52)	804.1 (766.1)	–2.8; .03	1.4 (5.3)	573.4 (630.5)	–3.4; .004	0.7 (3.8)	299.2 (519.1)	–3.0; .005
Perineum tanning[b]	0.1 (0.0)	36.1 (37.4)	–2.5; .04	0.1 (0)	27.8 (28.4)	–3.6; .003	0.1(0)	15.0 (23.7)	–3.3; .002

[a]Data reflects average daily relative search interest (0%-100%).

[b]Data reflects average daily number of actual tweets.

The area under the curve (shaded in Figure 2) for "perineum tanning" indicated a cumulative increased interest of 919.00% from the day the post went viral to the end of the year.

Monthly search volumes from UberSuggest show no search interest in "perineum sunning" or "perineum tanning" before the post went viral on November 25, 2019. After the post, search volumes for the search terms "perineum sunning" and "perineum tanning" increased from 0 in October to a combined 52,599 searches for the remaining days in November and climbed to 67,598 searches in December. User engagement showed that nearly half of the individuals who searched for "perineum sunning" or "perineum tanning" were likely to click a returned link for more information. Search trends for perineum sunning showed additional spikes in the week of June 6 (29% of the original search interest peak), June 28 (60% of the original search interest peak), and July 5 (50% of the original search interest peak) (Figure 3).

XSL•FO
RenderX

Figure 2. ARIMA (autoregressive integrated moving average)-forecasted trend of "perineum tanning" from November 25 to December 31, 2019 (blue), and actual search trends (green) with the shaded area showing the cumulative area of increase.

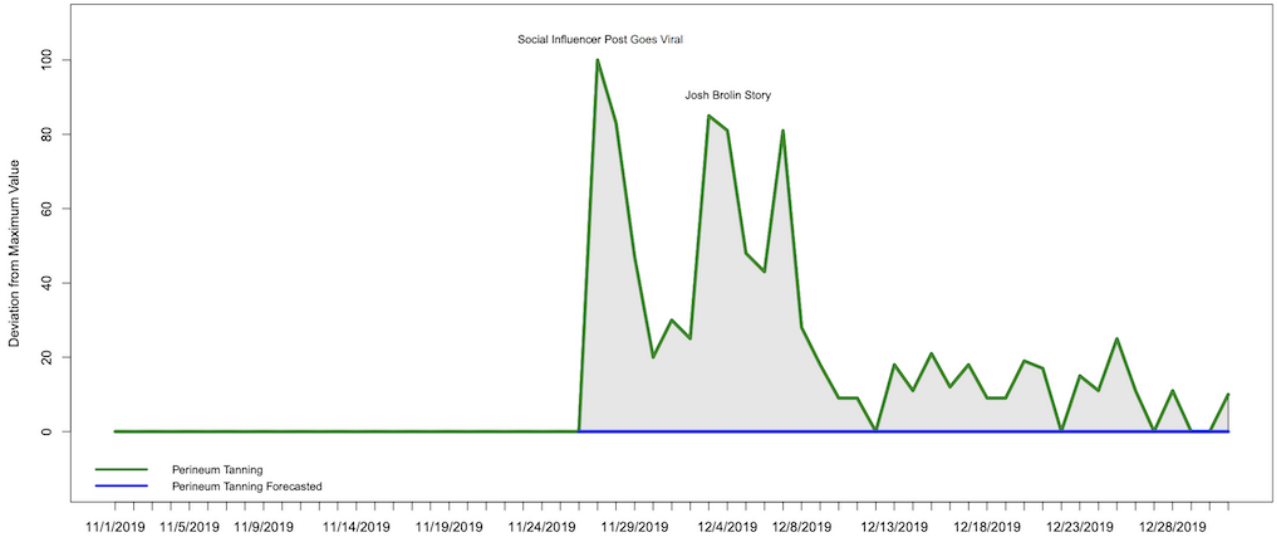
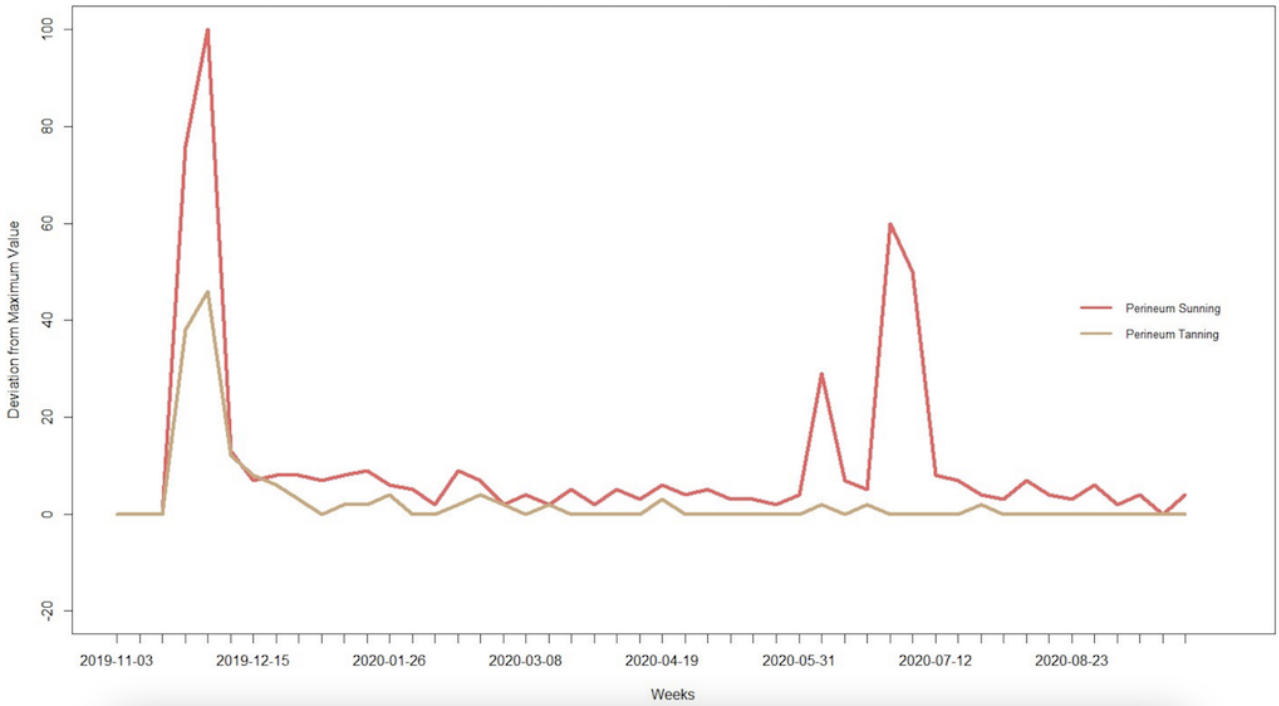


Figure 3. Google Trends analysis of the terms "perineum sunning" and "perineum tanning" from November 1 to September 30, 2020.



Discussion

Principal Findings

Our results show that one Instagram post, a subsequent viral tweet, and mainstream media coverage generated significant interest in perineum sunning. This new proposed health trend appeared in over 250 articles from numerous media outlets, which spurred others to engage in the behavior. For example, actor Josh Brolin attempted perineum sunning, which resulted in a severe sunburn to his anogenital area. Other iconic figures such as the famous American music producer Diplo, popular health author and entrepreneur Dave Aspery, and American actress Shailene Woodley have all shared their experience of perineum sunning through news media. Despite being deemed a "wellness" technique, the mainstream attention garnered by perineum sunning could lead to harmful health consequences.

Our trends analysis demonstrates continued public search interest in "perineum sunning" and "perineum tanning" for almost a year since the original post on October 21, 2019. Continued search interest in perineum sunning showed a resurgence during the summer months. This finding is concerning because UV exposure increases during the summer, and the solar radiation during these months has the greatest intensities of UV-B [7]. Additionally, Tripathi et al [8] found an increase in the prevalence and costs associated with sunburn-related emergency department visits, especially during

XSL•FO
RenderX

the months of June, July, and August. While this study did not explore intent to act, if increased search interest during these summer months resulted in more people attempting this practice, they would be exposing themselves to more dangerous levels of UV radiation. While unsure why other spikes of public interest in perineum sunning occurred, we speculate that continued interest is being generated through social media platforms and ongoing news media coverage. Regardless of the reasons for the increased interest, our study suggests that people are continuing to search for perineum sunning, which may lead to higher rates of cutaneous malignancies and poorer health outcomes if more people attempt this unsafe wellness trend.

Exposure of skin to the UV rays present in sunlight has acute and chronic effects that can occur at doses of UV light that are nonerythemogenic. Short-term effects are sunburn (ranging from solar erythema to vesiculation/bullae formation) and tanning. Long-term effects include photoaging and UV-induced tumor formation [9,10]. It is well known that UV exposure is the most obvious risk factor for cutaneous malignancies such as melanoma, basal cell carcinoma, and squamous cell carcinoma [11]. To make matters worse, melanomas in less visible areas, such as the buttocks and perineum, have worse prognosis independent of tumor characteristics and visibility on self-skin examinations [10]. Furthermore, perineum skin is still vulnerable to risk of sunburn and, over time, cancer formation. To our knowledge, no study has shown perineal skin to have a special ability to generate more vitamin D production than other areas of the skin, nor is there any human evidence that sunning this specific area promotes positive changes in mood, increases libido, and improves regulation of hormones or circadian rhythm. Promotion of health misinformation, such as perineum sunning, via social media is quickly becoming a public health threat.

Non–evidence-based health trends and medical misinformation originating on social media are recognized challenges with serious public health implications (eg, antivaccination campaigns), which can place a significant burden on medical professionals and health care systems in one day, as our results show. Protecting the value of accurate medical information is of utmost importance as science and health information can be strategically manipulated by social media while perpetuating misinformation [12]. Strategies to combat the spread of misinformation require a collaborative approach involving medical journals, researchers, and physicians [13]. Doctors and health care professionals are encouraged to use social media platforms—the source of the majority of misinformation—as educational tools to promote accurate medical information and protect the integrity of online health information [14].

Along with health care professionals, journals must also be proactive in coordinating efforts to address public health misinformation that may harm the general public. We agree with Armstrong et al [15] and recommend journals publish articles with the intention of educating and redirecting public behavior at pertinent times when widespread dissemination of health misinformation has occurred. The *Journal of Medical Internet Research*, and its sister journal *JMIR Dermatology*, are two examples of journals that seem to be dedicated to publishing research focused on combating medical misinformation and raising awareness concerning the quality of health information on the internet [1,16-19]. For example, one study recently published by *JMIR Dermatology* evaluated the quality of sun-protection information by examining the most popular YouTube videos covering sunscreen [16]. Here the authors concluded that content about sunscreen use was often negative or failed to include important sunscreen use recommendations. Low-quality information surrounding sunscreen use, coupled with our study's results, further demonstrates the need for a collaborative approach to combat medical misinformation, especially in risky sun behaviors.

Limitations

Our study is limited by its cross-sectional design and should not be generalized. While Google Trends has been used to examine increased public interest and subsequent actions [20,21], our study did not determine intent. Therefore, future research in social media health trends may consider collecting participant surveys of *intent to act* after viewing the post. Lastly, by using Google Trends, we could only calculate relative search volumes.

Conclusion

Our findings suggest that it took only 24 hours for a potentially dangerous "health" trend to capture the spotlight of mainstream media outlets—an alarming exposé in the power of social media concerning perineum sunning. Additionally, continued observance of the search interest in perineum sunning showed a resurgence during the summer months. Exposure to sunlight is dangerous, and sensitive areas such as the perineum have worse prognosis even when detected during skin examinations. Dermatologists and physicians in other fields of medicine should be aware of perineum sunning and should consider that its popularity may warrant additional inquiry about sun exposure and tanning during patient encounters.

Acknowledgments

MV is funded through the US Department of Health and Human Services Office of Research Integrity and the Oklahoma Center for the Advancement of Science and Technology.

Conflicts of Interest

None declared.

References

XSL•FO
RenderX

1. Park M, Sun Y, McLaughlin ML. Social Media Propagation of Content Promoting Risky Health Behavior. Cyberpsychol Behav Soc Netw 2017 May;20(5):278-285. [doi: 10.1089/cyber.2016.0698] [Medline: 28498046]
2. Smailhodzic E, Hooijsma W, Boonstra A, Langley DJ. Social media use in healthcare: A systematic review of effects on patients and on their relationship with healthcare professionals. BMC Health Serv Res 2016 Aug 26;16(1):442 [FREE Full text] [doi: 10.1186/s12913-016-1691-0] [Medline: 27562728]
3. Groth L. So, Perineum Sunning is a Thing Now—Here's Why Doctors Definitely Don't Want You to Try It. Health. 2020 Feb 2. URL: https://www.health.com/mind-body/perineum-butt-sunning-wellness-trend [accessed 2020-02-09]
4. Google Trends. URL: https://trends.google.com/trends/?geo=US [accessed 2020-12-06]
5. Sprout Social. Social Media Management Solutions. URL: https://sproutsocial.com/?utm_source=google&utm_medium=cpc&utm_campaign=US_Brand_Sprout_Social_Phrase&utm_content=Brand_Sprout_Social_Brand_Name_Phrase&utm_term=sprout%20social&creative=436167110791&AdExtension=&Location=9026132&Matchtype=p&Device=c&gclid=Cj0KCQiA2af-BRDzARIsAIVQUOed2uHkbfe9oM6Uduxsl2WoLScsTHXwOJ6YBbnDOhIPqmelDYMZf7UaAm1nEALw_wcB&gclsrc=aw.ds [accessed 2020-12-04]
6. Ubersuggest. URL: https://app.neilpatel.com/en/ubersuggest [accessed 2020-12-06]
7. Scotto J, Nam J. Skin melanoma and seasonal patterns. Am J Epidemiol 1980 Mar;111(3):309-314. [doi: 10.1093/oxfordjournals.aje.a112902] [Medline: 7361755]
8. Tripathi R, Mazmudar RS, Knusel KD, Ezaldein HH, Bordeaux JS, Scott JF. Trends in emergency department visits due to sunburn and factors associated with severe sunburns in the United States. Arch Dermatol Res 2020 Apr 09. [doi: 10.1007/s00403-020-02073-2] [Medline: 32274574]
9. Howard MD, Wee E, Wolfe R, McLean CA, Kelly JW, Pan Y. Anatomic location of primary melanoma: Survival differences and sun exposure. J Am Acad Dermatol 2019 Aug;81(2):500-509. [doi: 10.1016/j.jaad.2019.04.034] [Medline: 31009667]
10. Gordon D, Hansson J, Eloranta S, Gordon M, Gillgren P, Smedby KE. Primary tumor sites in relation to ultraviolet radiation exposure and skin visibility correlate with survival in cutaneous melanoma. Int J Cancer 2017 Oct 01;141(7):1345-1354 [FREE Full text] [doi: 10.1002/ijc.30843] [Medline: 28635084]
11. Carcoforo P, Raiji M, Palini G, Pedriali M, Maestroni U, Soliani G, et al. Primary anorectal melanoma: an update. J Cancer 2012;3:449-453 [FREE Full text] [doi: 10.7150/jca.5187] [Medline: 23193431]
12. Merchant RM, Asch DA. Protecting the Value of Medical Science in the Age of Social Media and "Fake News". JAMA 2018 Dec 18;320(23):2415-2416. [doi: 10.1001/jama.2018.18416] [Medline: 30453315]
13. Trethewey SP. Strategies to combat medical misinformation on social media. Postgrad Med J 2020 Jan 15;96(1131):4-6. [doi: 10.1136/postgradmedj-2019-137201] [Medline: 31732511]
14. Rubin R. Getting Social: Physicians Can Counteract Misinformation With an Online Presence. JAMA 2019 Jul 31;322(7):598 [FREE Full text] [doi: 10.1001/jama.2019.10779] [Medline: 31365030]
15. Armstrong PW, Naylor CD. Counteracting Health Misinformation: A Role for Medical Journals? JAMA 2019 May 21;321(19):1863-1864. [doi: 10.1001/jama.2019.5168] [Medline: 31009036]
16. Julian AK, Welch J, Bean MM, Shahid S, Perna FM. Information About Sunscreen on YouTube and Considerations for Sun Safety Promotion: Content Analysis. JMIR Dermatol 2020 Jun 2;3(1):e14411. [doi: 10.2196/14411]
17. Mueller SM, Jungo P, Cajacob L, Schwegler S, Itin P, Brandt O. The Absence of Evidence is Evidence of Non-Sense: Cross-Sectional Study on the Quality of Psoriasis-Related Videos on YouTube and Their Reception by Health Seekers. J Med Internet Res 2019 Jan 16;21(1):e11935 [FREE Full text] [doi: 10.2196/11935] [Medline: 30664460]
18. Dunnsiri T, Kawashita T, Lee SC, Monga AK, Woo BKP. Assessing YouTube as an Educational Tool for Shingles: Cross-Sectional Study. JMIR Dermatol 2020 Sep 3;3(1):e20338 [FREE Full text] [doi: 10.2196/20338]
19. Park TH, Kim WI, Park S, Ahn J, Cho MK, Kim S. Public Interest in Acne on the Internet: Comparison of Search Information From Google Trends and Naver. J Med Internet Res 2020 Oct 26;22(10):e19427 [FREE Full text] [doi: 10.2196/19427] [Medline: 33104003]
20. Torgerson T, Khojasteh J, Vassar M. Public Awareness for a Sexual Assault Hotline Following a Grey's Anatomy Episode. JAMA Intern Med 2020 Mar 01;180(3):456-458 [FREE Full text] [doi: 10.1001/jamainternmed.2019.5280] [Medline: 31790540]
21. Ayers JW, Nobles AL, Dredze M. Media Trends for the Substance Abuse and Mental Health Services Administration 800-662-HELP Addiction Treatment Referral Services After a Celebrity Overdose. JAMA Intern Med 2019 Mar 01;179(3):441-442 [FREE Full text] [doi: 10.1001/jamainternmed.2018.6562] [Medline: 30640378]

Abbreviations

ARIMA: autoregressive integrated moving average

XSL•FO
RenderX

Edited by G Eysenbach; submitted 04.09.20; peer-reviewed by A Benis, S Doan; comments to author 29.11.20; revised version received 07.12.20; accepted 24.12.20; published 26.01.21.

Please cite as:
Ottwell R, Hartwell M, Beswick T, Rogers TC, Ivy H, Goodman M, Vassar M
Public Interest in a Potentially Harmful, Non–Evidence-Based "Wellness" Practice: Cross-Sectional Analysis of Perineum Sunning
JMIR Dermatol 2021;4(1):e24124
URL: http://derma.jmir.org/2021/1/e24124/
doi:10.2196/24124
PMID:

©Ryan Ottwell, Micah Hartwell, Tracy Beswick, Taylor Calli Rogers, Heather Ivy, Marcus Goodman, Matt Vassar. Originally published in JMIR Dermatology (http://derma.jmir.org), 26.01.2021. This is an open-access article distributed under the terms of the Creative Commons Attribution License (https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work, first published in JMIR Dermatology Research, is properly cited. The complete bibliographic information, a link to the original publication on http://derma.jmir.org, as well as this copyright and license information must be included.

XSL•FO
RenderX

Original Paper

Instagram Content Addressing Pruritic Urticarial Papules and Plaques of Pregnancy: Observational Study

Ashley Payton[1,2*], BS, MS; Benjamin K P Woo[1*], MD

[1]Department of Psychiatry, Olive View Medical Center, University of California Los Angeles Medical Center, Sylmar, CA, United States

[2]College of Osteopathic Medicine of the Pacific, Western University of Health Sciences, Pomona, CA, United States

[*]all authors contributed equally

Corresponding Author:
Ashley Payton, BS, MS
Department of Psychiatry
Olive View Medical Center
University of California Los Angeles Medical Center
14445 Olive View Drive
Cottage H1
Sylmar, CA, 91342
United States
Phone: 1 858 243 7816
Email: aapayton16@gmail.com

Abstract

Background: Pruritic urticarial papules and plaques of pregnancy (PUPPP) is the most commonly diagnosed pregnancy-specific dermatosis. It presents with intense pruritus and can be difficult to manage, which encourages mothers to look to social media for camaraderie and advice.

Objective: This study aimed to characterize the sources and thematic content of Instagram posts in order to define influential groups of users. Our goal was to determine the status of online discourse surrounding PUPPP and elucidate any potential space for health care provider intervention via creation of Instagram accounts dedicated to information dissemination for patient populations.

Methods: Three hashtag categories were selected (#PUPPP, #PUPPPs, and #PUPPPrash), and the top public posts from each were analyzed and organized by source and by thematic content. The numbers of likes and comments were also recorded.

Results: Among the top 150 posts in each hashtag category, only 428 posts in total were eligible for this analysis. Majority (316/428, 73.8%) of posts were created by mothers who experienced PUPPP. These posts were testimonial accounts in nature. A small fraction of posts (14/428, 3.3%) were generated by physician accounts. Posts from blogs with extensive followings garnered the most attention in the form of likes and comments.

Conclusions: Mothers experiencing PUPPP comprised the majority of accounts posting under the hashtags selected. The most common themes included pictures of the rash and personal testimonies. Posts under blog posts received the most likes and comments on average. There is space for physician and health care specialists to improve their social media presence when it comes to discourse surrounding PUPPP. Patients are seeking out communities on social media, like Instagram, in order to have questions answered and obtain advice on management. Accounts with large followings tend to have more likes and more comments, which encourages information dissemination and awareness. Thus, we suggest that physicians create content and potentially partner with blog-type accounts to improve outreach.

(JMIR Dermatol 2021;4(1):e26200) doi:10.2196/26200

KEYWORDS

pruritic urticarial papules and plaques of pregnancy; dermatology; rash; pregnancy; obstetrics; dermatosis; Instagram; social media; patient education

XSL•FO
RenderX

Introduction

Pruritic urticarial papules and plaques of pregnancy (PUPPP) is the most common pregnancy-specific dermatosis affecting about 1 in 200 pregnancies [1]. It is also known as polymorphic eruption of pregnancy. PUPPP is more common in primiparous women and is characterized by erythematous papular lesions that classically arise within the confines of striae distensae on the gravid abdomen [1,2].

Typically, the eruptions begin on the abdomen and can spread to the thighs, arms, and buttocks, with onset occurring typically in the third trimester [3,4]. Symptoms tend to resolve 7 to 10 days postpartum [4]. However, this rash can be very pruritic, extensive, and difficult to manage for patients, especially in multiple gestation cases [4]. Many mothers try antipruritus creams and medications, with little or short-lasting relief. This could be one factor driving mothers with PUPPP to seek support in various outlets, including social media.

Social media has taken the spotlight in recent years as a tool for human interaction, which has changed how we learn from and engage with peers. Particularly within younger generations that grew up with internet access, it is increasingly common to find that people turn to social media for information and advice. A recent survey found that 72% of people reported turning to the internet to look up health information within the last year [5]. The convenience of the internet at the tips of our fingers has made it a preferred source for many Americans searching for answers.

Social media has become a way for patients with various unique conditions to post and find camaraderie with others who have similar afflictions, including during pregnancy [6]. We must be cognizant of the power that social media has to influence our decision-making ability in this regard [7,8]. Endorsements on social media sites, such as Instagram, have been shown to activate reward centers of the brain, making social media a powerful tool for peer influence [8]. According to Instagram's webpage, it boasts of having over 1 billion users worldwide. The Pew Research Center generated an estimate that roughly 72% of American adults have at least one social media account and that 37% have an Instagram account as of 2019 [9]. Creating posts for Instagram is free, and posts can be made available to the public. This makes the app a cost-effective and efficient way for health care specialists to widely distribute quick medical information to the public at large. In light of this, it is important to analyze how patient populations interact with content on social media so that we can determine whether there is space for health care professionals to provide evidence-based medical information and quell patient skepticism about information they are finding online.

PUPPP is a lesser publicized affliction, and thus, its discussion is not common in the public arena despite its relatively high prevalence in pregnant and postpartum mothers [1]. The rash can dramatically impact mothers during pregnancy and alter their experience. We hope to be able to shed some light on what information is being distributed on popular social media sites. In this study, we seek to characterize posts regarding PUPPP circulated on Instagram from the public. It is our goal to determine what discourse is generated by and for these pregnant mothers in order to define a potential space for increased physician and health care provider intervention, education, and advocacy.

Methods

Data Collection

Using the Instagram app, hashtag-based key terms were searched and identified (n=3; #PUPPP, #PUPPPs, and #PUPPPrash). Note that capitalization does not make a difference on the app hashtag search function; thus, "#PUPPP" yields the same result as "#puppp."

The top 150 posts from each tag were selected for analysis from all public posts. To be included in the study, the picture's caption had to include information or opinions regarding PUPPP. We excluded posts that were considered private because they would not be readily accessible to the public when using Instagram's search function. We excluded posts that had irrelevant material (ie, posts about puppies that were tagged within the #puppp thread and posts that did not include content regarding PUPPP) or were repeat tags (ie, posts tagged in the #puppp and #puppps categories). With these criteria, two of the tag categories yielded fewer than 150 posts that qualified for the study.

Data Analysis

Each post was assigned exclusively to a category based on source. The categories included the following: (1) mother, (2) physician/health care provider, (3) health care organization, (4) company/product, and (5) blog/blogger (Table 1). For further clarification, the category for physician/health care provider was scrutinized even further to determine if posts were from physicians or other providers such as midwives and doulas. In order for a post to be determined to be from a mother, caption information was taken into account and designation was granted if first person language was used. Many of these posts were accompanied by "selfies" that contributed to the decision of assigning a post to the mother category.

Characterization of the thematic content of each post was then determined by the team. Thematic content was categorized nonexclusively, meaning that each post could be assigned to more than one category based on image content as well as accompanying caption content. These categories included the following: (1) testimony, (2) educational information, (3) picture of PUPPP rash, (4) therapy advice & guidance, (5) blog post, and (6) product promotion (Table 1).

XSL•FO
RenderX

Table 1. Stratification methodology of Instagram posts that met the inclusion criteria.

Post source categories (exclusive assignment)[a]	Thematic content categories (nonexclusive assignment)[a]
1. Mother	1. Testimony
2. Physician/health care provider	2. Educational information
3. Health care organization	3. Picture of PUPPP[b] rash
4. Company/product	4. Therapy advice & guidance
5. Blog/blogger	5. Blog post
	6. Production promotion

[a]Individual posts could be placed exclusively in one category based on their source but were nonexclusively categorized by content of the post.
[b]PUPPP: pruritic urticarial papules and plaques of pregnancy.

The numbers of comments and endorsements or "likes" were recorded for each post after the characterization process. The average numbers of likes and comments were then calculated within each tag category.

Results

Tags

As of November 23, 2020, there were 2100 posts tagged with #PUPPP, 599 posts tagged with #PUPPPs, and 189 posts tagged with #PUPPPrash, which were publicly available on Instagram (totaling 2888 posts).

After determining which posts were eligible for study, 150 were included under #PUPPP, 141 were included under #PUPPPs, and 137 were included under #PUPPPrash (totaling 428 posts).

Source Categorization

Posts in all three tags were placed into one of five designated categories for characterization of the source. Overall, we found that the majority of posts available were created and shared by those who identified themselves as mothers (316/428, 73.8%), followed by blogs (58/428, 13.6%), companies (28/428, 6.5%), physicians or health care providers (14/428, 3.3%), and health care organizations (12/428, 2.8%) (Table 2).

Table 2. Post source categorization.

Tag category	Post source, n (%)				
	Mothers	Health care organizations	Physicians and health care providers	Companies	Blogs
#PUPPP (N=150)	134 (89.3%)	9 (6.0%)	7 (4.7%)	0 (0%)	0 (0%)
#PUPPPs (N=141)	132 (93.6%)	1 (0.7%)	0 (0%)	8 (5.7%)	0 (0%)
#PUPPPrash (N=137)	50 (36.5%)	2 (1.5%)	7 (5.1%)	20 (14.6%)	58 (42.3%)
Overall (N=428)	316 (73.8%)	12 (2.8%)	14 (3.3%)	28 (6.5%)	58 (13.6%)

In all categories, except for #PUPPPrash, mothers themselves were the predominant posters of content regarding PUPPP. In #PUPPPrash, the largest portion of content and discussion involved blogs (58/137, 42.3%), most of which were identified as "maternity lifestyle blogs" where women share experiences, advice, and information regarding pregnancy and motherhood to their followers (Table 2).

Only 14 posts came from health care providers overall, seven of which were from physicians licensed with an MD (Doctorate in Medicine) or DO (Doctorate in Osteopathic Medicine) medical degree (Table 2). The other seven advertised themselves as mid-level providers, such as nurse practitioners, lactation consultants or midwives, and doulas. This content made up 3.3% (14/428) of the overall number of posts.

#PUPPP had the majority of posts from accounts deemed as "health care organizations," such as a public account, @skincancerderminstitute, a dermatology clinic. Nine of the 12 posts coming from health care organizations were in this tag group. Other organizations represented were centered on pregnancy and women's health.

The "companies" category, which we defined as any account tied to a business that advertised a product or service that they themselves sell and/or provide for financial gain, was most prominent in the #PUPPPrash category, comprising 14.6% (20/137) of all posts analyzed (Table 2). Of the 28 posts from companies, 20 were found under #PUPPPrash.

Thematic Content Analysis

All posts were categorized nonexclusively into six categories based on the content in the image or the caption associated with the image.

By and large, the category "testimony" comprised a majority of the posts across all three tag groups. Out of all 428 posts, 309 (72.2%) were classified as a "testimony" based on the content within the caption provided by the poster. This meant that 72.2% of all posts contained personal accounts and anecdotes from mothers who had experienced PUPPP during one or more of their pregnancies (Table 3). Most of these testimonies were mothers describing their journeys, expressing

XSL•FO
RenderX

frustration with the pruritic rash, and providing encouragement to their followers who may be experiencing the same affliction.

Table 3. Analysis of thematic content of posts in each tag category and overall (N=428).

Theme[a]	Tag category			
	#PUPPP, n	#PUPPPs, n	#PUPPPrash, n	Across all tags, n (%)
Testimony	91	94	124	309 (72.2%)
Education	20	8	1	29 (6.8%)
Therapy advice	10	14	5	29 (6.8%)
Blog post	0	11	89	100 (23.4%)
Production promotion	15	23	5	43 (10.0%)
Picture of rash	58	55	115	228 (53.3%)

[a]Posts were nonexclusively categorized, that is, each post could be tallied in more than one of the six themes represented.

Posts were given a designation under the category "education" if they provided objective and factual medical information about PUPPP. Posts in this category, for example, included infographics, diagrams, and other texts that would provide information to moms about what PUPPP is, what the symptoms are, and what standard treatment includes, and/or provide epidemiological information. A popular fact included frequently in educational posts was that about 1 in 150 to 200 women will be affected by PUPPP [1,3].

Overall, 228 (53.3%) posts contained a picture of a rash directly. Pictures of a rash included an exposed abdomen with signs of PUPPP. Within the PUPPPrash tag, one picture of one blogger's rash was reposted 78 times with a copied caption. In the PUPPP and PUPPPs groups, pictures were all personal, meaning they were of the user's own rash.

Another important finding was that 100 of the 428 (23.4%) posts were from an account that advertised being a blog (Table 3). Blog posts either came from blog accounts, such as accounts that advertised being a "personal" or "maternity" blog, or from mothers who were self-promoting their own personal blogs. Of these 100 posts, 89 were found under the PUPPPrash tag.

Therapy advice included posts in which accounts offered advice on which over-the-counter products or home remedies worked best for the poster's PUPPP. These posts only comprised 6.8% (n=29) of all posts.

Lastly, product promotion included posts in which a specific product or service was advertised for financial gain by the poster. These posts included products, such as herbal soap bars, creams, and essential oils, designed to help with the symptoms of PUPPP. These posts could have links to the vendor's Instagram page or website for consumers to purchase products directly. Product promotion posts comprised 10.0% (43/428) of all posts and were more represented in the PUPPPs group followed by the PUPPP group (Table 3).

Endorsement and Follower Interaction

The number of likes was recorded for each post during analysis, and the average was calculated for each subsection. The highest average number of likes was found in the PUPPPrash tag with 2371.52. The same category also resulted in the highest average number of comments of 34.34 (Table 4).

Table 4. Likes and comments broken down by tag category.

Tag category	Mean number of endorsements	Range for the number of likes	Mean number of comments	Range for the number of comments
#PUPPP	50.53	0-458	10.46	0-65
#PUPPPs	67.39	1-1452	8.57	0-46
#PUPPPrash	2371.52	4-38,350	34.34	0-389

The PUPPPrash group had the highest average number of likes but also had the largest range of likes from 4 to 38,350. This category had 10 posts with more than 10,000 likes and 32 posts with between 1000 and 9999 likes. No other category had a post with more than 10,000 likes. PUPPPrash also had the largest average number of comments per post with a range of 0 to 389 (Table 4).

Of note, the PUPPPrash category also had the highest concentration of blog accounts (Table 3). These accounts tended to have more followers, which may have accounted for the higher number of likes and comments per post.

Discussion

Principal Findings

The presence of PUPPP on the social media app Instagram is significant yet small in comparison to the estimated number of pregnancies affected each year. With a little under 3000 posts available to the public on the popular app and around 3.7 million births in the United States annually, there appears to be a gap in discourse surrounding this common dermatosis [10]. A search on the Instagram interface reveals that other sequelae of pregnancy, such as hyperemesis gravidarum, have more dedicated posts. For example, searching

XSL•FO
RenderX

#hyperemesisgravidarum on Instagram returned approximately 49,200 posts as of November 30, 2020. Despite the low census of posts for PUPPP, the posts included in this analysis represented a diverse pool of sources as well as themes.

Interestingly, the overwhelming majority of posts came from mothers who were affected by the rash. These posts tended to contain testimonial captions and frequently included pictures of the mother's own rash. Based on caption analysis, most of these testimonial posts were intended to bring awareness to a condition that is considered "embarrassing" by many moms. Posts would include candid accounts of the mothers' experiences with combating PUPPP. Posts like this help to normalize the discourse and make others feel more comfortable discussing their rash with their followers. Some moms even included pictures of their exposed rash. These vulnerable pictures could put others at ease if the rash looks similar to their own. Overall, these testimonial posts really highlight the community's honesty with PUPPP and willingness to share their experiences for the benefit of others.

The amount of posts coming from health care professionals made up a small fraction of the sample (14/428, 3.3%). As a potential space for physicians to impact the public beyond their clinical domain, this analysis has made it apparent that there is room for improvement on the part of physicians to guide online discussion. Only 14 of all 428 posts were from professional health care providers, and only seven of those were from physicians (Table 2). A post that is created by a trained medical professional might be viewed as more credible by the public than a post from a layperson, meaning these posts could be more influential. The posts that did come from these accounts tended to be educational in nature with the goal of teaching followers about PUPPP. Again, only a small percentage of posts offered educational material signaling a place for growth for specialists who see and treat patients with PUPPP.

The posts that this study found to garner the most attention, in the form of likes and comments, were blog posts, although they made up only 23.4% (100/428) of the posts across all three investigated tags. Some of these posts gained tens of thousands of likes and hundreds of comments. The blog accounts that many of these "high-earning" posts came from boasted large followings, which may have been a contributing factor for the greater interaction of these posts than posts from any one mother. This makes sense given that Instagram's algorithm puts pictures from accounts you follow into one's home feed. Therefore, the more followers an account has, the more interaction its posts will receive. Many of the blogs that earned the most likes were advertised as maternity blogs, and the posts dealt with topics and issues for expecting mothers as well as new mothers. It is possible that mothers who have experienced complications during their pregnancy seek out and follow pregnancy-specific blogs on Instagram in the hope of finding camaraderie and reassurance in their peers and influential users.

Limitations and Future Directions

Several limitations became apparent during our analysis. First, Instagram has introduced a new policy that does not allow the general public to view all available posts. Currently, there is a disclaimer when one searches any given hashtag that states not all of the most recent posts will show up on the content feed. This is part of a new initiative by social media companies to stop the spread of misinformation.

On Instagram, we are not able to definitively determine the age or gender of the person posting the content as this information is not distributed by each user's account. This limited our analysis particularly when looking at the posts coming from mothers affected by PUPPP. Access to the demographic information of the mothers would have given us a better idea of what audience characteristics are better represented on Instagram.

There is future potential for a similar study to analyze the content of the comment sections. Previous studies have demonstrated that examining user comments on social media can provide an in-depth view of questions and concerns brought up by patients [11,12]. Characterization of the comments from followers in order to discover the nature of supportive or inquisitive feedback under each post could strengthen the argument that patients are seeking quality medical information on Instagram. A dive into the nuances of conversation between followers and posters could further elucidate the exact needs and curiosities of patients opting to research conditions on social media.

Other studies could be designed with this paradigm in order to examine other lesser known medical conditions in all specialties. It could be interesting to investigate some more "taboo" conditions as well in order to see how willing online users would be to ask about them behind the comfort and convenience of the keyboard rather than in person to their physician.

Clinical Applications and Conclusions

This study demonstrated that there is a considerable presence on Instagram of the most common dermatosis specific to pregnancy, PUPPP. We were able to examine this common skin condition of pregnancy through the unique lens of publicly available Instagram content. Through the use of hashtags on the popular social media app, we found that mothers with PUPPP readily expressed their experiences, asked questions, and shared advice with their followers. At times, these moms would even share their opinions on various treatments and therapies as well and generate dialogue among one another.

Importantly, there are very few physicians actively posting clinically valid information about the rash, which could address many of the questions and concerns that these mothers pose online. Health care professionals, such as dermatologists and obstetricians, should be aware of this social media presence and consider increasing their influence on applications since a high number of patients turn to internet communities for support.

One suggestion we propose is for physicians to increase their social media presence by creating public professional accounts that display their credentials [13]. In this way, physicians can advertise their professional accounts to the existing clientele and reach patient populations beyond those that they personally serve. Once an account is established, posts can be made that combine informative graphics with educational text. Therefore, if physicians generate more content and use hashtags so that their posts are searchable, they could reach a larger audience

XSL•FO
RenderX

interested in the topic. It might also behoove the physician to partner with bloggers, such as maternity bloggers in our case, in order to quickly gain visibility and reach a larger audience already seeking information and support [13].

The spread of misinformation has also become a topic of discussion in recent years as social media has become a dominant forum for peer conversation [13]. With the rise of social media as an arena for sharing, it has become apparent that perpetuation of incorrect medical statements may create mistrust and fear among patients [14]. Serious false information has been disseminated, such as the belief that vaccines cause autism, because physicians abuse the trust built. It is the duty of physicians, including physicians participating in online discourse, to ensure that facts are checked. Physicians are in a particularly unique position to create posts containing evidence-based information while also being key opinion leaders.

In a time where we have immediate access to any information through the internet, misinformation is rampant and physicians work hard to dispel concerns that patients bring in with them to the examination room. We suggest that clinicians build up their social media presence to offer legitimate responses and medical information to patients looking for quick answers before their next doctor's appointment.

Conflicts of Interest

None declared.

References

1. Lehrhoff S, Pomeranz MK. Specific dermatoses of pregnancy and their treatment. Dermatol Ther 2013;26(4):274-284. [doi: 10.1111/dth.12078] [Medline: 23914884]
2. Zhu P, Fung A, Woo BKP. Consumer Preference of Products for the Prevention and Treatment of Stretch Marks: Systematic Product Search. JMIR Dermatol 2020 Jun 4;3(1):e18295. [doi: 10.2196/18295]
3. Aronson IK, Bond S, Fiedler VC, Vomvouras S, Gruber D, Ruiz C. Pruritic urticarial papules and plaques of pregnancy: Clinical and immunopathologic observations in 57 patients. Journal of the American Academy of Dermatology 1998 Dec;39(6):933-939. [doi: 10.1016/s0190-9622(98)70265-8] [Medline: 9843004]
4. Matz H, Orion E, Wolf R. Pruritic urticarial papules and plaques of pregnancy: polymorphic eruption of pregnancy (PUPPP). Clin Dermatol 2006;24(2):105-108 [FREE Full text] [doi: 10.1016/j.clindermatol.2005.10.010] [Medline: 16487883]
5. Zhao Y, Zhang J. Consumer health information seeking in social media: a literature review. Health Info Libr J 2017 Dec;34(4):268-283 [FREE Full text] [doi: 10.1111/hir.12192] [Medline: 29045011]
6. Baker B, Yang I. Social media as social support in pregnancy and the postpartum. Sex Reprod Healthc 2018 Oct;17:31-34. [doi: 10.1016/j.srhc.2018.05.003] [Medline: 30193717]
7. Lam NH, Woo BK. Efficacy of Instagram in Promoting Psychoeducation in the Chinese-Speaking Population. Health Equity 2020 Apr 01;4(1):114-116 [FREE Full text] [doi: 10.1089/heq.2019.0078] [Medline: 32258963]
8. Sherman LE, Payton AA, Hernandez LM, Greenfield PM, Dapretto M. The Power of the Like in Adolescence: Effects of Peer Influence on Neural and Behavioral Responses to Social Media. Psychol Sci 2016 Jul;27(7):1027-1035 [FREE Full text] [doi: 10.1177/0956797616645673] [Medline: 27247125]
9. Social Media Fact Sheet. Pew Research Center for Internet and Technology. 2019. URL: http://www.pewinternet.org/fact-sheet/social-media/ [accessed 2020-12-01]
10. Martin JA, Hamilton BE, Osterman MJK, Driscoll AK. Births: Final Data for 2018. Natl Vital Stat Rep 2019 Nov;68(13):1-47 [FREE Full text] [Medline: 32501202]
11. Chong KPL, Guo JZ, Deng X, Woo BKP. Consumer Perceptions of Wearable Technology Devices: Retrospective Review and Analysis. JMIR Mhealth Uhealth 2020 Apr 20;8(4):e17544 [FREE Full text] [doi: 10.2196/17544] [Medline: 32310148]
12. Chung S, Woo BK. Using Consumer Perceptions of a Voice-Activated Speaker Device as an Educational Tool. JMIR Med Educ 2020 Apr 24;6(1):e17336 [FREE Full text] [doi: 10.2196/17336] [Medline: 32329740]
13. Trethewey SP. Strategies to combat medical misinformation on social media. Postgrad Med J 2020 Jan 15;96(1131):4-6. [doi: 10.1136/postgradmedj-2019-137201] [Medline: 31732511]
14. Larson HJ. The biggest pandemic risk? Viral misinformation. Nature 2018 Oct 16;562(7727):309-309. [doi: 10.1038/d41586-018-07034-4] [Medline: 30327527]

Abbreviations

PUPPP: pruritic urticarial papules and plaques of pregnancy

XSL•FO
RenderX

Edited by G Eysenbach; submitted 01.12.20; peer-reviewed by J Chung, S Chung; comments to author 05.12.20; revised version received 09.12.20; accepted 20.01.21; published 11.02.21.

Please cite as:
Payton A, Woo BKP
Instagram Content Addressing Pruritic Urticarial Papules and Plaques of Pregnancy: Observational Study
JMIR Dermatol 2021;4(1):e26200
URL: http://derma.jmir.org/2021/1/e26200/
doi:10.2196/26200
PMID:

©Ashley Payton, Benjamin K P Woo. Originally published in JMIR Dermatology (http://derma.jmir.org), 11.02.2021. This is an open-access article distributed under the terms of the Creative Commons Attribution License (https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work, first published in JMIR Dermatology Research, is properly cited. The complete bibliographic information, a link to the original publication on http://derma.jmir.org, as well as this copyright and license information must be included.

XSL•FO
RenderX

Original Paper

Risks and Benefits of Using Social Media in Dermatology: Cross-sectional Questionnaire Study

Moshe Y Bressler[1,2], BS; Eugene Grudnikoff[3], MD; Yaakov Bressler[2], BA; Rebecca Tamez[2], MD; John G Zampella[4], MD

[1]New York Institute of Technology College of Osteopathic Medicine, Old Westbury, NY, United States
[2]Department of Dermatology, Jamaica Hospital Medical Center, Richmond Hill, NY, United States
[3]Department of Psychiatry, South Oaks Hospital, Amityville, NY, United States
[4]Ronald O Perelman Department of Dermatology, New York University, New York, NY, United States

Corresponding Author:
John G Zampella, MD
Ronald O Perelman Department of Dermatology
New York University
555 Madison Ave, 4th Floor
New York, NY, 10022
United States
Phone: 1 646 754 2000
Email: John.zampella@nyulangone.org

Abstract

Background: Dermatological information on social media is often presented by nondermatologists. Increasing the online engagement of trained dermatologists may improve information quality, patient education, and care.

Objective: Our study assesses dermatologists' perceptions of social media and patterns of use to identify barriers limiting engagement.

Methods: In our cohort study, a 36-item online survey was distributed to dermatologists in the United States; responses were captured on a 1-100 sliding scale.

Results: Of 166 initiated surveys, 128 valid responses were submitted. Dermatologists showed greater concern for social media risk-related issues (mean 77.9, SD 15.1) than potential benefits (mean 61.8, SD 16.4; $P<.001$). Leading concerns were poor patient care, nonevidence-based information, and breaching patient privacy. Benefits included interphysician collaboration, patient education, and public health awareness. The most avid and enthusiastic social media users were millennials (mean total optimism score 67.5, SD 14.9) and baby boomers (mean total optimism score 63.1, SD 11.2) compared with Generation X dermatologists (mean total optimism score 52.2, SD 16.3, $P<.001$). Of 128 dermatologists, 103 (82.4%) plan on increasing their social media use ($P=.003$). Predictors showing an intent to increase future social media use were younger age, integration into professional use, and an optimistic view (r2=.39; $P<.001$).

Conclusions: Dermatologists perceive the risk of social media to be considerable but still intend to increase its use, likely recognizing the value and importance of social media to the field.

(JMIR Dermatol 2021;4(1):e24737) doi:10.2196/24737

KEYWORDS

social media; dermatologist; generational differences; Instagram; Facebook; information quality; patient education; online content; risk; benefit; dermatology; cross-sectional; survey; online health information

Introduction

Americans spend an average of 142 minutes per day on social media, and this number is expected to rise [1]. It is no surprise that patients have turned to social media for information regarding health care, with reports of more than 125 million Americans using social media to search for health-related information [2]. The use of social media as a health care resource has documented benefits. Studies point to improved patient well-being and empowerment through the use of social media, especially among those with new medical diagnoses [3].

XSL•FO
RenderX

Patient use of social media also has its downfalls, with little quality control or regulation of the information posted to social media platforms. Patients often encounter misinformation with potentially harmful outcomes [4,5]. Campaigns such as the #VerifyHealthcare movement encourages physicians on social media to validate their credentials to help identify posts with reliable medical information; however, the extent to which such interventions alter health literacy has not been evaluated [6].

Indeed, false information tends to spread 6 times faster on social media than factual information [7,8], and re-educating patients to correct false information can be challenging [9]. For health-related content, a physician's engagement on social media is effective in spreading quality information and has the potential to reach millions of people [10]. The barriers preventing practitioners and experts from participating are likely multifactorial but may involve concerns over privacy violations [11], fear of litigation [12], and uncertainty surrounding patient-physician boundaries on social media [13].

Dermatologists were early adopters of social media, and many continue to make educational and relevant content for consumers. A recent study showed that "top influencer" dermatologists have large social media audiences and provide a valuable educational service to patients [14]. However, these influencers may not be sufficient to combat the gaps in public health education, as other studies show that as little as 4%-5% of dermatology-related content on Instagram is posted by board-certified dermatologists [2,15].

To increase dermatologist engagement and the positive outcomes associated with a strong physician presence on social media, we aim to understand the perceptions and behaviors of dermatologists in the United States using social media. With this understanding, we can appropriately guide policies to promote safe and effective participation on social media while mitigating risks.

Methods

Study Design

Using the SurveyMonkey tool (SVMK Inc), we created and distributed an anonymous, open, online survey of 36 questions (Multimedia Appendix 1) to board-certified dermatologists and dermatology residents enrolled in an Accreditation Council for Graduate Medical Education (ACGME)–accredited program in accordance with the Checklist for Reporting Results of Internet eSurveys (CHERRIES) [16]. Participants disclosing non-US–based practices were screened. Multiple entries were prevented by limiting duplicate IP address entries. The survey design was created using prior models [17] and piloted by 6 dermatologists and 2 dermatology residents.

The survey was distributed using an academic listserv (Association of Professors in Dermatology [APD]), which was distributed to 486 members and the private Facebook group "Board Certified Dermatologists," with more than 4500 board-certified dermatologists. Survey questions used a 0-100 sliding scale, where 100 represented maximal agreement. Information collected included demographic data, social media usage patterns and preferences, and perceptions of social media, including positive and negative effects of social media and its effect on relationships. Upon completion, users were able to share the survey with their peers using our web landing page.

Data Analysis

Data were stratified for credentials, degree, employment type, years of experience, years on social media, geographical region, favorite social media platform, and generational differences. We compared millennials (ages 23-38 years in 2019), Generation X (ages 39-54 years), and baby boomers (ages 55-73 years) using definitions outlined by Pew Research [18]. Chi-square and ANOVA tests were used for the analysis of categorical and continuous variables, respectively. When an omnibus ANOVA F-test revealed significant differences between multiple groups, we performed group-to-group post hoc analyses; the Fisher exact test was used due to low *n* in some cells. A *t* test was used for group comparisons with unequal variances. Variables associated at $P<.1$ with a response of "yes" or "maybe" regarding the intention to increase social media use were entered in a backward elimination multiple linear logistic regression model to identify variables independently associated with intent to increase social media use. All analyses were 2-sided with alpha set at .05, and they were conducted using JMP statistical software (version 9.0; SAS Institute Inc).

We created a scoring system to evaluate positive and negative perceptions of social media by calculating the net sum-average of all the responses in each category. Potential benefits yielded a total optimism score, risks and concerns yielded a total pessimism score (wherein a higher value indicates greater pessimism), and a positive or negative effect on relationships generated the total relationship scores (wherein a higher value indicates a positive effect on relationships).

Results

Respondent Demographics

Of 166 initiated surveys, 128 were valid—38 entries were disqualified from the analysis due to a location outside of the United States, or a nonphysician or nondermatologist status.

Of the 128 valid entries, 48 (37%) respondents were male and 80 (63%) were female, with an average age of 38.7 (SD 9.7) years and an average time in clinical practice of 9.3 (SD 9.2) years. Of the 128 respondents, 36 were residents (28%) and 93 (72%) were board-certified dermatologists; 117 (91%) had Doctor of Medicine (MD) degrees and 11 (9%) had Doctor of Osteopathic Medicine (DO) degrees; 71 (57%) were millennials, 42 (34%) were Generation X, and 12 (10%) were baby boomers. The respondents were evenly distributed by sex ($P=.72$) and geographical region ($P=.34$). Our sample was representative of the US dermatological workforce. Additional demographic, experience, and employment characteristics are reported in Table 1.

XSL•FO
RenderX

Table 1. Demographic characteristics of survey responders (n=128).

Variable	Total (n=128)	Millennial (n=71, 56.8%)	Generation X (n=42, 33.6%)	Baby boomer (n=12, 9.6%)	*P* value
Age in years, mean (SD)	38.7 (9.7)	31.9 (3.0)	44.1 (4.4)	59.6 (6.6)	<.001[a]
Gender, n (%)					.72
Female	80 (62.5)	47 (66.2)	26 (61.9)	6 (54.6)	
Male	48 (37.5)	24 (33.8)	16 (38.1)	5 (45.5)	
Region, n (%)					.34
Midwest	17 (13.3)	9 (12.7)	6 (14.3)	2 (16.7)	
Northeast	54 (42.2)	34 (47.9)	14 (33.3)	3 (25.0)	
South	40 (31.3)	20 (28.2)	16 (38.1)	3 (25.0)	
West	18 (14.1)	8 (11.3)	6 (14.3)	4 (33.3)	
Clinical experience in years, mean (SD)	9.3 (9.2)	3.5 (3.3)	7.3 (10.1)	29.4 (9.9)	<.001[b]
Employment, n (%)					.016[c]
Academic institution	79 (61.7)	40 (58.0)	28 (66.7)	8 (66.7)	
Equity owner of a group practice	4 (3.1)	0 (0.0)	3 (7.1)	1 (8.3)	
Owner of a solo practice	12 (9.4)	5 (7.3)	4 (9.5)	3 (25.0)	
Group practice, hospital or health care system	32 (25.0)	24 (34.8)	7 (16.7)	0 (0.0)	

[a]Age: all post hoc comparisons significant at *P*<.001.

[b]Years of clinical experience: all post hoc comparisons significant at *P*<.001.

[c]Employment: millennials are less likely to be employed as equity owners of a group practice vs. nonmillennials (*P*=.035) and more likely to be employed at a group practice or hospital (*P*=.007; baby boomers are less likely to be employed at a group practice or hospital (*P*=.036).

Social Media Practices

Among the 128 respondents, 120 (93.8%) reported using social media across a variety of platforms, including Facebook (109/128, 85.2%), Instagram (85/128, 66%), and LinkedIn (51/128, 40%; Table 2), for an average of 45.9 (SD 35.2) minutes/day. Millennials had used social media for an average of 11.8 (SD 3.0) years, significantly longer than either GenX (mean 9.4, SD 3.6 years) or baby boomers (mean 6.2, SD 3.4 years; *P*<.001). The overall time spent on social media for professional use was 16.9 (SD 24.3) minutes/day and 31.1 (SD 22.0) minutes/day for personal use; millennials spent more total time on social media compared to baby boomers and GenX respondents. Unexpectedly, baby boomers' time spent on social media for professional use (mean 17.3, SD 18.9 minutes/day) was comparable to that of millennials (mean 21.6, SD 28.6 minutes/day; *P*=.67).

Owners of private practices and solo practitioners spent more time on social media for professional use compared to all other respondents (mean 41.7, SD 41.5 minutes/day vs. mean 13.9, SD 20.2 minutes/day; *P*<.001), while physicians working at academic institutions spent less time on social media (mean 11.6, SD 18.6 minutes/day vs. mean 24.8, SD 29.9 minutes/day; *P*=.003). Overall, 44% (53/128) of physicians found Instagram to be the most valuable platform, followed by Facebook (49/128, 40.7%), and preferences varied by generation. Social media usage patterns and preferences are reported in Table 2.

XSL•FO
RenderX

Table 2. Social media patterns and preferences observed from the survey responses (n=128).

Variable	Total (n=128)	Millennial (n=71, 56.8%)	Generation X (n=42, 33.6%)	Baby boomer (n=12, 9.6%)	*P* value
Years of social media use, mean (SD)	10.6 (3.7)	11.8 (3.0)	9.4 (3.6)	6.2 (3.4)	<.001[a]
Personal time spent on social media, min/day, mean (SD)	31.1(22.0)	38.5(20.2)	22.7(21.9)	15.0 (12.8)	<.001[b]
Professional time spent on social media, min/day, mean (SD)	16.9 (24.3)	21.6 (28.6)	8.5 (13.1)	17.3 (18.9)	.021[b]
Total time spent on social media, min/day, mean (SD)	45.9 (35.2)	59.6 (34.7)	30.5 (29.2)	29.6 (25.5)	<.001[c]
Plan to increase social media use, n (%)	103 (82.4)	67 (94.4)	28 (66.7)	8 (66.7)	.001[d]
Platforms with an active account, n (%)					
Facebook	109 (85.2)	62 (87.3)	36 (85.7)	8 (66.7)	.18
Instagram	85 (66.4)	58 (81.7)	21 (50.0)	4 (33.3)	<.001[e]
LinkedIn	51 (39.8)	25 (35.2)	19 (45.2)	5 (41.7)	.56
Reddit	16 (12.5)	8 (11.3)	5 (11.9)	2 (16.7)	.87
Snapchat	33 (25.8)	30 (42.3)	2 (4.8)	0 (0.0)	<.001[f]
Twitter	29 (22.7)	14 (19.7)	11 (26.2)	3 (25.0)	.71
WhatsApp	49 (38.3)	32 (45.1)	15 (35.7)	2 (16.7)	.15
YouTube	35 (27.3)	18 (25.4)	12 (28.6)	3 (25.0)	.93
Most valuable platform, n (%)	Instagram, 53 (44.4)	Instagram, 42 (60.0)	Facebook, 22 (59.5)	Facebook, 6 (50.0)	.004[g]
Location where social media is accessed, n (%)					
Home	114 (89.1)	66 (93.0)	35 (83.3)	10 (83.3)	.24
Work	54 (42.2)	38 (53.5)	11 (26.2)	4 (7.6)	.014[h]
During commute	32 (25.0)	24 (33.8)	5 (11.9)	2 (16.7)	.027[i]

[a]Years on social media: all post hoc comparisons significant at *P*<.033.

[b]Time spent on social media: all post hoc comparisons significant at *P*<.031.

[c]Time on social media above average: millennial>GenX, *P*<.001; millennial>baby boomer, *P*<.001.

[d]Plan to increase social media use: millennial>GenX, *P*<.001; millennial>baby boomer, *P*=.013.

[e]Active Instagram account: all post hoc comparisons significant at *P*<.02.

[f]Active Snapchat account: all post hoc comparisons significant at *P*<.036.

[g]Most valuable platform: Facebook, GenX>millennials, *P*<.001; Instagram, millennial>GenX, *P*<.001 , millennial>baby boomers, *P*<.001.

[h]Social media use at work: GenX>millennials, *P*<.001.

[i]Social media use during commute: millennial>GenX, *P*=0.014.

Perceptions

Overall, dermatologists perceived that social media has many benefits and uses (total optimism score 61.8, SD 16.4). There was strong agreement that social media use increases patient education (69.4, SD 20.6), while less agreement concerning access to care or strengthening the doctor-patient relationship (50.3, SD 21.8, and 46.1, SD 24.7, respectively). Millennials (67.5, SD 14.9) and baby boomers (63.1, SD 11.2) were more optimistic about the benefits of social media than the GenX physicians (52.2, SD 16.3; *P*<.001 and *P*=.030, respectively). Attitudes and perceptions regarding social media are reported in Table 3 and Figure 1.

Dermatologists showed greater concern for risk-related issues on social media compared to potential benefits (mean score 77.9, SD 15.1 vs. mean score 61.8, SD 16.4, paired *t* test; *P*<.001). The greatest concerns were that social media use contributes to the substitution of proper dermatological care with unqualified providers (88.5, SD18.0), promotion of nonevidence-based products (82.1, SD 20.6), and the threat of breaching patients' privacy (78.9, SD 19.9); however, this varied by generation, with millennials being less pessimistic than GenX dermatologists (*P*=.018).

Most dermatologists believed that social media use improves relationships with friends (65.3, SD 21.0) and professional colleagues (61.4, SD 22.3) but were more neutral about social media's effect on relationships with patients (50.3, SD 21.2).

XSL•FO
RenderX

Table 3. Future users versus nonusers of social media (n=128).

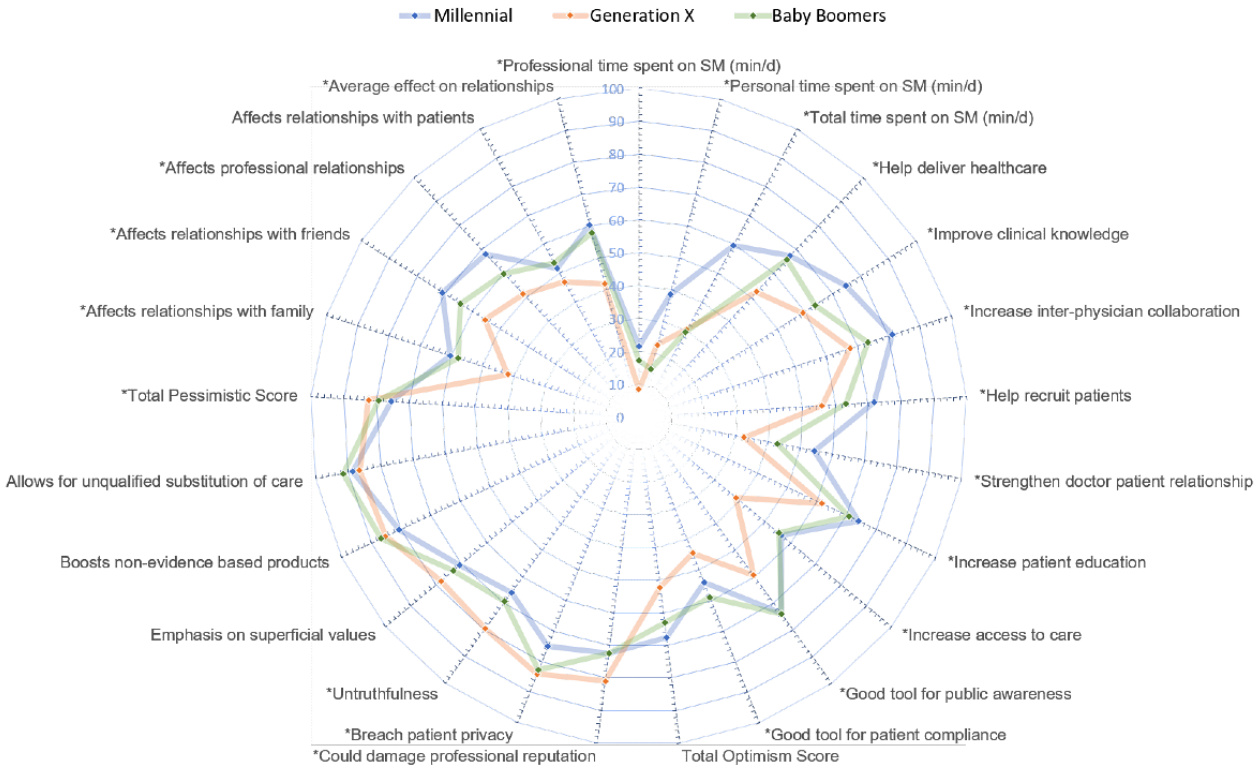
Survey question	Response score by generation, mean (SD)				*P* value[a,b]
	Total (n=128)	Millennial (n=71, 56.8%)	Generation X (n=42, 33.6%)	Baby boomer (n=12, 9.6%)	
Perceived benefits related to social media					
Help deliver health care	61.9 (24.2)	67.3 (24.7)	52.3 (22.3)	65.8 (19.5)	.005
Improve clinical knowledge	68.2 (24.6)	74.7 (20.5)	59.2 (27.9)	63.6 (22.9)	.003
Increase interphysician collaboration	75.3 (21.2)	81.3 (19.0)	67.6 (23.4)	73.3 (17.3)	.005
Help recruit patients	65.7 (22.1)	71.9 (21.2)	55.9 (23.3)	63.1 (11.8)	<.001
Strengthen doctor-patient relationship	46.1 (24.7)	54.4 (23.9)	32.7 (23.2)	43.0 (16.1)	<.001
Increase patient education	69.4 (20.6)	74.0 (22.6)	61.6 (16.4)	70.8 (15.6)	.008
Increase access to care	50.3 (21.8)	56.5 (19.5)	38.5 (22.4)	55.3 (20.6)	<.001[b]
Good tool for public awareness	68.8 (22.6)	73.8 (20.7)	59.5 (24.9)	73.9 (18.4)	.004[b]
Good tool for patient compliance	51.5 (22.2)	54.1 (23.1)	44.5 (21.0)	59.0 (17.9)	.040[b]
Total optimism score	61.8 (16.4)	67.5 (14.9)	52.2 (16.3)	63.1 (11.2)	<.001[b]
Perceived risks related to social media					
Could damage professional reputation	74.9 (21.4)	72.5 (23.3)	80.9 (15.8)	72.4 (22.5)	.11
Breach patient privacy	78.9 (19.9)	75.0 (21.4)	84.1 (16.3)	82.8 (17.1)	.044
Untruthfulness	70.1 (26.3)	65.9 (25.8)	79.5 (25.1)	69.4 (19.9)	.024
Emphasis on superficial values	72.9 (24.0)	70.6 (25.0)	78.2 (22.1)	73.3 (24.0)	.27
Boosts nonevidence-based products	82.1 (20.6)	80.5 (20.2)	85.2 (21.9)	86.6 (12.4)	.38
Allows for unqualified substitution of care	88.5 (18.0)	88.7 (18.0)	86.5 (20.1)	91.7 (9.3)	.66
Total pessimism score	77.9 (15.1)	75.5 (14.8)	82.4 (15.0)	79.4 (12.7)	.058
Perceived social media effect on relationships					
Affects relationships with family	54.1 (22.5)	60.3 (20.7)	41.9 (22.7)	57.8 (19.9)	.002[b]
Affects relationships with friends	65.4 (21.1)	70.7 (20.3)	55.4 (20.8)	64.4 (18.5)	.006
Affects professional relationships	61.3 (22.3)	68.0 (21.5)	51.4 (23.2)	59.9 (15.9)	.011
Affects relationships with patients	50.2 (21.2)	51.6 (26.0)	47.0 (18.5)	53.6 (7.9)	.68
Average effect on relationships	60.2 (19.1)	60.3 (20.7)	41.9 (22.7)	57.8 (19.9)	.002[b]

[a]All significant *P* values ≤.05 for millennials vs. GenX.

[b]*P*≤.05 for GenX vs. baby boomer; there were no significant differences between millennials and baby boomers.

XSL•FO
RenderX

Figure 1. Generational differences of social media use and perceptions. Survey questions were answered on a 0-100 agreement scale. The radar chart demonstrates the average for each question grouped by generation. Questions calculated toward the total optimism score are highlighted teal, pessimistic questions are highlighted pink, and questions affecting relationships are highlighted yellow. (*) denotes statistically significant different answers by generation using a Fisher test, P≤.05. min/d: minutes per day; SM: social media.



Future Users vs. Nonusers

Of the 128 dermatologists surveyed, 103 (82.4%) are actively or considering increasing their social media usage. The variables independently associated with a plan to use more social media in the future were younger age (P=.023), use at work (P=.028), and average optimism (P<.001) in the logistic regression model using backward elimination. In contrast, other variables (eg, average pessimism, employment type, favorite social media platform) were codependent or not significant (final model r^2=.390, P<.001).

Discussion

Principal Findings

Our survey of US dermatologists demonstrates that there are many perceived risks and benefits of social media. These views vary significantly across generations, yet our data suggest the perceived benefits outweigh the associated risks. Our study provides insight into physicians' perceptions of social media; the results may serve as a guide to promoting dermatologist engagement on social media.

The total pessimism score revealed a general negativity surrounding social media use among dermatologists. Pessimism was driven by perceived risks of poor patient care, misinformation, damage to professional reputation, and privacy breaches, consistent with prior reports of social media risks [2,11–13] (Figure 1). Mitigating these risks will be essential for increasing the engagement of dermatologists on social media. Indeed, the risks associated with physicians sharing information online have been identified as a key area for social media research [13], with little data currently reported. Patient privacy violations resulting from posting and sharing patient photographs are common among some specialties [19] and represent real concern, as images can be downloaded and reshared, increasing patient exposure to privacy breaches. The lack of clear guidelines for sharing photos of patients online may cause physicians to avoid creating patient-centered content altogether [20].

Alternatively, there is promising optimism for social media use among dermatologists. The total optimism score calculated from our survey reflects the perceived benefits of social media, which include increased health care access, improved education, and improved public health (Figure 1). Despite a more prominent, uniform, overall pessimism score acknowledging inherent risks, a preponderance of those surveyed (103/128, 82.4%) plan to increase social media usage. Using a linear regression model, we found that optimism predicts an increase in future social media usage, while the pessimism score has no predictive value. This implies that perceived benefits outweigh the risks.

Additional predictors of increasing social media use are younger age and use at work. Dermatologists may be moving to social media for economic reasons, and younger physicians may consider a social media presence necessary to compete in a modern medical marketplace. This is likely a self-reinforcing process where physicians that use social media to recruit more patients will benefit most and feel more positively about it. Alternatively, physicians who are currently not using social

XSL•FO
RenderX

media are not exposed to its benefits and therefore view social media as nonadvantageous. Studies suggest that 32% of people have made health decisions using social media [21] and may explain that one of the perceived benefits of social media discovered in our survey was the ability to recruit patients. A recent study by Murphy et al [22] found that 43% of all patients consider social media to be moderately to extremely important in choosing a dermatologist, particularly for patients seeking cosmetic procedures [23-25].

Perception of benefits and risks of social media varied by generation. Unexpectedly, millennials (ages 23-38 years in 2019) and baby boomers (ages 55-73 years) shared similar views of social media, while GenX (ages 39-54 years) tended to be the least optimistic. Prior studies show that older internet users are less optimistic about social media [26]; however, the common notion that older practitioners are less likely to adapt to emerging technologies may not be true [27]. The discovery that millennials have more optimism regarding social media may not be surprising; however, the shift in demographics is important, as millennials are now the largest proportion of the adult US population [28]. It is likely that millennial and Generation Z (ages 7-23 years) patients will drive an increased need for quality dermatologic information on social media. This underscores the importance of mitigating risks to encourage dermatologists of all generations to engage on social media.

Finally, our survey found that educational and collaborative capabilities were cited among the key advantages of using social media. The rapid dissemination and easy accessibility of new treatments, interesting cases, and continuing medical education through social media highlight this benefit. The perceived benefit of educational opportunities stands in contrast to the lower utilization of social media by academic dermatologists uncovered in our survey. A list of the top influencers in dermatology was recently published [14]; however, less than half (14/30) were faculty at academic institutions, highlighting an opportunity for academic dermatologists to engage on social media.

Limitations

Our study was limited by a small sample size. Our sample population demonstrates similar demographics to other studies [29]; however, few responses from baby boomers require caution in the interpretation of our generational results. Similarly, bias toward positive social media perceptions may have been introduced by delivering our survey using a social media platform. The APD listserv was utilized to mitigate this bias and increase the practice diversity of our cohort.

Our survey's completion rate was 77.7% (128/166); however, a response rate could not be calculated since our survey was posted online and was shareable. We mitigated this by tracking clicks on our survey, which produced 166 respondents.

Conclusion

Our survey identified risks that act as barriers and perceived benefits driving increased social media usage. Views varied significantly among generations, with millennial and baby boomer dermatologists expressing more optimistic outlooks than Generation X. Our research can be used to develop best practices to mitigate risks of privacy violation, litigation, and poor patient care, while promoting education and collaboration can help shape the presence of dermatology on social media.

Conflicts of Interest

MYB is a consultant for Med Engagement Labs for work unrelated to this project. JGZ is a consultant for X4Pharmaceuticals for a project unrelated to this paper. The other authors have no conflicts of interest to declare.

Multimedia Appendix 1
Web-based survey assessing dermatologists' social media perceptions.
[PDF File (Adobe PDF File), 2222 KB - derma_v4i1e24737_app1.pdf]

References

1. Salim S. How much time do you spend on social media? Research says 142 minutes per day. Digital Information World. URL: https://www.digitalinformationworld.com/2019/01/how-much-time-do-people-spend-social-media-infographic.html [accessed 2020-05-12]
2. Park JH, Christman MP, Linos E, Rieder EA. Dermatology on Instagram: An Analysis of Hashtags. J Drugs Dermatol 2018 Apr 01;17(4):482-484 [FREE Full text] [Medline: 29601627]
3. Smailhodzic E, Hooijsma W, Boonstra A, Langley D. Social media use in healthcare: A systematic review of effects on patients and on their relationship with healthcare professionals. BMC Health Serv Res 2016 Aug 26;16:442 [FREE Full text] [doi: 10.1186/s12913-016-1691-0] [Medline: 27562728]
4. Tan A, Gutierrez D, Milam EC, Neimann AL, Zampella J. Patient health-seeking behavior on WeChat: Social media and dermatology. JAAD Case Reports 2020 Feb;6(2):136-138. [doi: 10.1016/j.jdcr.2019.11.015]
5. Julian AK, Welch J, Bean MM, Shahid S, Perna FM. Information About Sunscreen on YouTube and Considerations for Sun Safety Promotion: Content Analysis. JMIR Dermatol 2020 Jun 2;3(1):e14411. [doi: 10.2196/14411]
6. Croley JAA. Emerging roles of social media in dermatology. Cutis 2019 Jan;103(1):E13-E14. [Medline: 30758345]
7. Vosoughi S, Roy D, Aral S. The spread of true and false news online. Science 2018 Dec 09;359(6380):1146-1151. [doi: 10.1126/science.aap9559] [Medline: 29590045]

XSL•FO
RenderX

8. Nsoesie EO, Cesare N, Müller M, Ozonoff A. COVID-19 Misinformation Spread in Eight Countries: Exponential Growth Modeling Study. J Med Internet Res 2020 Dec 15;22(12):e24425 [FREE Full text] [doi: 10.2196/24425] [Medline: 33264102]
9. Granter SR, Papke DJ. Opinion: Medical misinformation in the era of Google: Computational approaches to a pervasive problem. Proc Natl Acad Sci U S A 2018 Jun 19;115(25):6318-6321. [doi: 10.1073/pnas.1808264115] [Medline: 29921726]
10. Pulido CM, Ruiz-Eugenio L, Redondo-Sama G, Villarejo-Carballido B. A New Application of Social Impact in Social Media for Overcoming Fake News in Health. Int J Environ Res Public Health 2020 Apr 03;17(7) [FREE Full text] [doi: 10.3390/ijerph17072430] [Medline: 32260048]
11. Gómez-Zúñiga B, Fernandez-Luque L, Pousada M, Hernández-Encuentra E, Armayones M. ePatients on YouTube: Analysis of Four Experiences From the Patients' Perspective. Med 2.0 2012 Apr 25;1(1):e1. [doi: 10.2196/med20.2039]
12. George D, Rovniak L, Kraschnewski J. Dangers and opportunities for social media in medicine. Clin Obstet Gynecol 2013 Sep;56(3):453-462 [FREE Full text] [doi: 10.1097/GRF.0b013e318297dc38] [Medline: 23903375]
13. Campbell L, Evans Y, Pumper M, Moreno M. Social media use by physicians: A qualitative study of the new frontier of medicine. BMC Medical Informatics and Decision Making 2016 Jul 15;16(1):91 [FREE Full text] [doi: 10.1186/s12911-016-0327-y] [Medline: 27418201]
14. Sierro TJ, Young PM, Kassabian SK, Wu KK, Armstrong AW. Dermatologists in social media: A study on top influencers, posts, and user engagement. J Am Acad Dermatol 2020 Nov;83(5):1452-1455. [doi: 10.1016/j.jaad.2020.03.001] [Medline: 32151630]
15. Ranpariya V, Chu B, Fathy R, Lipoff JB. Dermatology without dermatologists? Analyzing Instagram influencers with dermatology-related hashtags. Journal of the American Academy of Dermatology 2020 Dec;83(6):1840-1842. [doi: 10.1016/j.jaad.2020.05.039]
16. Eysenbach G. Improving the quality of Web surveys: the Checklist for Reporting Results of Internet E-Surveys (CHERRIES). J Med Internet Res 2004 Sep 29;6(3):e34 [FREE Full text] [doi: 10.2196/jmir.6.3.e34] [Medline: 15471760]
17. Alsobayel H. Use of Social Media for Professional Development by Health Care Professionals: A Cross-Sectional Web-Based Survey. JMIR Med Educ 2016 Sep 12;2(2):e15. [doi: 10.2196/mededu.6232]
18. Dimock M. Where Millennials end and Generation Z begins. Pew Research Center. 2019. URL: https://www.pewresearch.org/fact-tank/2019/01/17/where-millennials-end-and-generation-z-begins/ [accessed 2019-01-17]
19. Fanti Silva DA, Colleoni R. Patient's Privacy Violation on Social Media in the Surgical Area. Am Surg 2018 Dec 01;84(12):1900-1905. [Medline: 30606346]
20. Nettrour J, Burch M, Bal B. Patients, pictures, and privacy: managing clinical photographs in the smartphone era. Arthroplast Today 2019 Mar;5(1):57-60 [FREE Full text] [doi: 10.1016/j.artd.2018.10.001] [Medline: 31020023]
21. Is Social Media Changing the Doctor-Patient Relationship? American Academy of Family Physicians. 2018 Jun 08. URL: https://www.aafp.org/news/practice-professional-issues/20180608commsurveys.html [accessed 2020-05-10]
22. Murphy E, Nelson K, Friedman A. The Influence of Dermatologists' Use of Social Media on Attracting Patients. J Drugs Dermatol 2020 May 01;19(5):532-538. [Medline: 32484619]
23. Maisel A, Waldman A, Furlan K, Weil A, Sacotte K, Lazaroff JM, et al. Self-reported Patient Motivations for Seeking Cosmetic Procedures. JAMA Dermatol 2018 Oct 01;154(10):1167-1174 [FREE Full text] [doi: 10.1001/jamadermatol.2018.2357] [Medline: 30140900]
24. Yoon S, Kim Y. Cosmetic Surgery and Self-esteem in South Korea: A Systematic Review and Meta-analysis. Aesthetic Plast Surg 2020 Feb;44(1):229-238 [FREE Full text] [doi: 10.1007/s00266-019-01515-1] [Medline: 31637500]
25. Nayyar A, Jadi J, Garimella R, Elkins-Williams S, Gallagher K, Kalliainen L, et al. Are You on the Right Platform? A Conjoint Analysis of Social Media Preferences in Aesthetic Surgery Patients. Aesthet Surg J 2019 Aug 22;39(9):1019-1032 [FREE Full text] [doi: 10.1093/asj/sjy238] [Medline: 30239573]
26. Older internet users less likely to view the internet as a positive for society. Pew Research Center. 2019. URL: https://www.pewresearch.org/fact-tank/2019/09/09/us-generations-technology-use/ft_19-09-06_internetgenerations_older-internet-users-less-likely-view-internet-positive-society/ [accessed 2020-04-27]
27. Yarbrough AK, Smith TB. Technology acceptance among physicians: a new take on TAM. Med Care Res Rev 2007 Dec;64(6):650-672. [doi: 10.1177/1077558707305942] [Medline: 17717378]
28. Fry R. Millennials outnumbered Boomers in 2019. Pew Research Center. URL: https://www.pewresearch.org/fact-tank/2020/04/28/millennials-overtake-baby-boomers-as-americas-largest-generation/ [accessed 2020-05-10]
29. DeWane ME, Grant-Kels JM. A commentary on gender bias in dermatology and its perceived impact on career development among women dermatologists. International Journal of Women's Dermatology 2020 Dec;6(5):440-444 [FREE Full text] [doi: 10.1016/j.ijwd.2020.07.010]

Abbreviations

APD: Association of Professors in Dermatology

XSL•FO
RenderX

Edited by G Eysenbach; submitted 07.10.20; peer-reviewed by K Acquaviva, M K.; comments to author 24.11.20; revised version received 27.01.21; accepted 31.01.21; published 24.02.21.

Please cite as:
Bressler MY, Grudnikoff E, Bressler Y, Tamez R, Zampella JG
Risks and Benefits of Using Social Media in Dermatology: Cross-sectional Questionnaire Study
JMIR Dermatol 2021;4(1):e24737
URL: https://derma.jmir.org/2021/1/e24737
doi:10.2196/24737
PMID:

©Moshe Y Bressler, Eugene Grudnikoff, Yaakov Bressler, Rebecca Tamez, John G Zampella. Originally published in JMIR Dermatology (http://derma.jmir.org), 24.02.2021. This is an open-access article distributed under the terms of the Creative Commons Attribution License (https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work, first published in JMIR Dermatology Research, is properly cited. The complete bibliographic information, a link to the original publication on http://derma.jmir.org, as well as this copyright and license information must be included.

XSL•FO
RenderX

Original Paper

Tetrahydrocannabinol and Skin Cancer: Analysis of YouTube Videos

Andrina Mamo[1], BS; Mindy D Szeto[1], MS; Roya Mirhossaini[2], MD; Andrew Fortugno[3], MD; Robert P Dellavalle[1], MD, PhD, MSPH

[1]Department of Dermatology, University of Colorado Anschutz Medical Campus, Aurora, CO, United States

[2]Department of Medicine, Riverside Community Hospital, Riverside, CA, United States

[3]Department of Medicine, University of Tennessee Health Sciences Center, Memphis, TN, United States

Corresponding Author:
Mindy D Szeto, MS
Department of Dermatology
University of Colorado Anschutz Medical Campus
1665 Aurora Court, 3rd Floor
Mailstop F703
Aurora, CO, 80045
United States
Phone: 1 720 848 0500
Email: mindy.szeto@cuanschutz.edu

Abstract

Background: Cannabis oil is being used topically by patients with skin cancer as a homeopathic remedy, and has been promoted and popularized on social media, including YouTube. Although topical cannabinoids, especially tetrahydrocannabinol (THC), may have antitumor effects, results from a sparse number of clinical trials and peer-reviewed studies detailing safety and efficacy are still under investigation.

Objective: We sought to assess the accuracy, quality, and reliability of THC oil and skin cancer information available on YouTube.

Methods: The 10 most-viewed videos on THC oil and skin cancer were analyzed with the Global Quality Scale (GQS), DISCERN score, and useful/misleading criteria based on presentation of erroneous and scientifically unproven information. The videos were also inspected for source, length, and audience likes/dislikes. Top comments were additionally examined based on whether they were favorable, unfavorable, or neutral regarding the video content.

Results: All analyzed videos (10/10, 100%) received a GQS score of 1, corresponding to poor quality of content, and 9/10 (90%) videos received a DISCERN score of 0, indicating poor reliability of information presented. All 10 videos were also found to be misleading and not useful according to established criteria. Top comments were largely either favorable (13/27, 48%) or neutral (13/27, 48%) toward the content of the videos, compared to unfavorable (1/27, 4%).

Conclusions: Dermatologists should be aware that the spread of inaccurate information on skin cancer treatment currently exists on popular social media platforms and may lead to detrimental consequences for patients interested in pursuing alternative or homeopathic approaches.

(JMIR Dermatol 2021;4(1):e26564) doi:10.2196/26564

KEYWORDS

THC; tetrahydrocannabinol; skin cancer; YouTube; cannabis; social media; internet

Introduction

Cannabis oil as a homeopathic remedy for skin cancer was most popularized by Rick Simpson, a Canadian medical marijuana activist. In 2003, Rick Simpson claimed that he was able to cure his basal cell carcinoma with his specially extracted "Rick Simpson Oil," an illegally produced high-tetrahydrocannabinol (THC) oil made from *Cannabis indica* [1]. An online documentary called Healing Cancer with Cannabis: The Rick Simpson Story [2] currently has over 150,000 views on YouTube and documents Rick Simpson's journey to curing both his skin cancer and that of others, including basal cell

XSL•FO
RenderX

carcinoma and melanoma. Given the increasing importance of social media and YouTube in disseminating information about health care and dermatology [3], we sought to characterize the quality of information patients attain from popular YouTube videos concerning THC and skin cancer.

Methods

On June 5, 2020, we searched YouTube using the phrase "THC skin cancer." The ranking option of "view count" was selected. The search resulted in a total of 32 videos; however, only nonduplicate videos with over 1000 views were analyzed in order to obtain accurate representation and capture the most popular videos that had reached the largest YouTube audiences. Two independent reviewers viewed and evaluated all videos, and any discrepancies between reviewers were discussed and resolved in a consensus meeting. All reviewers were experienced in skin cancer pathogenesis, clinical presentation, and treatment. Various predetermined attributes were surveyed, and videos were scored for quality and usefulness with the 5-point Likert scale Global Quality Scale (GQS) as described in Textbox 1 [3,4].

Textbox 1. Global Quality Scale 5-point scale description.

1. Poor quality, poor flow of the video, most information missing, not at all useful for patients. I would highly discourage a patient with skin cancer from watching this video.
2. Generally poor quality and poor flow. Some information listed but many important topics missing. Of very limited use to patients. I would discourage a patient with skin cancer from watching this video.
3. Moderate quality, suboptimal flow. Some important information is adequately discussed but other information is poorly discussed. Somewhat useful for patients. I would neither encourage nor discourage a patient with skin cancer from watching this video.
4. Good quality and generally good flow. Most of the relevant information is listed, but some topics not covered. Useful for patients. I would encourage a patient with skin cancer to watch this video.
5. Excellent quality and flow, very useful for patients. I would highly encourage a patient with skin cancer to watch this video.

Videos were additionally rated on an adapted DISCERN 5-point reliability scale, an assessment of health information quality used in previous studies [3,5]. Scoring of content accounted for the breadth of skin cancer information discussed, including epidemiology, pathogenesis, clinical features, and treatment. One DISCERN point was earned for each criteria fulfilled, for a maximum of 5 points (Textbox 2).

Textbox 2. Adapted DISCERN content reliability score description.

Reliability of information (0 points for no, 1 point for yes)

1. Are the aims clear and achieved?
2. Are reliable sources of information used? (ie, speaker is a dermatologist, publications were cited)
3. Is the information presented balanced and unbiased?
4. Are additional sources of information listed for patient reference?
5. Are areas of uncertainty mentioned?

Videos were further classified as useful or misleading based on the following yes/no criteria established in prior literature [6-10]:

1. Useful, if they contained scientifically sound information about any aspect of skin cancer.
2. Misleading, if they contained scientifically erroneous or unproven information about any aspect of skin cancer.

For each video, the top 3 comments determined by YouTube according to the number of "thumbs up" ratings were additionally assessed for whether the comment was favorable, neutral, or unfavorable toward the video content. The source and date of the comment were also recorded.

Results

The 10 videos surveyed (Multimedia Appendix 1) had a total view count of 645,821 views, with an average of 64,582 views per video. Video length ranged from around 2 minutes to over 107 minutes. Sources of videos were varied, and included cannabis companies, Rick Simpson affiliates, and patient perspectives. The surveyed videos had positive social engagement, with a cumulative "thumbs up" score of 4923, and a "thumbs down" score of 183.

Overall, 10/10 videos (100%) had a GQS score of 1, corresponding to "poor quality, poor flow of the video, most information missing, not at all useful for patients." Just 1 of 10 (10%) videos received a score of 1 of a possible 5 points on the DISCERN scale, corresponding to poor content reliability, while 9/10 (90%) videos received a score of 0. All 10 videos received a "no" rating according to the useful criteria, and a "yes" rating for misleading.

Summaries of video content and top comments for each video are shown in Multimedia Appendix 2. The commenting feature was turned off for one video. Overall, comments were all posted by individual YouTube users, and were largely favorable or neutral toward the video content, with 13/27 comments (48%)

XSL•FO
RenderX

classified as favorable, 13/27 (48%) neutral, and 1/27 (4%) unfavorable.

Discussion

Principal Findings

Patients are increasingly interested in and selecting nontraditional and alternative therapies for a variety of health conditions. Cannabis oil has achieved great popularity in the past few decades for the treatment of both nonmelanoma and melanoma skin cancers, despite the current lack of evidence; no clinical trials have yet to test their safety and efficacy in humans. Although early preclinical studies have shown that cannabinoids and cannabinoid derivatives may potentially have antitumor effects on keratinocyte carcinoma and melanoma [11], other studies have demonstrated that cannabinoids can be potent proinflammatory chemotactic agents in cell culture models [12].

The body's endocannabinoid system regulates cell growth through primary endocannabinoids, such as arachidonoyl ethanolamide (AEA) and 2-arachidonoyl glycerol (2-AG), and their metabolism by fatty acid amide hydrolase (FAAH). As detailed in previous reports [13], cannabinoid receptors CB1 and CB2 are found to be expressed on both nonmelanoma and melanoma skin cancers, with the former being largely expressed in the synaptic terminal in order to regulate neurotransmission, and the latter playing a role in activation of psychoactive properties [13].

Melanoma has largely been attributed to chronic sun damage (CSD) as well as non-CSD causes due to mutations in the cell regulatory pathway [14]. A study conducted by Armstrong et al [15] on melanoma cells treated with the cannabinoid THC displayed antitumor properties through the activation of autophagy and apoptotic pathways in vivo and in vitro. Similarly, cannabinoids have displayed antitumor effects in several other studies, focusing on CB2's anti-inflammatory properties and inhibition of Akt, a key element in the survival pathway of melanomas [16,17].

Cannabinoids have also demonstrated antitumor effects in nonmelanoma skin cancers. Squamous cell carcinomas (SCCs) are some of the most common cancers in humans and have been linked to risk factors including, but not limited to, UV exposure, chemical carcinogens, and viral infections [18]. Induction of apoptosis and tumor regression as an established effect of cannabinoid application has become evident through depression of angiogenic factors, such as vascular endothelial growth factor (VEGF) and angiopoietin-2 (Ang2), as well as decreasing activation of epidermal growth factor receptors (EGF-R) [19].

Although promising research on the treatment of skin cancers with cannabinoids is currently being conducted, the spread of information rooted in evidence-based medicine remains minimal on social media sites such as YouTube. Analysis of video content by two separate reviewers with health care experience and an educational background in skin cancer resulted in assessment of the information presented as uniformly misleading to viewers, along with a GQS of 1 assigned to all videos, demonstrating the pervasiveness of poor-quality information, and also largely unreliable content according to DISCERN criteria. It is concerning that top comments in response to these videos were overwhelmingly either favorable or neutral, highlighting the possibility that fake or secondary individual user accounts could be commenting to generate the outward appearance of validity and support for the video content. With the increasing use of social media, viral content, and thus the immense audience that can be reached via different platforms, including YouTube, inaccurate information can easily be spread to viewers who may be searching for solutions to skin-related problems. It is important for dermatologists to be aware that social media use may subsequently encourage patients to rely on information not provided by trained physicians and health care teams. Potentially harmful side effects or adverse consequences could be experienced by patients due to the dissemination of incorrect or poorly understood information. An increase in the presence of board-certified dermatologists on social media platforms would allow for improved patient education and propagation of medically accurate information to audiences seeking knowledge on skin cancer treatment with cannabinoids.

Conclusion

This study reiterates the importance of accessible, trustworthy, and engaging educational content curated by medical professionals for patients seeking information about skin cancer treatment online. In the surveyed YouTube data, no videos were curated by medical professionals tackling the popular issue of THC for the treatment of skin cancer, thus highlighting an opportunity for future engagement on social media to improve health education.

Conflicts of Interest

RPD is a Joint Coordinating Editor for Cochrane Skin, a dermatology section editor for UpToDate, a Social Media Editor for the *Journal of the American Academy of Dermatology (JAAD)*, and a Podcast Editor for the *Journal of Investigative Dermatology (JID)*. He is a coordinating editor representative on *Cochrane Council*. RPD receives editorial stipends (JAAD, JID), royalties (UpToDate), and expense reimbursement from Cochrane Skin. RPD is the Editor-in-Chief for *JMIR Publications* since April 2021, but had no role in reviewing this paper for publication in *JMIR Dermatology*. The other authors report no conflicts of interest.

Multimedia Appendix 1
Attributes of evaluated YouTube videos.

XSL•FO
RenderX

[DOCX File , 17 KB - derma_v4i1e26564_app1.docx]

Multimedia Appendix 2
Content summary and evaluation of the top 3 comments posted for each YouTube video.
[DOCX File , 17 KB - derma_v4i1e26564_app2.docx]

References

1. Li JY, Kampp JT. Review of Common Alternative Herbal “Remedies” for Skin Cancer. Dermatol Surg 2019;45(1):58-67. [doi: 10.1097/dss.0000000000001622]
2. Harrigan C. Healing Cancer with Cannabis: The Rick Simpson Story. 2017 May 12. URL: https://www.youtube.com/watch?v=Ak3Zo7-hNO0) [accessed 2020-09-21]
3. Qi J, Trang T, Doong J, Kang S, Chien A. Misinformation is prevalent in psoriasis-related YouTube videos. Dermatol Online J 2016 Nov 15;22(11):13030/qt7qc9z2m5. [Medline: 28329562]
4. Bernard A, Langille M, Hughes S, Rose C, Leddin D, Veldhuyzen van Zanten S. A systematic review of patient inflammatory bowel disease information resources on the World Wide Web. Am J Gastroenterol 2007 Sep;102(9):2070-2077. [doi: 10.1111/j.1572-0241.2007.01325.x] [Medline: 17511753]
5. Charnock D, Shepperd S, Needham G, Gann R. DISCERN: an instrument for judging the quality of written consumer health information on treatment choices. J Epidemiol Community Health 1999 Feb 01;53(2):105-111 [FREE Full text] [doi: 10.1136/jech.53.2.105] [Medline: 10396471]
6. Pandey A, Patni N, Singh M, Sood A, Singh G. YouTube as a source of information on the H1N1 influenza pandemic. Am J Prev Med 2010 Mar;38(3):e1-e3. [doi: 10.1016/j.amepre.2009.11.007] [Medline: 20171526]
7. Murugiah K, Vallakati A, Rajput K, Sood A, Challa NR. YouTube as a source of information on cardiopulmonary resuscitation. Resuscitation 2011 Mar;82(3):332-334. [doi: 10.1016/j.resuscitation.2010.11.015] [Medline: 21185643]
8. Singh AG, Singh S, Singh PP. YouTube for information on rheumatoid arthritis--a wakeup call? J Rheumatol 2012 May 01;39(5):899-903. [doi: 10.3899/jrheum.111114] [Medline: 22467934]
9. Sood A, Sarangi S, Pandey A, Murugiah K. YouTube as a source of information on kidney stone disease. Urology 2011 Mar;77(3):558-562. [doi: 10.1016/j.urology.2010.07.536] [Medline: 21131027]
10. Delli K, Livas C, Vissink A, Spijkervet F. Is YouTube useful as a source of information for Sjögren's syndrome? Oral Dis 2016 Apr 11;22(3):196-201. [doi: 10.1111/odi.12404] [Medline: 26602325]
11. Mounessa JS, Siegel JA, Dunnick CA, Dellavalle RP. The role of cannabinoids in dermatology. J Am Acad Dermatol 2017 Jul;77(1):188-190. [doi: 10.1016/j.jaad.2017.02.056] [Medline: 28416341]
12. Klein TW. Cannabinoid-based drugs as anti-inflammatory therapeutics. Nat Rev Immunol 2005 May;5(5):400-411. [doi: 10.1038/nri1602] [Medline: 15864274]
13. Scheau C, Badarau IA, Mihai L, Scheau A, Costache DO, Constantin C, et al. Cannabinoids in the Pathophysiology of Skin Inflammation. Molecules 2020 Feb 04;25(3):652 [FREE Full text] [doi: 10.3390/molecules25030652] [Medline: 32033005]
14. Turner N, Ware O, Bosenberg M. Genetics of metastasis: melanoma and other cancers. Clin Exp Metastasis 2018 Aug 2;35(5-6):379-391. [doi: 10.1007/s10585-018-9893-y] [Medline: 29722002]
15. Armstrong JL, Hill DS, McKee CS, Hernandez-Tiedra S, Lorente M, Lopez-Valero I, et al. Exploiting cannabinoid-induced cytotoxic autophagy to drive melanoma cell death. J Invest Dermatol 2015 Jun;135(6):1629-1637 [FREE Full text] [doi: 10.1038/jid.2015.45] [Medline: 25674907]
16. Kis B, Ifrim FC, Buda V, Avram S, Pavel IZ, Antal D, et al. Cannabidiol-from Plant to Human Body: A Promising Bioactive Molecule with Multi-Target Effects in Cancer. Int J Mol Sci 2019 Nov 25;20(23):5905 [FREE Full text] [doi: 10.3390/ijms20235905] [Medline: 31775230]
17. Blázquez C, Carracedo A, Barrado L, Real PJ, Fernández-Luna JL, Velasco G, et al. Cannabinoid receptors as novel targets for the treatment of melanoma. FASEB J 2006 Dec 25;20(14):2633-2635. [doi: 10.1096/fj.06-6638fje] [Medline: 17065222]
18. Dotto G, Rustgi A. Squamous Cell Cancers: A Unified Perspective on Biology and Genetics. Cancer Cell 2016 May 09;29(5):622-637 [FREE Full text] [doi: 10.1016/j.ccell.2016.04.004] [Medline: 27165741]
19. Casanova ML, Blázquez C, Martínez-Palacio J, Villanueva C, Fernández-Aceñero MJ, Huffman JW, et al. Inhibition of skin tumor growth and angiogenesis in vivo by activation of cannabinoid receptors. J Clin Invest 2003 Jan 1;111(1):43-50. [doi: 10.1172/jci200316116]

Abbreviations

2-AG: 2-arachidonoyl glycerol
AEA: arachidonoyl ethanolamide
AP-2: angiopoietin-2
CSD: chronic sun damage
EGF-R: epidermal growth factor receptor
FAAH: fatty acid amide hydrolase

XSL•FO
RenderX

GQS: Global Quality Scale
SCC: squamous cell carcinoma
THC: tetrahydrocannabinol
VEGF: vascular endothelial growth factor

Edited by G Eysenbach; submitted 18.12.20; peer-reviewed by SAH Aqajari, A Hidki; comments to author 08.02.21; revised version received 16.02.21; accepted 14.04.21; published 04.05.21.

Please cite as:
Mamo A, Szeto MD, Mirhossaini R, Fortugno A, Dellavalle RP
Tetrahydrocannabinol and Skin Cancer: Analysis of YouTube Videos
JMIR Dermatol 2021;4(1):e26564
URL: https://derma.jmir.org/2021/1/e26564
doi:10.2196/26564
PMID:

©Andrina Mamo, Mindy D Szeto, Roya Mirhossaini, Andrew Fortugno, Robert P Dellavalle. Originally published in JMIR Dermatology (http://derma.jmir.org), 04.05.2021. This is an open-access article distributed under the terms of the Creative Commons Attribution License (https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work, first published in JMIR Dermatology Research, is properly cited. The complete bibliographic information, a link to the original publication on http://derma.jmir.org, as well as this copyright and license information must be included.

XSL•FO
RenderX

Original Paper

Tanning Misinformation Posted by Businesses on Social Media and Related Perceptions of Adolescent and Young Adult White Non-Hispanic Women: Mixed Methods Study

Megan Andreas Moreno[1], MD, MSEd, MPH; Marina C Jenkins[1], BS; DeAnn Lazovich[2], PhD

[1]Department of Pediatrics, University of Wisconsin-Madison, Madison, WI, United States

[2]Department of Epidemiology and Community Health, University of Minnesota, Minneapolis, MN, United States

Corresponding Author:
Megan Andreas Moreno, MD, MSEd, MPH
Department of Pediatrics
University of Wisconsin-Madison
2870 University Ave
Suite 200
Madison, WI, 53705
United States
Phone: 1 608 512 2525
Email: mamoreno@pediatrics.wisc.edu

Abstract

Background: Indoor ultraviolet (UV) tanning is common and consequential, increasing the risk for cancers including melanoma and basal cell carcinoma. At-risk groups include adolescents and young adults, who often report beliefs about benefits of tanning. Adolescent and young adults are also among the most ubiquitous social media users. As previous studies support that content about tanning is common on social media, this may be a way that young women are exposed to influential content promoting tanning, including health misinformation.

Objective: The purpose of this study was to evaluate health misinformation promoted by indoor tanning businesses via social media and to understand young women's perceptions of this misinformation.

Methods: This mixed methods study included (1) retrospective observational content analysis of indoor tanning salons' content on Facebook over 1 year and (2) qualitative interviews with a purposeful national sample of 46 White non-Hispanic women, age 16 to 23 years, who had recently tanned indoors. We assessed experiences with tanning businesses' posted content on social media through interviews. We used the constant comparative approach for qualitative analyses.

Results: Content analysis findings included data from indoor tanning businesses (n=147) across 50 states, yielding 4956 total posts. Among 9 health misinformation topics identified, the most common was the promotion of UV tanning as a safe way to get Vitamin D (n=73, 1.5%). An example post was "Stop by Body and Sol to get your daily dose of Vitamin D." Another misinformation topic was promoting tanning for health benefits (n=31, 0.62%), an example post was "the flu is not a season, it's an inability to adapt due to decreased sun exposure…" A total of 46 participants completed interviews (age: mean 20 years, SD 2). Almost all participants (45/46, 98%) used Facebook, and 43.5% (20/46) followed an indoor tanning business on social media. Approximately half of participants reported seeing social media posts from tanning salons about Vitamin D, an example of a participant comment was "I have [seen that] a few times..." Among the participants, approximately half believed it was safe to get Vitamin D from indoor UV tanning; a participant stated: "I think it is a valid benefit to UV tanning."

Conclusions: Despite the low frequency (range 0.5%-1.5%) of social media posts promoting health misinformation, participants commonly reported viewing these posts, and their perceptions aligned with health misinformation. Health education campaigns, possibly using social media to target at-risk populations, may be an innovative approach for tanning prevention messages.

(JMIR Dermatol 2021;4(1):e25661) doi:10.2196/25661

KEYWORDS

adolescent; social media; tanning; technology; media

XSL•FO
RenderX

Introduction

In 2009, the World Health Organization classified ultraviolet (UV) radiation-emitting tanning devices as Class I carcinogens [1]. Indoor UV tanning has been shown to increase the risk of developing squamous and basal cell carcinoma and melanoma, particularly among people who start at an early age or tan frequently [1-5]. Fortunately, indoor tanning has declined over the past decade among adolescents and young adults, who have traditionally represented a population with a high prevalence of this behavior [6,7]. However, among the highest adolescent risk group of White non-Hispanic females, indoor tanning rates remained above 10% in 2017, which is nearly twice the overall rate of tanning among adolescents [8,9].

Previous studies have identified several factors that influence an adolescent or young adult's decision to pursue indoor tanning. These include beliefs about tanning contributing to beauty [10], social factors such as peer tanning behaviors [11], and positive attitudes and intentions toward tanning [12,13]. The role of media in promoting positive attitudes and intentions toward indoor tanning remains understudied. Previous studies have examined traditional media and found that watching reality television was associated with tanning [14] and that exposure to tan models in magazines promoted positive attitudes toward tanning [15]

In today's digital world, messages promoting indoor tanning may be shared through social media [16], which has nearly ubiquitous use among adolescent and young adults [17]. Previous studies [18,19] support social media as a platform in which comparison to others' appearances is positively associated with body dissatisfaction and even as a risk factor for eating disorders. Social media content related to tanning behavior is common, a previous study [20] examined Twitter and found 7.7 mentions of indoor tanning per minute, with only a small percentage mentioning health risks. While studies such as this have illustrated how users generate and share content about tanning on social media, less is known about the content shared by tanning businesses. Researchers in related fields, such as alcohol research, have hypothesized that the engagement and interaction that can occur with businesses via social media influence how marketing effects progress from awareness to encouraging behavior [21].

The spread of misinformation through social media can be particularly influential, as it is tied to emotions, identity, and one's social network. For this study we define misinformation as inaccurate or false information. Indoor tanning salons' business profiles on social media may increase exposure to misinformation among adolescent and young adults. The purpose of this mixed methods study was to evaluate health misinformation promoted by indoor UV tanning salons via social media and to understand adolescent and young adult's perceptions of this misinformation.

Methods

Overview

This mixed methods study included social media content analysis and qualitative interviews. Content analysis was conducted on the social media platform Facebook between the dates May 1, 2015 and April 30, 2016. This data collection received an exemption for observation of public information from the Seattle Children's institutional review board (15506 exempt).

Participant interviews were conducted after content analysis was complete in order to include observations from content analysis in the interview. These data were collected between May 8, 2017 and July 7, 2017. This data collection was approved by the Seattle Children's institutional review board (15710).

Social Media Content Analysis

Design

At the time of this study, Facebook was among the most popular sites used by the adolescent and young adult population [22]. Facebook also offered business profiles that allowed development of a free-standing multimedia profile with capacity to connect to and interact with users. Given its popularity among our target population and the robust content available for coding, this platform was selected for evaluation for this study.

Purposeful Sampling

The focus of this study was content posted on social media by businesses that provide indoor UV tanning. Our goal was to identify social media profiles created and maintained by indoor tanning salons. We focused on profiles that were popular among users and had both current and historical content to evaluate. Our goal was to evaluate 1 year of content retrospectively. For each of the 50 states, we evaluated 3 tanning business profiles to capture range and variation across businesses. We used purposeful sampling to identify profiles, a strategy used for description and investigation into social processes of particular groups.

Search Strategy

To identify potential profiles for evaluation, we conducted a search on Facebook for each of the 50 states using search terms in the form *"tanning salon"* + *[state]*, where *[state]* was replaced by each state name; we set the search criteria to deliver responses by relevance.

From the list of search results, we reviewed the first 10 business profiles listed, and from those profiles, we selected the 3 business profiles that had the largest number of followers.

We then evaluated each of the 3 profiles to ensure that they were publicly available profiles and that they prioritized UV tanning services. To confirm that the business prioritized UV tanning services, the business profile needed to meet a minimum of 2 of the 3 criteria: (1) include the word "tanning" in name of the business or business category selected on Facebook was "tanning salon," (2) describe the provision of UV tanning services in the About Me section of the profile, and (3) have 25% or more of the posts by the profile owner in the past month

XSL•FO
RenderX

refer to UV tanning. Additional inclusion criteria were that the business must have had the profile for at least 1 year (in order for us to be able to evaluate a full year of content) and that the business must have made at least 1 post during 2015 (to ensure that the profile was active during the coding period).

Facebook profiles that were labeled as unofficial pages were excluded: Facebook profiles have the option to indicate whether they are an official page sponsored by a busines or an unofficial page, which often represents an individual who is a fan or supporter of the business. Furthermore, because of our state-based approach to coding, tanning salon chains that extended to multiple states were excluded, though tanning chains located within single states were included.

If inclusion criteria were not met by a given profile, we selected the profile with the next highest number of followers. We developed a list of all salons that met inclusion criteria and the link to the Facebook page (so that the pages could be returned to later for coding).

Codebook Development and Variables

Through a previous study [23], we have created various codebooks containing keywords and image interpretation used in evaluating Facebook profiles for references to other health risk behaviors such as substance use and risky sexual behavior. Through a review of the literature [13,23,24] and pilot coding, we developed and tested a codebook focused on tanning-related health misinformation. We also recorded basic information about the tanning business, including the name, location, and number of followers.

Interrater Reliability

We conducted interrater agreement assessments at the beginning and end of the coding process. Interrater agreement ranged from 84% to 99% at the beginning to 91% to 100% at the end of coding across the health misinformation variables.

Procedure

Trained coders reviewed 1 year of content on each business social media profile. Assessing a full year of content allowed us to capture data to represent events (ie, spring break) and seasons. Pilot data collection illustrated that most tanning business profiles posted multiple times per day and frequently duplicated the same post during a given day or across a given month. Thus, our content analysis strategy was to evaluate 1 post per day, selected as the final post of that day, every third day of the month. This strategy allowed us to ensure that both weekdays and weekends were included in each month's evaluations and to vary the day of the week evaluated over time. Furthermore, if that post was identical to the post evaluated from a previous day, that post was skipped and the prior post for that day was evaluated. This allowed us to diversify the content evaluated.

We recorded data for each selected post as follows: for text posts, we recorded verbatim text; for user-generated photos, we recorded a thorough description of the photo; and for popular public images, such as memes or other downloadable icons, we copied and pasted the image into the data set. We also recorded the date that the post was uploaded to the social media profile. Each social media post was considered the unit of analysis and was thus categorized and coded based on which constructs were represented in that post. Data were extracted to a customized database (FileMaker, Claris International) and saved into a secure data file that was password protected.

Qualitative Interviews

Design

A qualitative approach was best suited to investigating young women's experiences and perspectives [25]. The goal of this inquiry was to understand individual experiences and allow participants privacy in their responses to questions. Thus, individual interviewing was selected as the method.

Participant Sample and Recruitment

Given the qualitative approach, the goal sample size was 40 participants with experience with both indoor tanning and engagement with a tanning salon on social media. With purposeful sampling and this sample size, we estimated we could achieve theoretical saturation. We conducted purposeful recruitment to target participants who were among the demographic most likely to engage in tanning: White non-Hispanic females ages 16 through 23 years [26]. Our purposeful sampling also included focused recruitment efforts on participants who were likely to have engaged with indoor tanning salon content on social media. Thus, we recruited participants via Facebook advertisements. A Facebook advertisement was created and targeted to a national sample of women ages 16 through 23 years. The advertisement was posted for a total of 3 weeks. The advertisement described an interview study about indoor UV tanning experiences. Interested participants were directed to a website to complete eligibility screening to ensure they met inclusion criteria (experienced indoor tanning in the past year and were in our target demographic). These potentially eligible participants then underwent phone screening to confirm eligibility and complete informed consent. We obtained informed consent from participants over the age of 18 years and the parents of minors; We obtained informed assent from participants under the age of 18 years.

Interview Guide Development and Training

During interviews, we asked about perceptions and experiences viewing content from indoor tanning businesses on social media. Questions were designed to invite sharing of perspectives without judgment. Interview questions were designed to be semistructured and open-ended, allowing participants to expand their comments with follow-up prompts. Interview questions included asking participants about their indoor tanning experiences as well as their social media usage. Example questions included "In what ways do indoor tanning salons use social media?" Interviewers then provided a brief overview of the study findings regarding observations of health misinformation on social media. Participants were asked about thoughts, experiences, and reactions to this shared information.

Interviewer training involved reading training materials, observing standardized interviews, and conducting a minimum

XSL•FO
RenderX

of 1 pilot interview prior to conducting interviews for this study. There were 2 interviewers for this study.

Data Collection

Interviews were conducted by phone. The interviewer confirmed that the participant was in a private and comfortable location prior to beginning the interview. Data were recorded in a customized online platform (FileMaker Pro) during the interviews. Interviews lasted between 20 and 40 minutes. Participants received a US $40 incentive upon completing the interview.

Analysis

Three investigators with experience in qualitative analysis were involved in the analysis process. The investigators utilized a constant comparative approach to categorize responses [25]. Two of the 3 investigators first individually reviewed all transcripts and then met to discuss data categorization. The goal of the first cycle was to collaboratively develop and apply a coding schema. The 2 investigators then independently coded 5 interviews (blinded to one another's coding). After coding the transcripts, they reviewed the codes unblinded. All 3 investigators then met and discussed and reached consensus for any additions or revisions to coding categories. The third senior investigator served to resolve unclear areas or disagreements between investigators. The coding process was then applied to a second set of interviews with 2 investigators. The purpose of this second review was to evaluate reliability and validity of the initial classification criteria. After coding review, discussion and achieving consensus on the coding categories, the coding approach was applied to the remaining interviews using the same constant comparative approach.

Results

Social Media Content Analysis

Of a total of 147 indoor tanning business Facebook pages that were evaluated across 50 states, 3 businesses closed prior to coding initiation. This sample of indoor tanning business Facebook pages yielded 4956 posts. Among 8 health misinformation topics identified, the most common were posts promoting misinformation about Vitamin D (n=73, 1.3%). This misinformation typically focused on tanning as a safe and healthy way to get Vitamin D. The American Academy of Dermatology notes that tanning beds are not a safe way to get Vitamin D given the cancer risk [27]. Furthermore, since bulbs in tanning beds mostly emit UVA light, vitamin D can only be generated via UVB light. Thus, tanning beds do not provide sufficient exposure to create adequate doses of Vitamin D [27]. An example post was

> *Stop by Body and Sol to get your daily dose of Vitamin D.*

Most indoor tanning businesses that displayed misinformation about Vitamin D did so infrequently. Many businesses had only 1 Vitamin D–related post within the 1-year sample, though 3 businesses had 5 or more of this category of posts.

A second category was misinformation about tanning as a medical treatment (n=31 posts, 0.6%), for example,

> *...the flu is not a season, it's an inability to adapt due to decreased sun exposure…*

Some of these posts were consistent with described inaccuracies in an investigative report provided to the US House of Representatives. These inaccuracies mainly center on promoting tanning as having health benefits or as a health treatment, there is no evidence to support tanning as a safe health treatment for illness including mental illness, inflammatory diseases, sleep problems or pain disorders [28]. Most businesses that displayed misinformation about tanning as a medical treatment had only 1 of these posts within the 1-year sample; there were no businesses with more than 3 posts of this type in the 1-year sample.

Another category of misinformation was promoting misinformation about the benefits of a "base tan" (n=29 posts, 0.5%) The posts often argued that a base tan would prevent sunburn or was a protective measure to take prior to a vacation. There is no evidence that a base tan is protective against sunburn or against cancer risks from sun exposure [27]. Most tanning businesses displayed only 1 of these posts in the 1-year sample, and many were posted in late winter, prior to spring break season. Table 1 displays the 8 categories of health misinformation, and Table 2 displays example social media posts.

XSL•FO
RenderX

Table 1. Health misinformation displayed on Facebook posts (N=4956) by businesses across 50 states over a 1-year period.

Misinformation category and number of posts	Businesses (N=147), n
About Vitamin D (n=73)	37
1	26
2	6
3	2
5	1
9	1
15	1
Tanning as a medical treatment (n=31)	26
1	22
2	3
3	1
Indoor tanning is equivalent to sunshine (n=31)	18
1	11
2	4
3	2
9	1
About base tan (n=29)	14
1	10
2	3
13	1
Indoor tanning as safer than outdoor tanning (n=3)	3
1	3
About health benefits of tanning (n=7)	6
1	5
2	1
About skin appearance (n=40)	21
1	15
2	4
3	1
14	1
About cancer (n=7)	5
1	4
2	1

XSL•FO
RenderX

Table 2. Example posts.

Misinformation category	Posts
About Vitamin D	• "Best supplementation of UV next to an IV" • #VitaminD • "D is for doping: Vitamin D"
Tanning as a medical treatment	• "UVB from tanning is a safe treatment for acne, eczema and seasonal depression" • "Link to article describing tanning as prevention for cancer, autism and depression"
Indoor tanning is equivalent to sunshine	• "Tanning=sunshine" • "Now serving sunshine"
About base tan	• "A base tan will keep you safe from UV rays" • "Start working on that base tan so you don't burn at the beach"
Indoor tanning as safer than outdoor tanning	• "Tanning indoor is taking responsibility for your tan. Prevent sunburn and using an indoor tanning lotion for best results!"
About health benefits of tanning	• "Women who avoid sunbathing during the summer are twice as likely to die as those who sunbathe every day" • "Getting enough sun optimizes 10% of our genes"
About skin appearance	• "Tanning lotions will tighten your skin" • "Tanning as 'age rewinding'"
About cancer	• "A great peer-reviewed journal article…but a little nerdy :) from the US National Library of Medicine and the National Institute of Health, showing that a continuous pattern of sun exposure appears NOT to increase risk of melanoma." • "According to a recent study the risk of skin cancer, particularly melanoma, decreases with proper tanning bed use"

Qualitative Interviews

A total of 46 interviews were conducted (age: mean 20 years, SD 2) and 26 states were represented in our sample. Among our participants, 45 (97.8%) used Facebook, and 20 (43.5%) followed an indoor tanning salon on social media. Most participants (38/46, 82.6%) mentioned viewing indoor tanning salon posts on social media to find out about sales or special offers; fewer (3/46, 6.5%) noted that they learned tips related to tanning from these posts.

Approximately half (21/46, 45.5%) of participants acknowledged that indoor tanning businesses likely used social media to "draw people in" and influence tanning behavior. Some participants who followed tanning businesses on social media specifically noted that social media posts may normalize tanning behaviors or "promote tanning benefits." Table 3 includes the most common topics that participants described viewing on indoor tanning salons' social media pages.

Just over half (25/46, 54.3%) of participants expressed that social media influenced their friends, or people in general, to go tanning more often, and 52.2% (24/46) mentioned that social media influenced them personally to tan more. Some participants (4/46, 8.7%) stated that posts on social media by indoor tanning salons led them to see tanning as safer than the sun or the business as trustworthy.

As Vitamin D was the most common category of social media misinformation posts, we asked participants whether they had seen indoor tanning businesses post on social media about Vitamin D. Approximately half (20/46, 43%) of participants reported seeing social media posts from tanning salons about Vitamin D:

> *I have [seen that] a few times...* [Participant]

Among those participants, approximately half (25/46, 54%) believed it was safe to get Vitamin D from indoor tanning stating, for example,

> *I think it is a valid benefit to UV tanning.* [Participant]

XSL•FO
RenderX

Table 3. Qualitative interviews with White non-Hispanic adolescent and young adult women about indoor tanning and social media (n=46).

Topic	Participants (n=46), n (%)	Example quotations
Type of content posted by indoor tanning salons on social media reported by participants		
Deals and sales	38 (82.6)	"They post $4 tan weeks, come tan for $5, promotions and deals mainly"
Lotions	12 (26.0)	"They post sales on lotion and promotions trying to get new people to come in, on Twitter for retweets they give away free lotion and tanning minutes"
Tanning tips	3 (6.5)	"…they also give tips for what is good for your skin and what isn't"
How tanning salons use social media		
Attract new customers	20 (45.5)	"They are trying to get customers or potential customers"
Showcase deals or promotions	18 (40.9)	"To promote brand recognition and specials they are running that month…They also promote employment for that salon. If you work at the salon, you get free tanning."
Remind and/or motivate people to tan	7 (15.9)	"There is also the psychological aspect to it where they post motivations like, "everyone looks good tan" to try to get more people to start tan"
Sell lotions	6 (13.6)	"Advertising their prices and different lotions they have for their clients"
Promote tanning benefits	4 (9.1)	"They probably want to decrease the stigma in tanning to make it look more beneficial"
Target young people	3 (6.8)	"To reach their target market or to target those who are younger"
What role does social media play in you or your friends tanning		
Influences people to tan more	25 (54.3)	"I think it would make us tan more than we actually do want to or intend to"
Influence the participant to tan more	24 (52.2)	"It has made me want to tan. I used to be against, but then Facebook drew me into it and now I'm doing it"
Motivate to go tanning by deals	18 (38.1)	"If there's a deal more people will be inclined to do it, even people that don't regularly tan will go to take advantage of the deal"
Seeing friends post about tanning, not tanning salons, is influence to them	14 (30.4)	"When you see your friends on Facebook and they're tan it makes you want to be tan as well"
Motivate to go tanning by pictures of tan people	13 (28.3)	"I definitely see that it affects it. When you see people that are tan on social media you wish you were that tan"
Normalizes tanning	7 (15.2)	"I definitely thinking that seeing it a lot on social media makes it very normal. Since you see everyone else on social media, it makes it very acceptable"
Influences viewers to see tanning as safe	4 (8.7)	"Makes it seem like a safe thing to do. You don't think about the risks"

Discussion

General

This mixed methods study included social media content analysis and qualitative participant interviews. We found an overall low frequency of social media posts promoting health misinformation (range 0.5%-1.5%); however, many (20/46,43.5%) of our participants actively followed tanning businesses on social media, and participants commonly reported remembering misinformation posts such as those promoting tanning as a safe way to get Vitamin D.

Our first finding was that social media posts related to health misinformation were uncommon. Most of the content posted by tanning businesses was related to other topics, such as deals or sales as described by our participants. These findings are consistent with a previous study examining hashtags related to tanning that found that most tanning salon posts were related to price reductions [29]. We found that the most common category of misinformation—indoor tanning as a safe way to get Vitamin D—comprised less than 2% of posts recorded across the year. It is important to clarify that our data did not represent that UV tanning could provide Vitamin D, but that posts described UV tanning as a safe way to achieve Vitamin D, which identifies these statements as clear misinformation as there is no evidence that the body can achieve adequate Vitamin D levels safely (given cancer risks) or adequately [27]. Furthermore, in many categories of health misinformation, most tanning businesses displayed only 1 post in that category across our 1-year evaluation period. Given these findings, it is even more striking that many participants reported recalling these posts. This finding suggests that these health misinformation posts, while uncommon, were memorable and may have been influential. Our findings from participant comments clearly support that the practice of following social media tanning businesses contributed to reminders to participants to go tanning, through deals and specials, and reminders about motivations to tan. It is also important to note that a social media platform is interactive, whereby users and businesses can interact bidirectionally. Thus, while the frequency of these health misinformation posts displayed by tanning businesses was

XSL•FO
RenderX

uncommon, these posts can be shared or distributed across an individual's own social media.

Our second finding was that, among our purposeful sample focused on those who engage in indoor tanning as well as social media, participants commonly engaged with social media related to tanning. As nearly half (20/46, 43.5%) participants followed a tanning business on social media, this supports the potential reach and influence that tanning salons have among young social media users. Participants described that indoor tanning salons' social media pages provided them reminders, nudges, and information about special deals and sales. Participants described the influence of tanning-related social media on their own tanning attitudes, as well as on their behaviors. This finding suggests that, of the approximately 10% of young White females who continue to engage in indoor tanning, social media may be a viable platform to reach this at-risk population with education or intervention approaches.

Limitations

Our study is not without limitations. This study focused on tanning businesses that were present on Facebook, and we did not examine other platforms such as Snapchat or Instagram. We were interested in how popular tanning businesses utilized social media to engage with customers. Thus, our purposeful sampling strategy prioritized selection of tanning businesses that were popular on social media (ie, by number of followers). We excluded tanning salon chains that extended across states, which allowed us to focus on individual businesses within states. However, tanning salons within chains may reach more viewers compared to individual businesses. Furthermore, our Facebook data were from 2015; however, the role of Facebook as a platform to connect to businesses remains relevant today, and no new laws or regulations governing tanning business content on social media have arisen since that time. Finally, our qualitative interviews were purposeful in order to target the at-risk population for indoor tanning, thus evaluating external validity of our sample was not appropriate for this study.

Implications

Despite these limitations, our study has implications in the area of health misinformation. While the overall reduction in indoor tanning behaviors among women and adolescents [6,7] is a public health triumph, a significant at-risk group of White young women remain engaged in this health risk behavior [8,9]. Our study findings suggest that some of these women who tan are also connected to indoor tanning salons on social media. While misinformation may not be common or a significant motivator for adolescent and young adult tanning, social media connections between businesses and adolescents and young adults are very common and may provide ongoing engagement with and encouragement of tanning behavior, that is, this social media connection may foster ongoing relationships with tanning businesses and behavioral nudges to go tanning through deals and reminders about motivations to tan.

An initial strategy to prevent adolescents from following these businesses on social media may be to consider requiring *age-gating* for indoor tanning businesses. Age-gating would block access to indoor tanning social media pages for youth under age 18. The age-gating approach is currently used by alcohol companies on social media, and youth are supportive of applying this restriction to other businesses on social media [30]. Additional strategies may include creating regulations about health misinformation directed at indoor tanning businesses, similar to strategies used to limit health misinformation about tobacco and marijuana. Finally, strategies to reach at-risk women may include placing targeted educational campaigns on social media, similar to the Facebook advertisements that we used to recruit for this study, which were successful in identifying the population at risk for consequences of indoor tanning.

Our study focused on health misinformation messages shared on social media by tanning salons. However, the implications of our findings may contribute to a critical conversation about how health misinformation shared via social media may reach vulnerable populations and potential prevention strategies. First, age-gating may present a valid approach to limit youth access to content from businesses based on minimum age limits, such as alcohol, tobacco, e-cigarettes, marijuana, and tanning. Second, regulations that clearly define allowable messages on any medium (print, online, or social media) are critical to consider. Enhancing efforts around surveillance of social media would be an important part of such regulations. It is possible that funds from tax revenues related to these sale of these products could support regular and ongoing monitoring of industry compliance. Challenges to monitoring social media content include its potentially ephemeral nature, as well as the ability in social media to target content behaviorally, geographically, and temporally. While surveillance may not capture all businesses that post misinformation, for example, many of the businesses that posted Vitamin D misinformation did so only once during our data collection time period. However, ongoing surveillance may be likely to identify businesses that repeatedly post misinformation. For example, we found that 1 tanning business displayed 13 posts promoting misinformation about benefits of a base tan. Finally, our study illustrates that it is possible to create a sampling strategy to evaluate posts over time and to develop a codebook to identify content and achieve interrater reliability for such content. The content and keywords identified in this study may inform other social media surveillance methods using machine learning or automated text analysis for more widespread evaluation. It is also possible that partnering with adolescents and young adults who are often at the forefront of the learning curve for digital media may lead to creative prevention approaches.

Acknowledgments

The authors would like to thank contributors Nikita Midamba and Adrienne Ton. This study was funded by the National Cancer Institute (grant R03 CA201953-01); the funders had no involvement in study processes or writing.

XSL•FO
RenderX

Conflicts of Interest

None declared.

References

1. El Ghissassi F, Baan R, Straif K, Grosse Y, Secretan B, Bouvard V, WHO International Agency for Research on Cancer Monograph Working Group. A review of human carcinogens--part D: radiation. Lancet Oncol 2009 Aug;10(8):751-752. [doi: 10.1016/s1470-2045(09)70213-x] [Medline: 19655431]
2. International Agency for Research on Cancer Working Group on artificial ultraviolet (UV) lightskin cancer. The association of use of sunbeds with cutaneous malignant melanoma and other skin cancers: a systematic review. Int J Cancer 2007 Mar 01;120(5):1116-1122 [FREE Full text] [doi: 10.1002/ijc.22453] [Medline: 17131335]
3. Ferrucci L. M., Indoor tanning and risk of early-onset basal cell carcinoma. J Am Acad Dermatol 2012;67(4):552-562. [doi: 10.1158/1538-7445.am2012-635] [Medline: 22153793]
4. Lazovich D, Vogel RI, Berwick M, Weinstock MA, Anderson KE, Warshaw EM. Indoor tanning and risk of melanoma: a case-control study in a highly exposed population. Cancer Epidemiol Biomarkers Prev 2010 Jun;19(6):1557-1568 [FREE Full text] [doi: 10.1158/1055-9965.EPI-09-1249] [Medline: 20507845]
5. Colantonio S, Bracken MB, Beecker J. The association of indoor tanning and melanoma in adults: systematic review and meta-analysis. J Am Acad Dermatol 2014 May;70(5):847-57.e1. [doi: 10.1016/j.jaad.2013.11.050] [Medline: 24629998]
6. Guy GP, Watson M, Seidenberg AB, Hartman AM, Holman DM, Perna F. Trends in indoor tanning and its association with sunburn among US adults. J Am Acad Dermatol 2017 Jun;76(6):1191-1193 [FREE Full text] [doi: 10.1016/j.jaad.2017.01.022] [Medline: 28522044]
7. Holman DM, Jones SE, Qin J, Richardson LC. Prevalence of indoor tanning among U.S. high school students from 2009 to 2017. J Community Health 2019 Dec 22;44(6):1086-1089 [FREE Full text] [doi: 10.1007/s10900-019-00685-y] [Medline: 31230221]
8. Guy GP, Berkowitz Z, Tai E, Holman DM, Everett Jones S, Richardson LC. Indoor tanning among high school students in the United States, 2009 and 2011. JAMA Dermatol 2014 May 01;150(5):501-511 [FREE Full text] [doi: 10.1001/jamadermatol.2013.7124] [Medline: 24577222]
9. Skin cancer prevention progress report. Centers for Disease Control and Prevention. 2019. URL: https://www.cdc.gov/cancer/skin/pdf/SkinCancerPreventionProgressReport-2019-508.pdf [accessed 2020-12-20]
10. Mosher CE, Danoff-Burg S. Addiction to indoor tanning: relation to anxiety, depression, and substance use. Arch Dermatol 2010 Apr 01;146(4):412-417 [FREE Full text] [doi: 10.1001/archdermatol.2009.385] [Medline: 20404230]
11. Mosher CE, Danoff-Burg S. Social predictors of sunscreen and self-tanning product use. J Am Coll Health 2005 Nov;54(3):166-168. [doi: 10.3200/jach.54.3.166-168] [Medline: 16335316]
12. Mayer JA, Woodruff SI, Slymen DJ, Sallis JF, Forster JL, Clapp EJ, et al. Adolescents' use of indoor tanning: a large-scale evaluation of psychosocial, environmental, and policy-level correlates. Am J Public Health 2011 May;101(5):930-938 [FREE Full text] [doi: 10.2105/AJPH.2010.300079] [Medline: 21421947]
13. Lazovich D, Forster J, Sorensen G, Emmons K, Stryker J, Demierre M, et al. Characteristics associated with use or intention to use indoor tanning among adolescents. Arch Pediatr Adolesc Med 2004 Sep 01;158(9):918-924. [doi: 10.1001/archpedi.158.9.918] [Medline: 15351760]
14. Fogel J, Krausz F. Watching reality television beauty shows is associated with tanning lamp use and outdoor tanning among college students. J Am Acad Dermatol 2013 May;68(5):784-789. [doi: 10.1016/j.jaad.2012.09.055] [Medline: 23261546]
15. Dixon HG, Warne CD, Scully ML, Wakefield MA, Dobbinson SJ. Does the portrayal of tanning in Australian women's magazines relate to real women's tanning beliefs and behavior? Health Educ Behav 2011 Apr 24;38(2):132-142. [doi: 10.1177/1090198110369057] [Medline: 21263062]
16. Hossler EW, Conroy MP. YouTube as a source of information on tanning bed use. Arch Dermatol 2008 Oct 20;144(10):1395-1396. [doi: 10.1001/archderm.144.10.1395] [Medline: 18936411]
17. Smith A, Anderson M. Social media use in 2018. Pew Research Center. 2018. URL: http://www.pewinternet.org/2018/03/01/social-media-use-in-2018/ [accessed 2020-12-20]
18. Cohen R, Blaszczynski A. Comparative effects of Facebook and conventional media on body image dissatisfaction. J Eat Disord 2015 Jul 2;3(1):23-15-0061-3 [FREE Full text] [doi: 10.1186/s40337-015-0061-3] [Medline: 26140215]
19. Lee H, Lee HE, Choi J, Kim JH, Han HL. Social media use, body image, and psychological well-being: a cross-cultural comparison of Korea and the United States. J Health Commun 2014 Dec 09;19(12):1343-1358. [doi: 10.1080/10810730.2014.904022] [Medline: 24814665]
20. Seidenberg AB, Pagoto SL, Vickey TA, Linos E, Wehner MR, Costa RD, et al. Tanning bed burns reported on Twitter: over 15,000 in 2013. Transl Behav Med 2016 Jun 18;6(2):271-276 [FREE Full text] [doi: 10.1007/s13142-016-0388-6] [Medline: 27356997]
21. McClure AC, Tanski SE, Li Z, Jackson K, Morgenstern M, Li Z, et al. Internet alcohol marketing and underage alcohol use. Pediatrics 2016 Feb;137(2):e20152149 [FREE Full text] [doi: 10.1542/peds.2015-2149] [Medline: 26738886]

XSL•FO
RenderX

22. Lenhart A. Pew Research Center. URL: https://www.pewresearch.org/internet/2015/04/09/teens-social-media-technology-2015/ [accessed 2021-05-03]
23. Moreno MA, Parks MR, Zimmerman FJ, Brito TE, Christakis DA. Display of health risk behaviors on MySpace by adolescents: prevalence and associations. Arch Pediatr Adolesc Med 2009 Jan 05;163(1):27-34. [doi: 10.1001/archpediatrics.2008.528] [Medline: 19124700]
24. Bagdasarov Z, Banerjee S, Greene K, Campo S. Indoor tanning and problem behavior. J Am Coll Health 2010 Aug 06;56(5):555-562. [doi: 10.3200/jach.56.5.555-562]
25. Glesne C. Becoming Qualitative Researchers. 2nd ed. Reading, MA: Longman; 1999:34-65.
26. Guy GP, Berkowitz Z, Everett Jones S, Holman DM, Garnett E, Watson M. Trends in indoor tanning among US high school students, 2009-2013. JAMA Dermatol 2015 Apr 01;151(4):448-450 [FREE Full text] [doi: 10.1001/jamadermatol.2014.4677] [Medline: 25535810]
27. 10 surprising facts about indoor tanning. American Academy of Dermatology Association. URL: https://tinyurl.com/xpbm3kpa [accessed 2021-05-01]
28. False and misleading health information provided to teens by the indoor tanning industry investigative report. Dermatology Nurses' Association. Washington, DC: U.S. House of Representatives Committee on Energy and Commerce URL: https://www.dnanurse.org/sites/default/files/downloads/2012/Tanning%20Investigation%20Report%202.1.12.pdf [accessed 2021-05-01]
29. Ricklefs CA, Asdigian NL, Kalra HL, Mayer JA, Dellavalle RP, Holman DM, et al. Indoor tanning promotions on social media in six US cities #UVTanning #tanning. Transl Behav Med 2016 Jun 26;6(2):260-270 [FREE Full text] [doi: 10.1007/s13142-015-0378-0] [Medline: 27356996]
30. Moreno MA, Gower AD, Jenkins MC, Kerr B, Gritton J. Marijuana promotions on social media: adolescents' views on prevention strategies. Subst Abuse Treat Prev Policy 2018 Jul 02;13(1):23-24 [FREE Full text] [doi: 10.1186/s13011-018-0152-7] [Medline: 29961426]

Abbreviations

UV: ultraviolet

Edited by G Eysenbach; submitted 10.11.20; peer-reviewed by DW Yoo, Y Miao, L Rutter; comments to author 07.01.21; revised version received 05.03.21; accepted 04.04.21; published 19.05.21.

Please cite as:
Moreno MA, Jenkins MC, Lazovich D
Tanning Misinformation Posted by Businesses on Social Media and Related Perceptions of Adolescent and Young Adult White Non-Hispanic Women: Mixed Methods Study
JMIR Dermatol 2021;4(1):e25661
URL: https://derma.jmir.org/2021/1/e25661
doi:10.2196/25661
PMID:

©Megan Andreas Moreno, Marina C Jenkins, DeAnn Lazovich. Originally published in JMIR Dermatology (http://derma.jmir.org), 19.05.2021. This is an open-access article distributed under the terms of the Creative Commons Attribution License (https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work, first published in JMIR Dermatology Research, is properly cited. The complete bibliographic information, a link to the original publication on http://derma.jmir.org, as well as this copyright and license information must be included.

XSL•FO
RenderX

Original Paper

Nonprescription Products of Internet Retailers for the Prevention and Management of Herpes Zoster and Postherpetic Neuralgia: Analysis of Consumer Reviews on Amazon

Pengyi Zhu[1,2*], BS; Benjamin K P Woo[1*], MD

[1]Olive View-University of California Los Angeles Medical Center, Sylmar, CA, United States

[2]College of Osteopathic Medicine of the Pacific, Western University of Health Sciences, Pomona, CA, United States

[*]all authors contributed equally

Corresponding Author:
Pengyi Zhu, BS
College of Osteopathic Medicine of the Pacific
Western University of Health Sciences
309 E 2nd St
Pomona, CA, 91766
United States
Phone: 1 909 623 6116
Email: sharonpzhu2@gmail.com

Abstract

Background: Herpes zoster affects approximately 1 million people annually in the United States, with postherpetic neuralgia as the most common complication. The frequent prescription of opioids as the first-line medication for herpes zoster or postherpetic neuralgia contributes to the increasing health care costs of their treatment. Despite the advent of internet retailers providing alternative products for the prevention and management these conditions, there are limited studies on the availability, ingredients, and consumer preference for the products.

Objective: This study used the internet retailer Amazon to determine the availability of products for the management of herpes zoster and postherpetic neuralgia, and assessed consumer preference based on listed ingredients.

Methods: The internet retailer Amazon was used to perform a search for products related to “shingles” in September 2020. Top products sorted by reviews and ratings were determined to be either shingles-specific (including “shingles” in either the product title or description) or shingles-nonspecific. Analysis of price, rating, type of vehicle, and ingredients was performed. The types of vehicles, ingredients, and percentages of positive and negative reviews related to “shingles” of the product groups were analyzed with a two-tailed two-sample proportions *Z*-test to assess the difference between shingles-specific and shingles-nonspecific products. Statistical significance was judged at $P<.05$.

Results: The top 131 products among over 3000 products retrieved were determined based on a rating of 4 or more stars after searching for the term “shingles” on Amazon. Forty-six of the 131 products (35.1%) were shingles-specific. Shingles-nonspecific products were more likely to have positive reviews mentioning “shingles” ($P=.005$). Vehicles, balms ($P=.02$), and salves ($P=.04$) were more likely to be shingles-specific, whereas tablets or capsules ($P=.002$) were more likely to be shingles-nonspecific. Among the ingredients analyzed, aloe vera was the top-ranked ingredient, included in 29 of the 131 total products (22.1%). Aloe vera ($P=.01$), lemon balm ($P<.001$), vitamin E ($P=.03$), and peppermint oil ($P=.008$) were more likely to be included in the shingles-specific products, whereas magnesium ($P=.01$) was more likely to be included in shingles-nonspecific products.

Conclusions: There is an abundance of products and ingredients being used for the management and treatment of shingles with certain ingredients preferred by consumers. There is a discrepancy between approved ingredients and the ingredients preferred by consumers. Furthermore, there are insufficient studies on ingredients used by consumers on internet retailers such as Amazon, and future studies can focus on the effectiveness of popular ingredients to decrease misinformation on the internet.

(JMIR Dermatol 2021;4(1):e24971) doi:10.2196/24971

KEYWORDS

Amazon; consumer preference; herpes zoster; postherpetic neuralgia; shingles; internet; customer; herpes; ingredients; treatment

XSL•FO
RenderX

Introduction

Shingles, or herpes zoster (HZ), is caused by reactivation of latent varicella zoster virus (VZV) in the sensory neurons, typically after the primary infection of chicken pox in childhood [1,2]. Previous studies have shown that more than 95% of adults across North America and Europe are at risk for HZ, and approximately 1 million people are affected by HZ in the United States annually [2,3]. Stress, aging, illness, medication, or other causes of decreased immunity can cause the activation of dormant VZV that commonly affects the cervical, thoracic, and trigeminal nerves [3,4]. Acute herpes zoster (AHZ) manifests as a painful blistering rash along a dermatome, initially presenting as a maculopapular rash that develops into vesicles and pustules [4,5]. Postherpetic neuralgia (PHN) is the most common complication of HZ, which is defined as the persistence of acute HZ pain in a dermatomal distribution that lasts over 3 months [1,3,6,7]. PHN is due to damage to the nerves from an inflammatory response caused by viral replication within the nerve [8]. PHN can cause allodynia, hyperalgesia, anesthesia, and other sensory deficits of the affected dermatome [3,9]. Owing to the debilitating nature of PHN, patients seek medications to manage the pain.

The therapies for AHZ include antivirals, corticosteroids as adjunctive therapy, acetaminophen or nonsteroidal anti-inflammatory drugs (NSAIDs) for analgesia, and capsaicin or lidocaine as topical treatment [8]. For PHN, first-line medications include calcium channel blockers (gabapentin and pregabalin), tricyclic antidepressants, and a lidocaine patch [10]. Second-line treatments include opioid analgesics and a capsaicin patch or cream [10]. A previous study showed that opioids were commonly prescribed as the initial treatment for PHN, followed by gabapentin, prescription NSAIDs, lidocaine patch, pregabalin, tricyclic antidepressant, topical lidocaine, and capsaicin, respectively [3].

However, with the advent of internet information and shopping through internet retailers such as Amazon, patients can now easily access nonprescription remedies for the rashes and neuropathic pain caused by shingles or PHN. Amazon has recently been utilized as a data source in studies to analyze consumer perception and preference for health-related products [11-13]. Some natural treatment choices offered on internet retailers have been studied for either PHN or neuropathic pain, including vitamins and nutrients such as zinc, licorice, honey, aloe vera, and St John's wort [14-16]. However, most herbal remedies such as St John's wort have not been assessed in proper clinical trials or have not been proven to be useful [17].

Given the readily available nonprescription options that claim effectiveness for shingles and PHN pain, it is important to understand what products are available for patients and the efficacy of the ingredients in these products. In this study, we evaluated the products that are available and preferred by customers through analyzing the vehicle types, ingredients, and customer reviews of shingles-related products sold on Amazon. Finally, we sought to understand the different factors and ingredients of products used for shingles or PHN prevention and treatment.

Methods

Amazon, the internet retailer, was accessed in September 2020 to search for products related to shingles. "Shingles" was used as the keyword to search in the "Health & Household" department of the website. The searches were screened for customer ratings of 4 stars and above. Products such as bandages or household items were excluded. Finally, only products that included the term "shingles" in the product title, description, Customer Reviews, or Customer Question and Answer were included in the final analysis. Product listings without mention of "shingles" in the product title, description, Customer Reviews, or Customer Question and Answer were excluded. For product listings with different quantities and sizes, only the listing with the most reviews was included. From the overall products, the average price, median price per unit, average ratings, average number of reviews, type of vehicle, and ingredients were determined. Several ingredients studied previously for shingles were analyzed in this study [14,17,18].

Two groups were derived from the original sample set. First, products that included the term "shingles" in either the product title or description were classified as shingles-specific products. Second, products that did not include the term "shingles" in either the product title or description, but included the term in either the Customer Reviews or the Customer Question and Answer sections were classified as shingles-nonspecific products. A two-tailed two-sample proportions *Z*-test was used to determine if a product specific to "shingles" was more likely to be a specific vehicle or to include certain ingredients. The numbers of positive and negative reviews in Customer Reviews including the term "shingles" were counted. The two-tailed two-sample proportions *Z*-test was also used to compare the means of percentages of positive and negative reviews among all reviews of products including "shingles" for shingles-specific and shingles-nonspecific products. A P value <.05 was considered to indicate a statistically significant difference.

Results

Over 3000 results were populated on the Amazon internet retailer when searching for the key term "shingles." There were 742 results in the "Health & Household" department that received a rating of 4 stars and above. Among the 131 top-rated products, there was a total of 215,225 reviews with a median of 698 reviews (range 24-16,523 reviews) and an average rating of 4.4 (out of 5) stars with a median of 4.4 (range 4-4.9 stars). Different types of vehicles for shingles were counted and categorized. Among the 131 total products, 44 (33.6%) were creams or lotions, 30 (22.9%) were tablets or capsules, 11 (8.4%) were gels, 10 (7.7%) were balms, 8 (6.1%) were bath products, 7 (5.3%) were ointments, 6 (4.6%) were oils, 5 (3.8%) were salves, and the remaining 10 products (7.6%) included powders, wipes, pump dispensers, liquids, and sprays. Among all reviews for the products that mentioned "shingles," there was an average of 82.6% positive reviews and 10% negative reviews.

Among the 131 products, 46 (35.1%) products that included "shingles" in either the title or product description comprised

XSL•FO
RenderX

shingles-specific products and 85 (64.9%) that did not include "shingles" in either the title or product description comprised the shingles-nonspecific products. Table 1 shows the top 10 most reviewed overall shingles products and Table 2 shows the top 10 most reviewed shingles-specific products. Comparison of the two tables reveals only three products among both the top 10 most reviewed overall products and the top 10 most reviewed shingles-specific products: Leven Rose Store's Jojoba Oil, Emuaid's EmuaidMAX Ointment, and Quantum Health's Super Lysine.

Table 1. Top 10 most reviewed overall products.

Rank	Manufacturer	Product name	Number of reviews	Mean rating (out of 5)
1	Leven Rose Store	Jojoba Oil	16,523	4.7
2	Puriya	Mother of All Creams	11,139	4.3
3	Sun Essential Oils	Geranium	9046	4.2
4	Emuaid	EmuaidMAX Ointment	8974	4.0
5	Truremedy	Remedy Soap	8800	4.5
6	Mederma	Mederma Advanced Scar Gel	8063	4.2
7	Ramina	Natural Hemp Cream	6377	4.3
8	Puriya	Wonder Balm	6050	4.3
9	Quantum Health	Super Lysine	5875	4.6
10	NOW Foods	Double Strength L-Lysine	5607	4.7

Table 2. Top 10 most reviewed shingles-specific products.

Rank	Manufacturer	Product name	Number of reviews	Mean rating (out of 5)
1	Leven Rose Store	Jojoba Oil	16,523	4.7
2	Emuaid	EmuaidMAX Ointment	8974	4.0
3	Quantum Health	Super Lysine	5875	4.6
4	Blue Emu	Original Blue-Emu Super Strength	4723	4.5
5	Dermachange	Shingles	3254	4.2
6	Wild Naturals	Eczema & Psoriasis Cream	2896	4.1
7	Clearbody Organics	Hemp Relief Cream	2828	4.4
8	Era Organics	Relief	1885	4.0
9	Emuaid	Emuaid	1794	4.2
10	Frankincense & Myrrh	Neuropathy Rubbing Oil	1574	4.3

When analyzing customer reviews including "shingles" among the shingles-specific products, there was an average of 69.5% positive reviews and 10.1% negative reviews among the total shingles-related reviews per product. Among the shingles-nonspecific products, there was an average of 89.9% positive reviews and 10% negative reviews out of the total shingles-related reviews per product. Shingles-nonspecific products were more likely to have positive customer reviews mentioning "shingles" based on the *Z*-test analysis (P=.005), whereas there was no significant difference in negative customer reviews between shingles-specific and shingles-nonspecific groups (P=.99).

Out of the 46 shingles-specific products, 18 (39%) were creams or lotions, 7 (15%) were balms, 4 (9%) were oils, 4 (9%) were salves, 3 (7%) were tablets or capsules, 3 (7%) were gels, 3 (7%) were ointments, 1 (2%) was a bath product, and 3 (7%) were other products, including pump dispenser, spray, and liquid. Among the 85 shingles-nonspecific products, 27 (32%) were tablets or capsules, 26 (31%) were creams or lotions, 8 (9%) were gels, 7 (8%) were bath products, 4 (5%) were ointments, 3 (4%) were balms, 2 (2%) were oils, 1 (1%) was a salve, and 7 (8%) were other products, including powders, liquid, sprays, wipes, and solutions. Balms (P=.02) and salves (P=.04) were more likely to be shingles-specific, whereas tablets or capsules (P=.002) were more likely to be shingles-nonspecific.

Based on previous studies related to treatment for shingles, several ingredients were assessed from the products [14,17,18]. Among all 131 products, 29 (22.1%) contained aloe vera, 18 (13.7%) contained honey, 17 (13.0%) contained magnesium, 16 (12.2%) contained lemon balm, 14 (10.7%) contained L-lysine, 13 (9.9%) contained menthol, 11 (8.4%) contained lidocaine, 10 (7.6%) contained zinc, 9 (6.9%) contained oatmeal or oat straw extract, 7 (7.6%) contained St John's wort, 6 (4.6%) contained licorice, 2 (1.5%) contained capsaicin, 2 (1.5%) contained Reishi mushroom, and 1 (0.8%) contained aspirin.

XSL•FO
RenderX

Out the 46 shingles-specific products, 16 (34.8%) contained aloe vera, 10 (21.7%) contained honey, 1 (2.2%) contained magnesium, 12 (26.1%) contained lemon balm, 5 (10.9%) contained L-lysine, 3 (6.5%) contained menthol, 2 (4.3%) contained lidocaine, 4 (8.7%) contained zinc, 2 (4.3%) contained oatmeal or oat straw extract, 4 (8.7%) contained St John's wort, 3 (6.5%) contained licorice, and none of the products contained capsaicin, Reishi mushroom, or aspirin. Among the 85 shingles-nonspecific products, 13 (15.3%) contained aloe vera, 8 (9.4%) contained honey, 16 (18.8%) contained magnesium, 4 (4.7%) contained lemon balm, 9 (10.6%) contained L-lysine, 10 (11.8%) contained menthol, 9 (10.6%) contained lidocaine, 6 (7.1%) contained zinc, 7 (8.2%) contained oatmeal or oat straw extract, 3 (3.5%) contained St John's wort, 3 (3.5%) contained licorice, 2 (2.4%) contained capsaicin, 2 (2.4%) contained Reishi mushroom, and 1 (1.2%) contained aspirin. Among all ingredients, aloe vera (P=.01) and lemon balm (P<.001) were more likely to be included in shingles-specific products, whereas magnesium (P=.01) was more likely to be included in shingles-nonspecific products.

Vitamins were assessed individually [15,16,18]. Among all 131 products, 4 (3.1%) included vitamin A, 3 (2.3%) included vitamin B2, 4 (3.1%) included vitamin B6, 2 (1.5%) included vitamin B9, 2 (1.5%) included vitamin B12, 15 (11.5%) included vitamin C, 3 (2.3%) included vitamin D, and 28 (21.4%) included vitamin E. Among the 46 shingles-specific products, 8 (17%) included vitamin C and 15 (33%) included vitamin E, whereas no products included vitamins A, B2, B6, B9, B12, or D. Of the 85 shingles-nonspecific products, 4 (5%) included vitamin A, 3 (4%) included vitamin B2, 4 (4%) included vitamin B6, 2 (2%) included vitamin B9, 2 (2%) included vitamin B12, 7 (8%) included vitamin C, 3 (4%) included vitamin D, and 13 (15%) included vitamin E. Vitamin E was more likely to be used in shingles-specific products (P=.03).

Specific oils were assessed based off prior studies, including peppermint oil, geranium oil, and hemp oil [19-21]. Among all 131 products, 19 (14.5%) included peppermint oil, 5 (3.8%) included geranium oil, and 15 (11.5%) included hemp oil. Of the 46 shingles-specific products, 12 (26%) included peppermint oil, none included geranium oil, and 8 (17%) included hemp oil. Out the 85 shingles-nonspecific products, 7 (8%) included peppermint oil, 5 (6%) included geranium oil, and 7 (8%) included hemp oil. Peppermint oil was more likely to be included in shingles-specific products (P=.008).

Discussion

Principal Findings

With nearly 1 million cases of HZ diagnosed annually in the United States, HZ can affect up to 20% of individuals within their lifetimes [22,23]. HZ is a large health care burden, with opioids prescribed as the most common first-line treatment, further contributing to the already high health insurance cost of opioids [3]. Patients inflicted by PHN can spend 2-4 times more on health costs than patients with only HZ [24]. As such, internet retailers such as Amazon provide other options for the management and treatment of HZ or PHN that can provide relief for patients. However, with the wide variety of products and ingredients available, it can be difficult for patients to determine which products would be effective. This study showed that among the variety of vehicles available, Amazon customers preferred creams or lotions, which comprised 33.6% of the 131 products, with tablets or capsules coming in second comprising 22.9% of the 131 products. Tablets or capsules were more likely to be shingles-nonspecific products, whereas balms and salves were more likely to be shingles-specific products. This suggests a lack of consensus regarding products recommended for shingles and products that patients prefer.

Over 3000 products were retrieved when searching "shingles" on Amazon. "Shingles" was used as the keyword as it is a term more widely known in the general population. Among the products indicated for shingles treatment, there were also household cleaning products, which raises concern that such products are being suggested for shingles use on the internet retailer. Out of the 131 products, only 35.1% included products that specifically mentioned shingles in either the title or product description, and the majority (64.9%) of products did not. Furthermore, only 3 products from the top 10 most reviewed overall shingles products were within the top 10 most reviewed shingles-specific products. This highlights the discrepancy between products that are suggested for shingles use and products that are labeled for shingles use. When comparing customer reviews that mention shingles between shingles-nonspecific and shingles-specific products, shingles-nonspecific products were more likely to have more positive customer reviews (89.9%) compared with shingles-specific products (69.5%). This suggests that customer reviews play a larger role in product selection compared to a specified product indication for shingles. Interestingly, there was no significant difference in customer reviews of shingles-specific and shingles-nonspecific products, further compounding the importance of reviews in the consumer selection of products.

Various ingredients were analyzed that were previously studied in relation to shingles or PHN treatment. A 5% lidocaine patch and 0.075% capsaicin cream are among first- or second-line topical treatment options for PHN [8]. In our analysis of the 131 products, 8.4% contained lidocaine and 1.5% contained capsaicin. Of the shingles-specific products, only 4.3% contained lidocaine and none contained capsaicin, whereas of the shingles-nonspecific products, 10.6% contained lidocaine and 2.4% contained capsaicin. Lidocaine acts as a local anesthetic with a mechanism of action involving partial inhibition of voltage-gated calcium channels and reducing the discharge of activity in afferent pain receptors [25]. Lidocaine is considered a first-line therapy for PHN despite limited studies on its effectiveness [26,27]. The lidocaine products found in the Amazon products were between 4% and 5% in concentration; however, none of the top products recommended including lidocaine was a patch, which is recommended in the literature [8]. The products including lidocaine were creams, gels, or sprays, which suggests that lidocaine administered using these vehicles was preferred among customers instead of patches. Topical capsaicin is an activator of the TRPV1 channel of nociceptor nerve fibers, leading to an influx of calcium that decreases the function of nociceptor nerve fibers [25]. Studies

XSL•FO
RenderX

have shown that a higher concentration of capsaicin was effective for PHN [28]. The concentration of capsaicin in the products found on Amazon was either 0.025% or 0.1%, whereas high-dose capsaicin products have a concentration of 8%. This may explain why capsaicin was not a highly preferred or recommended product as the smaller concentration only provides moderate relief for patients [25].

Other natural ingredients have been studied for their effects against HZ, such as licorice and Reishi mushroom [14]. Ingredients that have shown efficacy against herpes simplex virus (HSV) may also have a benefit for HZ, such as honey, aloe vera, and St John's wort [14,29]. Licorice may be able to inactivate viral particles and was reported to show in vitro antiviral activity against VZV, although further studies are needed to evaluate its use as a topical agent [14]. Reishi mushroom was tested in a small clinical trial and a case study, demonstrating relief of pain [14]. Honey has shown faster healing times for patients with HSV infection, suggesting a possible benefit against HZ [14]. Aloe vera is a known ingredient for wound healing, and St John's wort has shown antiviral activity against HSV-1 [14]. In this study, aloe vera was one of the top ingredients used among the 131 products, accounting for 22.1%, and is more likely to be used as an ingredient in shingles-specific products. This indicates that customers also prefer aloe vera for the treatment of shingles. Honey comprised 13.7% of all products, making it the second most likely included ingredient, suggesting that more studies should be performed to assess the efficacy of honey against HZ. St John's wort, licorice, and Reishi mushroom were less commonly used as ingredients; however, more studies can reveal if these ingredients will be of benefit to patients with HZ or PHN. Lemon balm was also more likely to be included in shingles-specific products; despite few studies regarding the use of lemon specifically for this condition, it is likely preferred for shingles owing to its high vitamin C level.

Decreased immunity is a known risk factor for HZ and PHN, with nutritional deficiency being a major cause [18]. Vitamin and nutrient deficiencies, such as zinc and magnesium, and their effect on HZ have been studied to assess their efficacy as potential treatments [18,30,31]. Low vitamin C levels have been found to play a role in the development of herpes infection and PHN, with trials of intravenous vitamin C demonstrating efficacy in relieving pain [16]. Hypovitaminosis D has been associated with the development of neuropathic pain due to various mechanisms, including inflammatory processes and an increase of reactive oxygen species [15,32]. Vitamin B such as cobalamin (vitamin B12) was shown to be effective for painful neuropathies, and deficiency of folic acid (vitamin B9) causes peripheral neuropathy [33,34]. Vitamin E has also been shown to act as an analgesic in rat models with neuropathic pain [35]. Zinc deficiency has been shown to be a risk factor for PNH [30]. Magnesium has been found to block the N-methyl-D-aspartate receptor, which is associated with hypersensitivity [30,36]. Among the ingredients assessed, magnesium was more likely to be included in shingles-nonspecific products, whereas vitamin E was more likely to be included in shingles-specific products. Given the sparsity of studies on the efficacy of either magnesium or vitamin E, these results suggest that more studies are warranted for assessing these nutrients in the treatment of HZ and PHN. Vitamin C was the second-ranked nutrient among the 131 products, although it was not necessarily preferred in shingles-specific products despite studies showing its role in HZ and PHN. This discrepancy could be due to the lower concentration of vitamin C as either an oral supplement or within topical agents compared to a higher available systemic dose as an intravenous treatment.

Finally, certain oils were assessed, including peppermint oil, geranium oil, and hemp oil [19-21]. Peppermint oil was more likely to be used as an ingredient in shingles-specific products. The main ingredient of peppermint oil is menthol, which is commonly used for musculoskeletal pain [19]. The possible mechanism of action of peppermint oil is the inhibition of sensitized nociceptors [19]. However, few studies have assessed peppermint oil; thus, its common use in shingles-specific products warrants more studies on its effect on HZ and PHN. Geranium oil was found to relieve pain quickly in a small study [16]; however, it was not widely used in shingles products available on Amazon. Hemp oil was used a primary ingredient in several products (11.5% of 131 total products); however, few studies have focused on its effect for shingles. A small trial showed the effectiveness of a cannabinoid receptor agonist topical for PHN [21]. Given that it is commonly used, hemp oil should be further studied to better understand if it is effective for the treatment of shingles.

Limitations

The main limitation of the study is that not all of the products related to "shingles" from Amazon were included in the analysis since there was over 3000 products found. Only the top 131 products were included with products receiving a rating of less than 4 stars excluded. Furthermore, products that did not include "shingles" in either the product name, description, or mentioned in the customer reviews were excluded. This excluded products that were suggested by the internet retailer algorithm but may not have been suggested by the manufacturer or customers to be used for shingles. Another limitation was that only "shingles" was used as the keyword to narrow down the search based on what the general populace would search. Searching for "postherpetic neuralgia" and "herpes zoster" could potentially produce more results. Furthermore, we did not analyze all of the active ingredients used by all of the products analyzed. Finally, we did not compare ingredients of the products with the amount of positive and negative reviews related to "shingles" that the product received. This comparison would allow for further analysis of whether specific ingredients were perceived to be effective to the general population.

Conclusion

Our analysis of "shingles" products on the internet retailer Amazon demonstrated an abundance of products and available ingredients used for shingles treatment. Although there are already available treatments that are approved for the management of AHZ and PHN, because these are conditions that are typically managed by several treatments, understanding over-the-counter management would benefit patients. Using Amazon to understand what is available to and preferred by

XSL•FO
RenderX

customers can allow us to assess which ingredients require further studies to better educate our patients on what would be effective for AHZ and PHN and to target potential misinformation online.

Conflicts of Interest

None declared.

References

1. Rahmatpour Rokni G, Rathod D, Tabarestani M, Mirabi A, Jha A, de Vita V, et al. Postherpetic neuralgia and recalcitrant cystic lesions following herpes zoster: A case report and review of treatment options. Dermatol Ther 2020 Jul 12;33(4):e13793. [doi: 10.1111/dth.13793] [Medline: 32510833]
2. Johnson RW, Rice AS. Postherpetic neuralgia. N Engl J Med 2014 Oct 16;371(16):1526-1533. [doi: 10.1056/nejmcp1403062]
3. Gudin J, Fudin J, Wang E, Haylon T, Patel K, Goss TF. Treatment patterns and medication use in patients with postherpetic neuralgia. J Manag Care Spec Pharm 2019 Dec;25(12):1387-1396. [doi: 10.18553/jmcp.2019.19093] [Medline: 31589557]
4. Argoff CE. Review of current guidelines on the care of postherpetic neuralgia. Postgrad Med 2011 Sep 13;123(5):134-142. [doi: 10.3810/pgm.2011.09.2469] [Medline: 21904096]
5. Ngo AL, Urits I, Yilmaz M, Fortier L, Anya A, Oh JH, et al. Postherpetic neuralgia: current evidence on the topical film-forming spray with bupivacaine hydrochloride and a review of available treatment strategies. Adv Ther 2020 May 15;37(5):2003-2016 [FREE Full text] [doi: 10.1007/s12325-020-01335-9] [Medline: 32297285]
6. Cunningham AL, Lal H, Kovac M, Chlibek R, Hwang S, Díez-Domingo J, ZOE-70 Study Group. Efficacy of the herpes zoster subunit vaccine in adults 70 years of age or older. N Engl J Med 2016 Sep 15;375(11):1019-1032. [doi: 10.1056/NEJMoa1603800] [Medline: 27626517]
7. Xing X, Sun K, Yan Y. Postherpetic Neuralgia. Topics in Pain Management 2001;17(4):13-17. [doi: 10.1097/00587875-200111000-00001]
8. Saguil A, Kane S, Mercado M, Lauters R. Herpes zoster and postherpetic neuralgia: prevention and management. Am Fam Physician 2017 Nov 15;96(10):656-663. [doi: 10.1093/med/9780190298357.003.0011]
9. Lin C, Lin Y, Lao H, Chen C. Interventional Treatments for Postherpetic Neuralgia: A Systematic Review. Pain Physician 2019 May;22(3):209-228 [FREE Full text] [Medline: 31151330]
10. Mallick-Searle T, Snodgrass B, Brant J. Postherpetic neuralgia: epidemiology, pathophysiology, and pain management pharmacology. J Multidiscip Healthc 2016;9:447-454. [doi: 10.2147/JMDH.S106340] [Medline: 27703368]
11. Xu S, Kwa M, Agarwal A, Rademaker A, Kundu RV. Sunscreen Product Performance and Other Determinants of Consumer Preferences. JAMA Dermatol 2016 Aug 01;152(8):920-927. [doi: 10.1001/jamadermatol.2016.2344] [Medline: 27385189]
12. Zhu P, Fung A, Woo BKP. Consumer preference of products for the prevention and treatment of stretch marks: systematic product search. JMIR Dermatol 2020 Jun 4;3(1):e18295 [FREE Full text] [doi: 10.2196/18295]
13. Chong KPL, Guo JZ, Deng X, Woo BKP. Consumer perceptions of wearable technology devices: retrospective review and analysis. JMIR Mhealth Uhealth 2020 Apr 20;8(4):e17544 [FREE Full text] [doi: 10.2196/17544] [Medline: 32310148]
14. Roxas M. Herpes zoster and postherpetic neuralgia: diagnosis and therapeutic considerations. Altern Med Rev 2006 Jun;11(2):102-113 [FREE Full text] [Medline: 16813460]
15. Chao C, Chiang C, Huang J, Hung K. Vitamin D is closely linked to the clinical courses of herpes zoster: From pathogenesis to complications. Med Hypotheses 2015 Oct;85(4):452-457. [doi: 10.1016/j.mehy.2015.06.027] [Medline: 26163058]
16. Kim MS, Kim DJ, Na CH, Shin BS. A Study of Intravenous Administration of Vitamin C in the Treatment of Acute Herpetic Pain and Postherpetic Neuralgia. Ann Dermatol 2016 Dec;28(6):677-683 [FREE Full text] [doi: 10.5021/ad.2016.28.6.677] [Medline: 27904265]
17. Boyd A, Bleakley C, Hurley D, Gill C, Hannon-Fletcher M, Bell P, et al. Herbal medicinal products or preparations for neuropathic pain. Cochrane Database Syst Rev 2019 Apr 02;4:CD010528 [FREE Full text] [doi: 10.1002/14651858.CD010528.pub4] [Medline: 30938843]
18. Chen J, Chu C, Lin Y, So EC, Shieh J, Hu M. Nutrient deficiencies as a risk factor in Taiwanese patients with postherpetic neuralgia. Br J Nutr 2011 Sep;106(5):700-707. [doi: 10.1017/S0007114511000481] [Medline: 21473799]
19. Davies SJ, Harding LM, Baranowski AP. A novel treatment of postherpetic neuralgia using peppermint oil. Clin J Pain 2002;18(3):200-202. [doi: 10.1097/00002508-200205000-00011] [Medline: 12048423]
20. Greenway FL, Frome BM, Engels TM, McLellan A. Temporary relief of postherpetic neuralgia pain with topical geranium oil. Am J Med 2003 Nov;115(7):586-587. [doi: 10.1016/s0002-9343(03)00434-0] [Medline: 14599644]
21. Phan N, Siepmann D, Gralow I, Ständer S. Adjuvant topical therapy with a cannabinoid receptor agonist in facial postherpetic neuralgia. J Dtsch Dermatol Ges 2010 Mar;8(2):88-91. [doi: 10.1111/j.1610-0387.2009.07213.x] [Medline: 19744255]
22. Insinga RP, Itzler RF, Pellissier JM, Saddier P, Nikas AA. The incidence of herpes zoster in a United States administrative database. J Gen Intern Med 2005 Aug;20(8):748-753 [FREE Full text] [doi: 10.1111/j.1525-1497.2005.0150.x] [Medline: 16050886]

XSL•FO
RenderX

23. Thompson R, Kong C, Porco T, Kim E, Ebert C, Acharya N. Herpes zoster and post-herpetic neuralgia: changing incidence rates from 1994 to 2018 in the United States. Clin Infect Dis 2020 Aug 23:ciaa1185. [doi: 10.1093/cid/ciaa1185] [Medline: 32829399]
24. Dworkin R, White R, O'Connor AB, Baser O, Hawkins K. Healthcare costs of acute and chronic pain associated with a diagnosis of herpes zoster. J Am Geriatr Soc 2007 Aug;55(8):1168-1175. [doi: 10.1111/j.1532-5415.2007.01231.x] [Medline: 17661954]
25. Shrestha M, Chen A. Modalities in managing postherpetic neuralgia. Korean J Pain 2018 Oct;31(4):235-243 [FREE Full text] [doi: 10.3344/kjp.2018.31.4.235] [Medline: 30310548]
26. Davies PS, Galer BS. Review of lidocaine patch 5% studies in the treatment of postherpetic neuralgia. Drugs 2004;64(9):937-947. [doi: 10.2165/00003495-200464090-00002] [Medline: 15101784]
27. Derry S, Wiffen P, Moore R, Quinlan J. Topical lidocaine for neuropathic pain in adults. Cochrane Database Syst Rev 2014 Jul 24(7):CD010958 [FREE Full text] [doi: 10.1002/14651858.CD010958.pub2] [Medline: 25058164]
28. Derry S, Sven-Rice A, Cole P, Tan T, Moore R. Topical capsaicin (high concentration) for chronic neuropathic pain in adults. Cochrane Database Syst Rev 2013 Mar 28(2):CD007393. [doi: 10.1002/14651858.CD007393.pub3] [Medline: 23450576]
29. Morelli V, Calmet E, Jhingade V. Alternative therapies for common dermatologic disorders, part 1. Prim Care 2010 Jun;37(2):269-283. [doi: 10.1016/j.pop.2010.02.004] [Medline: 20493336]
30. Lin Y, Lan K, Wang L, Chen J. Treatment of postherpetic neuralgia with intravenous administration of zinc sulfate: a case report. A A Pract 2018 Jul 01;11(1):8-10. [doi: 10.1213/XAA.0000000000000712] [Medline: 29634548]
31. Kim YH, Lee PB, Oh TK. Is magnesium sulfate effective for pain in chronic postherpetic neuralgia patients comparing with ketamine infusion therapy? J Clin Anesth 2015 Jun;27(4):296-300. [doi: 10.1016/j.jclinane.2015.02.006] [Medline: 25792176]
32. Chen J, Lin Y, Wang L, Hung K, Lan K, Ho C, et al. Hypovitaminosis din postherpetic neuralgia-high prevalence and inverse association with pain: a retrospective study. Nutrients 2019 Nov 15;11(11):2787 [FREE Full text] [doi: 10.3390/nu11112787] [Medline: 31731694]
33. Xu G, Lv Z, Xu G, Tang W. Thiamine, cobalamin, locally injected alone or combination for herpetic itching: a single-center randomized controlled trial. Clin J Pain 2014 Mar;30(3):269-278. [doi: 10.1097/AJP.0b013e3182a0e085] [Medline: 23887347]
34. Xu G, Lv Z, Feng Y, Tang W, Xu GX. A single-center randomized controlled trial of local methylcobalamin injection for subacute herpetic neuralgia. Pain Med 2013 Jun 08;14(6):884-894. [doi: 10.1111/pme.12081] [Medline: 23566267]
35. Kim HK, Kim JH, Gao X, Zhou J, Lee I, Chung K, et al. Analgesic effect of vitamin E is mediated by reducing central sensitization in neuropathic pain. Pain 2006 May;122(1-2):53-62. [doi: 10.1016/j.pain.2006.01.013] [Medline: 16524661]
36. Brill S, Sedgwick PM, Hamann W, Di Vadi PP. Efficacy of intravenous magnesium in neuropathic pain. Br J Anaesth 2002 Nov;89(5):711-714 [FREE Full text] [Medline: 12393768]

Abbreviations

AHZ: acute herpes zoster
HSV: herpes simplex virus
HZ: herpes zoster
NSAIDs: nonsteroidal anti-inflammatory drugs
PHN: postherpetic neuralgia
VZV: varicella zoster virus

Edited by G Eysenbach; submitted 12.10.20; peer-reviewed by S Lee, S Chung; comments to author 25.10.20; revised version received 27.10.20; accepted 18.01.21; published 08.02.21.

Please cite as:
Zhu P, Woo BKP
Nonprescription Products of Internet Retailers for the Prevention and Management of Herpes Zoster and Postherpetic Neuralgia: Analysis of Consumer Reviews on Amazon
JMIR Dermatol 2021;4(1):e24971
URL: http://derma.jmir.org/2021/1/e24971/
doi:10.2196/24971
PMID:

XSL•FO
RenderX

©Pengyi Zhu, Benjamin K P Woo. Originally published in JMIR Dermatology (http://derma.jmir.org), 08.02.2021. This is an open-access article distributed under the terms of the Creative Commons Attribution License (https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work, first published in JMIR Dermatology Research, is properly cited. The complete bibliographic information, a link to the original publication on http://derma.jmir.org, as well as this copyright and license information must be included.

XSL•FO
RenderX

Review

Does Wearing a Face Mask During the COVID-19 Pandemic Increase the Incidence of Dermatological Conditions in Health Care Workers? Narrative Literature Review

Robyn-Jenia Wilcha[1]

Faculty of Biology, Medicine and Health, University of Manchester, Manchester, United Kingdom

Corresponding Author:
Robyn-Jenia Wilcha
Faculty of Biology, Medicine and Health
University of Manchester
Oxford Road
Manchester, M13 9PL
United Kingdom
Phone: 44 (0)161 306 021
Email: robynwilcha05@gmail.com

Abstract

Background: COVID-19 is a health emergency. SARS-CoV-2 was discovered in Wuhan (Hubei Province, China) and has rapidly spread worldwide, leaving no country untouched. COVID-19 is a respiratory infection characterized by a pneumonia of unknown etiology. It is transmitted through respiratory droplets; for example: through breathing, talking, and coughing. Transmission of the virus is high. Health care workers play important roles in helping those affected by COVID-19; this could not be done without the use of personal protective equipment (PPE). PPE involves the use of goggles, masks, gloves, and gowns and is known to reduce COVID-19 transmission; however, multiple reports of skin disease and damage associated with occupational mask-wearing have emerged.

Objective: The objective of this study is to review the literature for newly emerging dermatological conditions as a result of occupational mask-wearing during the COVID-19 pandemic.

Methods: A narrative review of new reports of dermatological conditions associated with occupational mask-wearing was carried out in May 2020 by referencing keywords including: “covid mask dermatology,” “covid dermatological damage,” “covid mask skin,” “covid N95 mask damage,” and “covid mask skin damage” from PubMed, supplemented by searches on both Google Scholar and ResearchGate. A total of 287 articles were found, of which 40 were successfully included in this study, and an additional 7 were selected from the reference lists of these 40 articles. The findings were tabulated and analyzed under the following headings: dermatological diagnosis, causes, and management.

Results: Qualitative analysis of the reviewed data was carried out. A number of dermatological conditions were found to increasingly occur owing to prolonged and frequent use of face masks. Pressure-related injuries were often the most serious complaint; recommendations to reduce this type of injury include the use of hydrocolloid dressings, plastic handles, education, and regular moisturization. Innovation in PPE as well as services, such as virtual clinics, need to be advanced to protect the welfare of health care staff.

Conclusions: In these unprecedented times, PPE has been an effective barrier to the transmission of COVID-19 among health care workers. This has allowed health care workers to provide care to patients, with minimal risk. However, our findings suggest that despite the obvious benefits of using face masks to protect the respiratory system, there are also considerable health consequences to the skin. Future research studies are required to focus on improving face masks to ensure both the protection of the respiratory system as well as skin care, which, according to our study, has been overlooked.

(JMIR Dermatol 2021;4(1):e22789) doi:10.2196/22789

KEYWORDS

COVID-19; dermatology; face masks; health care worker; incidence; literature; mask; N95 mask; review; skin

XSL•FO
RenderX

Introduction

COVID-19, formerly known as the novel coronavirus infection, is a global public health emergency [1]. The causative virus was initially detected in Wuhan (Hubei Province, China) in December 2019; bats have subsequently been linked to the spread of the disease [1]. Typical symptoms of COVID-19 prominently include fever, cough, sore throat, breathlessness, fatigue, headache, and changes to cognition, although some infected individuals may be asymptomatic [1]. Human-to-human transmission of the virus occurs at high rates, and the virus can be spread through direct contact and respiratory particles [2]. Respiratory particles may be transmitted through breathing, talking, coughing, and sneezing [2].

As of May 2020, no drug nor antiviral vaccine has been officially approved for the treatment of COVID-19 [2]. The current state of emergency due to the COVID-19 pandemic has led to rapid acceleration of vaccine development. According to the World Health Organization, 10 vaccine candidates are currently in different clinical phases, and 123 vaccines are being evaluated in preclinical models [3]. Current management of COVID-19 includes infection prevention and supportive care, such as oxygen supplementation and maintenance of a continuous positive airway pressure [4]. Preventative strategies, such as face mask–wearing, help reduce respiratory transmission of COVID-19. The World Health Organization recommends the use of face masks among those who provide care to a person with suspected COVID-19 [5].

Protection against COVID-19 among health care workers is key to providing effective care; however, latest studies from China have reported a high number of adverse reactions caused by personal protective equipment (PPE), specifically surgical and N95 face masks. In a sample of 542 health care workers, 97% were found to have facial or hand dermatoses [6-10]. Despite published guidelines recommending to limit the time of wearing N95 masks to 2 hours, health care workers often wear masks for much longer periods [6]. The consequences of prolonged mask-wearing include the following: pressure-related injuries, various dermatoses, skin dryness, skin erythema, acne, eczema, urticaria, rosacea, secondary infections, nasal bridge ulceration, and exacerbation of known skin disorders [11,12]. The objective of this study is to review the emerging literature on newly emerging dermatological conditions as a result of occupational mask-wearing.

Methods

A narrative literature review was performed between May 1 and 29, 2020, in order to identify studies that evaluated the relationship between mask-wearing during the COVID-19 pandemic and the increase in the prevalence of certain dermatological conditions. Key search terms used herein included “covid mask dermatology,” “covid dermatological damage,” “covid mask skin,” “covid N95 mask damage,” and “covid mask skin damage.” The term “covid” was also replaced by “coronavirus,” “nCoV,” and “SARSCoV2” to increase the number of studies churned by the search. PubMed was the main electronic database that was searched, with search supplementation from Google Scholar and ResearchGate to identify missing articles. On eliminating duplicated searches, we found that the majority of studies found on Google Scholar and ResearchGate were duplicates of those found on PubMed. Qualitative results were obtained by comparing and summarizing results from all relevant and emerging studies by an independent researcher.

The inclusion criteria set for this study were vast owing to the limited literature sources and the novel exploratory design of the literature review. All articles included within the review explored new cases of dermatological damage caused by occupational use of PPE, focusing specifically on the damage caused by surgical and N95 masks, during the COVID-19 pandemic. Articles were sought from multiple institutions worldwide. Moreover, all articles focused on the effects of skin damage among health care workers; by definition, health care workers include physicians, nurses, health care assistants, pharmacists, students, therapists, and laboratory staff. Study designs included within the literature review were randomized controlled trials, cohort studies, and case studies. To further expand the breadth of the literature assessed, the review also accepted letters to the editors, commentaries, editorials, and perspectives. Articles that were case reports of individual patients’ dermatological findings in relation to COVID-19 were excluded from the study. Additionally, dermatological findings from previous pandemics including severe acute respiratory syndrome, Middle East respiratory syndrome, and Ebola were excluded.

On searching the aforementioned electronic databases, a total of 287 articles were found (PubMed: n=185, Google Scholar: n=67, and ResearchGate: n=35). After eliminating duplicate searches, 203 articles were screened by title and abstract, and a total of 120 articles were analyzed in full text. After full-text analysis, 40 articles, which satisfied the inclusion criteria, were included in the study. Through manual searches of the included articles’ reference lists, an additional 7 articles were identified. Prominent findings from the literature review are presented in a table under the following headings: dermatological diagnosis, causes, and management.

Results

A total of 287 articles were found from various searches. After the elimination of duplicated articles, the title and abstract of 203 articles were screened. Of these, 120 articles were deemed appropriate for full-text screening, of which 40 articles met the inclusion criteria. Manual review of their reference lists yielded an additional 7 articles.

The findings of these 47 papers reviewed in this study are summarized in Table 1. The table documents reported dermatological diagnoses resulting from prolonged mask-wearing with their relevant causes and the management of conditions. Qualitative analysis of the included articles was conducted.

XSL•FO
RenderX

Table 1. A table summarizing the causes and management of dermatological conditions resulting from occupational mask-wearing.

Dermatological diagnosis	Causes	Management
Pressure-related injuries	• Facial protective equipment, such as masks, place a significant amount of pressure on different facial areas, most notably the nasal bridge [13]. This can often cause numerous injuries at different facial points [14]. Pressure, friction and the hyperhydration effect caused by masks and goggles often result in skin indentation, mechanical skin damage, and epidermal barrier breakdown [12,15]. N95 masks specifically have increased air impermeability and a higher local pressure, increasing the risk of dermatological symptoms [7]. • Risk factors for pressure damage are the following: prolonged wearing of personal protective equipment (PPE) [14-17], repeated wearing of PPE [15], use of grade 3 PPE [14], joint use of masks and goggles [7], high humidity [15], and heavy sweating [14]. Conflicting findings based on the relevance of gender and pressure-related injuries were reported in several studies [7,14,17].	• Measures to reduce pressure-related injuries include the following: education of health care workers [7,17], wearing a properly fitted mask to minimize friction at specific points [7,11], regular moisturizing before and after the use of facial protective equipment for skin barrier repair [6,7,11,16], and limiting the time spent using a mask; published guidelines suggest limiting mask-wearing to 2 hours [6,11,13,16]. • Pressure-related injuries that are progressive or cause discomfort to the user may be relieved by the use of a hydrocolloid dressing [6,16-18]. Hydrocolloid dressings are composed of water, sodium polyacrylate, cellulose gum, and sodium hyaluronate; these components serve as a cushion for soft tissue, thus reducing pressure and retaining skin moisture [18]. Dong et al [18] conducted a study to observe if hydrogel patches relieve skin damage in 19 health care workers; they reported that using hydrogel patches resulted in a lower mean score for skin reactions (3.47, SD 1.39, compared to nonuse scores of 13.32, SD 2.06), demonstrating that hydrogel patches are able to reduce the emergence and severity of skin damage [18]. Furthermore, they reported that the use of hydrogel patches reduced skin indentation as well as pain [18]. • Conflicting evidence was reported on whether hydrocolloid dressings impacted the seal of facial masks [6,16,19]. • High levels of humidity are reportedly a predisposing factor to skin barrier damage [15]; to reduce humidity levels, it is recommended to line masks with a paper towel or gauze [15].
Irritant contact dermatitis (ICD)	• ICD is a common problem reported by health care workers [7,17,20]; symptoms include burning, itching, and stinging [11]. Formaldehyde, a material used in both surgical and N95 masks, has been recognized to be a frequent contact sensitizer for many people [7,16]. Acute and chronic dermatitis may be a result of skin and mucus membrane damage [11]. Facial protective equipment may induce ICD through occlusion and friction from the mask and the hyper-hydration effect of PPE; in turn, this breaks down the epidermal barrier of the skin [20]. Factors that predispose individuals to ICD include the following: increased moisture, warm environments, occlusion due to local pressure, and friction [7,21].	• Protective measures include the following: ensuring the proper fit of the mask, labeling of contact sensitizers on face masks [17], cooling the skin by ensuring adequate air conditioning at the site, and wiping skin to remove sweat at appropriate times [20]. Staff should limit the duration of mask-wearing by having rotating shifts and regular mask-free breaks [20]. Furthermore, staying hydrated may also reduce symptoms of dermatitis [20]. • Treatment of ICD includes the use of emollients before wearing masks [11,20,22]; emollients should be applied at least 30 minutes before wearing the mask to prevent damage to the mask [20]. Staff may also choose to line the mask with gauze to reduce the humidity [11]. For moderate to severe ICD, topical glucocorticoids may be recommended [11,20,22].
Allergic contact dermatitis (ACD)	• Occupational ACD was also a common problem reported among health care workers [17]. ACD has a similar set of symptoms to ICD, which includes the following: pruritus, burning sensations, facial and periocular erythema, and subtle eczematous lesions [12,17]. Aggravating factors that may induce ACD include the following: prolonged use of PPE [7], increased moisture from perspiration, occlusion effects from the mask [7,23], friction [7,23], atopic predisposition [7], and contact sensitizers including formaldehyde [17,23]. Maliyar et al [23] reported that 22.8% of the population is sensitive to formaldehyde.	• The gold standard for the diagnosis of ACD is patch testing [7]. • The treatment for ACD is similar to that recommended for ICD. It is important to ensure correct fitting of PPE [23], the use of facial moisturizers before and after using PPE [11,23], the avoidance of facial cleansing with overheated water, 75% ethanol, or a facial cleanser [11], and the use of hydrogel dressings on damaged skin [23]. Layers of gauze inside the mask may be used to reduce moisture effects within the mask [11]. For mild dermatitis, the use of emollients is adequate; if the dermatitis progresses, topical glucocorticoid ointments may be used [11].

XSL•FO
RenderX

Dermatological diagnosis	Causes	Management
Retroauricular dermatitis	• Retroauricular dermatitis is characterized by itching, redness, and scaling within the auricular region [24]. Ear pressure through the use of ear-hook masks is a reported cause of this type of dermatitis [15].	• Recommendations to reduce dermatitis and ear pain include the following: the use of strings or hairpins to lengthen the ear-hook string [15] help reduce the tightness of masks [25]. Jiang et al [26] explored the use of a plastic handle to reduce ear pressure exerted by N95 masks; the advantage of this method was the simplicity of the idea and the increase in comfort on using the masks.
Skin lesions	• Pei et al [27] reported that 73.1% of participants developed skin lesions due to PPE in a cohort of 484 health care workers. Skin lesions included the following: erythema, prurigo, blisters, rhagades, papule, oedema, exudation, crusting, and lichenification [12,27]. The most common sites were the nasal bridge as well as the cheeks and forehead [12]. Factors attributed to skin lesions included the following: higher grades of PPE, higher working frequency within PPE, and prolonged use of PPE [9,25,27].	• Measures to reduce the incidence of skin lesions include the following: wearing the mask correctly, taking mask-free breaks, and frequently replacing of protective gear [25].
Skin dryness	• In a sample of 542 participants in China, skin dryness was the most commonly reported symptom (70.3%) [9]. Closed humid environments, such as those resulting from breathing in masks and the use of PPE [9], result in skin barrier dysfunction [11,28]. Skin barrier dysfunction may consequently lead to skin dryness and scaling [11].	• Management of skin dryness involves the use of high-potency moisturizers before and after PPE use [11].
Skin erythema	• Hua et al [29] reported increased erythema following PPE use; erythema results from cutaneous blood vessel dilation and increased blood supply to the skin [29]. Although this may be a normal reaction to heat and pressure, long-lasting erythema may be a sign of inflammation [29]. Significant differences between the use of N95 masks and surgical masks have been reported; N95 masks reportedly increase the facial temperature of the user and are perceived to be more uncomfortable [30]. Factors potentially causing skin erythema include long hours and prolonged mask-wearing [20]. Campbell et al [31] reported that skin erythema may progress to miliaria owing to the associations of immobility and humidity through prolonged mask-wearing.	• Measures to reduce skin erythema include the following: limiting shift length [20], having mask-free breaks [20], and using a surgical mask rather than an N95 mask when appropriate [30].
Skin injury due to the use of disinfectants	• Skin injury due to the use of disinfectants may result in ICD [32] and ACD [13]. Excessive stress among health care workers because of working with patients with COVID-19 may increase the frequency and duration of skin cleansing, which disrupts the skin barrier and inevitably leads to skin damage [13].	• Although it is important to clean the face using soap-based cleansers after contact with patients with COVID-19 owing to the high risk of disease transmission, health care workers should be wary of excessive washing and the repeated application of disinfectants to the skin [13].
Secondary infections	• Skin and mucous membrane injury, through the disruption of the epidermal barrier, may lead to secondary infections [11]. Factors aggravating membrane injury include the following: prolonged mask-wearing resulting in a closed environment, compression, friction, and humidity [33].	• Avoidance of PPE and the use of antihistamines and antibiotics are recommended for the treatment of secondary infections [13,33]. To prevent secondary infections, it is important to stop water from entering damaged skin; this can be done using waterproof plasters [33].
Acne vulgaris		• The management of acne vulgaris includes the following: liberal use of moisturizers before and after using facial protective equipment, topical antibiotic creams for mild papules and pustules, as well as topical retinoid creams for blackheads and whiteheads [11]. Cases of severe acne vulgaris should be referred to a dermatologist [11].

XSL•FO
RenderX

Dermatological diagnosis	Causes	Management
	• Flares of acne have been reported to result from the use of facial protective equipment; this is thought to be due to increased temperature and humidity caused by the mask [34]. High temperatures as well as high humidity facilitate the progression of acne due to bacterial proliferation and the portal occlusive effect of skin hydration and irritation to the upper parts of the pilosebaceous duct; in turn, this causes swelling of the epidermal keratinocytes, leading to acute blockage of the skin barrier [11,34]. Other underlying mechanisms potentially include pressure and friction [11]. Interestingly, Han et al [34] observed no correlation between acne severity and prolonged mask-wearing. Signs of acne include comedones, papules on the cheeks and nose, as well as nodules or cysts on the forehead, submaxillary, and neck region [34].	
Eczema	• Navarro - Triviño et al [35] found eczema to be one of the most frequently reported skin diseases associated with PPE use. The risk of eczema increased with continuous use of masks and protective glasses [32,35] as a result of increased heat owing to the closed environment, and increased stress [28].	• Use of topical glucocorticoid creams or ointments is suggested for eczematous skin changes [13].
Rosacea	• Rosacea has been frequently reported in association with PPE use [35]. Increased heat and stress is linked to the exacerbation of rosacea [28]. Prolonged PPE use is a risk factor for developing rosacea [32].	N/A[a]
Urticaria	• Urticaria of the face has been linked to the resulting vertical pressure of facial protective equipment [11]. Risk factors include the following: prolonged wearing of protective equipment and excessive personal hygiene [12].	• Preventative measures include the use of correctly fitted protective equipment and antihistamines [11].
Impetigo	• Yu et al [36] documented a case of impetigo due to occupational goggle-mask–wearing during the pandemic [36]. Increased humidity, skin trauma, and malnutrition can increase the skin's vulnerability to infection and create a moist occlusive environment, allowing *Staphylococcus aureus* to grow and infect the damaged skin [36].	• Management of this condition included rest away from PPE and the application of topical 2% fusidic acid cream twice daily [36].
Nasal bridge ulceration	• Owing to occupational use of PPE, the nasal bridge was reported to be damaged in 83.1% of health care workers [37]. Pressure, friction, and the hyperhydration effect are known risk factors for ulceration [12,15.]	• Hydrocolloid dressings may be of use to successfully treat nasal bridge ulceration [37].
Exacerbations of known skin disease	• Flares of pre-existing dermatoses have been reported to result from PPE use [17,28,32]. Stress, due to the pandemic, has been linked to the aggravation of skin conditions such as psoriasis, eczema, atopy, and neurodermatitis [28,32].	• Zheng et al [32] questioned the use of psychological counseling to reduce the stress experienced by health care workers in order to reduce exacerbations of skin diseases.

[a]N/A: not applicable.

Discussion

Principal Findings

This preliminary and exploratory review documents the different dermatological conditions associated with occupational mask-wearing, by causes and management, among health care workers during the COVID-19 pandemic from the existing literature (in May 2020) (Table 1).

Personal Perspectives of Health Care Workers in Relation to Dermatological Problems

The literature reveals a high number of health care workers who are affected by skin damage; in a sample of 546 individuals, 526 (97%) staff members reported negative skin consequences

XSL•FO
RenderX

as a result of PPE use [6-10]. Symptoms of skin barrier damage, as reported by health care professionals, include burning, itching, and stinging [11]. The most common site of skin damage was the nasal bridge, and this occurred in 83.1% of health care workers [6-8,13].

Pei et al [27] conducted a study involving 484 health care workers and reported that 73.1% experienced various skin lesions including the following: erythema (38.8%), prurigo (22.9%), blisters (13.8%), rhagades (13.6%), papules (12.8%), exudation (6.8%), and lichenification.

Facial erythema was reported at varying rates; Pei et al [27] reported that 38.8% of health care workers experienced erythema, whereas Balato et al [38] found erythema rates to be higher at 60.4%. Singh et al [20] categorized two varying forms of erythema: whole face erythema (linked to prolonged hours) and lip lick erythema (linked to constant licking of lips from excessive thirst and fluid restriction). Scarano et al [30] investigated facial skin temperature in relation to occupational mask-wearing and reported a significant difference between surgical and N95 masks with regard to humidity, heat, breathing difficulty, and discomfort. Erythema, as a result of increased warmth, may cause health care workers to alter the position of their mask using contaminated hands, which may increase the risk of self-infection with COVID-19 [30].

Furthermore, skin papules have been reported to result from mask-wearing; papules are often a common sign of acne, alongside other symptoms such as comedones, nodules, and cysts [34]. Gheisari et al [21] reported that 35.5% of health care workers experienced acne as a consequence of occupational mask-wearing. Skin damage, such as an irritating pimples in the case of acne, may cause health care workers to repeatedly touch their face, thus increasing the risk of infection [34,39].

Iatrogenic skin damage, resulting from allergic and irritant contact dermatitis, is associated with occupational mask-wearing. In a sample of 14 health care workers, 35.7% of participants developed irritant contact dermatitis, and 28.6% of participants developed allergic contact dermatitis, which was associated with facial masks [24].

Another common complaint among health care workers concerned pressure-related injuries. Jiang et al [14] conducted a cross-sectional study, incorporating the views of 4308 health care workers and reported that 42.8% of respondents had skin injuries resulting from pressure (95% CI 41.30-44.30). Moreover, health care workers develop multiple skin lesions across different areas of the face; the disruption of the epidermal skin barrier across multiple sites may increase the risk of contracting COVID-19 among health care workers [14].

Lastly, Szepietowski et al [40] investigated the prevalence of pruritus among health care workers as a result of mask-wearing. From among 1393 participants, 273 (19.6%) reported an itching sensation. Higher incidences of pruritus have been reported in studies from Singapore and China; in Singapore, 51.4% of health care workers developed a facial itch [24], as opposed to 61.8% in China [27]. The risk of pruritus was further increased among those with an atopic predisposition, facial dermatoses, and prolonged PPE use [40]. Moreover, it was found that the sensation of pruritus caused health care workers to itch and touch their mask, reducing its protectiveness against COVID-19 [40].

Recommendations to Reduce the Adverse Effects Associated With Facial Masks

Despite evidence regarding the vast number of dermatological conditions resulting from mask-wearing, limited evidence is available on the occupational management of these problems. One study advocated the use of virtual occupational health checks to prevent serious skin damage among health care workers [41]. The virtual clinic was led by nurses who advised health care workers on protective self-care and skin care measures and triaged moderate and severe skin disorders to dermatologists if needed [42].

Pressure-related injuries associated with occupational mask-wearing has been common. Letters to the editor, written by multiple working health care professionals throughout the current pandemic, have highlighted the immense discomfort and pressure damage faced by staff on a regular basis [13,16,41]. Surprisingly, despite reports of discomfort and pressure damage, Jiang et al [14] reported that only 17.7% of health care professionals used prophylactic dressings and lotions. Hydrocolloid dressings have been suggested to reduce skin damage and improve comfort among health care workers who use facial masks [16]. A study by Dong et al [18] found that the use of hydrogel patches resulted in lower skin reaction mean scores (3.47, SD 1.39) compared to their nonuse (13.32, SD 2.06), demonstrating their ability to reduce the severity and incidence of skin damage. Furthermore, Payne [16] argued that a strip of hydrocolloid dressing over the area of pressure damage should not impair the mask seal and should be used by health care workers with pre-existing skin disease or those who wear masks for over 2 hours. Buckley et al [6] agreed with the use of hydrocolloid dressings; however, they recommended refit testing for staff members to ensure the seal was intact to prevent infection. In stark contrast, Yin et al [41] reported that hydrocolloid dressings may be harmful to the skin owing to the extreme stickiness of the dressing and the potential to rip away skin on removal. A recent study by Jiang et al [26] documented the use of a plastic handle on the N95 respirator to reduce pressure injuries to the ear and reduce mask adjustments made by health care workers. The advantages of using a plastic handle included improved comfort, intact mask seal, reduced risk of infection through a lower rate of mask adjustments, and easy disinfection of the handles [27]. Other methods to reduce pressure-related injuries include the following: education of health care professionals [7,38], use of a correctly fitted mask to minimize friction [7,11], regular moisturizing [6,7,11,16], and frequent mask-free breaks [6,11,13,16].

The alleviation of mental health conditions, such as stress and anxiety, within these unprecedented times also plays a key role in preventing skin damage. Li et al [33] reported that high mental stress may precipitate endocrine disorders such as acne through excessive secretion of androgens, which in turn stimulate excess sebum secretion from the sebaceous glands. This, along with mask-wearing, reduces local blood circulation and oxygen levels and causes occlusion of the sebaceous ducts

XSL•FO
RenderX

in hair follicles [33]. Additional factors that exacerbate skin stress include high-intensity work, irregular eating habits, and poor rest [32]. Other studies further corroborated the findings of Li et al, linking stress to acne [28], dermatitis [28], and pre-existing skin disorders [28,32].

In addition, anxiety has proved to be a problem among health care workers. A study conducted in Malaysia [41] reported that several pressure-related injuries were self-inflicted by health care professionals owing to overtightening of their N95 masks. Although overtightening of the masks provided the staff with mental relief of improved protection, it consequently increased the risk of skin damage and inadvertently increased the risk of COVID-19 infection through disrupted skin [41]. Staff members responsible for providing care to patients with COVID-19 should be educated on the efficacy of masks to reduce overtightening as well as anxiety [41].

Furthermore, nonmodifiable risk factors, such as gender, influenced the progression of skin damage. One study [25] reported that rashes were more likely to affect women. Zuo et al [39] found that women had a lower threshold for reporting symptoms of skin damage. However, Gefen et al [43] surveyed 4308 health care workers and found that the male prevalence of pressure injuries was significant and 1.6-fold that among women. Possible theories for this finding include differences in the facial architecture between men and women [41]. Moreover, this result may demonstrate the need for gender-specific PPE to prevent skin damage among men [41].

Limitations

Notable limitations of our study include the exploratory direction of the literature review; the available literature was restricted owing to the emerging nature of COVID-19 and lack of studies during the search period (May 1-29, 2020). Moreover, the data included within the review may be constrained by PubMed being the only legitimate scientific database being used herein; this may raise concerns that other important studies may have been missed. As a result of limitations arising from the aforementioned reasons, our literature review accepted all types of articles, which may have limited the applicability of the results to the broader population. Furthermore, numerous studies included within our literature review reported their findings on the basis of a small cohort, which may have decreased the reliability of the results. Furthermore, articles included in this literature review were from multiple institutions worldwide, most notably the United Kingdom and Asia. Difficulties, such as finding reliable translations of articles as well as a lack of literature from other countries, may also skew the results of this literature review.

Conclusions

PPE has been invaluable throughout the COVID-19 pandemic; it has allowed health care workers to safely provide care to the most vulnerable individuals, with minimal risk. Masks have provided the main form of essential protection to the respiratory system against COVID-19; however, owing to the rapid global threat COVID-19 presents, it is clear that the risk of skin damage resulting from mask-wearing has not been considered. The effects of skin damage can be dangerous among health care workers; the risk of infection may be increased through disruptions in the skin barrier as well as self-contamination through mask adjustments. The highly contagious nature of SARS-CoV-2 increases the likelihood that protective measures may stay in place from this day forward; innovation and advancements in PPE need to be sought to protect the skin and to reduce the currently increasing incidence of dermatological conditions among health care workers.

Conflicts of Interest

None declared.

References

1. Singhal T. A Review of Coronavirus Disease-2019 (COVID-19). Indian J Pediatr 2020 Apr 13;87(4):281-286 [FREE Full text] [doi: 10.1007/s12098-020-03263-6] [Medline: 32166607]
2. Zhang L, Wang M, Wang Y, Zhu J, Zhang N. Focus on the 2019 novel coronavirus (SARS-CoV-2). Future Microbiol 2020 Jul;15:905-918 [FREE Full text] [doi: 10.2217/fmb-2020-0063] [Medline: 32524843]
3. Al-Kassmy J, Pedersen J, Kobinger G. Vaccine Candidates against Coronavirus Infections. Where Does COVID-19 Stand? Viruses 2020 Aug 07;12(8):861 [FREE Full text] [doi: 10.3390/v12080861] [Medline: 32784685]
4. Abd El-Aziz TM, Stockand JD. Recent progress and challenges in drug development against COVID-19 coronavirus (SARS-CoV-2) - an update on the status. Infect Genet Evol 2020 Sep;83:104327 [FREE Full text] [doi: 10.1016/j.meegid.2020.104327] [Medline: 32320825]
5. Feng S, Shen C, Xia N, Song W, Fan M, Cowling BJ. Rational use of face masks in the COVID-19 pandemic. Lancet Respir Med 2020 May;8(5):434-436 [FREE Full text] [doi: 10.1016/S2213-2600(20)30134-X] [Medline: 32203710]
6. Buckley D, Stone N, British Society for Cutaneous Allergy Committee. British Society for Cutaneous Allergy advice on skin damage from FFP3 masks. BMJ 2020 Jun 09;369:m2268. [doi: 10.1136/bmj.m2268] [Medline: 32518080]
7. Bhatia R, Sindhuja T, Bhatia S, Dev T, Gupta A, Bajpai M, et al. Iatrogenic dermatitis in times of COVID-19: a pandemic within a pandemic. J Eur Acad Dermatol Venereol 2020 Oct;34(10):e563-e566 [FREE Full text] [doi: 10.1111/jdv.16710] [Medline: 32495393]

XSL•FO
RenderX

8. Fahmy D, El-Amawy HS, El-Samongy MA, Fouda A, Soliman S, El-Kady A, et al. COVID-19 and dermatology: a comprehensive guide for dermatologists. J Eur Acad Dermatol Venereol 2020 Jul;34(7):1388-1394 [FREE Full text] [doi: 10.1111/jdv.16545] [Medline: 32428303]
9. Lan J, Song Z, Miao X, Li H, Li Y, Dong L, et al. Skin damage among health care workers managing coronavirus disease-2019. J Am Acad Dermatol 2020 May;82(5):1215-1216 [FREE Full text] [doi: 10.1016/j.jaad.2020.03.014] [Medline: 32171808]
10. Elston DM. Occupational skin disease among health care workers during the coronavirus (COVID-19) epidemic. J Am Acad Dermatol 2020 May;82(5):1085-1086 [FREE Full text] [doi: 10.1016/j.jaad.2020.03.012] [Medline: 32171807]
11. Yan Y, Chen H, Chen L, Cheng B, Diao P, Dong L, et al. Consensus of Chinese experts on protection of skin and mucous membrane barrier for health-care workers fighting against coronavirus disease 2019. Dermatol Ther 2020 Jul;33(4):e13310 [FREE Full text] [doi: 10.1111/dth.13310] [Medline: 32170800]
12. Darlenski R, Tsankov N. COVID-19 pandemic and the skin: what should dermatologists know? Clin Dermatol 2020;38(6):785-787 [FREE Full text] [doi: 10.1016/j.clindermatol.2020.03.012] [Medline: 33341217]
13. Zhang B, Zhai R, Ma L. 2019 novel coronavirus disease epidemic: skin protection for healthcare workers must not be ignored. J Eur Acad Dermatol Venereol 2020 Sep;34(9):e434-e435 [FREE Full text] [doi: 10.1111/jdv.16573] [Medline: 32358808]
14. Jiang Q, Song S, Zhou J, Liu Y, Chen A, Bai Y, et al. The Prevalence, Characteristics, and Prevention Status of Skin Injury Caused by Personal Protective Equipment Among Medical Staff in Fighting COVID-19: A Multicenter, Cross-Sectional Study. Adv Wound Care (New Rochelle) 2020 Jul;9(7):357-364. [doi: 10.1089/wound.2020.1212] [Medline: 32320359]
15. Yu N, Xiao Y, Su J, Huang K, Zhao S. Practical tips for using masks in the COVID-19 pandemic. Dermatol Ther 2020 Jul;33(4):e13555 [FREE Full text] [doi: 10.1111/dth.13555] [Medline: 32390307]
16. Payne A. Covid-19: skin damage with prolonged wear of FFP3 masks. BMJ 2020 May 04;369:m1743. [doi: 10.1136/bmj.m1743] [Medline: 32366499]
17. Aerts O, Dendooven E, Foubert K, Stappers S, Ulicki M, Lambert J. Surgical mask dermatitis caused by formaldehyde (releasers) during the COVID-19 pandemic. Contact Dermatitis 2020 Aug;83(2):172-173. [doi: 10.1111/cod.13626] [Medline: 32468589]
18. Dong L, Yang L, Li Y, Yang J, An X, Yang L, et al. Efficacy of hydrogel patches in preventing facial skin damage caused by mask compression in fighting against coronavirus disease 2019: a short-term, self-controlled study. J Eur Acad Dermatol Venereol 2020 Sep;34(9):e441-e443 [FREE Full text] [doi: 10.1111/jdv.16638] [Medline: 32421878]
19. Smart H, Opinion FB, Darwich I, Elnawasany MA, Kodange C. Preventing Facial Pressure Injury for Health Care Providers Adhering to COVID-19 Personal Protective Equipment Requirements. Adv Skin Wound Care 2020 Aug;33(8):418-427 [FREE Full text] [doi: 10.1097/01.ASW.0000669920.94084.c1] [Medline: 32530822]
20. Singh M, Pawar M, Bothra A, Maheshwari A, Dubey V, Tiwari A, et al. Personal protective equipment induced facial dermatoses in healthcare workers managing Coronavirus disease 2019. J Eur Acad Dermatol Venereol 2020 Aug;34(8):e378-e380 [FREE Full text] [doi: 10.1111/jdv.16628] [Medline: 32396675]
21. Gheisari M, Araghi F, Moravvej H, Tabary M, Dadkhahfar S. Skin reactions to non-glove personal protective equipment: an emerging issue in the COVID-19 pandemic. J Eur Acad Dermatol Venereol 2020 Jul;34(7):e297-e298 [FREE Full text] [doi: 10.1111/jdv.16492] [Medline: 32302444]
22. Preventing and Treating Occupationally Induced Dermatologic Conditions During COVID-19. American Academy of Dermatology Association. URL: https://www.aad.org/public/diseases/coronavirus/occ-induced [accessed 2020-06-02]
23. Maliyar K, Sachdeva M, Mufti A, Yeung J. Reply to: "Skin damage among health care workers managing coronavirus disease 2019". J Am Acad Dermatol 2020 Aug;83(2):e169-e170 [FREE Full text] [doi: 10.1016/j.jaad.2020.05.037] [Medline: 32417418]
24. Bothra A, Das S, Singh M, Pawar M, Maheswari A. Retroauricular dermatitis with vehement use of ear loop face masks during COVID-19 pandemic. J Eur Acad Dermatol Venereol 2020 Oct;34(10):e549-e552 [FREE Full text] [doi: 10.1111/jdv.16692] [Medline: 32491204]
25. Hu K, Fan J, Li X, Gou X, Li X, Zhou X. The adverse skin reactions of health care workers using personal protective equipment for COVID-19. Medicine (Baltimore) 2020 Jun 12;99(24):e20603 [FREE Full text] [doi: 10.1097/MD.0000000000020603] [Medline: 32541493]
26. Jiang W, Cao W, Liu Q. Wearing the N95 mask with a plastic handle reduces pressure injury. J Am Acad Dermatol 2020 Jun;82(6):e191-e192 [FREE Full text] [doi: 10.1016/j.jaad.2020.04.001] [Medline: 32283239]
27. Pei S, Xue Y, Zhao S, Alexander N, Mohamad G, Chen X, et al. Occupational skin conditions on the front line: a survey among 484 Chinese healthcare professionals caring for Covid-19 patients. J Eur Acad Dermatol Venereol 2020 Aug;34(8):e354-e357 [FREE Full text] [doi: 10.1111/jdv.16570] [Medline: 32362062]
28. Goldust M, Shivakumar S, Kroumpouzos G, Murrell DF, Mueller SM, Navarini AA. Where do we stand as dermatologists in combat with COVID-19. Dermatol Ther 2020 Jul;33(4):e13638 [FREE Full text] [doi: 10.1111/dth.13638] [Medline: 32441435]
29. Hua W, Zuo Y, Wan R, Xiong L, Tang J, Zou L, et al. Short-term skin reactions following use of N95 respirators and medical masks. Contact Dermatitis 2020 Aug;83(2):115-121 [FREE Full text] [doi: 10.1111/cod.13601] [Medline: 32406064]

XSL•FO
RenderX

30. Scarano A, Inchingolo F, Lorusso F. Facial Skin Temperature and Discomfort When Wearing Protective Face Masks: Thermal Infrared Imaging Evaluation and Hands Moving the Mask. Int J Environ Res Public Health 2020 Jun 27;17(13):4624 [FREE Full text] [doi: 10.3390/ijerph17134624] [Medline: 32605056]
31. Campbell V, Middleton D, Donnelly J, Hunter H. Localized mid-face miliaria as a consequence of filtering face piece respirator use during the COVID-19 pandemic. J Eur Acad Dermatol Venereol 2020 Aug;34(8):e375-e376 [FREE Full text] [doi: 10.1111/jdv.16624] [Medline: 32386442]
32. Zheng Y, Lai W. Dermatology staff participate in fight against Covid-19 in China. J Eur Acad Dermatol Venereol 2020 May;34(5):e210-e211. [doi: 10.1111/jdv.16390] [Medline: 32201983]
33. Li C, Shen J, Ju Y, Huang X, Huang L, Zeng K. [Management and prevention of common skin problems during epidemic prevention and control of COVID-19]. Nan Fang Yi Ke Da Xue Xue Bao 2020 Mar 29;40(2):168-170 [FREE Full text] [doi: 10.12122/j.issn.1673-4254.2020.02.05] [Medline: 32376531]
34. Han C, Shi J, Chen Y, Zhang Z. Increased flare of acne caused by long-time mask wearing during COVID-19 pandemic among general population. Dermatol Ther 2020 Jul;33(4):e13704 [FREE Full text] [doi: 10.1111/dth.13704] [Medline: 32472634]
35. Navarro-Triviño FJ, Ruiz-Villaverde R. Therapeutic approach to skin reactions caused by personal protective equipment (PPE) during COVID-19 pandemic: An experience from a tertiary hospital in Granada, Spain. Dermatol Ther 2020 Nov;33(6):e13838 [FREE Full text] [doi: 10.1111/dth.13838] [Medline: 32543015]
36. Yu Q, Li W, Yang L. A case of goggle-mask-related impetigo at the time of the COVID-19 pandemic. Dermatol Ther 2020 Jul;33(4):e13636 [FREE Full text] [doi: 10.1111/dth.13636] [Medline: 32436604]
37. Sernicola A, Chello C, Cerbelli E, Adebanjo GAR, Parisella FR, Pezzuto A, et al. Treatment of nasal bridge ulceration related to protective measures for the COVID-19 epidemic. Int Wound J 2020 Oct;17(5):1520-1522 [FREE Full text] [doi: 10.1111/iwj.13397] [Medline: 32379379]
38. Balato A, Ayala F, Bruze M, Crepy M, Gonçalo M, Johansen J, et al. European Task Force on Contact Dermatitis statement on coronavirus disease-19 (COVID-19) outbreak and the risk of adverse cutaneous reactions. J Eur Acad Dermatol Venereol 2020 Aug;34(8):e353-e354. [doi: 10.1111/jdv.16557] [Medline: 32356382]
39. Zuo Y, Hua W, Luo Y, Li L. Skin reactions of N95 masks and medial masks among health-care personnel: A self-report questionnaire survey in China. Contact Dermatitis 2020 Aug;83(2):145-147 [FREE Full text] [doi: 10.1111/cod.13555] [Medline: 32297349]
40. Szepietowski J, Matusiak L, Szepietowska M, Krajewski P, Białynicki-Birula R. Face Mask-induced Itch: A Self-questionnaire Study of 2,315 Responders During the COVID-19 Pandemic. Acta Derm Venereol 2020 May 28;100(10):adv00152 [FREE Full text] [doi: 10.2340/00015555-3536] [Medline: 32449781]
41. Yin Z. Covid-19: countermeasure for N95 mask-induced pressure sore. J Eur Acad Dermatol Venereol 2020 Jul;34(7):e294-e295 [FREE Full text] [doi: 10.1111/jdv.16490] [Medline: 32302449]
42. Chowdhury MM, Bevan N, Ryan K. Covid-19: virtual occupational skin health clinics for healthcare workers. BMJ 2020 Jun 18;369:m2281. [doi: 10.1136/bmj.m2281] [Medline: 32554389]
43. Gefen A, Ousey K. Prevention of skin damage caused by the protective equipment used to mitigate COVID-19. J Wound Care 2020 Jun 02;29(6):311 [FREE Full text] [doi: 10.12968/jowc.2020.29.6.311] [Medline: 32530779]

Abbreviations

ACD: allergic contact dermatitis
ICD: irritant contact dermatitis
PPE: personal protective equipment

Edited by G Eysenbach; submitted 23.07.20; peer-reviewed by N Mohammad Gholi Mezerji, B Skidmore; comments to author 09.08.20; revised version received 21.08.20; accepted 17.04.21; published 06.05.21.

Please cite as:
Wilcha RJ
Does Wearing a Face Mask During the COVID-19 Pandemic Increase the Incidence of Dermatological Conditions in Health Care Workers? Narrative Literature Review
JMIR Dermatol 2021;4(1):e22789
URL: https://derma.jmir.org/2021/1/e22789
doi:10.2196/22789
PMID:34028470

XSL•FO
RenderX

©Robyn-Jenia Wilcha. Originally published in JMIR Dermatology (http://derma.jmir.org), 06.05.2021. This is an open-access article distributed under the terms of the Creative Commons Attribution License (https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work, first published in JMIR Dermatology Research, is properly cited. The complete bibliographic information, a link to the original publication on http://derma.jmir.org, as well as this copyright and license information must be included.

XSL•FO
RenderX

Publisher:
JMIR Publications
130 Queens Quay East.
Toronto, ON, M5A 3Y5
Phone: (+1) 416-583-2040
Email: support@jmir.org

XSL•FO
RenderX