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 5 (2022), Issue 1 ISSN: 2562-0959 Editor in Chief: Gunther Eysenbach, MD, MPH

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Research Letter

The Importance of Exploring the Role of Anger in People With Psoriasis

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(JMIR Dermatol 2022;5(1):e33920) doi:10.2196/33920

KEYWORDS

psoriasis; skin conditions; psychodermatology; stigma; chronic illness; dermatology; mental health; quality of life

For over 26 years, research has outlined the need for more awareness of the psychological burden of living with a skin condition [1], although the scarcity of research remains an ongoing concern. The All-Party Parliamentary Group on Skin [2] reported that 98% of people in the United Kingdom surveyed were negatively psychologically affected by their skin condition, but only 18% reported receiving psychological support. This discrepancy in care and lack of attention to the role of psychological factors in psoriasis must be addressed if we are to optimize dermatological treatments and patient outcomes. At the very least, the current care pathway could be more psychologically informed to consider the emotional challenges faced by people with psoriasis, providing opportunities for the development of targeted interventions.

There is robust evidence that the clinical course of psoriasis is influenced by social determinants including stress, as well as stressful life events [3], but the exact role emotion plays in the onset and progression of psoriasis seems multifactorial. For example, depression is a common comorbidity in psoriasis, which can be reduced by treatment with biologic drugs, suggesting the potential stigmatizing role of visibility in the psychological impact of the condition [4]. It is perhaps a consequence of the challenges of managing fluctuating skin conditions like psoriasis, including dealing with negative appraisals from other people, that have contributed to reports of anger and aggression among patients [5].

Despite this, the role of anger, whether as an outcome of poor mental health or from stressful life events, remains underexplored. The prevalence of anger is not currently measured within mainstream dermatological services, and considering the potential role of negative emotions in the development, maintenance, and exacerbation of symptoms, exploration could provide valuable insights and benefits for patients. For example, understanding how feeling angry or internalizing aggression could trigger or perpetuate an "itch-scratch cycle" could provide opportunities for intervention [3].

We aim to address this gap in the literature, with a qualitative inquiry to study the complexities of individual experiences and emotions. By developing clearer insights into the role of this emotion, clinicians may be able to better support patients in all aspects of their condition. Specifically, considering psychological contributors and the emotional burden of psoriasis could enable more effective management. For example, combining the physical and psychological manifestations of psoriasis in a holistic approach could promote adaptation, reduce maladaptive coping, and improve patient outcomes. As a minimum, equipping patients with a healthy coping "toolkit" for managing both the physical and psychological effects of psoriasis seems essential.

From a thematic exploration of 12 patient narratives, there appear to be reports suggesting that anger could play a contributory role in the onset and clinical progression of psoriasis for some people. We intend to find answers about how the experience of anger can be addressed to support people living with the skin condition and mitigate potential negative effects. It is time for the 26-year wait to come to an end and for

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psychological factors to become an integral part of assessment, intervention, support, and research.

Conflicts of Interest

None declared.

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Edited by R Dellavalle, T Sivesind; submitted 30.09.21; peer-reviewed by S Gulliver, H Shakshouk; comments to author 28.11.21; revised version received 13.01.22; accepted 19.02.22; published 15.03.22.

Please cite as:
Hughes O, Hunter R
The Importance of Exploring the Role of Anger in People With Psoriasis
JMIR Dermatol 2022;5(1):e33920
URL: https://derma.jmir.org/2022/1/e33920
doi:10.2196/33920
PMID:

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Original Paper

Intent to Change Sun-Protective Behaviors Among Hispanic People After a UV Photoaging Intervention: Cohort Study

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Abstract

Background: Mortality rates from melanoma are higher among Hispanic populations than non-Hispanic White (NHW) populations. Interventions to improve sun safety are needed. The Reveal Imager is a camera that uses standard cross-polarized flash photography to record surface and subsurface skin conditions.

Objective: This study aims to determine the intervention's effectiveness in increasing awareness of sun damage and exposure reduction between Hispanic and NHW populations.

Methods: A cohort of 322 participants, aged ≥18 years, were recruited from community events in 2018. Baseline information was collected on demographics, sun exposure, and perception of risk factors. A facial image was then captured using the Reveal Imager. The results were explained and counseling on sun safety was given, followed by filling out an immediate postimage survey. Chi-square tests, analysis of variance, Wilcoxon signed-rank test, McNemar tests, and multivariable logistic regression were used.

Results: At follow-up, 125 of 141 (89%) Hispanic participants reported that viewing the UV photoaged image influenced intent-to-change sun protection behaviors, compared to 88 of 121 (73%) NHW participants (odds ratio 2.9, 95% CI 1.5-5.6). Of 141 Hispanic participants, 96 (68%) reported that they intended to increase sunscreen use, compared to only 41 of 121 (34%) NHW participants (P<.001).

Conclusions: We demonstrated an application of Reveal Imager for education and risk assessment. The Reveal Imager was especially helpful in motivating intention to change sun exposure among Hispanic populations.

(JMIR Dermatol 2022;5(1):e33339) doi:10.2196/33339

KEYWORDS

risk assessment; sun safety; intention to change; sun exposure behavior; melanoma; Hispanic; sun damage; skin cancer

Introduction

Skin cancer is the most common malignancy in the United States, outnumbering all other cancers combined [1]. Although cutaneous cancers are uncommon in Hispanic people in the United States, mortality rates are much higher compared to non-Hispanic White (NHW) people [2]. These discrepant outcomes may be attributed to late detection and biologically more aggressive tumors [2-6].

Numerous studies suggest that Hispanic people differ in their perceptions of skin cancer risk compared to their NHW counterparts [3,7-10]. Hispanic populations perceive themselves to be at a low-risk for skin cancer due to their darker skin tone and lack of family history, and therefore are less likely to

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undertake sun-protective measures [10]. Buster et al [8] found that Hispanic people were more likely to believe they were unable to lower their skin cancer risk. Nonetheless, late-stage melanoma rates continue to rise in Hispanic populations [11]. The Hispanic population in the United States continues to grow, increasing the magnitude of this disease [5]. The lower prevention rates and poorer prognosis among the Latinx population necessitates interventions to increase awareness of skin cancer burden among this population.

The pattern of UV exposure is correlated with the development of different types of cutaneous melanoma, basal cell carcinoma (BCC), and suamous cell carcinoma (SCC). Overall, melanoma is correlated with long-term, intermittent UV exposure, BCC was found to depend on intensive sunlight exposure earlier in life before adulthood, and SCC was related to prolonged and persistent UV exposure over a period of decades [12]. Within melanoma, superficial spreading melanoma and nodular melanoma are associated with a history of sunburns and intermittent UV exposure in healthy young patients. In contrast, chronic lifetime sun damage increased the risk of developing lentigo maligna melanoma [13]. One case control study showed a correlation between multiple lifetime sunburns from UV exposures to increased incidences of superficial spreading melanoma but no link with lentigo maligna melanoma [14].

The increasing rates of skin cancers and mortality in Hispanic populations, the majority of which is SSM [15], makes protection against UV rays an issue of paramount importance [13,14]. Diligent UV protection is well known for its efficacy in preventing skin cancer occurrences [12]. However, in one study, although Hispanic adolescents reported engaging in sun protection behaviors, they were found to have higher rates of sunburns compared to national estimates for NHW children [16]. Thus, more efforts are needed to educate the Hispanic population and disseminate information on sun protection. Educational interventions geared toward sun protection are critical to early detection and prevention of future skin cancer–related mortalities [17].

In this study, we sought to compare the effectiveness of the Canfield Reveal Imager (UV photoaged facial imager) on intent-to-change sun-protective behaviors between Hispanic and NHW populations. We further characterized the Hispanic people who intended to change sun protection behaviors.

Methods

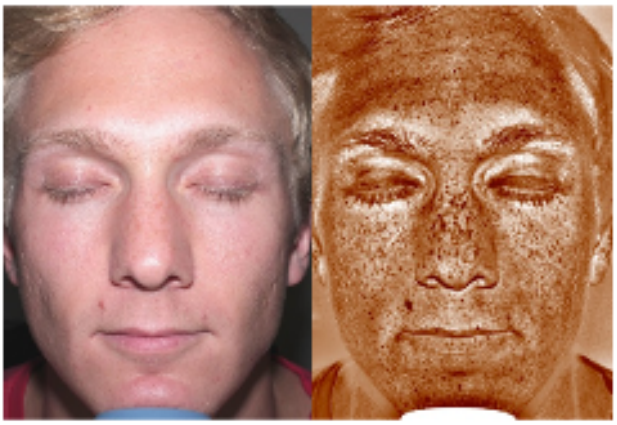
Study Population and Procedures

In this prospective cohort study, we recruited 322 adults (≥18 years of age) from 9 community events in Denver, Colorado from May 2018 through March 2019, primarily in the winter and summer seasons. Participants were recruited from diverse community and health promotion events ranging from cancer benefits, campus wellness fairs, to consulate events. Attendees of the event were introduced to the UV photoaged facial imager, given a brief description of the study, and offered an opportunity to participate. Informed consent was obtained by all participants, and the study was approved by the Colorado Multiple Institutional Review Board.

Data were collected at two time points: (1) baseline, immediately before the photoaged image, and (2) follow-up, immediately after the photoaged image, typically within 30 minutes of each other. All participants completed the baseline questionnaire that assessed demographic information, sun exposure history (both in childhood and in the past year), sun protection behaviors, perceptions of tanning, and perceived risk of skin cancer.

After the baseline questionnaire was completed, participants had a UV photoaged facial image taken and shown to them (Figure 1). The investigators consisted of a medical resident, medical students, and research coordinators who interpreted the images, answered participant questions, and provided sun protection education. Participants were then asked to complete a postimaging follow-up questionnaire that assessed perceptions of tanning, perceived risk of skin cancer, and intent-to-change sun protection behaviors after seeing the UV photoaged facial image.

Figure 1. Standard-light facial photograph (left); cross-polarized filter photograph (right).



Description of the Intervention (UV Photoaged Image)

The Canfield Reveal Imager (UV photoaged facial imager) is a camera that uses standard white light and cross-polarized flash photography to record surface and subsurface skin conditions, capturing two images in quick succession. The crossed-polarizing filter reduces skin surface reflections and allows visualization of skin changes and damages (eg, brown pigmentation, wrinkles, and lines) and provides immediate visual feedback to the individual, demonstrating the harm caused

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by chronic sun exposure. The UV photoaged facial image can be used as a form of fear appeals educational intervention for skin cancer. The two images are juxtaposed on the screen for visualization and the education of participants (Figure 1).

Education

Study team members were trained on by the principal investigator on interpreting the UV photos and delivering education to the participants. Participants were shown reference photos from the UV Reveal Camera of individuals with varying levels of sun damage visualized prior to seeing their own UV photos. This prior knowledge provided context for participants to self-assess the amount of sun damage they accumulated relative to standard controls. Verbal feedback was provided by the medical team by pointing out specific areas of sun damage (brown spots) visualized on the UV Reveal Camera. Any further questions were answered.

Measures

Sun protection behaviors, perceptions of tanning, and risk perception of skin cancer was based on a subset of items from the Sun Protection Awareness Questionnaire. The following are the measured items:

- Sunscreen use (preimage only): Frequency of sunscreen use in the past 12 months was assessed from Always to Never. The sun protection factor of the sunscreen was recorded. If sunscreen was never used, open text responses of reasons why sunscreen was not used were recorded.
- Sun protection behavior (preimage only): Childhood and adult sun protection behaviors were assessed using three questions. Two questions asked about protective clothing worn during childhood and adulthood. Age at first deep tan was also asked.
- Perceptions of tanning: Perceptions of tanning were measured with three questions asking participants to measure their agreement from untrue to very true on statements about the importance of tanning, if tanning increases attractiveness, and if the participant wanted to get a tan. For the analysis, these were dichotomized into untrue and somewhat untrue versus somewhat true and true.
- Risk perception of skin cancer: Risk perception of skin cancer was measured using three questions. Two asked participants to measure their level of agreement from untrue to very true to statements about current sun exposure and future risk of developing damaged skin and skin cancer. The second question asked participants to compare their risk of developing skin cancer to an average person of similar age and sex, with answers ranging from “I am at much less risk than others” to “I am at much greater risk than others.” For the analysis, these were dichotomized into untrue and somewhat untrue versus somewhat true and true.

Both the baseline and follow-up questionnaires were completed in-person on a paper. The primary outcome of this study was intent-to-change sun protection behaviors immediately after seeing the UV photoaged image. This variable was originally collected with 3 levels (yes/no/unsure) but was dichotomized as yes versus no/unknown. The primary independent variable was ethnicity (Hispanic vs NHW). Secondary outcomes included change of pre- to postimage perceptions of tanning and risk perception of skin cancer.

Statistical Analysis

The analysis included participants that identified as Hispanic or NHW (n=278), which comprised 86% of the total sample (N=322). We excluded other races because our primary research question focused on Hispanic individual’s sun protection behaviors compared to NHW individuals, and the sample size was small for other races. We excluded records with a missing pre- or postimage date. Missing data analysis using analysis of variance for continuous variables and Pearson chi-square tests for categorical variables were conducted on demographic variables to determine if any differences existed by ethnicity.

Descriptive statistics were performed on baseline demographic information and sun exposure information. The proportion of individuals who intended to change sun protection behaviors was compared using Pearson chi-square test. We compared the coefficient on the predictor from a mixed model with no fixed effect covariates to that from a model with a single covariate. If the coefficients differed by >10%, the covariate was included in the full multivariate analysis. Mixed effects logistic regression was used to assess the relationship between ethnicity and intent-to-change sun protection behaviors. Ethnicity was included in the model as the main effect, and education and age were included in the model as covariates. Location of community event that the interview took place was dichotomized (health event vs not health event) and included in the model as a random intercept. In a post hoc analysis, we included the final model stratified by season (winter vs summer) to investigate if this relationship varied by the season in which the data were collected.

Changes in tanning and skin cancer perception from pre- to postimage were compared using McNemar test and Wilcoxon signed-rank tests for ordinal, repeated data. Variables that changed the coefficient more than 10% were included in the final multivariable model. A mixed effects linear model was used to assess main effects of the intervention, estimating mean change in perception of tanning and risk of skin cancer from pre- to postimage. Ethnicity, education, and age were included in the model as fixed effects. An alpha criterion of $P<.05$ was used. All tests were 2-tailed. Statistical analyses were performed using Stata version 15 (StataCorp). This study was approved by the Colorado Multiple Institutional Review Board.

Results

Description of Cohort

We recruited 278 Hispanic and NHW participants from 9 community events. Of the 278 participants, 262 (94%) completed the follow-up questionnaire. Comparisons of baseline information by ethnicity are described in Table 1. At baseline, compared to NHW participants, Hispanic participants were younger, less educated, more likely to work outdoors, had fewer self-reported past diagnoses of skin cancer, and were less likely to use sunscreen in the past 12 months. Furthermore, Hispanic participants’ perceived risk of developing skin cancer was lower; they were more likely to think a tan made them look attractive

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and were more likely to want a tan. By contrast, NHW participants were more likely to think they needed to cut down on tanning and felt guilty about tanning. No differences by ethnicity were observed by sex, perceptions on developing wrinkles, skin damage, skin cancer from sun exposure, importance of a tan, or use of tanning beds in the last 12 months. Missingness analyses found there were no significant differences between those who did not complete the pre- and postimage surveys by ethnicity, age, sex, or intent-to-change sun protection behaviors.

Table 1. Baseline characteristics of cohort stratified by ethnicity (n=278).

	Hispanic (n=150)	Non-Hispanic White (n=128)	*P* value
Baseline demographic and clinical information			
Age (years), mean (SD)	40.7 (11.4)	44.9 (15.2)	.01
Sex (male), n (%)	60 (40.3)	43 (33.6)	.25
Education (high school graduate or less), n (%)	98 (67.1)	19 (15.2)	<.001
Occupation (outdoor), n (%)	39 (26.9)	9 (7.3)	<.001
Previous skin cancer diagnosis (yes), n (%)	9 (6.1)	22 (17.7)	.002
Season of event (summer), n (%)	10 (6.7)	115 (90)	<.001
Sun protection behaviors and perceived risk of skin cancer, n (%)			
Sunscreen use (always or usually)	42 (28.2)	80 (64.0)	<.001
Perceived risk of skin cancer	24 (64.9)	10 (15.6)	<.001
Too much sun now may lead to wrinkles and skin damage	21 (14.0)	12 (9.4)	.24
Too much sun now may lead to skin cancer	17 (11.3)	13 (10.2)	.75
Perceptions of tanning, n (%)			
Good tan makes me more attractive (yes)	110 (73.3)	50 (39.1)	<.001
Important to have a tan (yes)	112 (74.7)	86 (67.2)	.17
Want to get a tan (yes)	114 (76.0)	74 (57.8)	.001
Used a tanning bed in last 12 months (yes)	19 (12.7)	10 (7.8)	.19
Felt you needed to cut down on tanning (yes)	18 (12.2)	24 (20.9)	.06
People criticized you for tanning (yes)[a]	7 (7.8)	2 (1.8)	.31
Felt guilty about tanning (yes)	10 (7.0)	24 (21.8)	.001

[a]Fisher exact test.

Intent to Change: Primary Outcome

At follow-up, 213 of 262 (81%) participants reported that viewing the UV photoaged image influenced an intent-to-change sun protection behaviors. However, this differed by ethnicity. Of 141 Hispanic participants, 125 (89%) reported a likelihood of change compared to 88 of 121 (73%) NHW participants (odds ratio 2.9, 95% CI 1.5-5.6). Demographic and clinical information, sun protection behaviors, perceived risk of skin cancer, and perceptions of tanning were not associated with intent-to-change sun protection behaviors. However, these were included in the multivariable model as covariates based on clinical importance. After adjusting for age, education (high school graduate or less vs some college or more), perceiving a tan was more attractive, tanning bed use, and normal sunscreen use, Hispanic participants were significantly more likely to have an intent-to-change sun protection behaviors compared to NHW participants (adjusted odds ratio [aOR] 4.04, 95% CI 1.6-10.4; Table 2). In post hoc analysis, Hispanic participants were more likely to have an intent-to-change sun protection behaviors compared to NHW participants in both summer (aOR 3.28, 95% CI 0.5-25.3) and winter seasons (aOR 4.54, 95% CI 1.1-18.2), although not significantly in summer due to reduced sample sizes.

The most common sun protection behavior changes that participants intended to implement were increases in sunscreen use (134/262, 51%), to start wearing protective clothing like hats (39/262, 15%), and reapplication of sunscreen (26/262, 10%). These sun protection behaviors also varied by ethnicity. Of the 141 Hispanic participants, 96 (68%) reported that they intended to increase sunscreen use, compared to only 41 of 121 (34%) NHW participants (*P*<.001). More Hispanic participants also reported the intention to reapply sunscreen more often, while NHW participants were more likely to report the intent-to-increase wearing protective clothing like hats, but neither of these differences were statistically significant.

Hispanic participants that intended to change their sun protection behaviors after viewing the UV photoaged image (125/141) trended toward being younger (*P*=.09), working indoors (*P*=.13), and having a high school degree or less (*P*=.07) than Hispanic participants that did not intend to change their sun protection behaviors. Of 122 Hispanic participants, 110 (90%) with low perceived risk of skin cancer at baseline intended to change

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their sun protection after seeing the UV photoaged image behaviors, compared to only 15 of 19 (79%) with high-perceived risk (*P*=.11). Sex, previous skin cancer diagnosis, sunscreen use, perceived risk of wrinkles, and perceptions of tanning did not differ by intent-to-change sun protection behaviors among Hispanic participants.

Table 2. Univariate and multivariable relationships of risk factors and intent to change sun protection behavior (m=262).

	Intent to change sun protection behaviors	
	OR[a] (95% CI)	aOR[b] (95% CI)
Baseline demographic and clinical information		
Ethnicity (Hispanic)	2.9 (1.5-5.6)[c]	4.0 (1.6-10.4)[c]
Mean age (SD)[d,e]	1.0 (0.96-1.0)	N/A[f]
Sex (male)	1.2 (0.61-2.3)	N/A
Education (high school graduate or less)[e]	0.9 (0.49-1.7)	N/A
Occupation (outdoor)	1.8 (0.85-3.8)	N/A
Previous skin cancer diagnosis (yes)	0.7 (0.30-1.6)	N/A
Sun protection behaviors and perceived risk of skin cancer		
Sunscreen use (always or usually)	1.4 (0.73.2.5)	N/A
Compared with the average person, risk of skin cancer	1.2 (0.49-2.9)	N/A
Too much sun now may lead to wrinkles and skin damage	0.7 (0.22-2.0)	N/A
Too much sun now may lead to skin cancer	1.0 (0.37-2.5)	N/A
Perceptions of tanning		
Good tan makes me more attractive (yes)[e]	0.6 (0.34-1.19)	N/A
Important to have a tan (yes)	0.9 (0.44-1.7)	N/A
Want to get a tan (yes)	1.0 (0.51-1.9)	N/A
Used a tanning bed in last 12 months (yes)[e]	0.4 (0.08-1.5)	N/A
Felt you needed to cut down on tanning (yes)[g]	Undefined	N/A
People criticized you for tanning (yes)[g]	Undefined	N/A
Felt guilty about tanning (yes)	1.8 (0.58-5.3)	N/A

[a]OR: odds ratio.

[b]aOR: adjusted odds ratio.

[c]*P*<.001.

[d]Continuous variable.

[e]Included in final multivariable model.

[f]N/A: not applicable.

[g]Zero counts lead to undefined analysis.

Pre- to Postimage Changes: Secondary Outcomes

Perceptions of Tanning

Perceptions of tanning did not change significantly from pre- to postimage. Hispanic participants had perceived decrease in "importance of tanning" (β=–.06; *P*=.87), "attractiveness from tanning" (β=–.33; *P*=.35), and wanting to get a tan (β=–.13; *P*=.73) from pre- to postimage compared to NHW participants. These results, although not statistically significant, indicate that perception of tanning changed more for Hispanic participants than NHW participants and moved in the expected direction.

Risk Perception of Skin Cancer

Risk perception of skin cancer did not change from pre- to postimage. Hispanic participants had a perceived decrease in "risk of developing skin cancer compared to an average person of similar age and sex" (β=–.15; *P*=.78) and "risk of cancer" (β=–.30; *P*=.61), while an increase of perceived "future skin damage" (β=.45; *P*=.50) was observed.

Discussion

In this study, we demonstrated the feasibility of using the Canfield Reveal Imager to motivate intent-to-change sun protection behaviors among NHW and Hispanic populations. We also showed the efficacy of the modified Sun Protection

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Awareness Questionnaire for education, risk assessment, and improvements in sun safety behaviors. Our study found that showing the damaging effects of the sun on skin, in addition to education provided by a medical provider can motivate intent-to-change behaviors in Hispanic populations who traditionally perceive themselves to be at lower risk to developing skin cancer. An image demonstrating photo damage along with verbal sun protection education by medical personnel was especially helpful among Hispanic participants with a baseline low-perceived risk of skin cancer.

Fear appeals is a strategy used in public health to change behaviors. Public health campaigns such as antismoking, antialcohol, and hypertension awareness have used the fear appeals methods [18]. However, most of the literature suggests that fear appeals are ineffective in motivating changes in behavior [18-22]. On the contrary, the target population may feel threatened but are still not convinced of the effectiveness of the alternative behavioral modification. Indeed, they may become more defensive and oriented toward avoidance of the health-promoting messages rather than actions toward adoption [23]. The extended parallel process model suggests that the impact of fear appeals is most effective when they include both a threat emphasizing severity and susceptibility, as well as recommended actions that reinforce self-efficacy [19,24,25]. In a recent randomized controlled trial (RCT), UV skin damage visuals generated greater fear than other visuals (sun burn, mole removal, and photoaging), resulting in increased sun safe behaviors [26]. In a study of Facebook skin cancer prevention groups, fear was the most used persuasive appeal [27]. Similar to the RCT, we found that intent-to-change sun protection behaviors after a fear appeals intervention was high, especially among Hispanic participants.

Hispanic participants in our sample may have been especially responsive to the UV photoaged facial image, a type of fear appeals intervention, because their perceived risk of skin cancer was lower at baseline. More studies are needed to determine if this finding is generalizable. Further, visualizing the actual skin damage caused by chronic sun exposure when there is still time to act could potentially influence intention-to-change sun protection behaviors.

Despite evidence of a higher intent-to-change among Hispanic participants, perceptions of the risks of tanning and skin cancer did not change from pre- to postviewing the image. This finding suggests that the Reveal Imager has the potential to help promote sun awareness but not necessarily increase knowledge around the risks of tanning and skin cancer.

Our study also demonstrates that community-based screening programs held at large events provide an opportunity to identify a substantial number of people who could benefit from sun protection education. Importantly, our study has implications for future efforts to educate the public about minimizing skin cancer risk. Educational endeavors may be particularly efficacious if used in combination with fear appeals and a visual component with direct involvement of the participant. Given the highly preventable nature of the disease, successful education and implementation of sun-protective measures may decrease new incidences of skin cancer over time, perhaps leading to substantial shifts in epidemiological trends in the future.

Strengths of this study include strong representation from NHW and Hispanic populations from various neighborhoods around the Denver Metro Area, measurement of attitudes toward both sun-exposing and sun-protective behaviors, and being among the first studies to use fear appeals as an intervention to target changes in sun-protective behaviors among Hispanic people.

There were also limitations to this study. First, there is likely self-selection bias as people who attend health and wellness fairs and cultural events are likely more health conscious or may be more open to health behavior prompts than those who do not attend. Second, most of the participants were women and all lived in Denver, Colorado, which reduces the generalizability of these results. However, because we recruited from substantially different neighborhoods, we think the results are at least generalizable to the Denver Metro Area and possibly to other diverse cities. Third, other booths at the events presented information on sun protection behaviors and skin cancer awareness. The proximity of this information may have contaminated our results. Fourth, *Hispanic* is a heterogeneous category, and heritage subgroups may differ from one another; there are other unmeasured cultural variables (nativity, acculturation, language preference). Further, there is considerable variety of skin pigmentation among those who identify as Hispanic, and this may be associated with sun protection habits. However, we did not collect information on pigmentation. Fifth, the questionnaire and education were only offered in English. Finally, in addition to the small sample size, there was a large difference in education levels between NHW and Hispanic populations.

Compared to NHW participants, Hispanic participants are more likely to be diagnosed in later stages when the cancers are more difficult to treat and survival rates are lower [28,29]. This motivated us to compare an educational intervention that has worked among NHW participants as a potential educational intervention for sun protection behavior to Hispanic participants [30]. We found that Hispanic respondents were more likely to have intent-to-change sun protection behavior compared to NHW participants after viewing the UV photoaged facial image. The virtue of the UV photoaged image is that it provides an immediate, easily comprehensible measurement of personal risk and individual assessment of sun-induced skin damage that could otherwise remain invisible to the naked eye, especially among Hispanic people, who perceive themselves as being at lower risk for skin cancer. It is important to adopt different forms of awareness for the primary prevention of skin cancers, especially in populations at risk. Although the use of polarized flash photography is no longer innovative, it can be a useful tool to raise awareness, especially among vulnerable populations.

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Acknowledgments

This study was partly supported by the Population Health Shared Resource of the University of Colorado Cancer Center (P30CA046934).

Conflicts of Interest

RD is the Editor-in-Chief of *JMIR Dermatology* but had no role in the evaluation of the manuscript for publication. The other authors have no conflicts to declare.

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Abbreviations

aOR: adjusted odds ratio
BCC: basal cell carcinoma
NHW: non-Hispanic White
RCT: randomized controlled trial
SCC: squamous cell carcinoma

Edited by A Mavragani; submitted 02.09.21; peer-reviewed by F Wallnöfer, J Robinson; comments to author 12.10.21; revised version received 22.11.21; accepted 09.12.21; published 25.01.22.

Please cite as:
Bonnell LN, Obi N, Miller K, Hu S, Dellavalle R, Cockburn M
Intent to Change Sun-Protective Behaviors Among Hispanic People After a UV Photoaging Intervention: Cohort Study
JMIR Dermatol 2022;5(1):e33339
URL: https://derma.jmir.org/2022/1/e33339
doi:10.2196/33339
PMID:

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Original Paper

Patients' Experiences of Telemedicine for Their Skin Problems: Qualitative Study

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Abstract

Background: Teledermatology is a cost-effective treatment modality for the management of skin disorders. Most evaluations use quantitative data, and far less is understood about the patients' experience.

Objective: This qualitative study aimed to explore patients' perceptions of a teledermatology service linking public primary care clinics to the national specialist dermatology clinic in Singapore. A better understanding of patients' experiences can help refine and develop the care provided.

Methods: Semistructured in-depth interviews were conducted with patients who had been referred to the teledermatology service. The interviews were digitally recorded and transcribed before undergoing thematic content analysis.

Results: A total of 21 patients aged between 22 and 72 years were recruited. The following 3 themes were identified from the data of patients' experiences: positive perceptions of teledermatology, concerns about teledermatology, and ideas for improving the teledermatology service. The patients found the teledermatology service convenient, saving them time and expense and liberating them from the stresses incurred when making an in-person visit to a specialist facility. They valued the confidence and reassurance they gained from having a dermatologist involved in deciding their management. The patients' concern included data security and the quality of the images shared. Nonetheless, they were keen to see the service expanded beyond the polyclinics. Their experiences and perceptions will inform future service refinement and development.

Conclusions: This narrative exploration of users' experiences of teledermatology produced rich data enabling a better understanding of the patients' journey, the way they understand and interpret their experiences, and ideas for service refinement. Telemedicine reduces traveling and enables safe distancing, factors that are much needed during pandemics.

(JMIR Dermatol 2022;5(1):e24956) doi:10.2196/24956

KEYWORDS

teledermatology; qualitative; patients experience; telemedicine; dermatology; Singapore

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Introduction

The Global Burden of Disease lists skin disease in the top 20 leading causes of disability-adjusted life years, and the 4th leading cause of disability worldwide [1]. With dermatological disorders being so prevalent, it is not surprising that many consultations with a primary care physician focus on skin symptoms. A study in the Netherlands reported that about 13% of patients visiting a primary care practice were seeking help for a skin problem [2], and in the UK, the estimate was even higher at 24% [3]. When there is diagnostic uncertainty or unresponsiveness to treatment, the primary care practitioner will need to refer the patient for an expert dermatological opinion.

When telemedicine was developing in the 1990s, dermatology was identified as one of the clinical areas that could readily benefit from this mode of practice as it is a very visual specialty. Its applicability to rural areas where specialist care is not readily available was noted [4]. Since then, teledermatology has been initiated widely, aided by advancements in technology and internet availability. There are 3 modes of teledermatology consultation, which are "store-and-forward," live videoconferencing, and a combination of both. The store-and-forward teledermatology consultation involves digital images being sent to the expert for later review, whereas live videoconferencing consultations are synchronous, with the patient and the clinicians interacting in real time. The store-and-forward mode is less resource intensive and flexible and is thus more widely used in dermatology. When compared to conventional care or live videoconferencing, the store-and-forward mode costs less and reduces the disruption in the daily workflow of clinicians [5]. The store-and-forward mode also offers greater privacy for patients [6] but is disadvantaged by the lack of opportunity for the specialist to interact with the patient or ask for further images.

Teledermatology has been reported to be efficacious across different patient populations [7]. In Singapore, it has been used previously to manage skin problems in nursing home residents where the nurses or nurse aides photographed the lesions and uploaded these images for dermatological opinion [8]. The system was used regularly for diagnosis and follow-up and enabled residents to obtain dermatological care from the comfort of their residence. Preparation of the referral request was onerous, taking an average of 86 minutes of nursing time, but entailed less disruption and inconvenience than accompanying the resident to an outpatient appointment.

The National Healthcare Group Polyclinics are public primary care health facilities serving the central and northern parts of Singapore with an approximately 2.5 million attendances each year. Disorders of the skin and subcutaneous tissue are among the 10 most common diagnoses, with 45,987 in 2019 [9]. Traditionally, if the attending physician required advice on diagnosis and management, patients were referred to the National Skin Centre, a tertiary health care institution. With the aim of bringing specialist care closer to patients in order to reduce the expenditure and waiting time for specialist referrals and to increase the dermatology skills of family physicians, National Healthcare Group Polyclinics and National Skin Centre collaborated to introduce the first teledermatology service in primary care for Singapore [10]. Adopting the store-and-forward methodology, the clinical history and digital photographs of eligible patients are shared through a secure web portal and their management guided by a dermatologist without the need for a dermatological outpatient consultation [11] (Figure 1). This teledermatology process is mediated by "Derm Champs," family physicians with a special interest in Dermatology and with a graduate diploma in Family Practice Dermatology or master's degree in Family Medicine.

This study was designed to better understand the experiences of adult patients who had used the teledermatology services and to identify areas where their experiences could be improved.

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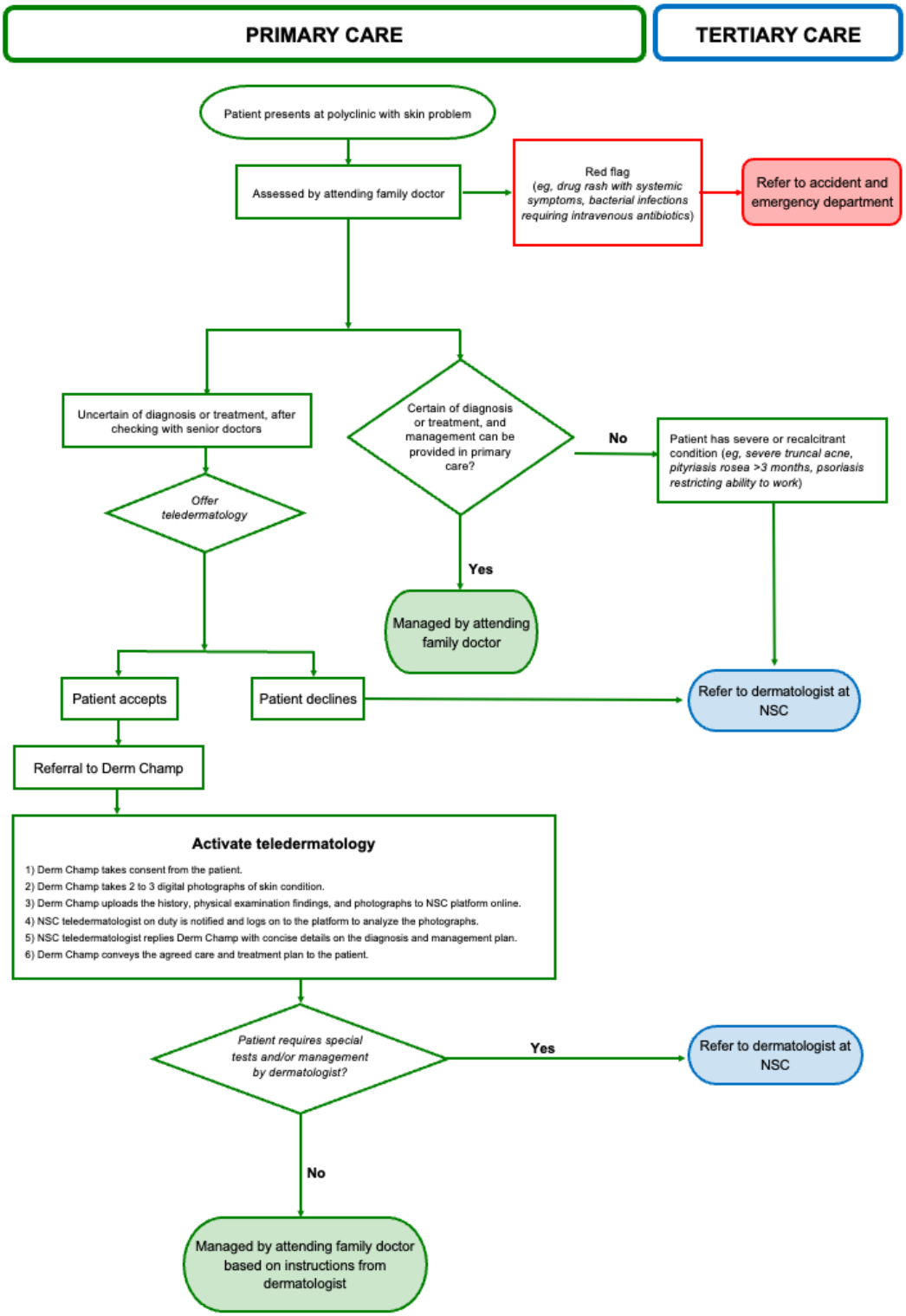
Figure 1. The TeleDERM process. NSC: National Skin Centre.



Methods

Recruitment

The participants were attendees at one of 5 polyclinics, were English speaking, were at least 21 years old, and had undergone teledermatology within the last year. Eligible patients were identified by the medical staff involved in the telemedicine service within the polyclinics and at the National Skin Centre. The patients were invited to participate in this study when they attended for a follow-up consultation. They were given a leaflet about the study to consider at their leisure, and those willing to participate subsequently contacted the research team by mail, email, or telephone. This recruitment strategy was simple and was not resource intensive, but was not purposeful, and the 20 Singapore dollars (US $15) given as a token of appreciation may have encouraged respondents motivated by financial benefit.

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Data Collection

The face-to-face, semistructured interviews were conducted by a researcher trained in qualitative interview techniques. The topic guide explored patients' experiences of the teledermatology service and how it could be improved for others (Multimedia Appendix 1). Interviews were audio recorded with the patient's consent. One patient preferred not to be recorded, and the researcher took contemporaneous notes instead.

Data Processing and Analysis

Digital audio recordings were transcribed verbatim. De-identified and cleaned data were entered into NVivo (QSR International) [12] to facilitate organization into analytical themes. The data were analyzed using a structured and rigorous approach of thematic content analysis [13]. Two members of the research team (AC and SHT) independently coded each interview before discussing with a third researcher (HS) to reach consensus. The themes are illustrated verbatim quotes identified with the two following descriptors: (1) type of consultation (telemedicine only [TM] or telemedicine plus referral to specialist center) and (2) patient's study number. Our findings are reported in accordance with the Consolidated Criteria for Reporting Qualitative Research [14].

Ethics Approval

This study was approved by the National Healthcare Group Domain Specific Review Board (ethics approval 2018/01112).

Results

Characteristics of Patients

A total of 21 interviews were conducted between March and July 2019. The participants' age ranged from 22 to 72 years, and 65% (13/21) were male. These patients presented with rashes (11, 52%), pigmented lesions (4, 19%), itching (3, 14%), and dry skin (2, 10%). Moreover, 7 (33%) patients were referred to the National Skin Centre after their telemedicine consultation. Three major themes emerged from the transcripts: positive perceptions of teledermatology, concerns about teledermatology, and suggestions for improving the patient's teledermatology journey.

Patients' Positive Perceptions of Teledermatology

Convenience

The patients generally found the teledermatology service convenient, reducing the need to travel elsewhere for a second opinion and minimizing their transport costs and loss of earnings.

> *It's good for people who are working. They don't have the time to go down and then they get the assurance, they get the results immediately.* [TM 32]
>
> *…you also have work schedule to conflict. And then sometimes, you know, you have better things to do.* [TM 25]
>
> *It's like, it can be done over here, rather than going up to the skin centre and you have to spend most of the day at the skin centre. I've been there before and have to wait there quite a long time…saves time travelling…* [TM 33]

The convenience of teledermatology was recognized as being particularly beneficial for those with mobility problems.

> *It's good for elderly also…Cause there's no need to travel all the way there [National Skin Centre], like disabled, all these...* [TM 30]

Care in a Familiar Health Care Setting

Some users commented on their preference to be managed in a familiar health care environment rather than being challenged by navigating somewhere unfamiliar.

> *…for those, like for me, for the first time to go to the kind of new places [National Skin Centre] I need to, ah, google for the location...And go there, don't know how, the way, the operation line, register, everything...* [TM 9]

Timely Consultation

Some skin conditions are intermittent. While it is relatively easy for patients to get a same day consultation in the polyclinic when they are symptomatic, there is no guarantee that these signs will persist or recur for an outpatient appointment days or weeks later.

> *…all the rashes, all the symptoms...they're gone, during my appointment time…So it's [teledermatology consultation] instant, can show to the specialist, my symptom, my sickness, everything, there on the spot...* [TM 9]

On occasions, because of diagnostic uncertainty or the severity of the skin issue, the teledermatology consultation resulted in an immediate referral to the National Skin Centre.

> *...my situation is quite serious, then it's good ...they take a picture …then I can come to the Skin Centre to do all the things …. it's fast.* [TM plus referral to specialist center 45]

Expert Involvement

The patients felt that receiving a medical opinion from a dermatologist was always preferable because of their expert knowledge about skin disorders.

> *But then, knowledge-wise, probably the skin doctor would be more knowledgeable about it…. It's more reliable…* [TM 31]
>
> *[Prefer] specialist to see my skin. [Family physician] may not be as trained as specialists.* [TM 27]

Feeling their management was informed by a specialist rather than a generalist, the patients spoke of the care plan in terms of being "reliable," "right," or "correct."

> *…give the right advice, and then the right medicine.* [TM 23]
>
> *…the correct diagnosis, the correct medication is issued, and then my skin is better. The psoriasis is suppressed for now.* [TM 25]

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Such comments about the relative status of the generalist and specialist were often balanced by complements about the polyclinic staff's professionalism when arranging the teledermatology consultation.

> *...our doctors here [in the polyclinic] are very proficient… very proficient. They would know what the angle to take [of the photos for teledermatology]* [TM 32]

Reassurance

The very quick availability of a specialist's clinical assessment, diagnosis, and management were reassuring to patients; they described how their anxieties were addressed and how they experienced a sense of relief.

> *…the telederm [teledermatology consultation] helped reduce that anxiety and the worry about the skin condition being contagious.* [TM 35]

> *…gives me the reassurance, because they can follow up on the spot instead of having to physically wait for like, maybe a few months for follow-up to see a real specialist.* [TM 41]

> *Then I get the results immediately … they give me the assurance there's nothing sinister … I feel so happy.… So, it's very calming effect.* [TM 32]

Better Prepared for Their Outpatient Appointment

Not all problems could be resolved by a teledermatology consultation, and some patients were thus referred for an outpatient consultation, diagnostic tests, and treatment at the national specialist center. Rather than resenting telemedicine as an unnecessary and additional step in the referral pathway to dermatology, some patients considered it helpful, describing how the dermatologist would already be familiar with their case.

> *…when I go to a skin centre, they already have my records…instead of like, when I go there, they will start from scratch or they didn't know what happened to me. But at least now, they have also my picture …And they have a more, like, the background profile…So, when I go there, maybe, it's a bit faster.* [TM plus referral to specialist center 38]

Speed of Specialist Response

Although the teledermatology service is store-and-forward rather than a video consultation, many patients valued the short interval between presenting for their polyclinic appointment and receiving advice from a dermatologist later that day. Interestingly, although the service was asynchronous, some used descriptors such as "instant" or "immediate."

> *…this [teledermatology] is quite unique, and quite good, because this feedback is immediate. So, you don't have to delay. So at least they [doctors] have first-hand information. It eases the patients' anxiety.* [TM plus referral to specialist center 14]

> *It is fast, and I can see on the same day. You get the instant result …* [TM 32]

> *…I liked it that the advice was given immediately …Very timely.* [TM plus referral to specialist center 38]

Consultation With a Specialist Without the Cost

Unlike the health care system in many socialist nations, Singaporeans cannot walk into a health care facility and receive treatment for free. Instead, Singapore imposes user fees, a policy designed to reduce inappropriate and unnecessary use of medical services. Therefore, while an outpatient appointment with a dermatologist would normally incur some fee, access via telemedicine to a specialist opinion incurred no costs for the patient beyond that of consultation with a primary care practitioner.

> *Cost wise… [I] only pay for consultation to see doctor here [National Healthcare Group Polyclinics], then the specialist, no need to pay.* [TM 30]

Patients' Concerns About the Teledermatology Service

Waiting Time

While patients valued having a dermatologist's opinion and a definitive care plan on the same day as their visit to the polyclinic, there were conflicting views on the waiting times. We saw above how some service users commented on the immediacy of the feedback, but others expressed discontent about the time they waited before the dermatologist responded. Not only was the duration perceived as inconveniently long, but there was also concern about the uncertainty and unpredictability of the waiting time.

> *…at the polyclinic, I was told to wait for, like, maybe, like, two hours…I understand…the doctors might be busy…But the waiting time is probably one of the hindrance…* [TM 31]

For some patients, having waited for advice from the teledermatologist, they found that a trip to the specialist center was still going to be necessary. These patients often expressed surprise, indicating it their frustration about this unexpected outcome.

> *It seems like a waste of time…come to a big round…we are referred to the specialist, we are going through the same old thing, we wait for weeks for appointment, and we, doesn't [sic] know what happened to us.* [TM plus referral to specialist center 40]

Apparent Unsophistication of the Equipment Used

Some patients commented on the simplicity of the photographic equipment used and wondered if the pictures had sufficient clarity for an accurate diagnosis.

> *They use a camera…like normal camera only, …. cannot zoom, I don't think the quality of camera is good, I don't think so.* [TM plus referral to specialist center 45]

> *…it wasn't a special camera, where they can adjust the light or pixel… I think it was his personal phone*

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> *or it was a government phone…* [TM plus referral to specialist center 10]
>
> *…[general practitioner (GP)] could … take multiple views, multiple shots, instead of two pictures…I think one picture with light, one picture under bright light, maybe with, under bright light skin appear different…Bit more information, bit more input for the specialist to see, so he can do a better picture… more accurate diagnosis.* [TM 25]

Comments about equipment were intertwined with issues of security, allayed in part by the consent form.

> *Even though it's just using a phone, it's not a very professional way, but at least there's this form [consent form], whereby you know that it's still safe and you can daringly allow them to take the picture.* [TM 33]

The patients wanted more information about what personal details were being shared between the 2 institutions. Data security was perhaps in the forefront of their minds as the interviews were conducted soon after an incident in Singapore where some sensitive information had been mismanaged and other data misappropriated by computer hackers.

> *…let the patient know …. know what was shared with the skin centre.* [TM 17]

The sending of photographic images was not considered as risky as information transmitted in text format. The photos were considered generally to maintain anonymity, as illustrated by the following quote:

> *I mean they will actually focus on your areas that was affected and try to take a clear picture…And they will try to avoid your face, features…* [TM 35]

Unavailability of the Recommended Medication in the Polyclinic

As a primary care medical facility, the polyclinic dispensaries did not always have the medication recommended by the dermatologist. The patients then had to go elsewhere or wait for their medications to be delivered to the polyclinic pharmacy.

> *Of course, they [the specialist center] have lots, lots of creams, because they are looking after the skin, so they got whole range of, of treatment. Sometimes, some of the creams [the polyclinic] may not have.* [TM 32]

Patients' Suggestions for Improving Their Teledermatology Journey

The interviewees recognized that the start to finish time for teledermatology was much shorter than a conventional polyclinic referral to the specialist center and outpatient attendance, which could be many weeks later. However, for some patients, the time spent at the polyclinic was felt to be unnecessarily long and unpredictable and an aspect of the service needing refinement. Delays could happen at several points within the process, including the internal referral from the attending clinician to the "Derm Champ" to initiate the teledermatology process, the setting up of the camera, and the time waiting for a response from the dermatologist. Patients who had experienced delays for the camera to be set up wondered if there could be a dedicated facility to minimize the time spent preparing for the teledermatology referral.

> *…things like the camera, the equipment, everything is ready when the patient comes in. Take photo immediately, then just upload.* [TM 9]

The interval between referral and response was not predictable as it depended on the availability of the receiving dermatologist who fitted the teleconsultations in between their other clinical commitments. The resultant undefined waiting time when having scheduled a standard polyclinic appointment was not always convenient for the patient. Their suggestions for reducing the amount of waiting time needed to be spent in the polyclinic included allowing patients to leave the polyclinic after their clinical data had been transmitted to the dermatologist, and to be contacted later in the day with details of the management plan proposed.

> *…maybe I'm able to receive message, or phone mobile message, by phone, then it's okay, maybe, then faster.* [TM 17]

Such suggestions about the adoption of more technology into the teledermatology process was at variance with the views of others who wanted greater opportunity to debrief and discuss with the referring GP about the recommended management plan. Such discussions were particularly valued when the diagnosis had implications for work, lifestyle, or the well-being of others.

> *…explain better on the care plan. Yeah, because it's a suspected diagnosis, it's not like a…confirmed diagnosis. So, I'm very scared because scabies is contagious. I have my kid at home, and my husband is sleeping with me…When I left the clinic, I was, I was worried.* [TM 28]

The validity of the overall positive feedback was also evidenced by the many requests to expand teledermatology. The patients described their surprise on encountering this facility and challenged if the level of awareness of the service was sufficient.

> *How many patients know about this? I think [a] publicity programme. I don't know if the public is aware of this.* [TM plus referral to specialist center 29]

Those patients with good experiences felt that the teledermatology service should not only be promoted within the polyclinics, but that access should be also extended to those patients who attend a private GP for their primary health care. One respondent envisaged the development of a mobile teledermatology service to facilitate solo GP clinics using the service.

> *…think of is like blood test, X-ray; if there is a mobile service, people may just attend to it… More accessible, not just at the Polyclinic.* [TM 14]

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Discussion

Principal Findings

This study explored the experiences of patients using a teledermatology service linking a public polyclinic with a specialist dermatology service in Singapore. The patients found the teledermatology service convenient, saving them time and expense. It liberated them from the stresses incurred when making an in-person visit to a specialist facility. They valued the confidence and reassurance they had from the specialist's input to the management plan. The patients expressed concerns related to the security of their personal data as it was transferred between institutions; the unpredictability of the time spent waiting; the fact that the virtual telemedicine consultation may not necessarily dispense with the need for an in-person visit to the specialist center; the apparent unsophistication of the photographic equipment; the lack of the recommended medication within the polyclinic; and the lack of adequate closure of the consultation. The patients were keen to see the service advertised and made available beyond the polyclinic.

Gradually, health care is moving away from the traditional, rather paternalistic health service that "does things for its patients" and toward one that is more patient-led in both design and organization [15]. Addressing patient's experiences enables the development of more patient-focused care, which in turn improves satisfaction and health outcomes [16]. Using the in-depth qualitative interviews, we were able to gain insight into the experiences and views of adult patients; such information may not be apparent in quantitative, fixed-response patient satisfaction surveys [17]. There were several aspects of the patients' telemedicine journey that they found inconvenient. These included uncertainty about the total duration of a telemedicine consultation and the unavailability of recommended medication from the polyclinic pharmacy. The lack of clarity about the total amount of time needed to complete the consultation and obtain a management plan was in part due to the use of "store-and-forward" telemedicine. This asynchrony was inevitable as the dermatologist on duty had other clinical duties running in parallel with their responsibilities for fielding the telemedicine calls. The multitasking of the recipient specialist will always be a workforce planning challenge if the referral institutions are not generating sufficient cases for the full-time attention of the clinician in receipt of referrals. The patients' satisfaction with the concept of virtual consultation was apparent when they spoke of a desire to see widening access to the telemedicine service beyond the polyclinic. The patients suggested that the service could be expanded to include private general practices and that the public should be made aware of its availability. Certainly, the expansion of the teledermatology service to additional sites and the introduction of an efficient electronic queuing system could justify the allocation of dedicated staff and more predictable turnaround times for patients.

Strengths and Weaknesses

This paper adds to the small number of qualitative studies [18] of teledermatology to be found among a rapidly growing quantitative literature on diagnostic accuracy [19], cost-effectiveness [20], and patient outcomes [21]. The advantage of a narrative approach is that it produces rich data enabling a better understanding of the patient's journey and the way they understand and interpret their experiences. For example, some interviewees interpreted the clinician putting on gloves before examining their skin as reticence engaging with them, rather than as a hygiene measure [22]. Such patient concerns illustrate how things that may be entirely reasonable to health care professionals may be challenging to a layperson if not explained.

There was diversity in the patient's responses; for example, some perceived the teledermatology consultation service as quick while others described it as a protracted experience. As service providers, we may see the organization of teledermatology as standardized and streamlined, failing to recognize that the journeys of individual patients are quite diverse, with different trajectories (eg, the involvement of 1 or 2 primary care doctors), different durations (eg, waiting times and delays), and different outcomes (eg, a management plan that can be implemented in primary care or an outpatient visit to the specialist center).

Being more attentive in our interviews to the patient's anticipated configuration of their journey and comparing patient expectations with the reality would have helped us develop a deeper understanding of incongruity. Perhaps those reporting a quick service were taking as their baseline previous experiences of referral to an outpatient clinic, whereas those who perceived it as slow were using the routine polyclinic waiting time of less than 10 minutes as their baseline [9]. A future qualitative study using purposive sampling of patients who had experienced the different patient pathways will help us explore these complexities further.

Conclusions

Recognizing that patients value telemedicine for its convenience and being less demanding on time and money, Duffy and Lee [23] recently posed the question whether in-person visits should become the second, third, or even last options for meeting patients' needs? This proposal challenges the traditional way of providing care; even though telemedicine has been available in many countries for more than 20 years, its incorporation into patient care has been patchy and often confined to remote areas, or where there is a paucity of appropriate expertise. In countries where remuneration is fee-for-service, the adoption of telemedicine has been complicated by disputes over the disparities in pay for telemedicine versus in-person care (eg, in the United States, there is parity in only one-fifth of the states [24]). With the COVID-19 pandemic in Singapore, we are seeing telemedicine being used more widely to reduce travel and enable safe distancing [25,26]. Perhaps this pandemic will provide the catalyst for practice redesign, with in-person health care becoming the second rather than the first option for patient care.

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Acknowledgments

We would like to thank the staff at the polyclinics and specialist center who helped us with the recruitment of patients. This study was funded by a research grant (CPHCRI1.1#001) under the Centre for Primary Health Care Research and Innovation, a partnership between the Lee Kong Chian School of Medicine, Nanyang Technological University Singapore, and the National Healthcare Group Singapore.

Conflicts of Interest

None declared.

Multimedia Appendix 1
Topic guide for semistructured interviews.
[DOCX File , 25 KB - derma_v5i1e24956_app1.docx]

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Abbreviations

GP: general practitioner
TM: telemedicine

Edited by R Dellavalle, T Sivesind; submitted 12.10.20; peer-reviewed by D Trupia, KP Wong, F Kaliyadan; comments to author 27.11.20; revised version received 20.01.21; accepted 20.12.21; published 22.02.22.

Please cite as:
Chow A, Teo SH, Kong JW, Lee S, Heng YK, van Steensel M, Smith H
Patients' Experiences of Telemedicine for Their Skin Problems: Qualitative Study
JMIR Dermatol 2022;5(1):e24956
URL: https://derma.jmir.org/2022/1/e24956
doi:10.2196/24956
PMID:

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Original Paper

The Effects of Using the Sun Safe App on Sun Health Knowledge and Behaviors of Young Teenagers: Results of Pilot Intervention Studies

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Abstract

Background: A balanced approach toward sun exposure and protection is needed by young people. Excessive sun exposure increases their risk for skin cancers such as melanoma, whereas some exposure is necessary for vitamin D and healthy bones. We have developed a new iOS smartphone app—Sun Safe—through a co-design process, which aims to support healthy and balanced decision-making by young teenagers (aged 12-13 years).

Objective: The aim of this study was to test the capacity of Sun Safe to improve sun health knowledge and behaviors of young teenagers in 3 pilot intervention studies completed in 2020.

Methods: Young teenagers (aged 12-13 years; N=57) were recruited through the web or through a local school via an open-access website and given access to Sun Safe (29/57, 51%) or a placebo (SunDial) app (28/57, 49%). Participants completed sun health questionnaires and knowledge quizzes before and after the 6-week intervention (either on the web or in class) and rated the quality of the app they used via a survey.

Results: Of the 57 participants, 51 (89%) participants (26, 51% for placebo arm and 25, 49% for the Sun Safe arm) completed these studies, with most (>50%) reporting that they used a smartphone to access their designated app either “once a fortnight” or “once/twice in total.” Improved sun health knowledge—particularly about the UV Index—was observed in participants who were given access to Sun Safe compared with those who used the placebo (−6.2 [percentage correct] difference in predicted means, 95% CI –12.4 to –0.03; *P*=.049; 2-way ANOVA). Unexpectedly, there were significantly more sunburn events in the Sun Safe group (relative risk 1.7, 95% CI 1.1-1.8; *P*=.02; Fisher exact test), although no differences in time spent outdoors or sun-protective behaviors were reported. COVID-19 pandemic–related community-wide shutdowns during April 2020 (when schools were closed) reduced the time spent outdoors by >100 minutes per day (–105 minutes per day difference in predicted means, 95% CI –150 to –59 minutes per day; *P*=.002; paired 2-tailed Student *t* test). Sun Safe was well-rated by participants, particularly for information (mean 4.2, SD 0.6 out of 5).

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Conclusions: Access to the Sun Safe app increased sun health knowledge among young teenagers in these pilot intervention studies. Further investigations with larger sample sizes are required to confirm these observations and further test the effects of Sun Safe on sun-protective behaviors.

(JMIR Dermatol 2022;5(1):e35137) doi:10.2196/35137

KEYWORDS

app development; co-design; knowledge gain; sun exposure; sun protection; sun behaviors; teenagers; UV Index; vitamin D; young adolescents; mobile phone

Introduction

Sun Health Promotion and Behaviors: Australian Teenagers

A balanced approach toward sun protection and sun exposure is needed to promote the health and development of young people living in Australia. Sun-protective messaging aims to prevent sunburn and intermittent excessive sun exposure during childhood and adolescence as these events increase the risk for melanoma [1]. Conversely, some sun exposure is needed for vitamin D, healthy bone development, and other normal physiological and disease-preventing processes [2,3]. Although Australian teenagers have good knowledge about the importance of sun protection for preventing melanoma, they underestimate the risks associated with sunburn in childhood and adolescence [4]. Healthy sun behaviors are promoted in Australia through the entrenched *SunSmart* programs of the Cancer Council in primary (elementary) schools. However, these supportive programs are less well-established in secondary schools. This reduced support coincides with a time of life when *risky* behaviors emerge in young teenagers.

Factors Affecting the Use of Sun Protection by Australian Teenagers

Other factors may also affect the use of sun protection by young people, including personal preference for tanned skin, peer influences, and resistance to adult advice [1,5,6]. Furthermore, communicating nuanced health messages about the fact that short regular exposures to sunlight are likely sufficient to maintain or raise circulating 25-hydroxyvitamin D levels (but insufficient to cause sunburn) [7] is challenging. Historical and existing health messaging in Australia has largely been via mass media (ie, news and television) campaigns of the Cancer Council. Novel approaches are emerging, such as the installation of highly visible UV meters in secondary schools [8]. Indeed, new public health strategies that target young adolescents are needed, which build on knowledge obtained from primary education and ongoing public health campaigns and provide more support to children as they transition into secondary schooling [9]. Currently, there is little specific mobile health support for the young adolescent age group, with more available for younger children (eg, *Cache-Cache Soliel* [10]), older teenagers (eg, *Sunface UV-selfie* [11]), and adults (eg, *SunSmart* [12]).

The Sun Safe App is a Health Promotion e-Tool for Australian Teenagers

We recently co-developed an Apple iOS app—*Sun Safe*—with young teenagers (aged 12-13 years), Australian sun health promotion experts and researchers, and digital health developers [9]. The process underpinning the co-design of *Sun Safe* is reported in detail elsewhere [9]. This app aims to improve sun health knowledge and promote sun safe practices among young adolescents, including effective protection from sunburn and sufficient exposure for vitamin D. The health promotion message underlying *Sun Safe* is for users to *spend some time outdoors being active for vitamin D using sun protection as indicated by the UV Index*. The UV Index is a linear scale (1 to >11) of the intensity of solar UV radiation, categorized to describe the daily danger (from low to extreme) of sunburn. It is widely used by health promotion agencies around the world (including Cancer Councils Australia and the World Health Organization) to help people make decisions regarding sun protection.

Study Objectives

Here, we report the findings of effectiveness pilot intervention studies that tested the capacity of *Sun Safe* to affect sun health knowledge and behaviors of young adolescents under *real-world* conditions. This research was conducted in 2020, with data collected across 3 pilot trials because of the impact of the COVID-19 pandemic (Multimedia Appendix 1) [13-32]. Our objectives are to obtain end user responses to *Sun Safe*, pilot-test its capacity to improve the sun health knowledge and behaviors of young adolescents (aged 12-13 years), estimate its likely acceptance and effectiveness, provide data to estimate sample sizes, and test recruitment strategies and methods for future definitive trials.

Methods

Additional details on the methodology are provided in Multimedia Appendix 1.

Ethical and Governance Approvals

Approval to conduct this study was obtained from the human research ethics committee of the University of Western Australia (WA; RA/4/20/4424). Project approval was received from the Department of Education of WA to allow researchers to recruit participants through a local Perth school [9]. Findings are reported according to CONSORT-EHEALTH (Consolidated Standards of Reporting Trials of Electronic and Mobile Health Applications and Online Telehealth) guidelines for pilot trials. This was a small pilot trial of a nonclinical intervention and not a randomized clinical trial.

Timing of Pilot Intervention Studies

Parallel-designed, placebo-controlled pilot intervention studies were conducted across 2020, with participants recruited through

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community-based social media strategies or through a local high school (in class). Three pilot studies were conducted:

1. Community phase 1 pilot study (February 2020-May 2020)
2. School pilot study (February 2020-November 2020)
3. Community phase 2 pilot study (July 2020-November 2020)

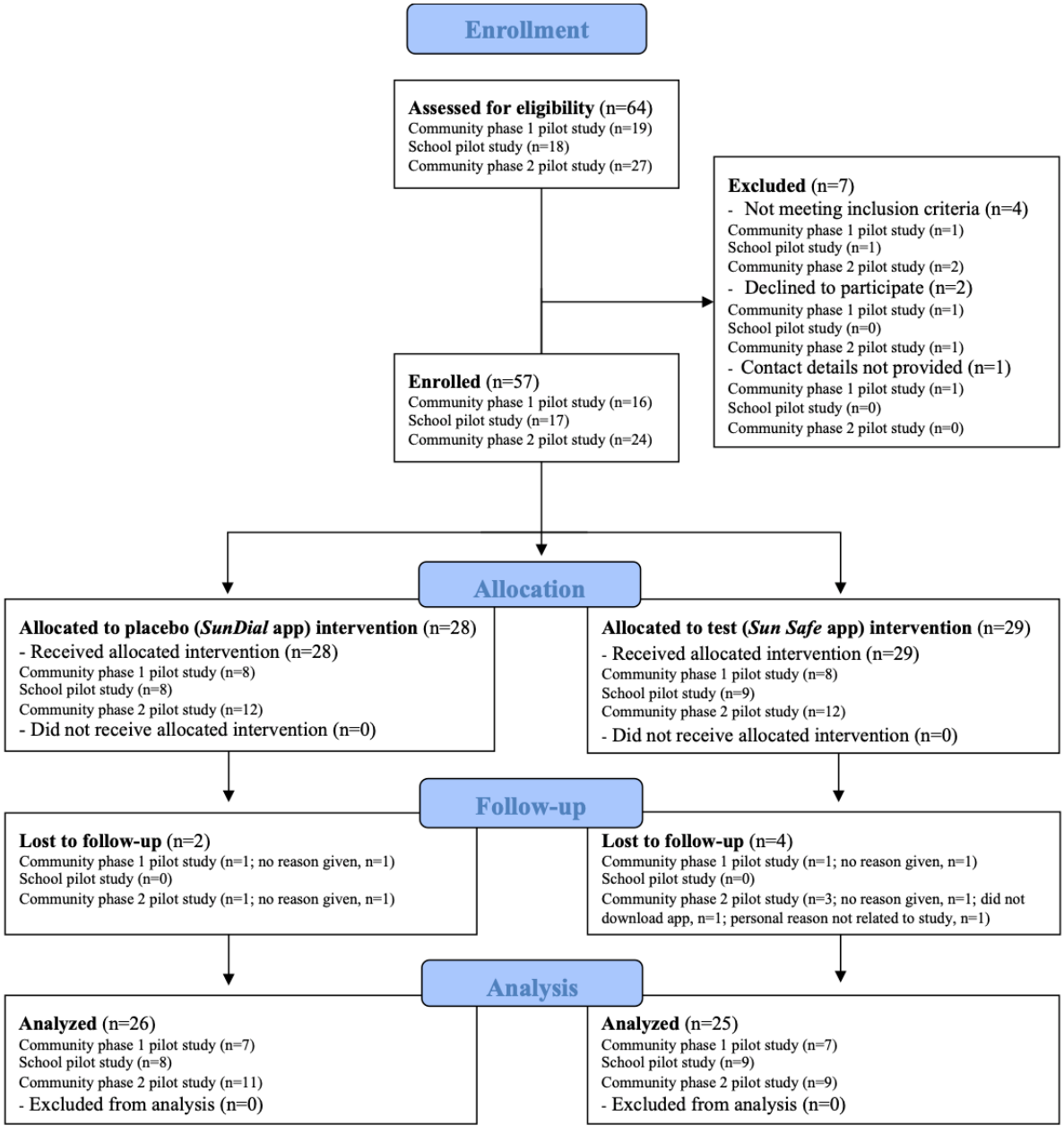
Recruitment of Participants

Recruitment was undertaken over two 5-week periods (February 2020 to March 2020 and July 2020 to August 2020). For community pilot studies, recruitment was conducted through notices placed on the Telethon Kids Facebook page (with >19,000 followers) and paid advertisements (total budget=Aus $400 [US $290]) specifically targeting parents living in WA aged ≥30 years. In the school pilot study, participants were recruited via in-class sessions with researchers speaking to 3 classes of students in years 7 and 8. Please see the *Methods* section of Multimedia Appendix 1 for COVID-19 pandemic impacts on recruitment and more details regarding timelines.

Eligibility Criteria

Eligible participants were aged 12 to 13 years and English speaking, with sufficient internet literacy to download and use the apps; had access to the internet and an Apple iOS device (ie, iPhone or iPad); and lived in WA (for community pilot studies) or attended the local school (for school pilot study). All eligible participants who provided informed consent were enrolled. A CONSORT (Consolidated Standards of Reporting Trials) flowchart detailing the enrollment of participants is shown in Figure 1.

Figure 1. Flowchart of recruitment of participants into the 3 pilot intervention studies. For some outcomes, data were not collected for all participants or were excluded from analyses.



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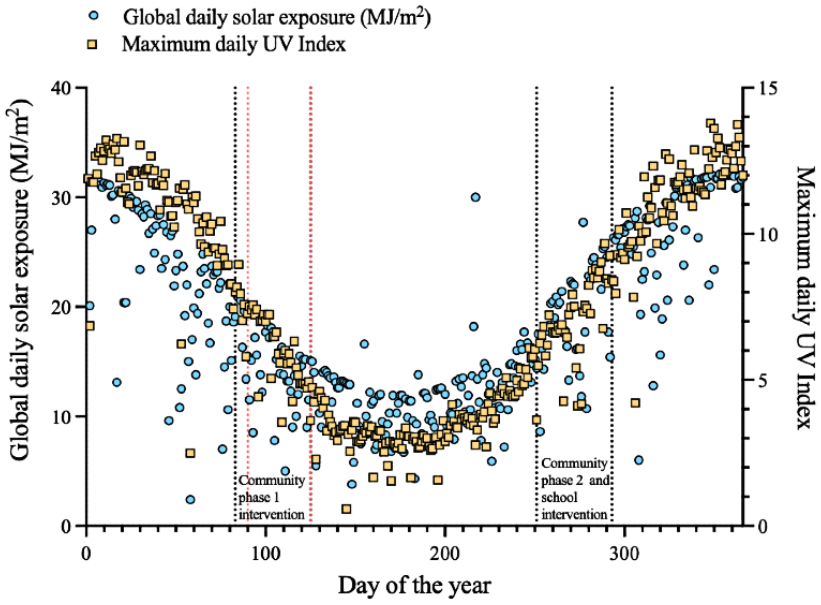
Study Location

These studies were largely conducted in Perth, the capital city of the state of WA (latitude 31.9°S, longitude 115.9°E) [33]. The *global daily solar radiation* (total solar energy levels per day, including UV, visible, and infrared radiation) levels measured at the *Perth Metro* terrestrial weather station (Australian Government Bureau of Meteorology [34]) and maximal daily UV Index levels for Perth (Australian Radiation Protection and Nuclear Safety Agency [35]) across 2020 are shown in Figure 2. A strong and statistically significant linear correlation between global daily solar exposure levels and maximum daily UV Index was observed (Spearman test, r=0.84, 95% CI 0.81-0.87; P<.001). For more details, see Multimedia Appendix 1.

Figure 2. Global daily solar exposure levels and maximum daily UV Index for Perth (Western Australia) in 2020. Black broken lines encapsulate 6-week intervention periods for each pilot study. Red broken lines encapsulate the days of the year during which schools were shut due to the COVID-19 pandemic.



Data Collection at Baseline

Participants were asked to provide self-assessed *baseline* responses, which were collected either through web-based questionnaires (for community pilot studies) or in-class completion of paper-based questionnaires (school pilot study). Data collected at recruitment and through questionnaires included the following:

1. Demographic information (age, gender, and postcode to estimate socioeconomic status)
2. Sun health knowledge (through completion of a multiple-choice quiz)
3. Skin type and responses to sun exposure
4. Sun health behaviors (time spent outdoors and sun-protective behaviors) and sunburn

A standardized multiple-choice quiz on sun health knowledge was developed from educational content included within the *Sun Safe* app [9] (see *Methods* section in Multimedia Appendix 1). The percentage of questions correctly answered and the time taken to complete the knowledge quizzes were recorded.

The sun health questionnaire included questions on time spent outdoors during weekdays, weekend days, and school holidays in the past 6 weeks and sun-protective behaviors at those times (wearing hats and long-sleeved or leg-covering clothing, seeking shade, and using sunscreen). Other questions included self-reported measures of sun sensitivity, tanning responses, skin type, number of moles and freckles, serious sunburns during the lifetime, and sunburns in the past 6 weeks. For more details, see Multimedia Appendix 1.

Skin type was determined by asking participants to choose a skin color they thought was closest to their own natural skin color (ie, skin of inner upper arm), which corresponded to *Fitzpatrick skin phototype color images* of types 1 to 6 (from 1=pale white skin to 6=deeply pigmented dark brown to black skin). For more details, see Multimedia Appendix 1.

In the school pilot study, self-reported sun behaviors (specifically time spent outdoors) were compared with the objective erythemally effective doses (EEDs; J/m^2) received on school days, as measured on polysulfone dosimeters [13] worn daily by participants for 7 days immediately before and during the final 7 days of the 6-week intervention. For more details, see Multimedia Appendix 1.

Intervention Group Allocations

After the completion of baseline questionnaires, participants were allocated into 1 of 2 intervention groups, with group allocation done by matching participants (1:1) based on age, gender, and skin type. Participants were recruited through the Qualtrics platform (Experience Management; hosted at the University of WA), with enrollment and assignment of interventions managed by SG. Participants were then invited to download either the *Sun Safe* app [14] (version 1.0.1, 2020, with further development frozen during these studies; available on the Australian Apple App Store only) or a placebo app. Major features of the *Sun Safe* app are summarized in Figure 3 (see

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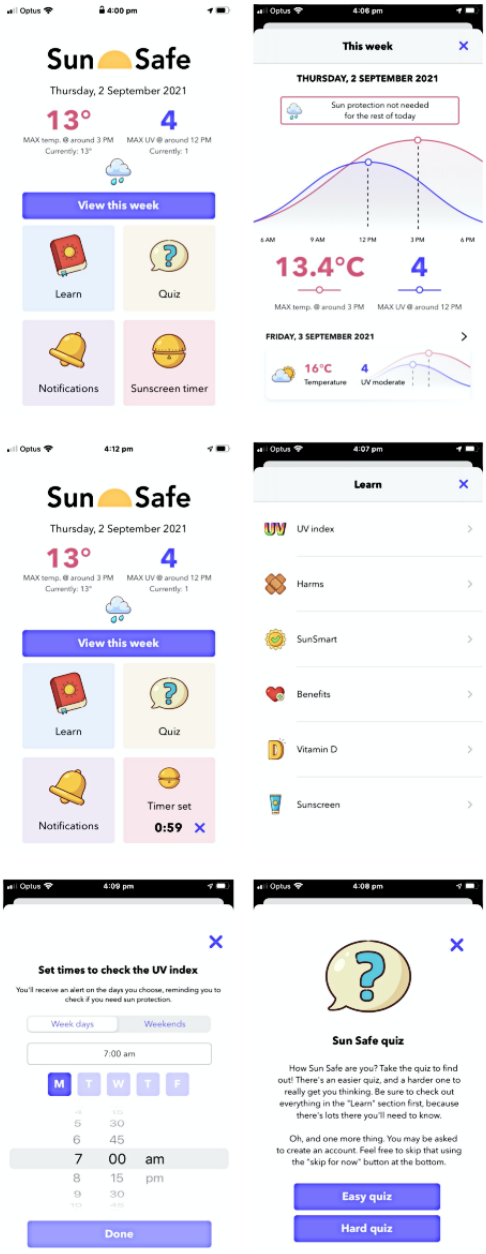
Multimedia Appendix 1 and the study by Nguyen et al [9]). The theoretical framework and co-design process underpinning the development of *Sun Safe* are reported in detail elsewhere [9]. *Sun Safe* requires the user's location and IP address to provide location-specific information; however, these data are not stored by the app nor the provider of the information. The placebo app selected was the *SunDial* iOS app (version 6.2, 2020), which notifies the user when sunrise and sunset events occur [15]. A placebo app was required to control for the *digital placebo effect*, which may occur when being involved in a digital intervention study [16]. Participants were blinded to which were the test (*Sun Safe*) and placebo (*SunDial*) apps and were initially encouraged to download and use either app (for free) through email or information provided during an in-class session. Researchers had no further contact with the participants during the 6-week app exposure period (Figure 2).

Figure 3. Screenshots of the Sun Safe app (clockwise from top left) include: the home page, predictive data and when to use sun protection (view this week), educational content (learn), easy and hard quizzes (quiz), notifications to check the UV Index, and a reminder to reapply sunscreen (sunscreen timer).



Data Collection After the Intervention

Data collected after 6 weeks of exposure to either app included the following:

1. Sun health knowledge (through the same multiple-choice quiz as the baseline)
2. Sun health behaviors (time spent outdoors and sun-protective behaviors) and sunburns received during 6 weeks of intervention
3. Assessments and ratings collected using a survey, which incorporated the user version of the Mobile App Rating Scale [17]

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The user version of the Mobile App Rating Scale survey includes 26 items, rated on 5-point (Likert) scales, and asks users to rate the app they used across six *areas of assessment*: (1) engagement, (2) functionality, (3) aesthetics, (4) information, (5) subjective quality, and (6) perceived impact (on related health knowledge, attitudes, and behaviors) [17]. An *overall quality* rating was produced by calculating the mean score of the engagement, functionality, aesthetics, and information areas of assessment [18]. For more information, see Multimedia Appendix 1.

Statistical Analyses

Results were analyzed using Microsoft Excel (version 16.52 for Mac, 2021) and GraphPad Prism (version 9.2.0 for Mac, 2021). Descriptive statistics were calculated, with mean and SD reported for continuous data and number and percentage (for data combined across the 3 pilot studies) for categorical data. We did not impute missing values for participants who did not complete the study, with most analyses considering data collected at baseline separate from that collected after the intervention. All data were subjected to normality tests (Shapiro–Wilk) to determine whether parametric data analyses were appropriate. Results were considered statistically significant for P values <.05. Unless otherwise stated, data were combined for the 3 pilot studies. For categorical data, Fisher exact tests or chi-square tests were performed to compare between intervention groups (ie, the app tested) for data combined for the 3 pilot studies. For continuous data, 2-way ANOVA with Tukey post hoc test or Student t test (if normally distributed) or Kruskal-Wallis test with Dunn post hoc or Mann–Whitney test (if not normally distributed) were used to determine the differences between intervention groups when data were combined across all 3 pilot studies or within each pilot study, respectively. Outcomes of the 2-way ANOVA are reported below as differences in predicted means with 95% CIs. Relative risk (RR) CIs were calculated using the Koopman asymptomatic score method. For dosimetry data, the strength of linear correlations was tested using the Pearson test. For more information, see also Multimedia Appendix 1.

Results

Participant Demographics

Across all 3 pilot studies, 57 participants were recruited who were given access to the placebo (28, 49% for *SunDial* [15]) and test (29, 51% for *Sun Safe*) apps (Figure 1) after matching for age, gender, and skin type, with 51 (89%) participants (26, 51% in the placebo arm and 25, 49% in the test arm) completing the studies. Overall, more participants were women who lived in postcodes of higher socioeconomic status (Socio-Economic Indexes for Areas Index of Relative Socioeconomic Advantage and Disadvantage quintiles 4 and 5) with *lighter* skin types (ie, Fitzpatrick skin types 1-3; Table 1). Approximately all individuals (56/57, 98%) lived in postcodes within the Perth metropolitan region. No statistically significant differences in gender (P=.99; Fisher exact test), age (P=.89; 2-way ANOVA), postcode-based socioeconomic status (P=.48; chi-square test), or skin type (P=.99; Fisher exact test) were observed between intervention groups (Table 1).

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Table 1. Demographics of participants in either placebo (SunDial app) or test (Sun Safe app) intervention arms (N=57).

Demographics	Pilot study and intervention groups							
	Community phase 1		Community phase 2		School		Combined[a]	
	Placebo	Test	Placebo	Test	Placebo	Test[b]	Placebo	Test
Participants completing baseline, n[c] (%)	8 (14)	8 (14)	12 (21)	12 (21)	8 (14)	9 (16)	28 (49)	29 (51)
Gender, n (%)								
Male	2 (25)	3 (38)	4 (33)	3 (25)	2 (25)	3 (33)	8 (29)	9 (31)
Female	6 (75)	5 (62)	8 (67)	9 (75)	6 (75)	6 (67)	20 (71)	20 (69)
Other or not stated	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Age (years), mean (SD)	12.8 (0.5)	12.9 (0.4)	12.7 (0.5)	12.8 (0.5)	12.7 (0.3)	12.6 (0.3)	12.7 (0.4)	12.8 (0.3)
Postcode-based SEIFA[d] IRSAD[e], n (%)								
Quintile 1	0 (0)	0 (0)	1 (8)	1 (8)	0 (0)	0 (0)	1 (4)	1 (3)
Quintile 2	0 (0)	2 (25)	4 (33)	2 (17)	0 (0)	1 (11)	4 (14)	5 (17)
Quintile 3	1 (12)	3 (38)	1 (8)	4 (33)	2 (25)	1 (11)	4 (14)	8 (28)
Quintile 4	0 (0)	0 (0)	3 (25)	3 (25)	3 (38)	3 (33)	6 (21)	6 (21)
Quintile 5	7 (88)	3 (38)	3 (25)	2 (17)	3 (38)	4 (44)	13 (46)	9 (31)
Fitzpatrick skin type, n (%)								
1	1 (12)	2 (25)	2 (17)	2 (17)	1 (12)	0 (0)	4 (14)	4 (14)
2	3 (38)	4 (50)	5 (42)	5 (42)	1 (12)	1 (11)	9 (32)	10 (34)
3	4 (50)	2 (25)	3 (25)	3 (25)	3 (38)	6 (67)	10 (36)	11 (38)
4	0 (0)	0 (0)	2 (17)	2 (17)	1 (12)	1 (11)	3 (11)	3 (10)
5	0 (0)	0 (0)	0 (0)	0 (0)	2 (25)	1 (11)	2 (7)	1 (3)
6	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

[a]For data combined across the 3 pilot studies, statistical comparisons were made between placebo and test interventions for the following: gender: RR=0.9 (95% CI 0.4-2.0); *P*=.99; Fisher exact test; age: –0.02 years difference in predicted means (95% CI –0.24 to 0.28); *P*=.89; 2-way ANOVA with Tukey post hoc test; SEIFA Index of Relative Socioeconomic Advantage and Disadvantage: *P*=.48; chi-square test; groups collapsed as described in the *Methods* section; Skin type: RR=0.9 (95% CI 0.5-1.6); *P*=.99; Fisher exact test; groups collapsed as described in the *Methods* section.

[b]One test participant did not complete the baseline surveys as they were not able to attend the in-school session.

[c]Participants recruited into each pilot study who completed all baseline questionnaires and were given access to either the placebo (*SunDial*) or test (*Sun Safe*) apps for 6 weeks.

[d]SEIFA: Socio-Economic Indexes for Areas.

[e]IRSAD: Index of Relative Socioeconomic Advantage and Disadvantage.

Skin Sensitivity, Tanning Responses, and Number of Moles and Freckles

At baseline, there were no statistically significant differences in skin-burning (sensitivity) or tanning responses to 30 minutes of exposure to summer sunlight, skin appearance at the end of summer, or number of moles or freckles between the test (*Sun Safe*) and placebo groups (Multimedia Appendix 1 Table S1).

Downloading and Using the Apps

In the community pilot studies, there were no significant differences in the time taken to download the apps (*P*=.64; Mann–Whitney test) or time for which apps were accessed (*P*=.20) between the placebo and test (*Sun Safe*) groups (Multimedia Appendix 1 Table S2). Most participants used a smartphone (>50%) to access their designated app either once a fortnight or once or twice (in total).

Sun Health Knowledge Was Increased With Exposure to the Sun Safe App

Participants completed a 20-question multiple-choice quiz before (Figure 4A) and after (Figure 4B) the 6-week intervention. Participants who were given access to the *Sun Safe* (test) app demonstrated greater sun health knowledge than those in the placebo group (Figure 4B; −6.2%, 95% CI –12.4% to –0.03%; *P*=.049, 2-way ANOVA). Specific knowledge improvements were about the UV Index, with significantly more participants from the *Sun Safe* group correctly answering the question, “At which UV Index values are sun protection recommended when you are outside?” (ie, 13/25, 52% in placebo and 20/25, 80% in test arms answered correctly; RR=0.65, 95% CI 0.41-0.97; *P*=.04; chi-square test; Multimedia Appendix 1, Table S3). There was no difference between men and women in the percentage of correct answers achieved before or after the intervention (Multimedia Appendix 1).

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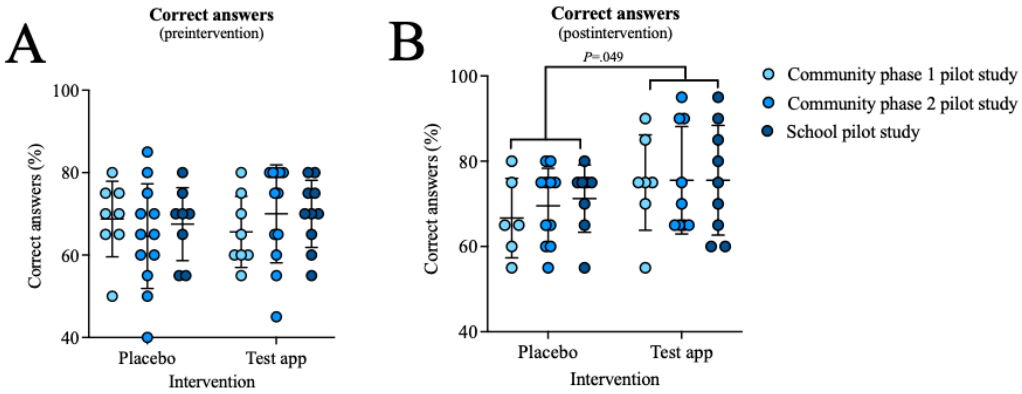
Figure 4. Exposure to the test app (Sun Safe) increased the percentage of questions correctly answered by participants (in a 20-question multiple-choice quiz) across all 3 pilot studies. Data collected during (A) preintervention assessment (28/28, 100% placebo and 29/29, 100% test) and (B) postintervention assessment (25/28, 89% placebo and 25/29, 86% test) were compared using 2-way analysis of variance (with Tukey post hoc analysis; −6.2% difference in predicted means, 95% CI –12.4 to –0.03; *P*=.049, 2-way analysis of variance). One participant from the placebo arm of the school pilot study did not attend the in-school session during which the multiple-choice quiz was conducted at the postintervention time point. Data are shown as mean (SD).



Sunburns

There were no statistically significant differences in the number of serious sunburn events reported across the lifetime or any sunburn during the 6 weeks before the intervention between the groups (Table 2). However, there were significantly more sunburn events reported by participants in the *Sun Safe* group during the 6 weeks of the intervention than those in the placebo group (Table 2; RR=1.7, 95% CI 1.1-2.8; *P*=.02; Fisher exact test). Within the *Sun Safe* group, these were mostly (10/13, 77%) not *bad sunburns*. No statistically significant difference observed between groups in the number of bad sunburns (RR=0.5, 95% CI 0.1-1.2; *P*=.27; Fisher exact test).

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Table 2. Sunburns during lifetime or the 6 weeks before or during the intervention[a,b].

Intervention group	Before intervention (combined; n=56), n (%)		During intervention (combined; n=51), n (%)	
	Placebo	Test	Placebo	Test
Participants	28 (50)	28 (50)	26 (51)	25 (49)
Lifetime sunburns[c]			N/A[d]	N/A
0	7 (25)	7 (25)		
1	4 (14)	7 (25)		
2-10	11 (39)	11 (39)		
>10	4 (14)	1 (4)		
Do not know	2 (7)	2 (7)		
Frequency of sunburn in the past 6 weeks				
Never	19 (68)	21 (75)	21 (81)	12 (48)
Once	7 (25)	4 (14)	3 (12)	10 (40)
2-10 times	1 (4)	2 (7)	1 (4)	2 (8)
>10 times	0 (0)	0 (0)	1 (4)	0 (0)
Do not know	1 (4)	1 (4)	0 (0)	1 (4)
How many of these were bad sunburns?[e]				
0	5 (62)[f]	4 (67)[g]	2 (40)[h]	10 (77)[i]
1	3 (38)[f]	1 (17)[g]	2 (40)[h]	2 (15)[i]
2-10	0 (0)[f]	1 (17)[g]	1 (20)[h]	1 (8)[i]
Do not know	0 (0)[f]	0 (0)[g]	0 (0)[h]	0 (0)[i]

[a]Data are shown as number (n) of each participant who selected each response and percentage within each intervention group, with data combined from participants enrolled in 1 of 3 pilot studies, who completed the survey before and after 6 weeks of access to either the placebo (*SunDial)* or test (*Sun Safe*) apps.

[b]Statistical comparisons were made between placebo and test interventions using the Fisher exact test (with groups collapsed, as described in *Methods* section of Multimedia Appendix 1) for the following: lifetime sunburn: RR=0.8 (95% CI 0.4-1.4); *P*=.59; frequency of sunburn (before): RR=0.9 (95% CI 0.6-1.3); *P*=.77; Frequency of sunburn (during): RR=1.7 (95% CI 1.1-2.8); *P*=.02; bad sunburns (during): RR=0.5 (95% CI 0.1-1.2); *P*=.27.

[c]Number of sunburns to a significant area of skin with pain lasting longer than a day, experienced in a lifetime (asked only at baseline; ie, before intervention).

[d]N/A: not applicable (as data were only collected at baseline).

[e]For those who experienced any sunburn in the past 6 weeks, how many of these were bad sunburns to a significant area of skin, with pain lasting longer than a day?

[f]n=8.

[g]n=6.

[h]n=5.

[i]n=13.

Time Spent Outdoors

There were no statistically significant differences in the time spent outdoors either before or during the intervention period between the placebo and test groups (Multimedia Appendix 1 Table S4). There were also no statistically significant differences in the time spent outdoors between the placebo and test groups either before or during the intervention within each pilot study (Multimedia Appendix 1 Table S4).

Within the community phase 1 pilot study, significant reductions in time spent outdoors were observed during the intervention compared with the time before the intervention (Figure 5A-5C; overall: –105 minutes, 95% CI –150 to –59 minutes; *P*=.002; school weekdays: –81 minutes, 95% CI –135 to –26 minutes; *P*=.008; weekend days: –96 minutes, 95% CI –169 to –23 minutes; *P*=.01, paired Student *t* test). This was notable, as the intervention ran across the initial COVID-19 pandemic–induced shutdown period of April 2020. Significant reductions in time spent outdoors occurred in the late afternoon (3 PM to 6 PM) on school days (before: mean 75, SD 40 minutes; during: mean 40, SD 33 minutes; *P*=.03; Wilcoxon test) and in the middle of the day (10 AM to 2 PM) on weekend days (before: mean 81, SD 47 minutes; during: mean 53, SD 39 minutes; *P*=.049; paired Student *t* test). These observations were not reproduced in the other pilot studies (Multimedia Appendix 1 Table S4 and data

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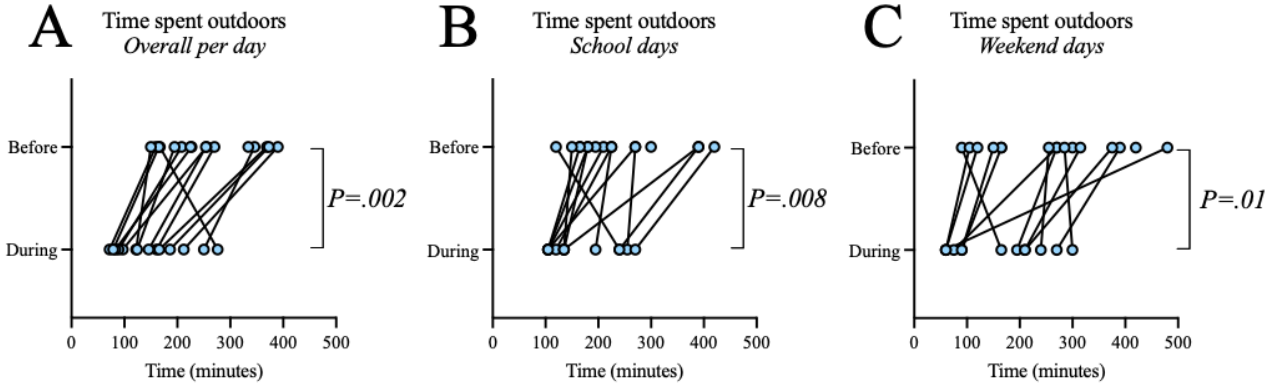
not shown, respectively) suggesting that the reduction in time spent outdoors was an effect of the COVID-19 pandemic.

Figure 5. Time spent outdoors was significantly reduced during the intervention period for participants of the community phase 1 pilot study. Data collected before (16/16, 100%) and during the intervention (13/16, 81%) were compared using paired Student t tests ($P<.05$), including (A) overall time spent outdoors per day (−105 minutes difference in predicted means, 95% CI −150 to −59 minutes; $P=.002$), (B) time spent outdoors on school days (−81 minutes, 95% CI −135 to −26 minutes; $P=.008$), and (C) time spent outdoors on weekend days (−96 minutes, 95% CI −169 to −23 minutes; $P=.01$). Data are shown for each individual and paired for responses before and during the intervention period (combined for both intervention groups).



Validation of Time Spent Outdoors With Dosimetry Data

Overall, the number of EED received by participants increased as time spent outdoors on school days increased, with a significant positive linear correlation observed before the intervention (Multimedia Appendix 1 Figure S1; Pearson $r=0.67$, 95% CI 0.22-0.89; $P=.008$). For more data related to wearing dosimeters, including compliance, please see Multimedia Appendix 1 Figure S1 and Table S5.

Personalized UV Exposure Measured by Dosimeters in School Pilot Study

There was no difference between UV exposure levels (ie, EED) measured via dosimeters worn by school pilot study participants in the placebo and test groups in the week before or last week of the intervention (Multimedia Appendix 1 Figure S1).

Sunscreen Use and Sun-Protective Behaviors

The preferred mode of sun protection by participants was seeking shade (Multimedia Appendix 1, Tables S6 and S7). No significant differences in the use of sunscreen were observed before or during the intervention between the placebo and test groups (Multimedia Appendix 1 Table S6). There was little difference in other sun-protective behaviors (including seeking shade, wearing a hat, or wearing clothing with long sleeves) on school days (between 10 AM and 3 PM; Multimedia Appendix 1, Table S7) and weekend days (between 10 AM and 2 PM; data not shown).

Sun Safe Was Rated Higher Across Most Areas of Assessment

When data were combined across all pilot studies, *Sun Safe* was rated highest for information (mean 4.2, SD 0.6) and lowest for engagement (mean 2.9, SD 0.6; Multimedia Appendix 1, Table S8). Across all areas of assessment except aesthetics, *Sun Safe* was rated significantly higher than the placebo app (Multimedia Appendix 1, Table S8; for combined data). Participants using *Sun Safe* were more likely to recommend it to others ($P=.003$; Mann–Whitney test) and use it more frequently in the next 12 months ($P=.008$) than those using the placebo app (Multimedia Appendix 1 Table S9). Only 12% (3/24) of the participants stated that they would pay for the *Sun Safe* app (Multimedia Appendix 1, Table S9).

Discussion

Principal Findings

Here, we describe how exposure to the *Sun Safe* app increased the knowledge that young Australian teenagers living in Perth (WA) had about the UV Index through placebo-controlled pilot intervention studies. Participants exposed to *Sun Safe* rated it highly, particularly for *information*. With some emphasis on the benefits of sun exposure, we may have expected that *Sun Safe* would increase the time spent outdoors using sun protection. However, no differences were observed in the time spent outdoors or sun-protective behaviors. These behaviors were likely strongly influenced by the COVID-19 pandemic. Indeed, during the shutdown period of April 2020, there was significantly reduced time spent outdoors observed in participants of the community phase 1 pilot study (mean 105, SD 78 minutes per day). This was likely linked to reduced opportunities to participate in outdoor sporting activities and the capacity of participants to engage in extracurricular outdoor activities. A participant stated that there was “no organized sport due to the COVID-19 pandemic.” Others have also reported reduced time spent outdoors by children living in Israel during COVID-19 restrictions [36]. There was increased reporting of (not bad) sunburns during the intervention period in the *Sun Safe* group compared with the placebo group. As there was no difference in time spent outdoors or reported sun behaviors between interventions, it may be that this increase in sunburns was because of increased awareness of the impacts of skin exposure to excessive sunlight, so that users of *Sun Safe* were more aware of sunburns and therefore more likely to recognize and report them.

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Although *Sun Safe* described some benefits of sun exposure, *using sun protection as indicated by the UV Index* was prioritized within the *learn* feature and across all app features (eg, *View this week* for when to use sun protection and *Quiz* questions [9]). Information on *harms* and *SunSmart* behaviors featured first in the *learn* feature. However, it is possible that sun behaviors worsened with exposure to *Sun Safe*, with these pilot studies insufficiently powered to detect significant changes in behavior. Indeed, a systematic review recently identified unexpected consequences of using the UV Index to make health decisions, such as intentional tanning [37]. It may be that using the UV Index to make sun health decisions is not the best approach for young teenagers, and sun health apps that target this age group need to promote sun-protective behaviors more generally. However, it is important to recognize the small sample size (N=57) of these pilot studies and that further studies are required with larger cohorts to reproduce and better understand these findings.

Using *Sun Safe* significantly increased important sun health–related knowledge among young teenagers, with no differences observed between male and female participants. This was perhaps unexpected as we observed less engagement of male coresearchers during the co-design process, with fewer men than women recruited as coresearchers, and some uncertainty regarding how feedback from male coresearchers translated into the development of *Sun Safe* [9]. Male coresearchers also displayed a sense of indifference regarding sun protection through interviews conducted as part of the *Sun Safe* co-design process [38]. Whether these increases in sun health knowledge translate into improved sun-protective behaviors by men is uncertain. Other uncertainties exist regarding whether knowledge gains observed for *Sun Safe* will have long-term effects on behavior with a relatively short intervention period (6 weeks) tested here.

A strength of these pilot studies was the relatively low dropout rate (approximately 10% overall) compared with the findings of a systematic review of intervention studies that included intervention lengths that ranged from 10 days to 6 months and tested mental health apps for which much higher (>25%) losses to follow-up were observed [19]. Another strength was the use of the *SunDial* app to control for the *digital placebo effect*, which may come about in digital intervention studies through positive expectations of receiving beneficial effects, as personal devices such as smartphones may be an *extension of self* [16]. The inclusion of digital controls may be essential to determine real-world effectiveness, with many mental health apps not demonstrating therapeutic effectiveness when a digital control was included as a comparator group [39,40]. *SunDial* was chosen as, although its focus was on the sun, no information related to sun health was imparted. It was free to download, included no in-app advertisements, and had few privacy concerns.

Blinding users to placebo and test apps is an ongoing challenge in digital health intervention studies. To aid this process, we included knowledge quiz questions related to the nature of the placebo app, which notify the user when sunrise and sunset events occur. However, it is uncertain whether *SunDial* was the best placebo app to use. A modified or disabled version of *Sun Safe* could be used as a placebo, although this might be obvious to participants (depending on the modifications made) and was beyond our funding budget. Furthermore, it is difficult to determine which features would be best excluded as the effective components of *Sun Safe*. Another approach could be to have a *no app* control group; however, this would not adequately control for the *digital placebo effect* [16]. Including a third, *no app* control group could be considered, as well as different experimental approaches, such as incorporating a crossover design (although this still might not overcome issues regarding blinding) or by testing another health app in a side-by-side fashion and including questions in surveys (or other) that also measure the health outcomes of the alternate app.

Limitations

Limitations of these pilot studies include biases in participant recruitment, particularly for gender, socioeconomic status, and skin type. Most participants were recruited from the Perth metropolitan area, and thus, it is unclear whether the methods used, and the findings of these pilot studies are applicable elsewhere. Future intervention studies should aim to increase the diversity of participants recruited (considering gender, socioeconomic status, skin type, and residence beyond metropolitan Perth). These could use a combined web-based and school recruitment strategy (managed via the web), targeting schools attended by students living in more disadvantaged Socio-Economic Indexes for Areas to increase participant numbers and diversity. Recruitment media and communications could also be provided in languages other than English for the recruitment of young people from culturally and linguistically diverse backgrounds. Further development of *Sun Safe* may be necessary to improve accessibility (ie, an Android version and language options) and engagement, which might be addressed by additional gamification suggestions raised by coresearchers during the *Sun Safe* co-design process (ie, incorporation of in-app minigames [9]). Other researchers have recently developed potentially engaging virtual reality games that promote sun protection [41]. The information content of *Sun Safe* may also need to be modified, particularly if an increased risk of sunburn persists in future (better powered) studies. Factors that may have affected recruitment in our pilot studies, which may be hard to address in future studies, could include parental concerns over smartphone use and the web-based environment, potential resistance by some young people to participate if recruited through their parents, and the ongoing influence of the COVID-19 pandemic. We now have a better understanding of the sample size requirements of future intervention studies, with sufficient sample size (N=57) demonstrated for user knowledge improvements but perhaps not for differences in sun-protective behaviors. Other limitations include those typical of eHealth trials, such as nonblinding of participants, the number of outcomes assessed (and risk of type 1 error), and biases introduced by limited use of the apps tested.

Conclusions

Skin cancers are the most prevalent form of cancer (affecting 2 in 3 adults) in Australia and bring substantial health and economic costs (eg, >Aus $1 billion [US $0.7 billion] in 2015-2016 nationally [42]), with prevention 30-fold less costly

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than treatment [43]. Adolescents are a key target population for skin cancer prevention campaigns and education, through which relatively small investments could bring about significant health and cost savings. Some sun exposure is important for maintaining vitamin D levels as teenagers become young adults, a population at risk for vitamin D deficiency in Australia [44]. We demonstrated that the use of the *Sun Safe* app in real-world settings improved the sun health knowledge that young teenagers have about the UV Index. Larger intervention studies in community and school settings with greater statistical power are needed to reproduce these findings and determine whether this app affects sun health behaviors.

Acknowledgments

The authors thank all the recruited participants and their parents or guardians for their input into this project. The authors also thank the administrators and teachers from the local school for their assistance in participant recruitment and participation and the officials from the Department of Education of Western Australia (WA) for their review of documents for governance approval. The authors also thank Caitlin Kameron and Sally Blane from Cancer Council WA for their development of content used within the *Sun Safe* app and intellectual input for interpreting the findings from these studies, Natalie Eastwell and Tammy Gibbs from the Telethon Kids Institute for their support with the administration and development of web-based recruitment portals and recruitment of participants through Facebook, and Oscar Del Borello (Biochemistry, University of WA) for assistance in spectrophotometry. This research was supported by Healthway (Health Department of WA) via a health promotion exploratory research grant (#31971). The sponsor had no role in the study design; the collection, analysis, and interpretation of data; the writing of the report; or the decision to submit the manuscript for publication. LB was supported by the Multiple Sclerosis Postdoctoral Research Fellowship and the Curtin University Research Fellowship. JF was supported by the Healthway Early Career Research Fellowship (#33020). RL was supported by the National Health and Medical Research Council (Australia) Senior Research Fellowship. SG was supported by an Al and Val Rosenstrauss Research Fellowship from the Rebecca L Cooper Foundation.

Conflicts of Interest

The Sun Safe wireframe and app prototype were developed by MJ (Curve Tomorrow) and JW (Reach Health Promotion Innovations), respectively.

Multimedia Appendix 1
Additional methods and results.
[PDF File (Adobe PDF File), 1656 KB - derma_v5i1e35137_app1.pdf]

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Abbreviations

CONSORT: Consolidated Standards of Reporting Trials
CONSORT-EHEALTH: Consolidated Standards of Reporting Trials of Electronic and Mobile Health Applications and Online Telehealth
EED: erythemally effective dose
RR: relative risk
WA: Western Australia

Edited by R Dellavalle, T Sivesind; submitted 22.11.21; peer-reviewed by B Bernardes-Souza, E Krieghoff-Henning; comments to author 04.01.22; revised version received 31.01.22; accepted 02.02.22; published 16.03.22.

Please cite as:
Clare IM, Gamage N, Alvares GA, Black LJ, Francis J, Jaimangal M, Lucas RM, Strickland M, White J, Nguyen R, Gorman S
The Effects of Using the Sun Safe App on Sun Health Knowledge and Behaviors of Young Teenagers: Results of Pilot Intervention Studies
JMIR Dermatol 2022;5(1):e35137
URL: https://derma.jmir.org/2022/1/e35137
doi:10.2196/35137
PMID:

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Original Paper

Spin in Abstracts of Systematic Reviews and Meta-analyses of Melanoma Therapies: Cross-sectional Analysis

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Abstract

Background: Spin is defined as the misrepresentation of a study's results, which may lead to misperceptions or misinterpretation of the findings. Spin has previously been found in randomized controlled trials and systematic reviews of acne vulgaris treatments and treatments of various nondermatological conditions.

Objective: The purpose of this study was to quantify the presence of spin in abstracts of systematic reviews and meta-analyses of melanoma therapies and identify any related secondary characteristics of these articles.

Methods: We used a cross-sectional approach on June 2, 2020, to search the MEDLINE and Embase databases from their inception. To meet inclusion criteria, a study was required to be a systematic review or meta-analysis pertaining to the treatment of melanoma in human subjects, and reported in English. We used the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) definition of systematic reviews and meta-analyses. Data were extracted in a masked, duplicate fashion. We conducted a powered bivariate linear regression and calculated odds ratios for each study characteristic.

Results: A total of 200 systematic reviews met the inclusion criteria. We identified spin in 38% (n=76) of the abstracts. The most common type of spin found was type 3 (selective reporting of or overemphasis on efficacy outcomes or analysis favoring the beneficial effect of the experimental intervention), occurring 40 times; the least common was type 2 (title claims or suggests a beneficial effect of the experimental intervention not supported by the findings), which was not present in any included abstracts. We found that abstracts pertaining to pharmacologic interventions were 3.84 times more likely to contain spin. The likelihood of an article containing spin has decreased annually (adjusted odds ratio 0.91, 95% CI 0.84-0.99). No significant correlation between funding source or other study characteristics and the presence of spin was identified.

Conclusions: We have found that spin is fairly common in the abstracts of systematic reviews of melanoma treatments, but the prevalence of spin in these abstracts has been declining from 1992-2020.

(JMIR Dermatol 2022;5(1):e33996) doi:10.2196/33996

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KEYWORDS

melanoma; spin; melanoma treatment; skin conditions; skin; misinterpreting data; misinterpretation; skin cancer

Introduction

Skin cancer is the most common form of cancer in the United States, with more than 9500 new diagnoses each day [1]. Among skin cancer types, melanoma remains the most deadly, responsible for an estimated 6850 deaths in 2020 [2]. Furthermore, the incidence of melanoma is projected to rise by 2% in 2020, continuing a trend that has existed for more than 6 decades [2,3]. Although the standard treatment for melanoma is surgical excision, new therapies have recently emerged, including targeted therapies (such as BRAF and MEK inhibitors) and immunotherapies (such as anti-PD1 and anti–CTLA-4 antibodies), which have contributed to a recent decrease in mortality rates [2,4]. An increase in the volume of published research, in tandem with an increased number of available effective therapies, has resulted in a substantial number of studies for dermatologists to consider when recommending melanoma therapies to their patients. For this reason, systematic reviews have become an essential tool for clinicians, making accurate reporting of the results in both abstracts and manuscripts an integral component of scientific writing.

The term *spin* has been defined as "specific reporting that could distort the interpretation of results and mislead readers" [5,6]. Although abstracts are historically viewed as compressed versions of a full manuscript, scientists may highlight specific findings in the abstract to make the study's results appear more compelling [6] and engage more readers [7]. Clinicians endeavoring to maintain an up-to-date evidence-based practice often rely on an abstract alone to formulate a clinical opinion [8-10]. One study found that clinicians were 2.4 times more likely to read an abstract than an entire article [11]. Therefore, it is not an unfair assumption that a study abstract may directly influence a dermatologist's approach to melanoma management, especially considering the breadth of new and emerging therapies and combination regimens.

Notwithstanding clinicians' reliance on systematic reviews in everyday decision-making, it has been demonstrated that reporting in the abstracts of systematic reviews is frequently flawed [12-15]. The presence of spin has been exhibited in abstracts of randomized controlled trials (RCTs) in a multitude of specialties, including psychiatry [16], anesthesiology [17], oncology [18], and emergency medicine [19], revealing significant issues of transparency in the reporting of results in published abstracts. Ottwell et al [20] recently identified spin in almost one-third of systematic reviews and meta-analyses of acne vulgaris therapies. In this study, we aimed to evaluate the presence of spin in abstracts of systematic reviews and meta-analyses focused on melanoma treatment. Additionally, we discuss the clinical repercussions if clinicians are presented with misleading information and provide recommendations to reduce spin and improve overall reporting in systematic reviews and meta-analyses.

Methods

Oversight, Transparency, Reproducibility, and Reporting

As no humans were involved in this study, it did not meet the regulatory definition of human subject research per the US Code of Federal Regulations and was not subject to institutional review board oversight. The associated protocol, extraction forms, data analysis scripts, and other study artifacts have been uploaded to Open Science Framework to ensure transparency and reproducibility [21]. To further ensure the reproducibility of our analyses, the data were reanalyzed in a masked fashion by a third-party statistician. This study was conducted concurrently with similar studies evaluating the presence of spin in systematic reviews in other fields of medicine. These studies adhered to a common methodology that has been described elsewhere [20]. The relevant reporting guidelines were incorporated in the drafting of this manuscript, specifically PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) [22] and Murad and Wang's [23] guidelines for meta-epidemiological studies.

Search Strategy

A study team member (DW), a systematic review librarian, constructed search strategies for the MEDLINE (Ovid) and Embase (Ovid) databases and used them to locate systematic reviews and meta-analyses of treatment modalities for melanoma (Textbox 1).

Both databases were searched from their inception. DW conducted these searches on June 2, 2020; the retrieved records were uploaded to Rayyan, a systematic review screening platform [24]. After duplicates were removed, two authors (RN and AW) independently screened the titles and abstracts of the remaining records to determine eligibility.

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Textbox 1. Search queries.

Ovid MEDLINE

1. exp Melanoma/
2. (melanoma* or (pigment* adj1 cancer*) or melanocarcinoma* or nevocarcinoma*).mp.
3. 1 or 2
4. exp Therapeutics/
5. (treat* or therap* or help* or interven*).mp.
6. 4 or 5
7. 3 and 6
8. exp Melanoma/dh, dt, th [Diet Therapy, Drug Therapy, Therapy]
9. 7 or 8
10. exp ”Systematic Review“/
11. exp Meta-Analysis/
12. (”systematic review“ or ”meta-analysis“ or (systematic* adj1 review*)).ti,ab.
13. 10 or 11 or 12
14. 9 and 13

Ovid Embase

1. exp melanoma/
2. (melanoma* or (pigment* adj1 cancer*) or melanocarcinoma* or nevocarcinoma*).mp.
3. 1 or 2
4. exp therapy/
5. (treat* or therap* or help* or interven*).mp.
6. 4 or 5
7. 3 and 6
8. exp melanoma/dm, dt, th [Disease Management, Drug Therapy, Therapy]
9. 7 or 8
10. exp ”systematic review“/
11. exp meta analysis/
12. (”systematic review“ or ”meta-analysis“ or (systematic* adj1 review*)).ti,ab.
13. 10 or 11 or 12
14. 9 and 13

Eligibility Criteria

Studies were required to meet the following inclusion criteria: (1) a systematic review with or without a meta-analysis; (2) focused on the treatment of melanoma; (3) conducted on human subjects only; and (4) available in English. We used the PRISMA definition of systematic reviews and meta-analyses [25]. Studies that met these criteria were uploaded to Stata 16.1 (StataCorp LLC) for randomization. Data were then extracted from the first 200 systematic reviews.

Training

Before title and abstract screening commenced, authors RN and AW completed an online training course on systematic reviews and meta-analyses by Li and Dickersin [26]. They then completed 2 days of online and in-person training on the definition and interpretation of the 9 most severe types of spin in systematic review abstracts [27]. Finally, they were trained in A MeaSurement Tool to Assess systematic Reviews (AMSTAR-2), a frequently used 16-item instrument for measuring the methodological quality of systematic reviews and meta-analyses [28]. A detailed outline of the training regimen can be found in our study protocol.

Data Extraction

Data were extracted in a masked, duplicate fashion using a pilot-tested Google form. Abstracts of the included systematic reviews were thoroughly examined for the presence of the 9 most severe types of spin. The 9 spin types, defined by Yavchitz et al [27], are as follows: (1) conclusion contains recommendations for clinical practice not supported by the findings, (2) title claims or suggests a beneficial effect of the experimental intervention not supported by the findings, (3)

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selective reporting of or overemphasis on efficacy outcomes or analysis favoring the beneficial effect of the experimental intervention, (4) conclusion claims safety based on non–statistically significant results with a wide confidence interval, (5) conclusion claims the beneficial effect of the experimental treatment despite high risk of bias in primary studies, (6) selective reporting of or overemphasis on harm outcomes or analysis favoring the safety of the experimental intervention, (7) conclusion extrapolates the review's findings to a different intervention (ie, claiming efficacy of one specific intervention although the review covers a class of several interventions), (8) conclusion extrapolates the review's findings from a surrogate marker or a specific outcome to the global improvement of the disease, and (9) conclusion claims the beneficial effect of the experimental treatment despite reporting bias.

The methodological quality of each study was rated as high, moderate, low, or critically low using the AMSTAR-2 scale [28]. In previous studies, the interrater reliability of AMSTAR-2 scores has been moderate to high, with high construct validity coefficients associated with both the original AMSTAR instrument (r=0.91) and the Risk of Bias in Systematic Reviews instrument (r=0.8429) [29].

The study characteristics extracted from each systematic review and meta-analysis were as follows: (1) type of intervention (surgery, pharmacologic, nonpharmacologic, combination, other); (2) date the review was received by the journal; (3) funding sources (hospital, industry, private, public, a combination of sources including industry, a combination of sources excluding industry, none, not mentioned, other); (4) whether the review discussed compliance with PRISMA or PRISMA for Abstracts [30]; (5) whether the journal required compliance with PRISMA; (6) the journal's word limit for abstracts, if any; and (7) the journal's 5-year impact factor. Once data extraction was complete, authors RN and AW were unmasked. If possible, discrepancies were resolved by consensus. Author RO adjudicated if consensus could not be achieved.

Statistical Analysis

The overall frequency of spin and its subtypes was characterized using descriptive statistics. We then used unadjusted logistic regression models to determine the binary associations of impact of extracted study characteristics on the presence of spin in the abstracts of systematic reviews and meta-analysis. We then constructed a multivariable logistic regression model to determine the influence of these variables, controlling for each, on the presence of spin. In our protocol, we prespecified the possibility of a binary logistic regression and calculated a power analysis before the start of this study to determine required sample size using GPower (version 3.1.9.7). A previous investigation of spin in abstracts of systematic reviews and meta-analyses focused on acne vulgaris suggested that spin was present in 31% of abstracts. We therefore based our power analysis on the following assumptions and parameters: (1) twenty percent of PRISMA-compliant systematic reviews and 40% of non–PRISMA-compliant systematic reviews contain spin; (2) a type I error rate of .05 (2-tailed); (3) power of .80; and (4) multiple coefficients of determination of 0.10. We thus concluded that 185 systematic reviews would be needed. These analytic decisions are documented in our protocol. We used Stata 16.1 for all analyses.

Results

General Characteristics

Our initial search returned 3106 unique articles, of which 718 were removed as duplicates. An additional 1972 articles were excluded during title and abstract screening. Full-text screening resulted in the exclusion of 189 articles. Thus, 227 systematic reviews met inclusion criteria and underwent random assignment, following which data were extracted from 200. Our screening (with rationale for exclusions) and randomization process is illustrated in Figure 1.

The most common intervention type was pharmacologic (115/200, 57.5%), followed by surgical interventions (38/200, 19%). The date range during which included systematic reviews were received by their publishing journal spanned from 1992 to 2020 (Table 1).

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Figure 1. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram demonstrating all steps of article screening with rationale provided for excluded articles.

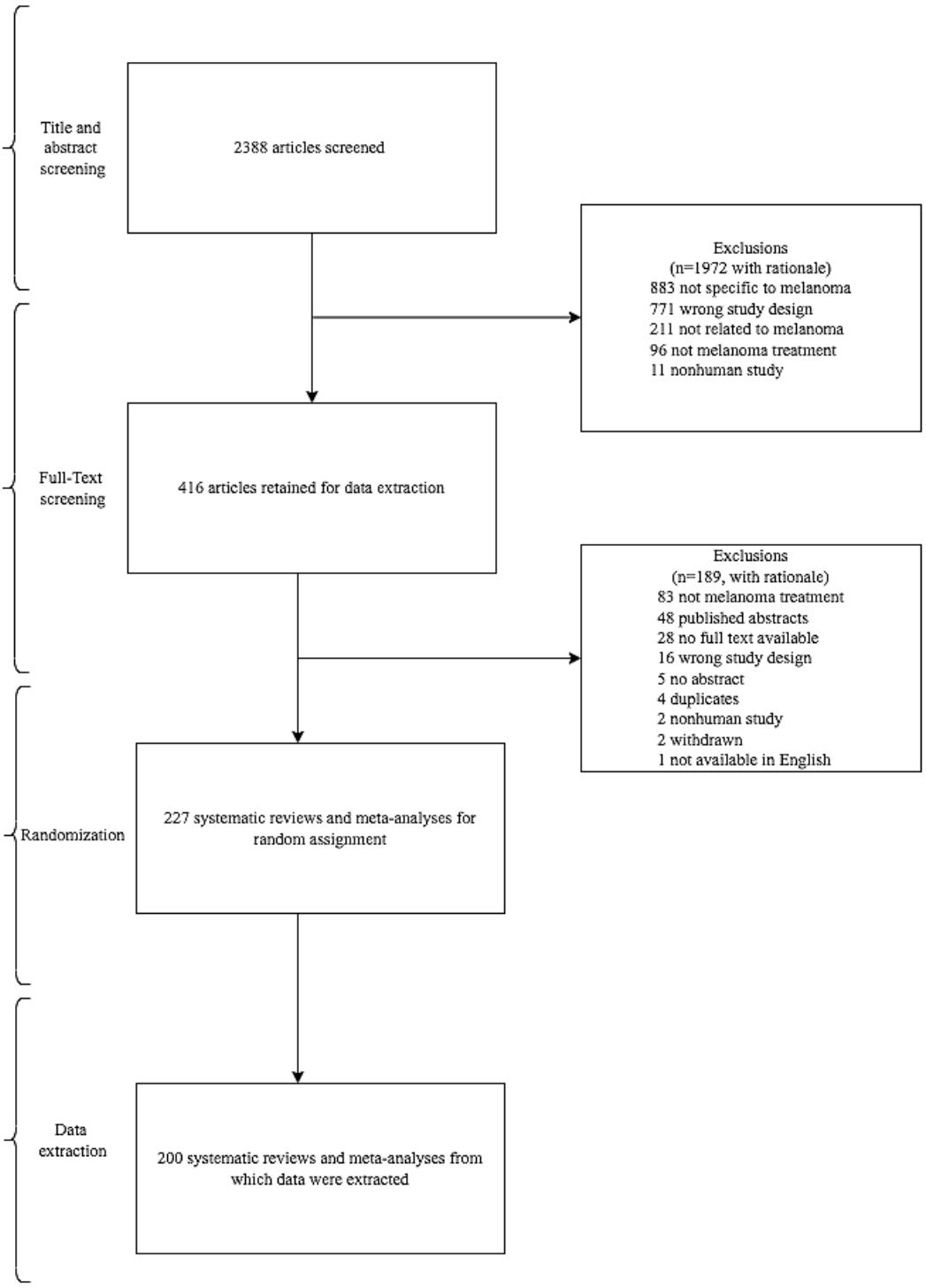

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Table 1. General characteristics of systematic reviews and meta-analyses.

Characteristics	Articles (N=200)		Odds ratio (95% CI)	
	Total	Abstract contains spin	Unadjusted	Adjusted
Intervention type, n (%)				
Mixed	32 (16)	6 (3)	1 (Reference)	1 (Reference)
Nonpharmacologic	15 (7.5)	7 (3.5)	3.79 (0.98-14.60)	4.69 (0.73-30.10)
Pharmacologic	115 (57.5)	54 (27)	3.84 (1.46-10.02)	2.60 (0.64-10.61)
Surgery	38 (19)	9 (4.5)	1.34 (0.42-4.29)	1.25 (0.24-6.35)
Study mentions adherence to PRISMA,[a] n (%)				
No	119 (59.5)	41 (20.5)	1 (Reference)	1 (Reference)
Yes	81 (40.5)	35 (17.5)	1.45 (0.81-2.58)	1.24 (0.49-3.13)
Publishing journal recommends adherence to PRISMA, n (%)				
No	98 (49)	40 (20)	1 (Reference)	1 (Reference)
Yes	102 (51)	36 (18)	0.79 (0.44-1.40)	0.55 (0.25-1.24)
Funding source, n (%)				
Not funded	46 (23)	15 (7.5)	1 (Reference)	1 (Reference)
Industry	27 (13.5)	14 (7)	2.23 (0.84-5.90)	2.08 (0.58-7.41)
Not mentioned	86 (43)	29 (14.5)	1.05 (0.49-2.25)	0.54 (0.18-1.61)
Private	24 (12)	8 (4)	1.03 (0.36-2.95)	0.74 (0.20-2.79)
Public	17 (8.5)	10 (5)	2.95 (0.94-9.29)	1.50 (0.35-6.44)
AMSTAR-2[b] rating, n (%)				
High	17 (8.5)	6 (3)	1 (Reference)	1 (Reference)
Moderate	47 (23.5)	27 (13.5)	2.48 (0.78-7.82)	1.83 (0.47-7.19)
Low	19 (9.5)	11 (5.5)	2.52 (0.65-9.71)	3.05 (0.60-15.48)
Critically low	117 (58.5)	32 (16)	0.69 (0.24-2.02)	0.45 (0.11-1.86)
5-year impact factor, mean (SD)	6.02 (6.57)	6.84 (7.36)	1.03 (0.98-1.08)	1.04 (0.98-1.10)
Abstract word limit, mean (SD)	281 (125.35)	276 (115.84)	1.00 (1.00-1.00)	1.00 (0.99-1.00)
Publication year (1992-2020)	N/A[c]	N/A	0.99 (0.93-1.04)	0.91 (0.84-0.99)

[a]PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

[b]AMSTAR-2: A MeaSurement Tool to Assess systematic Reviews.

[c]N/A: not applicable.

Of 200 studies, 68 (34%) were funded, with the most common funding source being industry (27/200, 13.5%), while 46 studies were not funded (46/200, 23%) and 86 did not mention a funding source (86/200, 43%). Most studies did not mention adherence to PRISMA (119/200, 59.6%) and a total of 102 studies (51%) were published in journals whose submission guidelines recommend PRISMA adherence. The average word limit for abstracts was 281 (SD 125.35). The average 5-year impact factor for our sample was 6.02 (SD 6.57).

Spin in Abstracts of Systematic Reviews and Meta-analyses

Among the 200 studies in our sample, we found spin in 76 (38%) of the abstracts. We frequently found more than 1 type of spin in an abstract; thus, 117 instances of spin were identified. Spin type 3—selective reporting of or overemphasis on efficacy outcomes or analysis favoring the beneficial effect of the experimental intervention—was the most common, occurring in 40 abstracts (20%; Table 2).

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Table 2. Spin types and frequencies (%) in abstracts (N=200).

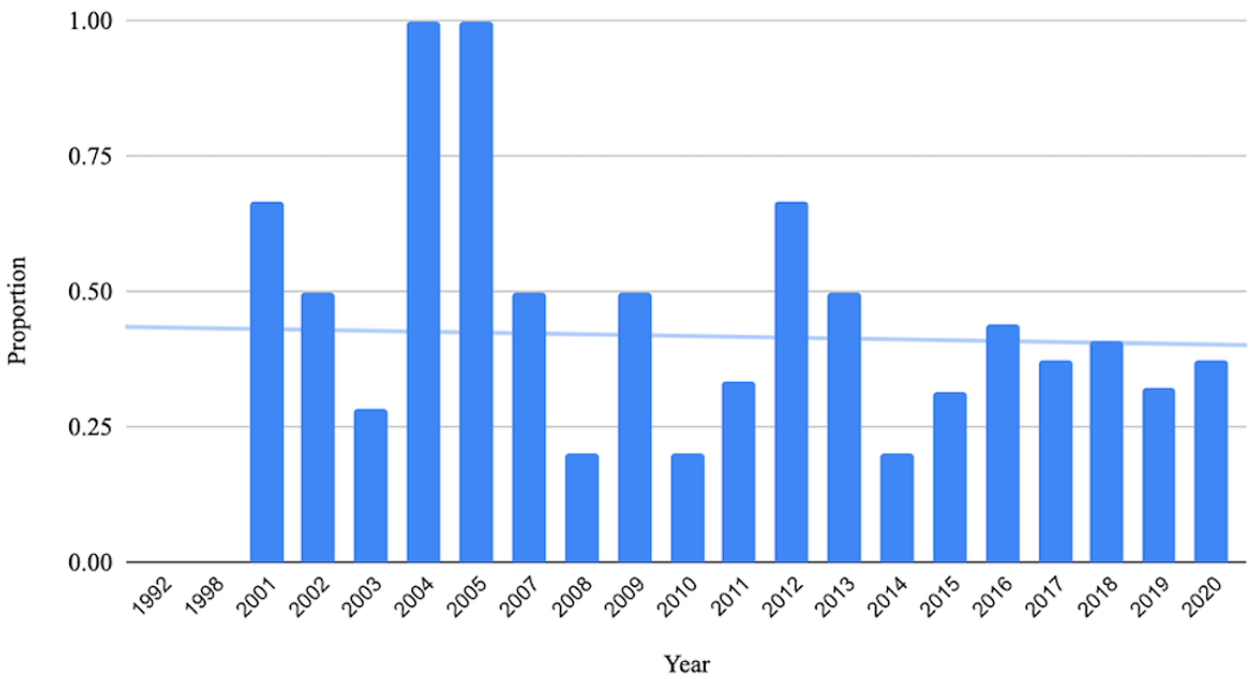
Nine most severe types of spin [27]	Abstracts containing spin, n (%)
1. Conclusion contains recommendations for clinical practice not supported by the findings.	4 (2)
2. Title claims or suggests a beneficial effect of the experimental intervention not supported by the findings.	0 (0)
3. Selective reporting of or overemphasis on efficacy outcomes or analysis favoring the beneficial effect of the experimental intervention.	40 (20)
4. Conclusion claims safety based on nonstatistically significant results with a wide confidence interval.	3 (7.1)[a]
5. Conclusion claims the beneficial effect of the experimental treatment despite high risk of bias in primary studies.	16 (8)
6. Selective reporting of or overemphasis on harm outcomes or analysis favoring the safety of the experimental intervention.	27 (13.5)
7. Conclusion extrapolates the review's findings to a different intervention (ie, claiming efficacy of one specific intervention although the review covers a class of several interventions).	4 (2)
8. Conclusion extrapolates the review's findings from a surrogate marker or a specific outcome to the global improvement of the disease.	13 (6.5)
9. Conclusion claims the beneficial effect of the experimental treatment despite reporting bias.	10 (5)

[a]A total of 158 abstract conclusions did not mention safety, thus n=42.

The most severe type of spin, type 1—conclusion contains recommendations for clinical practice not supported by the findings—occurred in 4 abstracts (2%). Because 158 studies did not mention safety outcomes or safety measures in their conclusions, only 42 abstracts could be assessed for spin type 4 (3/42, 7.1%). No abstracts contained spin type 2.

From the bivariate logistic regression, the odds were 384% higher for a systematic review covering pharmacologic interventions to contain spin compared with the reference group (odds ratio [OR] 3.84, 95% CI 1.46-10.2). After adjustment for possible covariates, this association between spin and pharmacologic interventions did not remain statistically significant (OR 2.60, 95% CI 0.64-10.61). We found that the likelihood of an article containing spin has decreased annually (adjusted OR 0.91, 95% CI 0.84-0.99; Table 1). Figure 2 illustrates the proportion and overall downward trend of spin prevalence in abstracts of systematic reviews focused on melanoma therapies from 1992 to 2020. We found no other association between the presence of spin and other study characteristics.

Figure 2. The proportion of systematic reviews containing spin in the abstract from 1992-2020.



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AMSTAR-2 Ratings

A total of 58.5% (117/200) of systematic reviews in our sample received a methodological quality rating of "critically low" on the AMSTAR-2 scale, 9.5% (19/200) were rated "low" quality, 23.5% (47/200) "moderate" quality, and 8.5% (17/200) "high" quality. The presence of spin was not significantly associated with a study's AMSTAR-2 rating. All AMSTAR-2 items and frequency of responses are found in Table 3.

Table 3. AMSTAR-2[a] items and frequency of responses (N=200).

AMSTAR-2 item	Response, n (%)		
	Yes	No	Partial yes
1. Did the research questions and inclusion criteria for the review include the elements of PICO (patient/population, intervention, comparison, and outcomes)?	200 (100)	0 (0)	0 (0)
2. Did the report of the review contain an explicit statement that the review methods were established prior to the conduct of the review and did the report justify any significant deviations from the protocol?	66 (33)	75 (37.5)	59 (29.5)
3. Did the review authors explain their selection of the study designs for inclusion in the review?	103 (51.5)	97 (48.5)	0 (0)
4. Did the review authors use a comprehensive literature search strategy?	37 (18.5)	54 (27)	109 (54.5)
5. Did the review authors perform study selection in duplicate?	121 60.5)	79 (39.5)	0 (0)
6. Did the review authors perform data extraction in duplicate?	126 (63)	74 (37)	0 (0)
7. Did the review authors provide a list of excluded studies and justify the exclusions?	15 (7.5)	65 (32.5)	120 (60)
8. Did the review authors describe the included studies in adequate detail?	46 (23)	23 (11.5)	131 (65.5)
9. Did the review authors use a satisfactory technique for assessing the risk of bias in individual studies that were included in the review?	51 (28.5)[b]	104 (58.1)[b]	24 (13.4)[b]
10. Did the review authors report on the sources of funding for the studies included in the review?	20 (10)	180 (90)	0 (0)
11. If meta-analysis was performed, did the review authors use appropriate methods for statistical combination of results?	95 (93.1)[c]	7 (6.9)[c]	0 (0)[c]
12. If meta-analysis was performed, did the review authors assess the potential impact of risk of bias in individual studies on the results of the meta-analysis or other evidence synthesis?	62 (60.7)[c]	40 (39.2)[c]	0 (0)[c]
13. Did the review authors account for risk of bias in primary studies when interpreting/discussing the results of the review?	74 (37)	126 (63)	0 (0)
14. Did the review authors provide a satisfactory explanation for, and discussion of, any heterogeneity observed in the results of the review?	121 (60.5)	79 (39.5)	0 (0)
15. If they performed quantitative synthesis, did the review authors carry out an adequate investigation of publication bias (small study bias) and discuss its likely impact on the results of the review?	53 (52)[c]	49 (48)[c]	0 (0)[c]
16. Did the review authors report any potential sources of conflict of interest, including any funding they received for conducting the review?	163 (81.5)	37 (18.5)	0 (0)

[a]AMSTAR-2: A MeaSurement Tool to Assess systematic Reviews.

[b]A total of 21 articles included only nonrandomized studies of interventions and were not included in the table, thus N=179.

[c]A total of 98 articles did not perform a meta-analysis, thus N=102.

Discussion

Primary Findings

Our study suggests that approximately 1 in 3 systematic reviews or meta-analyses focused on melanoma treatment modalities contain spin in their abstract. The most common type of spin identified in our sample was type 3—selective reporting of or overemphasis on efficacy outcomes or analysis favoring the beneficial effect of the experimental intervention. An example of such selective reporting occurred in a study by Verma et al [31], which reviewed systemic adjuvant therapies for patients at high risk for recurrent melanoma. The primary outcomes included overall survival, recurrence-free survival, adverse effects, and quality of life; however, the abstract failed to mention 3 of the 4 outcomes (recurrence-free survival, adverse effects, and quality of life). The selective omittance of primary outcomes in an abstract has the potential to allow readers to make assumptions regarding omitted outcomes based on the positive or negative nature of the outcomes that are reported. This finding is concerning as clinicians often use abstracts to guide clinical decisions. Because omitting primary outcomes may affect patient care [9,32,33], it is imperative that abstracts contain full information about both efficacy and adverse events.

An interesting finding was the frequency with which spin type 6 (selective reporting of or overemphasis on harm outcomes or analysis favoring the safety of the experimental intervention) occurred concurrently with spin type 3 (30.7%). For example, Dafni et al [34] reported overall survival and toxicities as 2 of

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their secondary outcomes but selectively did not report these findings alongside the other stated secondary outcomes. This example of the concurrent occurrence of spin types 3 and 6 demonstrates how selective reporting of efficacy and harm outcomes could distort a reader's interpretation of the full benefits and risks of an experimental regimen. This is especially important as we found that systematic reviews focused on pharmacologic interventions, which are often associated with higher toxicity profiles [35,36], had increased odds of containing spin. Thus, it is essential that clinicians recognize spin and its potential influence on therapeutic recommendations.

To incorporate our findings into the existing body of literature on spin, we must compare our results with previous evaluations of spin in RCTs and observational studies. Our team's previous investigations found spin in abstracts at rates ranging from 37% in oncology RCTs [18] to 70% in otolaryngology RCTs [37]. More recently, studies have shown that spin frequently occurs in abstracts of systematic reviews [38-48]. As previously mentioned, Ottwell et al [20] identified spin in 31% of the included abstracts of systematic reviews and meta-analyses on acne vulgaris therapies, a finding similar to ours. Although the presence of any amount of spin is relevant as it may mislead readers, it should be noted that our findings suggest that abstracts of systematic reviews focused on melanoma treatment appear to contain equal or fewer amounts of spin than their counterparts in other fields of medicine and may be improving with time.

In 2013, PRISMA released its extension for abstracts [30], an initiative to improve the quality of reporting in abstracts. However, findings are mixed on whether the release of PRISMA for Abstracts has improved the quality of abstract reporting. Interestingly, one consistent finding across these studies [49,50] is that authors do not report all 12 PRISMA for Abstracts items. A study by O'Donohoe et al [14] found that systematic reviews published in journals with higher abstract word limits had significantly higher PRISMA for Abstracts reporting scores. This finding seems logical, as higher word limits would allow all 12 items to be reported and permit the reporting of all outcomes, thus reducing the occurrence of selective-reporting spin. Although our study did not show that higher abstract word limits reduced spin, greater freedom for authors in regard to word limits seems justified as systematic reviews are considered the "gold standard" of scientific evidence and their abstracts have been shown to have a role in clinical decisions [9,32].

Strengths and Limitations

Our study was conducted in a fashion that maximized reproducibility and transparency. This was achieved by publishing our protocol (before the investigation's start date), all data, and training modules to the Open Science Framework. Additional statistical reproducibility was achieved by having all data analyses confirmed by an independent group. A final strength is that data were extracted in a duplicated and masked fashion, which the Cochrane Collaboration considers to be the gold standard [51].

Regarding limitations, the assessment of spin is inherently subjective. To reduce subjectivity, the investigators completed several days of online and in-person training in strictly defining spin and identifying its presence. Additionally, because we searched only 2 databases (MEDLINE and Embase), some relevant studies may have been missed. Specific study characteristics had inherent limitations. For example, some studies were published before the release of PRISMA. It is unclear when journals began recommending PRISMA guidelines as previous author guidelines were not available. In addition, owing to the wide date range of published studies, we used 5-year impact factors to account for variations, which may not accurately reflect past journal impact factors. Lastly, the tool we used to appraise systematic reviews, the AMSTAR-2, was developed and published in 2017; thus, using it to rate systematic reviews published before 2017 may have resulted in lower scores.

Conclusion

In summary, we found spin in 38% of abstracts of systematic reviews and meta-analyses pertaining to melanoma treatment. Our results indicate that the incidence of spin in abstracts of systematic reviews focused on melanoma therapies is on par with or less than the incidence reported by investigations in other medical fields. Additionally, our results show that spin in abstracts of systematic reviews focused on melanoma therapies is decreasing. The fields of dermatology and oncology therefore have the opportunity to be leaders in reducing abstract spin prevalence and improving the quality of reporting in abstracts of systematic reviews focused on melanoma treatment.

Acknowledgments

Development of this protocol and study was funded by the Oklahoma State University Center for Health Sciences Presidential Mentor-Mentee Research Fellowship Grant.

Conflicts of Interest

None declared.

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Abbreviations

AMSTAR-2: A MeaSurement Tool to Assess systematic Reviews
PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RCT: randomized controlled trial

Edited by R Dellavalle, T Sivesind; submitted 05.10.21; peer-reviewed by J Makin, S Pagoto; comments to author 30.12.21; revised version received 01.01.22; accepted 03.01.22; published 24.02.22.

Please cite as:
Nowlin R, Wirtz A, Wenger D, Ottwell R, Cook C, Arthur W, Sallee B, Levin J, Hartwell M, Wright D, Sealey M, Zhu L, Vassar M
Spin in Abstracts of Systematic Reviews and Meta-analyses of Melanoma Therapies: Cross-sectional Analysis
JMIR Dermatol 2022;5(1):e33996
URL: https://derma.jmir.org/2022/1/e33996
doi:10.2196/33996
PMID:

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Review

Patient Perceptions of Dermatologic Photography: Scoping Review

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Abstract

Background: Medical photography is used extensively in dermatology to record disease progression, measure treatment response, and help teach patients about skin disease; such photos are also commonly utilized in teledermatology, medical education, research, and medical reference websites. Understanding patient perceptions of medical photographs obtained during dermatologic care in the clinic or hospital setting is critical to enable the delivery of high-quality, patient-centered medical care.

Objective: The aims of this study were to elucidate patient perceptions of skin photos in dermatology and to explore possible next steps in improving the patient experience with medical photography in the hospital or clinic setting.

Methods: A scoping review of the literature was performed using the PubMed database, with clinic- or hospital-based full-text publications in English spanning the last 10 years considered for inclusion.

Results: The majority of included studies (10/11, 91%) found positive patient attitudes toward medical photographs. The majority of patients (1197/1511, 79.2%) felt that medical photographs could improve medical care in the clinic setting. Written consent detailing all photo uses, including secondary uses (such as research or teaching), was preferred, apart from in 1 study. Patients preferred or found it acceptable for the photographer of their medical photos to be a physician (1301/1444, 90.1%). Clinic-owned cameras with departmental record storage were the preferred modality. Latinx and African American patients expressed less trust in the utility of medical photographs to improve care, compared with Asian and White patients. The minimal number of available publications on this topic and the inclusion of articles older than 5 years are limitations, since patient perceptions of medical photography may have rapidly changed during this time span, particularly in light of the COVID-19 pandemic and the subsequent increase in teledermatology visits.

Conclusions: Patients reported positive perceptions of dermatologic photography for improving their medical care. Ethnic disparities in patient perceptions require further exploration to better elucidate nuances and develop interventions to improve the experience of marginalized patients. Building patient trust in nonphysician photographers may enhance clinic efficiency. Although clinic-owned cameras are well-accepted by patients, improved patient education surrounding the safety of electronic medical record phone applications is needed.

(JMIR Dermatol 2022;5(1):e33361) doi:10.2196/33361

KEYWORDS

patient perceptions; patient perspectives; medical photography; clinical photography; dermatology; skin disease; dermatologic photography; medical images; skin of color; SOC

Introduction

Dermatology is a medical field that prioritizes visualization of pathology. One important tool to aid this visualization is medical photography. Medical photographs can be used to record disease progression, measure response to treatments, and help teach patients about skin disease [1-3]. In addition to their use in the clinical setting, medical photographs are used to teach medical students, dermatologists, and other health care workers about skin disease. Medical photographs may also be incorporated into research and medical reference websites [4].

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Despite its prevalence in dermatology, few studies have examined how patients feel about medical photography in the hospital or clinic setting and whether discrepancies exist in patient perceptions of medical photography among various people, based on factors such as ethnicity, socioeconomic status, gender, and sexual orientation. Given the significant utilization of medical photography in daily dermatology practice, understanding patients' perceptions of this tool is necessary to achieve high-quality, patient-centered care. We therefore performed a scoping review of the literature to assess patient perceptions of skin photos in dermatology and to explore possible next steps in improving the patient experience with medical photography in the hospital or clinic setting.

Methods

A literature review was performed using the PubMed database. The following search string was utilized: ("Dermatology"[Mesh] OR "Skin Diseases"[Mesh] OR "skin*" OR "derm*") AND ("photography*" OR "picture*") AND ("perception*" OR "attitude*" OR "perspective*" OR "feel*" OR "satisfaction*" OR "acceptance*") AND ("patien*" OR "provider*" OR "clinician*"). All available full-text publications in English spanning the last 10 years involving patient perceptions of medical photography in a dermatology clinic or hospital setting were included. Studies largely focused on patient perceptions of teledermatology or in nondermatology settings were excluded from our study tables.

Results

We identified and selected 11 studies for inclusion after screening the abstracts of 468 articles. Table 1 includes a summary of the 11 articles and their primary findings surrounding patient perceptions of medical photography in dermatology. Table S1 in Multimedia Appendix 1 provides further granularity, categorizing perceptions by category: consent, photographer role and badge, gender, photograph capture method, image storage, image use and identifiers, mental well-being and trust, and ethnic variations.

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Table 1. Summary of included publications (2011-2021) with principal findings.

Article title	Author(s)	Year	Study location	Study setting	Study sample size	Perceptions of medical photography in dermatology
Patients' acceptance of medical photography in a French adult and paediatric dermatology department: a questionnaire survey	Hacard et al [5]	2013	France	Inpatient hospital	N=272 (158 adults and 114 children)	Positive perceptions by adult patients (99.3%) and parents of pediatric patients (96.0%)
Patient perspectives on medical photography in dermatology	Leger et al [4]	2014	New York, NY	Inpatient hospital (2), outpatient clinic (2)	N=398	Positive perceptions (88.7%) for patient medical care
Patient perception on the usage of smartphones for medical photography and for reference in dermatology	Hsieh et al [1]	2015	Chicago, IL	Inpatient hospital, outpatient clinic	N=300	Positive perceptions when used for patient care: charting (84.8%) and treatment/disease monitoring (82.1%)
Total body photography as an aid to skin self-examination: a patient's perspective	Secker et al [6]	2016	Leiden, Netherlands	University hospital	N=179	Neutral perceptions for total body photos as being useful (44.7%)
Smartphones in the dermatology department: acceptable to patients?	Soriano et al [7]	2017	London, England	Hospital (3)	N=203	Positive perceptions for medical photography of skin lesions by patient smartphone or hospital camera
Perception and acceptability of medical photography in Chinese dermatologic patients: a questionnaire survey	Wang et al [8]	2017	China	Outpatient clinic	N=474	Positive perceptions (79.9%) for improving care (diagnosis and treatment)
Attitudes to medical photography: study of a Spanish population at the Pius Hospital de Valls in Tarragona, Spain	Pasquali et al [9]	2019	Tarragona, Spain	Outpatient setting	N=134 (100 dermatology patients)	Positive perceptions for medical uses (94.8%)
Smartphones in dermatology: acceptance of smartphone photography by the informed patient	Accetta et al [10]	2020	Buffalo, NY; New Orleans, LA	Outpatient setting	N=400 (200 from each location)	Positive perceptions (95.5%) of medical photography
Patients' experiences and attitudes of using a secure mobile phone app for medical photography: qualitative survey study	Wyatt et al [11]	2020	Rochester, MN	18 departments including dermatology	N=71 (19 dermatology patients)	Positive perceptions of a secure EHR[a]-integrated (PhotoExam) application for medical care (67%) and would recommend to others (74%)
Study of patients' satisfaction toward photographing their skin lesions for educational purposes	Amirian et al [12]	2021	South Iran	Hospital	N=200	Positive perceptions, with majority (67.5%) satisfied with medical photography of skin lesions
Evaluation of standardized scalp photography on patient perception of hair loss severity, anxiety, and treatment	Pathoulas et al [3]	2021	Boston, MA	Outpatient setting	N=119	Positive perceptions of scalp photography as being helpful (98.3%) and increasing motivation (98.3%) to complete alopecia treatment

[a]EHR: electronic health record.

Discussion

Principal Findings

Overall, the majority of included studies (10/11, 91%) found positive patient attitudes toward medical photographs [1,3-5,7-12]. Additionally, many dermatology patients (1197/1511, 79.2%) felt that medical photographs could improve their care, diagnosis, or treatment in the clinical setting [3-6,8,11]. These positive patient attitudes of studies from diverse locations (including the United States, France, Spain, South Iran, China, and the United Kingdom) are reassuring that medical photographs are generally well-accepted by dermatology patients. Patient perceptions of several key aspects of medical photography in dermatology are discussed in further detail in the following sections.

Consent

The most recent US-based study (2020) [11] reported a slight patient preference for verbal over written consent, although prior studies indicated a preference for written consent [1,4,11]. Patients in China and France (adult population) had nearly equivalent preferences for oral or written consent [5,8]. Differences in cultural norms, survey question wording, and study population may have influenced these results. Given these geographical variations in consent preference and the possibility of intraregional variations, it is beneficial to obtain both oral and verbal photo consent, when feasible.

A standardized dermatologic medical photography consent form written in plain language that incorporates current research should be developed, detailing all possible medical photograph uses. An accompanying form for providers should also be developed and provide tips to improve the patient experience,

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along with ethnic disparities of which to be mindful [4,5,8,12]. A tiered consent form is currently being studied, "allowing patients to consent for use of photographs for (1) clinical care only; (2) clinical care and internal education; or (3) clinical care, internal education, and external education" [11]. An educational photograph booklet may also help improve patient satisfaction with medical photography but requires further research [13].

Photographer Role, Gender, and Identification

In general, patients seem to prefer physicians to act in the role of photographer (1301/1444, 90.1%)—apart from the findings of 3 studies that reported more equitable or indifferent opinions regarding who should assume the photographer role (physician, hospital staff, or professional photographer) [4,5,7-9,11,12]. Patient preferences for photographer gender varied based on study location [4,8]. Male patients provided greater consent for photo uses [12]. These preference variations regarding photographer role and gender may be influenced by societal perceptions of health care workers and gender-related patient experiences.

Leger et al [4] pointed out the necessity of strengthening overall patient trust in "nonphysician photographers and in physicians of the opposite gender." Improving patient trust in photographers of the opposite gender and in nonphysician photographers can enhance patient comfort, patient compliance, and clinic efficiency [4]. Part of ensuring patient trust in the medical photography process is having the photographers wear identifiable badges so patients know the clinical role of the photographer [5,8].

Image Capture and Storage

Most patients favored a clinic- or hospital-owned camera or patient personal phone rather than a physician's personal camera or cell phone for medical photographs, although one study reported findings of patient indifference with a mobile device versus a professional camera [1,4,5,7,8,11,12]. Patient concerns with the use of mobile phones were related to confidentiality, poor professionalism, and automatic photo uploading [1,5]. However, patients found smartphones acceptable to reference information when providing patient teaching, and 1 study reported a 79% acceptance rate for smartphones for medical photography after an information sheet detailing secure storage was provided [1,10]. Given the presence of electronic medical record (EMR) applications designed for cell or mobile phone use—with protection measures in place—it may be worthwhile to explain the security of using one's cell phone with an EMR application for photo capture, possibly with an information sheet, as this is highly conducive to efficiency and confidentiality [11].

Patients preferred and were satisfied with image storage within departmental records [5,7,8]. One storage solution for maximal confidentiality and protection is an EMR cloud-based storage system, such that photos are not stored locally on a physician's personal computer or phone [4]. An example is a mobile phone point-of-care application that safely uploads a medical photo to the patient's chart without saving the photograph to the physician's phone; 67% of patients felt this application improved patient care [11]. Alternatively, a clinic-owned camera that is used to take all patient photos, stays in the exam room, and is uploaded daily to patient charts is another reasonable option.

Image Uses and Identifiers

Patients were more comfortable with their photographs being used for diagnosis and treatment (including teledermatology), teaching, and research purposes [1,4,5,8,11]. One study reported patient attitudes towards scalp photography as useful, increasing motivation for treatment and improving alopecia-associated anxiety [3]. Patients were more comfortable and willing to allow secondary image use such as educational purposes when photos were unidentifiable [4,9,11]. For image uses external to the clinical setting, patients felt more comfortable with scientific publications or case discussion than with health websites [5,8]. Public health campaigns to strengthen patient trust in the use of medical photography for dermatologic websites (such as VisualDx, Dermnet, and even Wikipedia) can be beneficial. Greater incorporation of high-quality patient photographs into these web-based reference sites has the potential to improve education for both providers and patients. Ensuring the inclusion of dermatologic photos of all Fitzpatrick skin types is necessary to eliminate existing disparities related to skin of color (SOC) and to promote more equitable representation on these websites [14].

Body Region

The majority (348/398, 84.7%) of patients felt comfortable with their deidentified photos being used for teaching, and this rate decreased when involving an intimate body area (232/398, 58.3%) [4,9]. In general, patients were less comfortable with medical photography of genital regions [7]. A possible solution to improve patient comfort when involving an intimate body area includes an easily understandable, standardized consent form listing all possible image uses and verbally explaining that these images will be confidential.

Mental Well-being and Trust

Among the included studies, there were more missing data responses for negative perception questions, and about 5% of patients felt discomfort with medical photography [5,8]. Patients may feel intimidated to say "no" to a physician out of concern for subtle retaliation in care; ensuring that patients have the autonomy and space to say "no" to medical photography can foster a safe environment for patients and strengthen the patient-physician relationship.

Medical photography may be utilized to track patient response to treatments and has been shown to reduce disease-associated anxiety, although some patients reported feeling shame around photos [3,6]. Allowing patients to see their own medical photographs may contribute to better patient outcomes by strengthening trust, improving the patient-physician relationship, and increasing patient education and treatment satisfaction [3,5,8].

Ethnic and Age Variations

Latinx, African American, and Afro-Caribbean patients were more likely to believe medical photography would fail to improve their care and expressed greater discomfort with medical photography [4,7]. Among a multitude of related

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findings (Table S1 in Multimedia Appendix 1) was the discovery that White patients reported the least discomfort with medical photography [4].

Negative health care experiences by Latinx and African American patients may be due to systemic inequities and implicit biases in health care [4]. One study reported that Hispanic and Black patients were significantly less likely to receive medical outpatient care for a dermatologic disease [15]. If the process of medical photography contributes to distress for these patients, they may be less likely to seek dermatologic care, contributing to later diagnosis and more advanced skin cancers at time of first presentation for African American and Hispanic patients [16]. Thus, African American and Latinx patient perceptions of medical photography are of critical importance in promoting health equity.

Ethnic differences in perceptions should also be addressed to improve representation of SOC patients in dermatologic photography. Existing studies have categorized ethnic groups into broad categories such as African American, Latinx, Asian, and White, but further studies, (possibly including quality improvement studies) need to be done with more categorized ethnic groups such as Mexican, Puerto Rican, Chinese, Vietnamese, and others in order to better understand patient perceptions of medical photography in dermatology for various ethnic groups [4,7].

Skin diseases can appear visually different in SOC individuals compared with non-SOC individuals [17]. If patients with darker skin are uncomfortable having dermatologic photos taken, it limits the available number of photos of darker skin tones, hindering dermatologic education by not exhibiting the entire scope of skin disease presentations and contributing to incorrect diagnoses.

The relative lack of ethnic diversity among dermatology providers is another barrier—one solution to improve non-White patient comfort and trust in medical photography is to increase provider ethnic diversity within dermatology [18]. Future research on improving SOC patient perceptions of medical photography will improve the number and quality of SOC photographs, thus bolstering the accessibility and applicability of information related to skin disease presentations and improving health outcomes for non-White patients.

Teledermatology and COVID-19

The COVID-19 pandemic has drastically shifted teledermatology rates: 96.9% of dermatologists utilized teledermatology during the pandemic compared with 14.1% prior to COVID-19 [19]. Preliminary patient perceptions of teledermatology (using a patient's webcam or mobile phone to document skin disease presentation, progression, and treatment response) indicate patient satisfaction with teledermatology despite a preference for in-person visits; further exploration of this topic may inform teledermatology photography practice guidelines [20,21].

There is an inherent challenge in obtaining high-quality skin photographs through patients' own webcams or phones. Many factors can influence teledermatology skin photo quality, including lighting, resolution, and camera quality. Although studies indicate patient acceptance of medical photography for teledermatology, these additional factors may impact the quality of photographs, which can negatively affect overall care and disease outcomes, and thus warrant further research.

Future Directions

A recent US-based study indicated that verbal consent is now slightly preferred over written consent for medical photography—although importantly, a notable limitation of these results is the homogeneous study population (99% of participants identified as White) [11]. Further research into the possibly changing patient consent preference (written to verbal) among patient populations of all ethnicities is needed. Efforts to improve patient trust in nonphysician photographers, opposite-gender photographers, and EMR mobile applications will support clinic efficiency. Additional research regarding current perceptions of medical photography for various ethnic subgroups and on alternative interventions to improve patient acceptance of medical photography for Black and Latinx patients is also warranted. It may be worthwhile to investigate whether an informational booklet detailing the possible uses of medical photography and indicating the security of image storage improves Black or Latinx patient comfort with medical photography [4,10].

Limitations

Limitations of this study include a relative lack of prior studies surrounding patient perceptions of medical photography in dermatology. Additionally, some of these studies are greater than 5 years old, and patient perceptions may have changed in recent years, especially in light of the COVID-19 pandemic and increased rates of teledermatology. Lastly, the use of the term "positive perceptions" as a blanket category was a limitation as the included studies did not have the exact same variables studied; however, creating a general category of "positive perceptions" helped to understand the larger picture of patient perceptions of medical photography in dermatology.

Conclusions

The majority of published studies surveyed reported positive patient attitudes toward medical photography in dermatology. Patients felt that medical photography could improve their care and that research and teaching purposes were acceptable. Written consent forms listing all photo uses were preferred overall, with one recent 2020 US study [11] indicating a slight preference for verbal consent. Although physician and same-gender photographers were preferred, it is important to build patient trust in nonphysician and opposite-gender photographers to improve clinic efficiency [4]. Clinic-owned cameras with departmental record storage were preferred, but increased patient education regarding the safety of EMR phone applications is warranted. Disparities among ethnic groups were undeniable and were related to patient comfort with dermatologic medical photography. These disparities must be addressed to achieve equitable health outcomes for patients of all backgrounds. Future studies should be designed to capture the experiences of a wide array of ethnic subgroups to ensure health equity.

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Conflicts of Interest

TS is an Editorial Board Member-at-Large for JMIR Dermatology. TS receives funding from 58858477 Pfizer Pharmaceuticals Global Medical Grant, Dermatology Fellowship 2020, and fees for serving as a Medical Advisor and Principal Investigator for Antedotum Inc.

Multimedia Appendix 1
Table S1. Patient preferences of medical photography by category.
[DOCX File , 24 KB - derma_v5i1e33361_app1.docx]

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Abbreviations

EMR: electronic medical record
SOC: skin of color

Edited by G Eysenbach; submitted 03.09.21; peer-reviewed by K Wyatt, E Ray Chaudhuri; comments to author 16.10.21; revised version received 05.12.21; accepted 15.12.21; published 26.01.22.

Please cite as:
Kim W, Sivesind T
Patient Perceptions of Dermatologic Photography: Scoping Review
JMIR Dermatol 2022;5(1):e33361
URL: https://derma.jmir.org/2022/1/e33361
doi:10.2196/33361
PMID:

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Review

Common Dermatologic Disorders in Down Syndrome: Systematic Review

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Abstract

Background: Down syndrome (DS) has been associated with cardiovascular, gastrointestinal, and immune-related abnormalities. Several dermatologic conditions, including hidradenitis suppurativa, have also been found to be associated with DS.

Objective: The objective of this study was to characterize the prevalence, presentation, and unique features of dermatologic disorders associated with DS.

Methods: Electronic searches of EMBASE (via Ovid), MEDLINE (via Ovid), and Web of Science databases were conducted on December 14, 2020. Observational studies including case reports of patients with DS presenting with concomitant primary dermatologic disorder were included.

Results: This systematic review captured 40 observational studies and 99 case reports, including 10 observational studies that examined the prevalence of common skin disorders in patients with DS. The most common dermatologic conditions reported includes atopic dermatitis (8 studies, n=180; 19.7% mean prevalence), hidradenitis suppurativa (15, n=478; 3.2%), ichthyosis (4, n=16; 4.7%), lichen nitidus (6, n=6; 1.1%), psoriasis (21, n=65; 4.8%), alopecia areata (27, n=253; 7.4%), vitiligo (8, n=40; 4.4%), onychomycosis (3, n=198; 24.7%), calcinosis cutis (14, n=15), connective tissue nevi (6, n=6), dermatofibroma (3, n=3), melanoma (3, n=3), syringomas (14, n=182; 21.2%), and elastosis perforans serpiginosa (19, n=24; 0.5%).

Conclusions: Our results indicate an increased prevalence of common cutaneous disorders in patients with DS, particularly infectious, inflammatory, autoimmune, and connective tissue conditions. Current guidelines for the screening, general management, and use of systemic immunomodulatory agents in this patient population are lacking. Patients with DS would benefit from screening for dermatologic disorders not otherwise regularly performed for earlier diagnosis and treatment.

Trial Registration: PROSPERO International Prospective Register of Systematic Reviews CRD42021226295; https://www.crd.york.ac.uk/PROSPERO/display_record.php?RecordID=226295

(JMIR Dermatol 2022;5(1):e33391) doi:10.2196/33391

KEYWORDS

autoimmune; comorbidities; trisomy 21; inflammatory; Down syndrome; dermatology; hidradenitis suppurativa; systematic review

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Introduction

Down syndrome (DS) is one of the most common causes of intellectual disability in high-income countries and has been associated cardiovascular abnormalities, gastrointestinal defects, and immune-related disorders [1]. Dermatologic conditions are also found to be increased in patients with DS, including folliculitis, alopecia areata, and psoriasis [2,3]. A recent survey of 223 families with young adults with DS found that 56% suffered from a dermatological condition [4]. Identification and characterization of associated conditions, particularly those with unique clinical presentations in patients with DS, could help optimize early diagnosis and inform screening.

Thus, the aim of this systematic review was to summarize the prevalence of common dermatologic disorders in patients with DS and to characterize the presentation and unique features of dermatologic disorders when associated with DS.

Methods

Overview

This systematic review was conducted in accordance with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines and was prospectively registered on PROSPERO (International Prospective Register of Systematic Reviews; CRD42021226295). The PRISMA guidelines are an evidence-based guide created to improve the reporting of systematic reviews and follow a 27-item standardized checklist addressing items to include introduction, methods, results, and discussion sections.

Search Strategy and Inclusion Criteria

We searched EMBASE (via Ovid), MEDLINE (via Ovid), and Web of Science electronic databases from their respective dates of conception to December 14, 2020, with no restrictions. Our search strategy comprised key terms for DS and skin conditions, including specific disorders such as atopic dermatitis, psoriasis, and vitiligo.

We included any observational studies including case reports of patients with DS presenting with concomitant dermatologic disorder including, but not limited to, atopic dermatitis, psoriasis, vitiligo, alopecia areata, acne vulgaris, onychomycosis, hidradenitis suppurativa, and seborrheic dermatitis. Abstracts and unpublished studies were excluded.

Data Extraction and Synthesis

We screened titles and abstracts (ML and JDL), followed by full texts (ML, LE, and JDL) independently and in duplicate. When necessary, discrepancies were resolved by consulting a senior author (CS and RA). The following data were extracted using a standardized form: study characteristics (author, year, study design, country, and participant source); population characteristics (number of participants, age, sex, race, comorbid conditions, and concurrent medications); disease factors (subtype, age of onset, affected areas, and severity); treatment factors (current treatment, duration, effectiveness, past treatments, and complications of treatment); follow-up interval; and prevalence or incidence statistics if reported.

The quality assessment of included observational studies was performed using the National Institutes of Health's National Heart Lung and Blood Institute quality assessment tools. The National Institutes of Health quality assessment tools have been used in the systematic evidence review of national updates to clinical guidelines and offer nonnumeric methods for critical appraisal of the internal validity of a study, with specific tools for individual types of study designs, including controlled intervention, cross-sectional, and case-control studies. Reviewers respond "yes," "no," or "cannot determine/not reported/not applicable" in response to each item in the tool, which includes sources of bias, confounding, study power, and strength of causality, to assess the risk of bias in the study and determine a rating of "good," "fair," or "poor" quality. Case reports were evaluated for methodological quality using an updated 8-item tool proposed by Murad et al [5]. We anticipated that much of the body of evidence from this systematic review would consist primarily of uncontrolled clinical observations, and this tool was selected as it provided a tailored approach to the assessment of evidence derived from case reports and case series, based on 4 domains (selection, ascertainment, causality, and reporting).

Qualitative syntheses for study characteristics, as well as key characteristic, outcomes, and treatment regimens, were summarized for each dermatologic condition. Where applicable, weighted means were calculated for observational studies reporting the prevalence of skin disorders in persons with DS.

Results

Overview

Ultimately, 40 observational studies and 99 case reports were included in this systematic review (Table 1 and Figure 1).

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Table 1. Summary of search results by dermatologic condition.

Dermatologic condition	Number of studies			Weighted mean prevalence,[a] % (n/N)
	Case report, n	CS/Cohort,[b] n	Observational, n	
Inflammatory skin conditions				
Acne vulgaris	0	0	7	14.7 (149/1017)
Atopic dermatitis	2	0	6	19.7 (178/903)
Cheilitis	0	0	6	8.4 (68/805)
Folliculitis	1	0	7	21.2 (213/1006)
Hidradenitis suppurativa	2	1	6	3.2 (425/13266)
Ichthyosis	2	0	2	4.7 (14/298)
Keratosis pilaris	0	0	9	8.6 (97/1134)
Lichen nitidus	5	0	1	1.1 (—[c])
Pityriasis rubra pilaris	3	0	0	—
Psoriasis	14	1	6	4.8 (46/953)
Seborrheic dermatitis	0	0	8	18.5 (212/1149)
Autoimmune skin conditions				
Alopecia areata	11	5	11	7.4 (190/2574)
Vitiligo	3	0	5	4.4 (31/709)
Infectious skin conditions				
Leishmaniasis	4	0	0	—
Onychomycosis	0	2	3	24.7 (188/761)
Scabies	7	0	—	—
Tinea capitis	0	0	1	2.5 (6/243)
Tinea corporis	0	0	2	2.0 (9/446)
Tinea cruris	0	0	1	8.4 (18/214)
Tinea pedis	0	0	4	30.9 (190/615)
Cutaneous birthmarks, tumors, and depositions				
Café au lait macules	0	0	5	3.8 (24/633)
Calcinosis cutis	13	1	1	3.0 (—)
Connective tissue nevi	6	0	0	—
Dermatofibroma	3	0	0	—
Melanoma	3	0	0	—
Syringoma	8	0	6	21.2 (174/821)
Other skin conditions				
Acanthosis nigricans	0	0	3	30.7 (67/218)
Cutis marmorata	0	0	3	8.4 (28/335)
EPS[d]	16	2	1	0.5 (1/203)
Other case reports[e]	7	—	—	—

[a]Weighted mean prevalence of patients with dermatologic condition in a population with Down syndrome, calculated from values reported in observational studies.

[b]CS/Cohort: Case series or cohort studies with no prevalence value provided.

[c]Not available.

[d]EPS: elastosis perforans serpiginosa.

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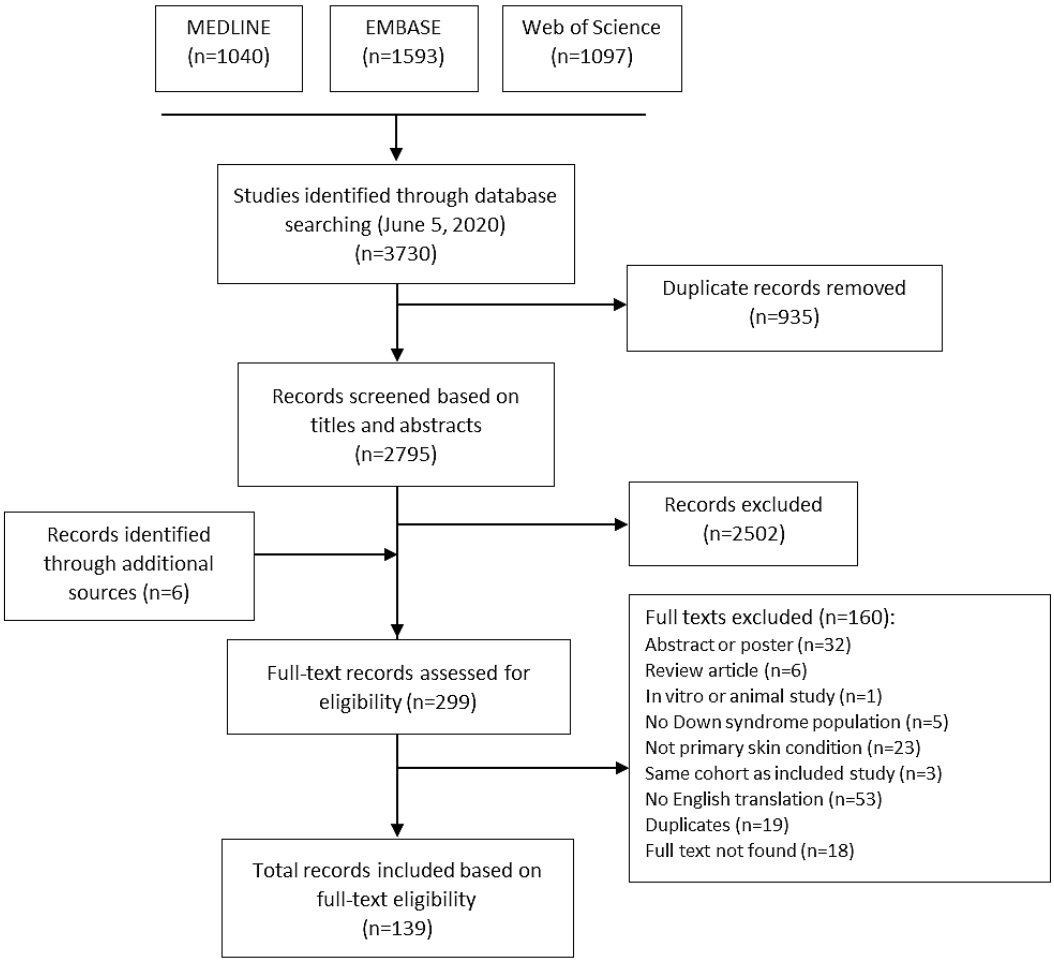
[e]Other case reports examined patients with actinomycetoma, cheilitis granulomatosa, epidermolysis bullosa, generalized perforating granuloma annulare, keratosis follicularis spinulosa decalvans, reactive perforating collagenosis, and familial urticaria pigmentosa.

Figure 1. Study selection methodology.



Ten of the observational studies reported the prevalence of cutaneous disorders in general in populations with DS (Table 2).

Case reports were primarily carried out in the United States (n=28), Japan (n=13), and Italy (n=11). Quality assessment yielded the following ratings for case reports: good, n=25; fair, n=70; and poor, n=5. It also yielded the following ratings for observational studies: good, n=25; fair, n=12; and poor, n=3.

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Table 2. Observational studies examining prevalence of dermatologic conditions in patients with Down syndrome.

Study	Country	Study setting	Criteria for dermatologic diagnosis	n[a]	Mean age (years), (range)	M/F[b]	Comorbidities	RoB[c]
Camacho et al, 2014 [6][d]	Spain	Trichology unit of the Department of Dermatology of the Virgen Macarena University Hospital; Jan 2001-Jan 2011	Focused clinical exam	15	11.2 (7-16)	8/7	Hypothyroidism (n=6); celiac disease (n=6); epilepsy (n=1)	Good
Camacho et al, 2014 [6]	Spain	Special Education Schools in Seville; March 1, 2011-April 30, 2011	Focused clinical exam	57	16.7 (2-29)	34/23	Hypothyroidism (n=22); celiac disease (n=28)	Good
Carter, 1976 [7]	United States	Southbury Training School	Focused clinical exam by investigators, with ancillary testing when necessary	214	—[e] (12-48)	128/86	3 of the 4 patients with vitiligo had AA[f]	Fair
Daneshpazhooh et al, 2007 [8]	Iran	Schools for children with special educational needs and centers in the Karaj and Sharyar provinces in Tehran, Iran, 2002	—	100	11.2 (3-20)	47/53	—	Good
Ercis et al, 1996 [9]	Turkey	Hacettepe University Children's Hospital Clinical Genetics Department; June 1991-Sept 1992	Focused clinical exam by an expert dermatologist	71	2.8 (0-25)	41/30	—	Good
Firsowicz et al, 2019 [10]	United States	Children with DS[g] with ICD[h]-10 code Q90.0 at Texas Children's Hospital Dermatology Clinic; May 2001-August 2018	Retrospective chart review	243	—	—	—	Good
Gunes Bilgili, 2011	Turkey	Outpatient pediatric and dermatology clinic	Focused clinical exam	50	2.2 (0-11)	28/22	—	Good
Rork et al, 2020 [11]	United States	At least 1 outpatient dermatology visit from Jan 1, 2008, to April 1, 2018, with ICD-9/ICD-10 codes 758.0/Q90.0 (DS or trisomy 21)	Retrospective chart review	101	19.7 (0-66)	62/39	Hypothyroidism (2 out of 7 AA patients)	Good
Schepis et al, 2002 [2]	Italy	Oasi Institute for Research on Mental Retardation and Brain Aging, consecutively seen 1990-2000	Focused clinical exam, with ancillary testing where applicable	203	11.7 (—)	125/78	Hypothyroidism (n=40)	Good
Sureshbabu et al, 2011 [12]	India	Consecutive DS patients recruited from special schools or homes in and around Pondicherry	Focused clinical exam by both a pediatrician and a dermatologist	95	12.0 (0-40)	59/36	—	Good
Tenenbaum et al, 2012 [13]	Israel	Adults with DS hospitalized at the Hadassah Medical Centers; 1988-2007	Retrospective chart review	120	36.3 (18-73)	73/47	—	Good

[a]Total number of patients with Down syndrome.

[b]M/F: male/female.

[c]RoB: risk of bias.

[d]Camacho et al [6] had 2 separate cohorts of patents with Down syndrome.

[e]Not available.

[f]AA: alopecia areata.

[g]DS: Down syndrome.

[h]ICD: International Classification of Diseases and Related Health Problems.

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Inflammatory Skin Conditions

Atopic Dermatitis

Six observational studies reported the prevalence of atopic dermatitis (AD) in their cohorts with DS. The mean prevalence was 19.7% (178 patients with AD out of 903 total patients with DS) [2,6,7,9,10,14]. The study by Schepis et al [14] in 1997 was the only observational study to examine AD specifically and compared its prevalence in a group with DS to a control group. The DS and control groups were reported to have the same prevalence of AD (3.0%).

Two case reports of patients with DS having scabies were also reported to have a history of AD [15,16].

Hidradenitis Suppurativa

Six observational studies with a mean prevalence of 3.2% (425/13266) of hidradenitis suppurativa (HS) in patients with DS were included [6,10,11,17-19]. One study reported a significantly increased risk of HS in patients with DS compared with controls after adjusting for age, sex, race, and obesity (odds ratio 5.24, 95% CI 4.62-5.94) [18]. Six other observational studies reported a weighted mean prevalence of 2.5% (40/1609) of DS among patients with HS [20-25]. The mean age of onset for HS in patients with DS in observational studies was 14.3 years.

There were also 2 case reports and 1 case series examining HS in patients with DS [26-28].

Ichthyosis

Two observational studies reported the prevalence of ichthyosis vulgaris in patients with DS, with a mean prevalence of 4.7% (14/298) [2,12].

Two case reports included patients with features of ichthyosis vulgaris; both cases were reported to clinically resemble ichthyosis vulgaris and were supported by histologic findings but were missing features of early onset in life and positive family history [29,30].

Lichen Nitidus

One observational study reported a prevalence of 1.1% (1/95) of lichen nitidus (LN) in patients with DS [12].

Five case reports of LN were reported (Multimedia Appendix 1) [31-35]. One other case report in French (not included in this systematic review) presented a patient with DS having LN with associated megacolon [36].

Pityriasis Rubra Pilaris

Three case reports of pityriasis rubra pilaris (PRP) were found (Multimedia Appendix 2) on 2 female patients with circumscribed juvenile PRP (type IV) [37,38] and 1 male patient with classic juvenile PRP (type III) [39]. Accordingly, 2 patients were treated with oral etretinate with long-term control of symptoms [38,39], while 1 patient was treated effectively with topical 0.1% trans retinoic acid [37].

Psoriasis

Six observational studies reported the prevalence of psoriasis in a population with DS, with a weighted mean prevalence of 4.8% (46/953) [2,6,7,10,11,13]. One observational study reported 2 (0.4%) patients with DS in a cohort of 419 children with psoriasis [40].

Moreover, there were 14 case reports and 1 case series with 17 patients in total, where 3 (17.6%) of the patients had psoriatic arthritis (Multimedia Appendix 3) [29,41-54]. Six studies reported failed or ineffective systemic treatment with immunosuppressants [41,45,46,51,52], including the study by Adamcyzk et al [41], who reported discontinuing cyclosporin A treatment due to elevated liver enzymes, and Alcaide et al [42], who reported contraindications for cyclosporin and methotrexate due to renal and liver problems, respectively. Of the 8 patients treated successfully with systemic immunosuppressive treatments, 5 patients were treated with biologics (etanercept [41,42], ustekinumab [52], infliximab [51], adalimumab [46]), and 3 with conventional systemic medications including cyclosporin [47], azathioprine [45], and oral or intramuscular hydrocortisone [53].

Autoimmune Skin Conditions

Alopecia Areata

Eleven observational studies examined the prevalence of alopecia areata (AA) in populations with DS, with a weighted mean prevalence of 7.4% (190 patients with AA, out of 2574 patients with DS), and a range of 1.4%-21.0% [2,6-12,55-57]. One observational study reported 5 (1.3%) patients with DS in a cohort of 392 patients with AA [58].

Three observational studies examined only patients with both AA and DS, with a total of 44 patients and a weighted mean age of onset of 7.0 years (Multimedia Appendix 4) [59-61]. Lima Estafan et al [59] also reported a mean duration of 2.7 years and recurrence in 27.7% of patients. The study found no concomitant vitiligo or autoimmune disease, as well as no first-degree relatives with AA [59]. By contrast, Ramot et al [60] reported that 8 (57%) of patients had a 1st or 2nd degree relative with AA. Ramot et al [60] and Schepis et al [61] reported 6 (42.9%) and 4 (33.3%) with thyroid abnormalities, and 1 (7.1%) and 4 (33.3%) with celiac disease.

In addition, 11 case reports and 2 case series presented 14 patients with AA and DS, with a mean age of onset of 7.0 (SD 4.5) (Multimedia Appendix 5) [26,49,54,62-71]. Three studies presented patients with normal hair growth in areas of comorbid inflammatory skin disease (HS [26] and psoriasis [49,54]), also known as the Renbok phenomenon. Moreover, 5 patients had concomitant hypothyroidism [26,49,67,69,71], with 1 patient demonstrating complete resolution of hair regrowth 12 months after starting thyroxine treatment [69].

Vitiligo

Five observational studies with a weighted mean prevalence of 4.4% (31/709) of vitiligo in patients with DS were included [6-8,10,12]. Two observational studies reported a mean prevalence of 0.6% (6/1030) of DS in a cohort of patients with vitiligo [72,73].

Three case reports on patients with DS having vitiligo were included, associated with LN (aged 4 years, female) [31], leishmaniasis (aged 35 years, male) [74], and PRP (aged 30

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years, female) [37]. One patient also had hypothyroidism and type II diabetes mellitus [74].

Infectious Skin Conditions

Fungal Infections

Three observational studies examining the prevalence of onychomycosis among patients with DS had a weighted mean prevalence of 24.7% (188/761) [2,7,10,11]. Two other observational studies examining the prevalence of DS in patients with onychomycosis had a mean prevalence of 30.3% (10/33) [75,76]. One other cohort study examining only patients with DS having onychomycosis treated with terbinafine reported that all 32 patients had negative cultures after 24 weeks of treatment [77].

Additionally, 4 observational studies reported a mean weighted prevalence of 30.9% (190/615) of tinea pedis; 2 studies reported a weighted mean prevalence of 2.0% (9/446) of tinea corporis; 1 study reported a prevalence of 8.4% (18/214) of tinea cruris; and 1 study reported a prevalence of 2.5% (6/243) of tinea capitis.

Goulen et al [78] reported the successful treatment of a 5-year-old female patient with a Trichophyton rubrum-infected toenail, with 12 months of griseofulvin, followed by 6 months of daily terbinafine.

Other Infections

There was 1 observational study of a scabies outbreak among persons with mental disability, which reported an index case of a 16-year-old patient with DS [79]. There were also 7 case reports of scabies (Multimedia Appendix 6) [15,16,80-84], where 4 of the cases reported an initial misdiagnosis of scabies, and the patients were instead treated ineffectively for presumed onychomycosis, psoriasis, eczema, tinea corporis, and psoriasiform dermatitis [16,80-82,84]. There were also 4 case reports of leishmaniasis (Multimedia Appendix 7) [74,85-87] and 1 case report of actinomycetoma [88].

Cutaneous Birthmarks, Tumors, and Depositions

Calcinosis Cutis

Thirteen case reports and 1 case series reported 15 patients with calcinosis cutis, where 12 were diagnosed with milia-like calcinosis cutis [89-100], 1 with dystrophic calcinosis cutis [101], and 1 unspecified case (Multimedia Appendix 8) [102]. There were no reports of abnormal laboratory values, including serum calcium, phosphate, and parathyroid hormone levels. Six studies reported concomitant presentation of syringomas, with 5 cases of palpebral syringomas [90,94,96,100,102], and 3 studies that reported perilesional syringomas [90,97,102].

Connective Tissue Nevi

Six case reports presenting patients with DS having collagenomas or connective tissue nevi were included, with a mean age of 22.8 (SD 14.9) years [30,95,103-106]. No history of trauma was reported.

Dermatofibroma

Three cases of multiple dermatofibromas were included (Multimedia Appendix 9) [107-109], commonly defined as the development of 5 to 8 lesions within 4 months. The number of lesions at the time of report ranged from 6 to approximately 30. None had evidence of immunosuppression, although 1 patient presented with mild lymphopenia [109], and another with a history of acute megakaryoblastic leukemia [107].

One other case report in Spanish (not included in this systematic review) presented 3 patients with DS having multiple dermatofibromas, where 1 patient was immunosuppressed receiving methotrexate [110].

Melanoma

Three patients with cutaneous melanomas were reported (Multimedia Appendix 10) [111-113]. Jafarian et al [111] reported an 11-year-old patient with a stage IIA melanoma of the leg. Satge et al [112] reported a 19-year-old female patient with superficial spreading melanoma (Clark level II) in the lumber region. Lastly, Nakano et al [113] reported a 39-year-old patient with an acral lentiginous melanoma (Clark level V) of the right foot with central ulcer. No evidence of metastasis was found in any of the patients at the time of presentation, and all were treated with surgical excision.

Syringomas

Six observational studies examined the prevalence of syringomas in patients with DS, with a weighted mean prevalence of 21.2% (174/821) (Multimedia Appendix 11) [2,6-8,114,115]. Two of these observational studies only investigated for syringomas, published in 1964 and 1991 [114,115]. Feingold et al [115] also included an age-matched control group, which had a prevalence of 2.0% of syringomas, and reported that cases of syringomas in patients with DS did not present concurrent hypothyroidism or congenital heart disease.

Eight case reports included patients with DS having syringomas [90,94,96,100,102,104,116,117]. Five reported periorbital or palpebral syringomas [90,96,100,102,117]. One report described a case of eruptive syringomas over the trunk over the course of 1 month [116].

Other Skin Conditions

Elastosis Perforans Serpiginosa

One observational study reported a prevalence of elastosis perforans serpiginosa (EPS) in 203 patients with DS of 0.5% [2].

Moreover, 16 case reports and 2 case series examined 23 patients with EPS, with a mean age of 22.1 (SD 9.2) years (Multimedia Appendix 12) [83,118-134]. Three studies reported spontaneous resolution of lesions, ranging from 6 months to 3 years [129,133,134]. Topical steroids were reported to be ineffective in 7 cases [83,118,122,123,132,133].

Other Case Reports

Other case reports involving primary skin conditions in patients with DS include anetoderma secondary to folliculitis [135], cheilitis granulomatosa [136], epidermolysis bullosa [137], generalized perforating granuloma annulare [138], keratosis follicularis spinulosa decalvans [139], reactive perforating collagenosis [140], and familial urticaria pigmentosa [141].

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Discussion

Principal Findings

This systematic review captured 40 observational studies and 99 case reports, including 10 observational studies that examined the prevalence of common skin disorders in general in patients with DS. Our results indicate a potential association between DS and common cutaneous disorders including alopecia areata, acne vulgaris, hidradenitis suppurativa, and seborrheic dermatitis, although the scope of evidence in the literature is quite limited. Less common skin disorders including calcinosis cutis, eruptive syringomas, and multiple dermatofibromas were frequently described in case reports of patients with DS. Connective tissue conditions were also observed frequently in patients with DS including EPS, collagenomas, and reactive perforating collagenosis. Some cases of EPS also had high incidence of joint hyperextensibility and premature skin aging [120,126], suggesting a presence of connective tissue dysplasia.

Autoimmune conditions including psoriasis and AA have been linked to immune dysregulation in patients with DS [26,50]. Increased activity of CD4 T-lymphocytes and their proinflammatory cytokines (IFN-γ [interferon gamma] and TNF-α [tumor necrosis factor alpha]) are also involved in psoriasis pathogenesis [46]. Patients with DS may also therefore be more prone to severe cases of infestation and bacterial proliferation in the skin [10,86]. The cases of scabies reported in this review were extensive, tended to be generalized to the whole body, and were often clinically misdiagnosed and treated ineffectively, for instance as AD or psoriasis, before the diagnosis of scabies was made. The most recent guidelines set by the American Academy of Pediatrics for the management of children with DS do not provide any skin care recommendations for patients with DS [142]. Given the prevalence of skin disorders as outlined in this review, patients with DS would benefit from screening of dermatologic disorders that are not otherwise regularly performed for earlier diagnosis and treatment. However, patients with DS may experience difficulties accessing adequate services for the screening and treatment of cutaneous disease, for instance, given cognitive disabilities, social barriers, and potentially impairing comorbid physical and mental health conditions. Potential difficulties adhering to screening and treatment regimens, as well as preventative measures such as sun protection, may also pose challenges to interventions.

With the exception of 1 case [82], none of the patients were medically immunosuppressed. Nevertheless, most reports of scabies included in this review had superimposed bacterial infections and received antibiotic treatment. Similarly, with infectious and inflammatory conditions in and around the pilosebaceous unit including acne vulgaris, folliculitis, and HS, immunodeficiency predisposes patients to these conditions. An association with HS and DS has been previously outlined in a recent meta-analysis by Lam et al [143], which not only demonstrated a significant association, but also a younger age of onset for patients with DS for HS.

Standardized guidelines for systemic immunomodulatory agents in this patient population are lacking, and reports of systemic immunosuppressants in the treatment of cutaneous disorders in patients with DS are limited. The theoretical increased risk of infection and other complications, possibly due to concerns of low compliance or other comorbidities including congenital heart, haemato-oncological and endocrinological disorders, as well as immunological alterations lead to prescriber hesitation when considering biologics in severe cases refractory to other treatments [52]. Several patients described in this review presented cases where treatment with immunomodulatory agents were discontinued due to adverse effects or contraindicated due to preexisting conditions; however, considerations in the safety of these systemic agents in patients with DS remain unclear [52,144].

Limitations

Our study had several limitations. First, our calculated prevalence of skin conditions may have overestimated real prevalence, as studies that either did not assess for or found no cases were not included in weighted mean calculations. Our conclusions based on prevalence are also limited by insufficient studies with age-matched controls to provide comparison of prevalence in a matched population. Selection bias for patients included in case reports and case series limits interpretation. Additionally, patients with DS may be more likely to interact with health care providers given their increased risk of comorbidities and medical complications, which may result in an increase in diagnoses of cutaneous disease, among other diseases. Lastly, 53 studies were not included due to language restrictions.

Conclusions

This review highlights the need for additional data on the true prevalence and onset of dermatologic conditions in persons with DS. Particularly for conditions including psoriasis and HS, early diagnosis and treatment as well as appropriate screening will be important. Patients with DS may also be at an increased risk of cutaneous infections, and possible misdiagnoses could lead to increased severity at presentation. For patients with DS who may have difficulty communicating their symptoms, screening for and recognizing the associated skin disorders in this population should be incorporated as a necessary part of care.

Conflicts of Interest

RA is a member of the Editorial Board of JMIR Dermatology.

Multimedia Appendix 1
Summary of case reports of Down syndrome patients with lichen nitidus.

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[DOCX File , 14 KB - derma_v5i1e33391_app1.docx]

Multimedia Appendix 2
Summary of case reports of Down syndrome patients with pityriasis rubra pilaris.
[DOCX File , 14 KB - derma_v5i1e33391_app2.docx]

Multimedia Appendix 3
Summary of case reports of Down syndrome patients with psoriasis.
[DOCX File , 17 KB - derma_v5i1e33391_app3.docx]

Multimedia Appendix 4
Observational studies examining only patients with both Down syndrome and alopecia areata.
[DOCX File , 14 KB - derma_v5i1e33391_app4.docx]

Multimedia Appendix 5
Summary of case reports of Down syndrome patients with alopecia areata.
[DOCX File , 16 KB - derma_v5i1e33391_app5.docx]

Multimedia Appendix 6
Summary of case reports of Down syndrome patients with scabies infestation.
[DOCX File , 15 KB - derma_v5i1e33391_app6.docx]

Multimedia Appendix 7
Summary of case reports of Down syndrome patients with leishmaniasis infestation.
[DOCX File , 14 KB - derma_v5i1e33391_app7.docx]

Multimedia Appendix 8
Summary of case reports of Down syndrome patients with calcinosis cutis.
[DOCX File , 15 KB - derma_v5i1e33391_app8.docx]

Multimedia Appendix 9
Summary of case reports of Down syndrome patients with dermatofibromas.
[DOCX File , 14 KB - derma_v5i1e33391_app9.docx]

Multimedia Appendix 10
Summary of cases of Down syndrome patients with confirmed melanoma.
[DOCX File , 15 KB - derma_v5i1e33391_app10.docx]

Multimedia Appendix 11
Summary of case reports of Down syndrome patients with syringoma(s).
[DOCX File , 14 KB - derma_v5i1e33391_app11.docx]

Multimedia Appendix 12
Summary of case reports of Down syndrome patients with elastosis perforans serpiginosa.
[DOCX File , 17 KB - derma_v5i1e33391_app12.docx]

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Abbreviations

AA: alopecia areata
AD: atopic dermatitis
DS: Down syndrome
EPS: elastosis perforans serpiginosa
HS: hidradenitis suppurativa
IFN-γ: interferon gamma
LN: lichen nitidus
PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PROSPERO: International Prospective Register of Systematic Reviews
PRP: pityriasis rubra pilaris
TNF-α: tumor necrosis factor alpha

Edited by R Dellavalle, T Sivesind; submitted 05.09.21; peer-reviewed by S Gulliver, T Ewais; comments to author 28.11.21; revised version received 19.12.21; accepted 20.12.21; published 08.02.22.

Please cite as:
Lam M, Lu JD, Elhadad L, Sibbald C, Alhusayen R
Common Dermatologic Disorders in Down Syndrome: Systematic Review
JMIR Dermatol 2022;5(1):e33391
URL: https://derma.jmir.org/2022/1/e33391
doi:10.2196/33391
PMID:

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Review

Vitiligo and Metabolic Syndrome: Systematic Review and Meta-Analysis

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Abstract

Background: Metabolic syndrome (MetS) has been associated with various skin conditions including vitiligo. However, the association between these 2 conditions has yet to be determined by quantitative meta-analysis.

Objective: The aim of this paper was to determine the association between vitiligo and metabolic syndrome via systematic review and meta-analysis.

Methods: A systematic literature search of Pubmed, Embase, Cochrane, and Web of Science was performed for all published literature prior to August 16, 2020. Case control and prospective cross-sectional studies analyzing the association between vitiligo and MetS were included in this review. The primary outcome measures include the type of vitiligo, diagnostic criteria for MetS, components of MetS (waist circumference, blood pressure, triglycerides, fasting glycemic index, and high-density lipoprotein cholesterol), low-density lipoprotein cholesterol levels, and BMI. A meta-analysis was performed to evaluate the prevalence and association of MetS in patients with vitiligo.

Results: A total of 6 studies (n=734 participants) meeting eligibility criteria were included for systematic review and meta-analysis. The pooled prevalence of MetS in patients with vitiligo was (0.296, 95% CI 0.206, 0.386; *P*<.001). Patients with vitiligo were no more likely to develop MetS compared to control patients (odds ratio 1.66, 95% CI 0.83, 3.33; *P*=.01). A leave-one-out sensitivity analysis showed a significant association between MetS and vitiligo (*P*<.001). Significant elevations in fasting glycemic index (mean difference 5.35, 95% CI 2.77, 7.93; *P*<.001) and diastolic blood pressure (mean difference 1.97, 95% CI 0.02, 3.92; *P*=.05) were observed in patients with vitiligo compared to control patients.

Conclusions: The association between vitiligo and metabolic syndrome carries important clinical implications. Dermatologists and other multidisciplinary team members should remain vigilant when treating this patient population in order to prevent serious cardiovascular complications that may arise as a result of metabolic disease.

(JMIR Dermatol 2022;5(1):e34772) doi:10.2196/34772

KEYWORDS

vitiligo; leukoderma; metabolic syndrome X; dysmetabolic syndrome X; insulin resistance syndrome X; syndrome X

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Introduction

Vitiligo is a depigmentary condition of the skin and hair follicles due to autoimmune destruction of melanocytes [1], affecting an estimated 1% of the world's population [2]. Vitiligo lesions commonly appear on exposed areas such as the face and extremities and can increase in size and number over time, frequently causing significant psychological impact to patients' quality of life [1,3]. Diagnosis is typically clinical and can be further subdivided into 3 major subtypes, which are nonsegmental, segmental, and unclassified [1,4]. The most common nonsegmental subtype (encompassing generalized vitiligo [4]) typically presents with a symmetric distribution and has a strong association with other autoimmune diseases, while the segmental subtype presents with a unilateral distribution and is less strongly associated with other autoimmune diseases [5]. The unclassified subtype encompasses rare variants of the disease [4]. Though the precise etiology of vitiligo remains unknown, it is hypothesized that CD4+ and CD8+ lymphocytes play a role in the pathogenesis. The involvement of cytokines such as tumor necrosis factor alpha (TNF-α), Interferon gamma (IFN-γ), interleukin (IL)-1, IL-6, IL-10, and IL-17 have also been linked to the disease [2,6]. Furthermore, patients with vitiligo and their first-degree relatives have been shown to have increased prevalence of other autoimmune conditions such as thyroid disease, type 1 diabetes mellitus, pernicious anemia, rheumatoid arthritis, Addison disease, lupus, and Guillain-Barré [1].

Metabolic disturbances are commonly seen in patients with systemic vitiligo [7]. Metabolic syndrome (MetS) is a collection of clinical findings that, when present, increases a patient's risk of developing cardiovascular disease and type 2 diabetes [8]. Though several definitions of MetS exist, 3 of the most commonly used guidelines include the National Cholesterol Education Program **(**NCEP) Adult Treatment Panel (ATP) III criteria, the International Diabetes Federation (IDF) criteria, and the Harmonization criteria, which is a result of a joint statement released by the IDF, American Heart Association, National Heart, Lung, and Blood Institute, World Heart Federation, International Atherosclerosis Society, and International Association for the Study of Obesity in 2009 to unify ATPIII and IDF guidelines [9,10]. Regardless of the diagnostic criteria used, core features such as insulin resistance, visceral adiposity, dyslipidemia, and endothelial dysfunction are central to the development of MetS [11]. Overall, it is estimated that up to a quarter of the world population may meet MetS criteria [9]. In addition to the increased risk for cardiovascular disease and type 2 diabetes, other associations seen with MetS include fatty liver disease, hepatocellular carcinoma, chronic kidney disease, polycystic ovary syndrome, and more [12-15].

Current literature suggests a potential link between vitiligo and MetS, based on a similar pathogenesis involving proinflammatory cytokines [7]. Insulin resistance and lipid profile disturbances have demonstrated a higher prevalence in patients with vitiligo when compared to age-matched and BMI-matched control groups [16]. In fact, several articles have reported a strong association between vitiligo and both type 1 and 2 diabetes mellitus; while the association between vitiligo and type 1 diabetes is not surprising given the autoimmune nature of both conditions, the association with type 2 diabetes necessitates close surveillance for metabolic derangements [17,18]. Despite the relationship between vitiligo and type 2 diabetes mellitus, few studies have investigated the relationship between vitiligo and MetS. Of the few studies that exist, some such as that by Atas et al [19] have noted a significant correlation whereas others, such as the study by Sallam et al [20] did not note such findings. Furthermore, in a recent study of patients with nonsegmental vitiligo (n=70), a significantly higher risk of cardiovascular disease was seen in those with more chronic and severe disease or concomitant MetS. Therefore, early diagnosis and treatment of MetS in patients with vitiligo may reduce cardiovascular complications [21]. While vitiligo is typically managed by a multidisciplinary team, increased vigilance of dermatologic signs of MetS, such as acanthosis nigricans, may allow for the early detection of disease progression [22]. In this paper, we conducted a systematic review and meta-analysis to resolve the current conflicts in the literature and to analyze the association between vitiligo and MetS with an emphasis on disease prevention and early detection.

Methods

This study was conducted in accordance with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines [23] and is illustrated in Figure 1.

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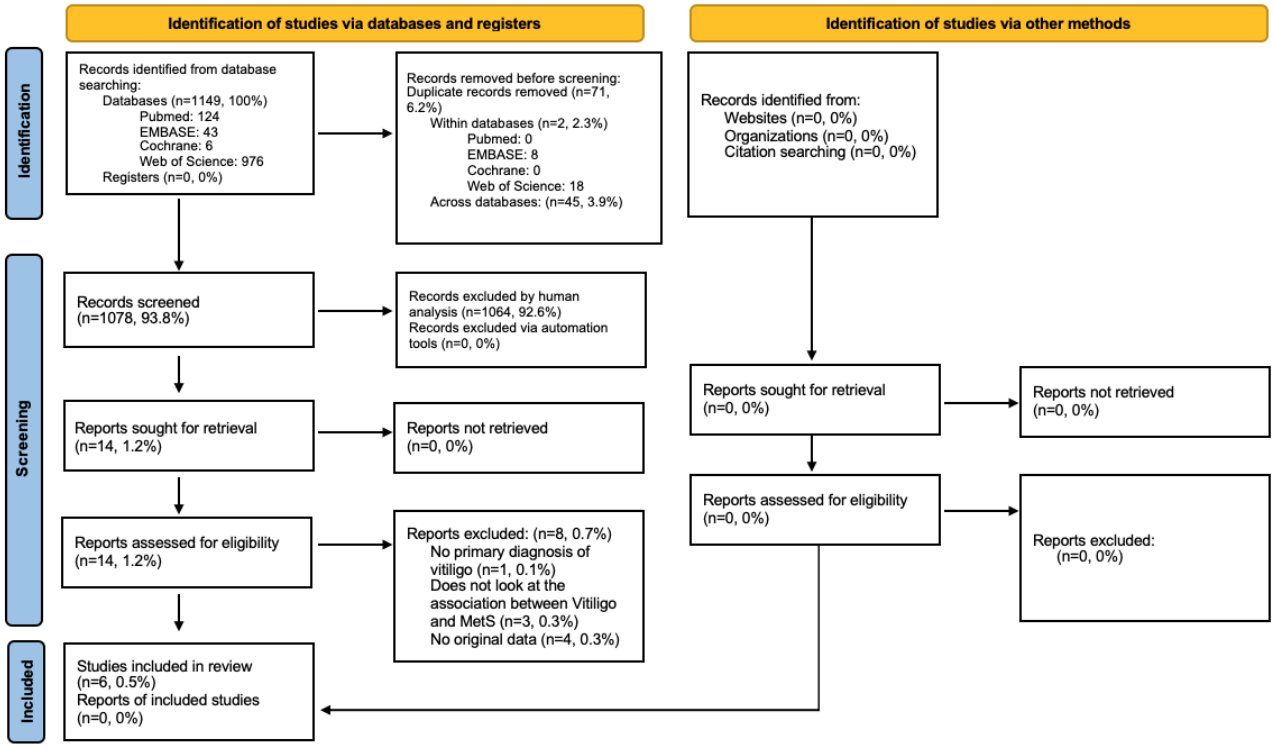
Figure 1. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) study flowchart. MetS: metabolic syndrome.



Literature Search

A comprehensive literature search of the electronic databases Pubmed, Embase, Cochrane, and Web of Science was carried out for all published literature from inception through August 16, 2020. The search terms used were found within the title, abstract, full text, or keywords. Search words included “vitiligo,” “leukoderma,” “metabolic syndrome X,” “dysmetabolic syndrome X,” “insulin resistance syndrome X,” and “syndrome X” (Supplemental Table 1 in Multimedia Appendix 1). The conjunctions “AND” and “OR” were used to yield maximal results. Additionally, a manual search of each included study’s reference list was performed to identify other relevant papers. No geographic or temporal restrictions were imposed. No gray literature was searched or included in the review, neither were dissertations, books, letters to the editor, or unpublished studies.

Study Selection

All studies were screened by 2 independent reviewers (JX and CM), and disagreements were resolved via a third independent party (WG). Of the papers produced by our search, the titles and abstracts were reviewed for eligibility. Papers that were deemed irrelevant based on title and abstract alone were not further analyzed, whereas those that were deemed relevant went on to full text review. Studies meeting any of the exclusion criteria were retracted from further analyses.

Inclusion Criteria

The inclusion criteria for this study were as follows: (1) only published articles written in English language from inception to August 16, 2020; (2) observational studies examining the association of vitiligo with MetS, including cross-sectional, case-control, or cohort studies; (3) studies that diagnosed subjects with MetS based on either NCEP ATP III [24,25], IDF [26], or Harmonization [10] criteria and specifically analyzed the relationship between vitiligo and all components of MetS. Studies discussing all forms of vitiligo were eligible for inclusion. No specific duration of vitiligo of MetS from diagnosis was necessary for inclusion; and (4) studies containing control groups n≥5.

Exclusion Criteria

The exclusion criteria for this study were as follows: (1) studies that did not specifically examine all components of MetS (eg, those only analyzing the relationship between vitiligo and insulin resistance or vitiligo and blood pressure); (2) studies using nonhuman subjects; (3) papers not written in English; (4) papers for which full text was not available; and (5) papers in the format of dissertations, books, or letters to the editor.

Data Extraction and Risk of Bias Assessment

Data extracted from the included studies consisted of first author, year of publication, country and city of origin, study type, total sample size, case group size, control group size, mean age, percentage of female participants, type of vitiligo, diagnostic criteria for vitiligo, inclusion criteria for vitiligo cases, percentage of affected body surface area, mean vitiligo disease duration, inclusion criteria for controls, number of patients diagnosed with MetS, MetS criteria for diagnosis, reported odds ratio (95% CI) for development of MetS in patients with vitiligo, MetS component values, fasting glycemic index (FGI), triglycerides, high-density lipoprotein (HDL) cholesterol, systolic blood pressure (SBP), diastolic blood pressure (DBP), waist circumference, low-density lipoprotein (LDL) cholesterol, BMI, smoking status, and alcohol use status (Supplemental Table 2 in Multimedia Appendix 1) [19,20,27-30].

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We used the Newcastle-Ottawa Scale (NOS) to assess risk of bias (Figure 1A [19,20,27-29] and 1B [30] in Multimedia Appendix 1). Separate scales were used to rate case control papers and cross-sectional papers. Case control papers were rated with regard to adequate definition of cases, representativeness of sample, representativeness of controls, definition of controls, comparability of cases and controls based on age and sex, adequacy of ascertainment of exposure, comparability of ascertainment method across cases and controls, and nonresponse rate. Cross-sectional papers were rated on an adapted scale for representativeness of sample, sample size, nonresponse rate, method of ascertainment of exposure, comparability of samples based on age and sex, method of outcome assessment, and viability of statistical analysis used. Two authors (CM and JX) individually scored each paper on these scales with a third author (WG) weighing in as a tiebreaker. We considered an NOS score greater than or equal to 5/9 as low risk of bias.

Statistical Analysis

A pooled odds ratio on the association between vitiligo and MetS and all mean differences for subgroup analyses were calculated and depicted in forest plots using Review Manager (version 5.4, Cochrane Collaboration) [31]. A random effects model of Mantel-Haenszel was used for the odds ratio due to high heterogeneity, as determined by I^2 values greater than 50%. Calculations for mean differences used an inverse variance method with a random effects or fixed effects model as determined by I^2 degree of heterogeneity. Pooled prevalence of MetS in patients with vitiligo was conducted using OpenMeta[Analyst], version 10.2 [32], using the random effects models of DerSimonian-Laird. All calculations were performed with a 95% CI. *P* values of <.05 were considered significant.

Results

Characteristics of Included Studies

Our search identified 1149 records by title alone. After duplicates were removed, 1078 records were reviewed for applicability. Of these records, 1064 articles were excluded based on title and abstract screening. The remaining 14 articles underwent full text review to assess for eligibility, 6 of which met the inclusion criteria. A summary of the inclusion process is presented in Figure 1. The characteristics of the included studies are listed in Supplemental Table 3 in Multimedia Appendix 1 [19,20,27-30]. Five papers were case control studies [19,20,27-29], and 1 was a prospective cross-sectional study [30]. Moreover, 3 studies were conducted in India [27-29], 2 in Turkey [19,30], and 1 in Egypt [20]. A total number of 734 participants (375 of which were diagnosed with vitiligo) were included across all studies: 128 (63 with vitiligo, 49.2%) from Atas et al [19], 191 (102 with vitiligo, 53.4%) from Sallam et al [20], 200 (100 with vitiligo, 50%) from Sharma et al [27], 65 (35 with vitiligo, 53.8%) from Singh et al [28], 150 (75 with vitiligo, 50%) from Sinha et al [29], and 310 (155 with vitiligo, 50%) from Tanacan et al [30]. The type of vitiligo varied across papers, with both segmental and nonsegmental types examined in 3 studies [19,20,30]; 1 paper exclusively studied nonsegmental types [27], and 2 studies did not specify the type of vitiligo the patients were diagnosed with [28,29]; 3 studies reported the duration of vitiligo (in years): 9.5 (SD 8.1) [19], 5.29 (SD 6.8) [20], and 43.5 (SD 10.5) [27]; however, the duration was statistically significant across these studies (*P*=.03). The diagnostic criteria for MetS also varied among studies, with 4 studies using NCEP ATP III criteria [19,27,29,30] and 2 using IDF criteria [20,28]. Two studies [27,30] took into consideration social risk factors such as alcohol and smoking use; Sharma et al [27] report no significant association between smoking (*P*=.31) or alcohol (*P*=.28) and the development of MetS in patients with vitiligo. Tanacan et al [30] report no significant relationship (*P*=.81) regarding smoking, but a significant relationship was observed (*P*=.01) regarding alcohol consumption. Comorbid conditions were not examined in any of the studies included.

Risk of Bias of the Included Studies

The risk of bias of the included studies is summarized in Supplemental Figure 1A [19,20,27-29] and 1B in Multimedia Appendix 1 [30]. The NOS was used to assess bias in the 5 case control studies [19,20,27-29], with a modified NOS scale adapted for cross-sectional studies [30]. Except for Sinha et al [29], all included studies [19,20,27,28,30] were rated at low risk of bias (ie, NOS score greater than or equal to 5). We rated Sinha et al [29] at high risk of bias because the same method of ascertainment for cases and controls was not used. The reason for unclear risk of bias in the nonresponse rate domain by Sinha et al was due to a discrepancy in the sample size for the control group without mention of loss to follow-up.

Prevalence and Association of Vitiligo With Metabolic Syndrome

Four studies presented the necessary data to determine the pooled prevalence of MetS in patients with vitiligo. Due to the high heterogeneity (I^2=76%), a random effects model of DerSimonian-Laird was adopted for the calculations. We calculated a pooled prevalence of 29.6% (95% CI, 20.6%-38.6%; *P*<.001; Figure 2) [19,20,27,30]. Individual studies had a prevalence ranging from 20.6% to 38.1%. These same 4 studies [19,20,27,30] were used to calculate the odds ratio. Overall, patients with vitiligo were not more likely to develop MetS compared to age-matched and sex-matched control patients (odds ratio 1.66, 95% CI 0.83, 3.33; *P*=.01; Figure 3 [19,20,27,30]). However, sensitivity analysis with removal of one study at a time revealed a statistically significant association between vitiligo and MetS when Sallam et al [20] was removed (odds ratio 2.39, 95% CI 1.64, 3.47; *P*<.001). Substantial statistical heterogeneity was reported across these 4 studies (I^2=77%).

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Figure 2. Forest plot of the pooled prevalence of metabolic syndrome in patients with vitiligo (*P*<.001). Ev/Trt: number of events in experimental/treated group.

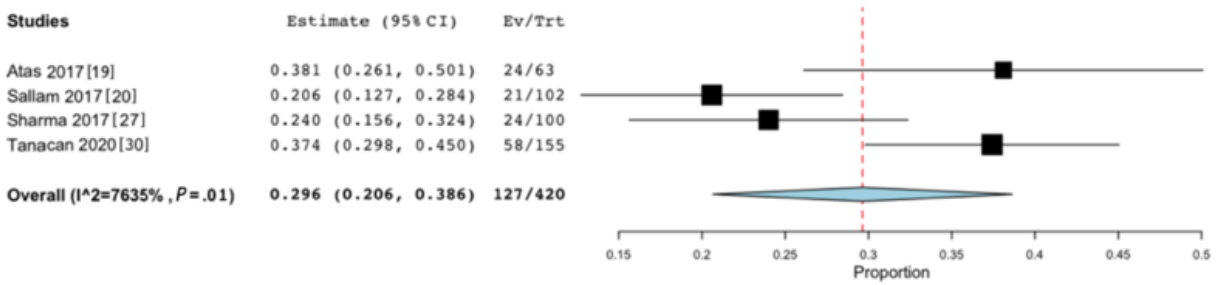
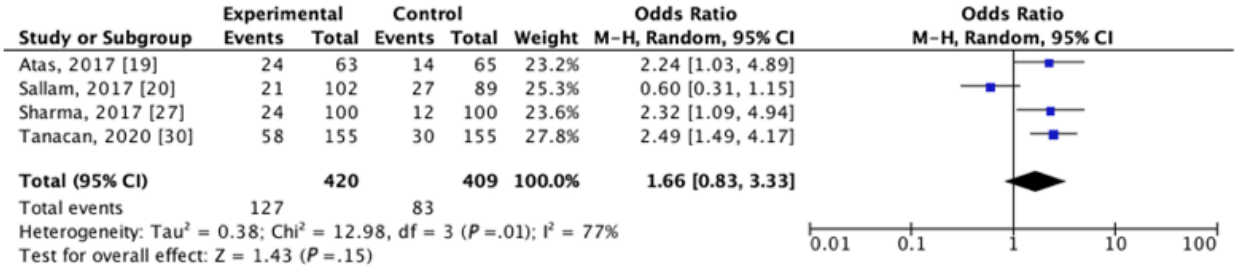


Figure 3. Forest plot of the association of vitiligo with metabolic syndrome: odds of vitiligo patients developing metabolic syndrome compared to healthy control. M-H: Mantel-Haenszel.



Components of Metabolic Syndrome in Patients With Vitiligo

A minimum of 5 studies [19,20,27-30] were used to calculate the mean difference of waist circumference, triglycerides, HDL, SBP, DBP, and FGI between vitiligo and control groups; significant elevations in FGI (mean difference [MD] 5.35, 95% CI 2.77, 7.93; *P*<.001) and DBP (MD 1.97, 95% CI 0.02, 3.92; *P*=.05) were observed in patients with vitiligo compared to age-matched and sex-matched control patients (Figure 4 [19,20,27-30]). Substantial statistical heterogeneity was found in DBP (I^2=74%), but not in FGI (I^2=0%). No significant difference was observed between patients with vitiligo and control patients regarding waist circumference (MD -1.14, 95% CI -6.11, 3.84; *P*<.001), HDL cholesterol (MD -0.47, 95% CI -3.42, 2.47; *P*<.001), SBP (MD 1.18, 95% CI -1.76, 4.12; *P*<.01), or triglycerides (MD 13.42, 95% CI -4.13, 30.97; *P*<.001). A leave-one-out sensitivity analysis revealed a significant elevation in triglyceride levels with removal of Sallam et al (MD 20.44, 95% CI 6.07, 34.81; *P*=.01; Supplemental Figure 2 in Multimedia Appendix 1 [19,20,27,30]). No significant changes were detected with sensitivity analysis across the remaining MetS components.

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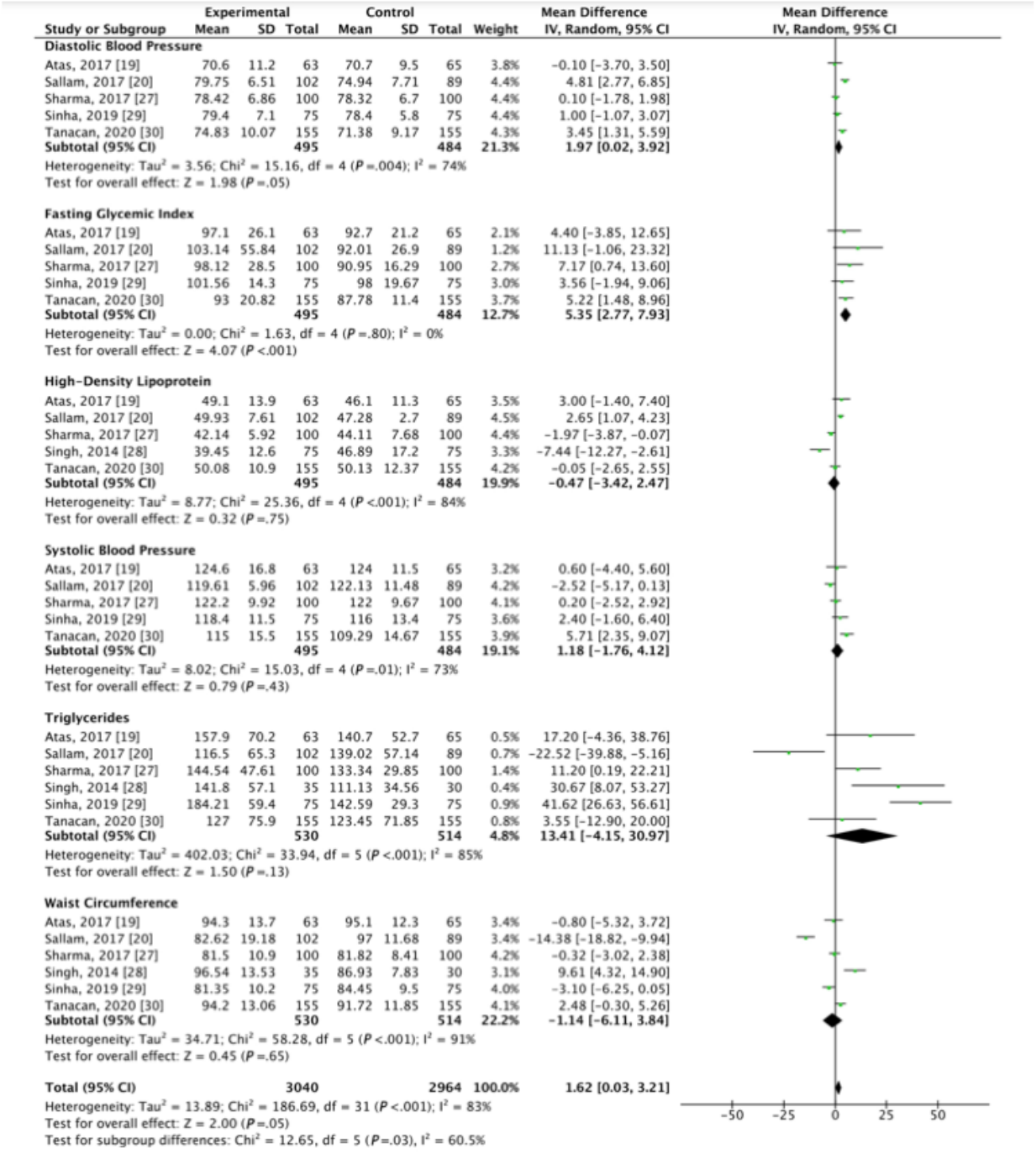
Figure 4. Forest plots of the mean difference of vitiligo with the components of metabolic syndrome.



Additional Metabolic Measurements in Patients With Vitiligo

Figure 5 [20,27,28,30] depicts the mean differences between patients with vitiligo and control patients regarding LDL cholesterol and BMI. Two studies [28,30] were used to calculate the mean difference in LDL cholesterol. A significant elevation in mean LDL cholesterol levels was reported in patients with vitiligo as compared to age-matched and sex-matched control patients (MD 27.06, 95% CI 14.50, 39.62; *P*<.001) with substantial heterogeneity identified across both studies (I^2=90%). Four studies [20,27,28,30] were used to calculate the mean difference of BMI between patients with vitiligo and control patients; however, no significant difference was detected even after sensitivity analyses (MD 0.29, 95% CI -1.87, 2.45; *P*<.001). Statistically significant heterogeneity was identified across all 4 studies (I^2=92%).

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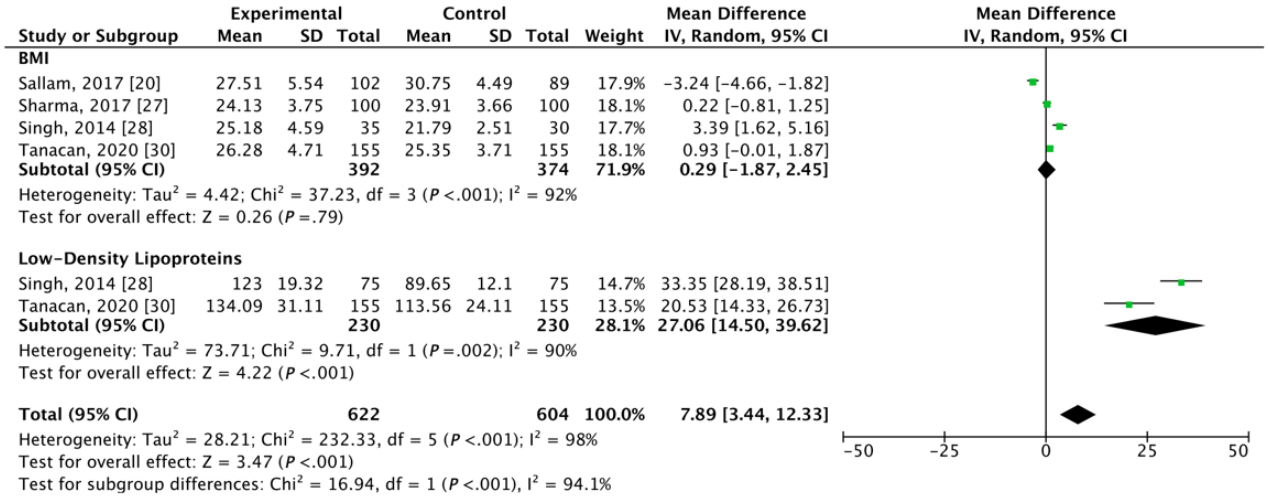
Figure 5. Forest plots of the mean difference of vitiligo with additional metabolic changes (low-density lipoprotein cholesterol and BMI).



Discussion

Analysis

The recommendation for metabolic screening in patients with vitiligo has not been well defined. While previous literature suggests a shared pathophysiology between vitiligo and metabolic syndrome (MetS), the association between the 2 conditions remains unclear. In our study, we approximate the prevalence of MetS in patients with vitiligo to be about 30%, corroborating rates of MetS seen in the general population. A 2017 study by Moore et al [33] found that the prevalence of MetS among US adults aged 18 years and older was approximately 34.2% from the period of 2007-2012, while a 2018 paper by Saklayen [9] estimates the global MetS prevalence to be approximately 25%. While the prevalence of MetS in patients with vitiligo is similar to that of the general population, we still recommend increased vigilance in patients with vitiligo due to the perceived risk for cardiovascular complications that may result from MetS.

While 5 [19,27-30] of the 6 research articles analyzed in this review demonstrate a significant association between vitiligo and MetS, our study shows an overall lack of association between vitiligo and MetS; however, a leave-one-out sensitivity analysis removing Sallam et al reveals that a significant association does exist [19,20,27,30]. Leave-one-out analyses are commonly performed to isolate studies that have disproportionate effect sizes on the overall meta-analysis. With exclusion of Sallam et al [20] producing a significant change in the results, consideration must be given as to whether the study is an outlier. It is possible that the nonsignificant findings observed in this study may be explained by the relatively short duration of vitiligo (2-6 years) among diagnosed cases [20]. Shorter vitiligo duration may allow less time for the development of MetS, possibly skewing the results.

A closer look at the diagnostic components of MetS demonstrates a significantly higher FGI in patients with vitiligo when compared to age-matched and gender-matched controls, though the mean for both groups remained within normal range (FGI of 96.66 in patients with vitiligo vs 91.30 in controls). The increased FGI seen in the vitiligo group brings this group closer to the prediabetes threshold of a value greater than 100. Several studies have reported an increased incidence of vitiligo as a result of insulin resistance [16]. It is possible that the elevation in FGI observed in patients with vitiligo reflect early changes of insulin resistance that may eventually progress to metabolic disease. While there are no current guidelines regarding yearly hemoglobin A1C screening for patients with vitiligo, these findings suggest a potential benefit in early glucose monitoring in patients diagnosed with vitiligo.

LDL cholesterol levels and BMI are outside of the diagnostic criteria for MetS. However, a case control study by Houssien et al [34] showed an increased incidence of chronic diseases such as type 2 diabetes, dyslipidemia, and obesity in patients with vitiligo. Consistent with the literature, we found a significant elevation in mean LDL cholesterol levels in patients with vitiligo compared to control groups. Similar to the elevations in FGI, patients with vitiligo had elevated LDL cholesterol levels, which may suggest an increased predisposition for metabolic derangements. On the other hand, no significant difference in mean BMI was observed across groups even after sensitivity analysis, suggesting that obesity may not be the underlying mechanism for metabolic disturbances observed in patients with vitiligo [16].

Alterations in cytokine production, autoimmunity, and genetic predisposition are thought to be the main factors in the pathogenesis of vitiligo [30]. Increased levels of proinflammatory cytokines such as TNF-α IL-1, and IL-6 have been shown to promote insulin resistance and cause metabolic disturbances in children with vitiligo [7]. Additionally, there is evidence that melanin exerts anti-inflammatory and antioxidant effects in adipose tissue [35]; thus, the decreased number of melanocytes and decreased melanogenesis seen in patients with vitiligo could serve as a source of oxidative stress involved in the pathogenesis of MetS [7]. Finally, homocysteine levels have been noted to be increased in patients with vitiligo as compared to control groups [36]. This molecule inhibits tyrosinase in melanin synthesis, acting as another potential contributor to vitiligo pathogenesis; in fact, elevated levels are a known risk factor for cardiovascular disease [36]. Such inflammatory

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changes are important to consider when assessing the risk of MetS in patients with vitiligo.

Interestingly, certain treatments for vitiligo have demonstrated cardiovascular benefits as well. A study by Bae et al [37] noted significantly decreased risk of subsequent cardiovascular and cerebrovascular events in patients with vitiligo who were treated with narrowband UV-B phototherapy when compared to the untreated group. The 2 groups were matched for covariables such as diabetes, hypertension, and hyperlipidemia, though the effects of treatment on these factors was not reported. While it is unclear as to whether this improvement was an effect of the treatment of vitiligo or UV-B therapy in and of itself, this finding emphasizes the need for further research regarding the effects of other common vitiligo therapies, such as topical steroids, on the prevention of cardiovascular disease.

Limitations

There are several limitations of this study. First, a small number of studies were included due to the paucity of literature on vitiligo and metabolic syndrome. There is a need for more comprehensive studies with a larger sample size. Second, though most papers reported study populations with a mean age corresponding to an adult cohort, Sinha et al [29] specified only that the study population was over 18 years in age. Therefore, though our findings largely apply to an adult population, we cannot exclude the possibility that geriatric patients were included in analysis. Our papers also did not report on the racial breakdown of the study groups. We therefore cannot exclude race as a confounder, and do not know the extent to which race affects access to medical care in the study countries. Third, except for Sallam et al [20], the criteria for diagnosing vitiligo were not specified, and different subtypes of vitiligo were evaluated across studies. While some studies included patients with both segmental and nonsegmental vitiligo [19,20,30], others limited their studies to include only nonsegmental vitiligo cases [27], and 2 studies did not specify [28,29]. Because nonsegmental vitiligo has been associated more with chronic inflammation and MetS as compared to segmental vitiligo [30], it is important to differentiate which subtypes are under investigation. Lastly, there were 3 diagnostic criteria used in this study for identifying MetS in patients with vitiligo, which were NCEP, IDF, and Harmonization guidelines. Although the guidelines differ only regarding waist circumference, a more consistent approach to diagnosing MetS should be used in the future. Future studies should examine the impact of other factors such as age, gender, race, and duration or severity of vitiligo in the development of MetS.

Conclusions

The association between vitiligo and metabolic syndrome carries important clinical implications that warrant increased vigilance by dermatologists and other health care professionals involved in the care of this unique patient population. Surveillance of FGI and LDL cholesterol levels may be beneficial in reducing serious cardiovascular complications that may result from comorbid metabolic disease. Further studies are needed to determine the extent of cardiometabolic derangements in order to set guidelines for monitoring and preventing disease progression.

Conflicts of Interest

None declared.

Multimedia Appendix 1
Supplementary figures and tables.
[DOCX File , 1979 KB - derma_v5i1e34772_app1.docx]

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Abbreviations

ATP: Adult Treatment Panel
DBP: diastolic blood pressure
FGI: fasting glycemic index
HDL: high-density lipoprotein
IDF: International Diabetes Federation
IFN-γ: interferon gamma
IL: interleukin
LDL: low-density lipoprotein
MD: mean difference
MetS: metabolic syndrome
NCEP: National Cholesterol Education Program
PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses
SBP: systolic blood pressure
TNF-α: tumor necrosis factor alpha

Edited by R Dellavalle, T Sivesind; submitted 07.11.21; peer-reviewed by H Ayatollahi, H Shakshouk; comments to author 04.01.22; revised version received 20.01.22; accepted 23.01.22; published 16.03.22.

Please cite as:
Xia J, Melian C, Guo W, Usmani H, Clark R, Lozeau D
Vitiligo and Metabolic Syndrome: Systematic Review and Meta-Analysis
JMIR Dermatol 2022;5(1):e34772
URL: https://derma.jmir.org/2022/1/e34772
doi:10.2196/34772
PMID:

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Original Paper

Treatments for Primary Delusional Infestation: Systematic Review

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Abstract

Background: Delusional infestation, also known as Ekbom syndrome, is a rare delusional disorder characterized by the fixed belief that one is infested with parasites, worms, insects, or other organisms. Although delusional infestation is a psychiatric condition, patients often consult dermatologists with skin findings, and it is currently unclear what treatments are recommended for this disorder.

Objective: We aimed to systematically review and describe the treatment and management of patients presenting with primary delusional infestation.

Methods: A systematic search was conducted using Ovid on MEDLINE, Embase, PsycINFO, and the Cochrane Register of Clinical Trials. Relevant data, including treatment, dosage, response, adherence, and side effects, were extracted and analyzed.

Results: A total of 15 case series were included, comprising 280 patients (mean age 53.3 years, 65.4% female) with delusional infestation. Overall, aripiprazole had the highest complete remission rate at 79% (11/14), although this was limited to 14 patients. Among drug classes, selective serotonin reuptake inhibitors were the most effective with a 79% (11/14) complete remission rate and 43% (9/21) partial remission rate in patients with comorbid depression, anxiety, or trichotillomania. First-generation antipsychotics and second-generation antipsychotics had similar complete remission rates (56/103, 54.4% vs 56/117, 47.9%, respectively) and partial remission rates (36/103, 35% vs 41/117, 35%, respectively).

Conclusions: Due to the rarity of delusional infestation, we only found 15 case series. However, we found that first-generation antipsychotics appear to be similar in effectiveness to second-generation antipsychotics for the treatment of primary delusional infestation. Larger studies and randomized controlled trials are needed to evaluate the efficacy of pharmacological therapy for delusional infestation.

Trial Registration: PROSPERO CRD42020198161; https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=198161

(JMIR Dermatol 2022;5(1):e34323) doi:10.2196/34323

KEYWORDS

delusional infestation; Morgellons disease; treatment; delusional parasitosis; atypical; typical; antipsychotic; SSRI; delusion; rare disorder; systematic review; pharmacology; pharmacological; psychiatric; dermatology; dermatologist; drug

Introduction

Delusional infestation, also known as delusional parasitosis, is a rare delusional disorder characterized by the fixed belief that one's skin is infested by parasites, worms, insects, or other organisms [1]. The prevalence of delusional infestation is estimated to be 27.3 per 100,000, and it is more frequent in individuals over the age of 50 years and in socially isolated women [2,3]. Despite the lack of microbiological evidence,

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patients are convinced they are infected and often present with cutaneous sensations, such as itching, crawling, and formication. These delusions may lead patients to injure themselves through cuts and chemical burns or destroy their furniture in an attempt to eliminate the perceived infestation [4]. The "specimen sign" is a classic feature of the illness present in about half of all patients, in which patients present fragments of skin, particles, threads, or insects to their healthcare provider as evidence of skin infestation [5].

Delusional infestation can be classified as either a primary or secondary variant. Primary delusional infestation is an isolated psychiatric disorder diagnosed after the exclusion of other causes, such as infection or an underlying medical or psychiatric condition. In secondary delusional infestation, the delusions are attributed to other conditions, including substance use, medications, other psychiatric conditions, and infections. Primary delusional infestation comprises approximately 56% of cases [6].

The etiology of primary delusional infestation is unclear, though disruptions in dopamine pathways are suspected to play a role. Antipsychotics improve delusional infestation symptoms, likely due to inhibition of dopamine transmission. Dopamine plays a role in probabilistic reasoning, and its disruption may cause patients to incorrectly attribute a rash or itch to skin infestation [1,7]. Another hypothesis suggests that dysfunction of striatal dopamine transporters leads to more postsynaptic dopamine, increasing the risk of developing delusional infestation [8]. Conditions associated with reduced dopamine transporter function, such as schizophrenia, depression, and alcoholism, have been associated with delusional infestation. Moreover, medications that inhibit dopamine reuptake, such as cocaine and amphetamines, often induce delusional infestation symptoms, such as formication [8]. There is also evidence that dysfunction in the fronto-striato-thalamic network mediates symptoms of delusional infestation [9].

The clinical management of delusional infestation is challenging, and dermatologists are often consulted due to patients conceptualizing the disease as somatic. Patients frequently refuse psychiatric therapy or referral and often present proof of infestation, which is commonly referred to as a "specimen sign" or "matchbox sign" and can include skin particles or hair. On average, dermatologists will manage 2 to 3 patients with delusional infestation every 5 years [10]. Common treatments reported in the literature include first-generation antipsychotics (FGAs) (eg, pimozide, fluphenazine, and haloperidol) and second-generation antipsychotics (SGAs) (eg, risperidone and olanzapine). A 2007 systematic review of papers on delusional infestation found FGAs and SGAs were effective in the majority of patients with primary delusional infestation, but remission rates did not differ between these 2 groups of antipsychotics [11]. A more recent systematic review reported similar results; there was no strong evidence to suggest any single antipsychotic agent over another [12]. Both of these reviews restricted their search strategy to antipsychotics; however, other pharmacological agents may also prove effective in treating delusional infestation. As such, we conducted a systematic review to identify pharmacological treatments used for primary delusional infestation to better understand their effectiveness and establish recommendations for the management of primary delusional infestation.

Methods

The protocol was registered on PROSPERO (CRD42020198161). The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines were utilized in this systematic review (Figure 1).

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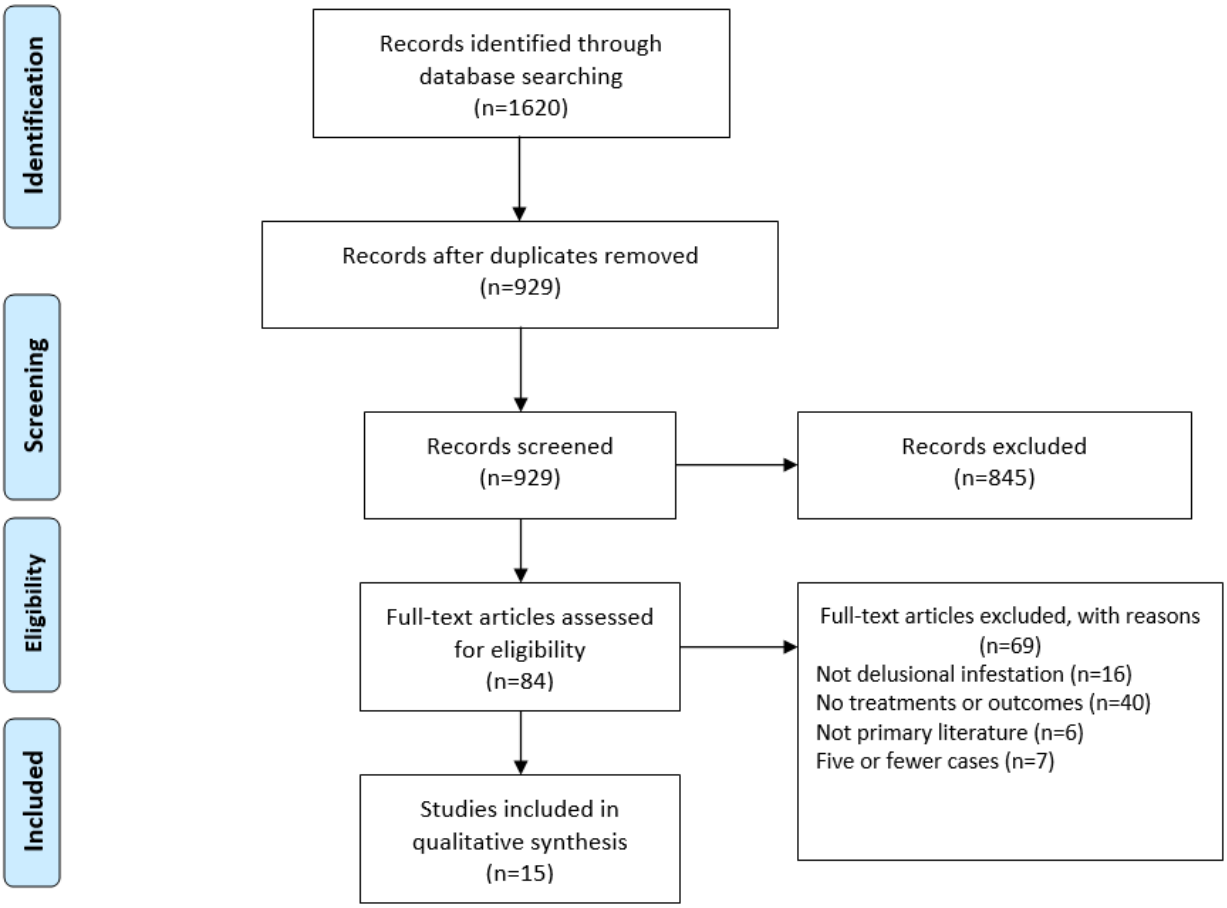
Figure 1. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram for identifying cases of delusional infestation.



Search Strategy and Data Extraction

A systematic search was conducted using Ovid on MEDLINE, Embase, PsycINFO, and the Cochrane Register of Clinical Trials from June 2020. The full search strategy is detailed in Textbox 1. Eligibility for inclusion of articles was established a priori. Articles were included if they (1) were written in English and (2) were original articles that evaluated pharmacological treatments for delusional infestation. Articles were excluded if they (1) were nonoriginal articles (eg, conference abstracts or reviews), (2) evaluated fewer than 5 patients (eg, case reports), or (3) did not evaluate pharmacological treatments. All keywords were searched and mapped onto subject headings where appropriate. References of included studies were screened for inclusion.

Screening of titles and abstracts was independently conducted by 2 reviewers (JDL and RDG) and was followed by a full text review. Discrepancies were resolved through consensus or by consulting the corresponding author (CL).

Variables related to general study data, including article title, journal, authors, year of publication, study design, and the number of cases were collected by 2 independent reviewers (JDL and RDG). Variables related to clinical information were also collected, including mean age, proportion of female patients, reported pathogens, psychiatric family history, co-occurring dermatological conditions, treatments (including placebo), dosage, treatment duration, treatment outcomes (including full remission, partial remission, no response, and nonadherence), and side effect profiles.

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Textbox 1. Search strategy for studies on delusional infestation.

1. Delusional Parasitosis.mp. or Delusional Parasitosis/
2. Morgellons Disease.mp. or Morgellons Disease/
3. Delusional infestation.mp.
4. Dermatozoic delusion.mp.
5. Delusory parasitosis.mp.
6. Delusions of parasitosis.mp.
7. Psychogenic parasitosis.mp.
8. Ekbom syndrome.mp.
9. Dermatophobia.mp.
10. Parasitophobia.mp.
11. Cocaine bugs.mp.
12. Chronic tactile hallucinosis.mp.
13. Acarophobia
14. Monosymptomatic hypochondriacal psychosis
15. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14

Risk of Bias

The quality of the included studies was appraised independently by 2 reviewers (JDL and RDG) with a formal risk of bias assessment. The National Institutes of Health (NIH) quality assessment tool for case series was used to evaluate the risk of bias in the included studies. Disagreements were resolved by consensus and discussion with a third reviewer (SV) as necessary. Eligible studies were excluded if they contained a high risk of bias.

Data Analysis

Data were reported as means, frequency, or proportions as needed. Study characteristics and outcome data were recorded, including the number of treatments and treatment efficacy (based on the categories of complete remission, partial remission, no response, and nonadherence). We assigned individual outcomes to 3 main categories: no response, partial remission (ie, some response), and full remission. Efficacy of treatment was synthesized by dividing the total number of patients with a certain response by the total number receiving treatment [11].

Results

Included Studies

A total of 1620 studies were identified by searching the databases and additional references (Textbox 1); 691 articles were duplicates, leaving 929 studies for title and abstract screening. After screening, 84 articles underwent full-text review. Next, 69 articles were excluded due to not involving delusional infestation (n=16), not reporting treatments or outcomes (n=40), not being primary literature (n=6), and having fewer than 5 cases (n=7). A total of 15 articles met the inclusion criteria and were included in the systematic review (Table 1) [13-27]. Most of the available studies had low methodological quality due to small sample sizes or having an uncontrolled or retrospective design, so a meta-analysis was not conducted.

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Table 1. Demographics and characteristics of included studies of primary delusional infestation.

	Author, year	Size	Mean age (years)	Sex (% female, n/N)	Reported pathogens	Psychiatric history	Co-occurring dermatological conditions	Comorbid conditions	Treatments	Side effects of treatments
1	Frithz, 1979 [13]	15	58.2	93% (14/15)	Parasites	None	__[a]	—	Fluphenazine, flupentixol	Extrapyramidal symptoms in half of patients, relieved with orphenadrine hydrochloride.
2	Sheppard et al, 1986 [14]	8	55.4	38% (3/8)	Lice, fleas, insects	Depression (n=1), social isolation (n=1)	Pruritus vulvae (n=1)	—	Pimozide	—
3	Srinivasa et al, 1994 [15]	19	40.4	63% (12/19)	—	—	—	—	Trifluoperazine,chlorpromazine, haloperidol	—
4	Räsänen et al, 1997 [16]	6	74.5	100% (6/6)	Fleas, insects, worms, lice	Insomnia (n=2), depression (n=2), anxiety (n=2), social isolation (n=1)	—	None	Perphenazine, haloperidol, melperone, citalopram, zuclopenthixol, sertraline	None
5	Zanol et al, 1998 [17]	20	40	55% (11/20)	Parasites	—	Ichthyosis vulgaris (n=1), scabies, body lice, crab lice (n=6)	T2DM[b] (n=2), renal failure (n=1), chronic hepatitis C infection (n=1)	Pimozide, alprazolam, doxepin, ativan, imipramine, haloperidol	—
6	Bhatia et al, 2000 [18]	52	54.5	64% (33/52)	Insects (n=23, 44%)	Adjustment disorder (n=1), trichotillomania (n=3), dementia (n=5), depression (n=4)	—	T2DM (n=2), leprosy (n=5)	Imozide, fluoxetine, amitriptyline	—
7	Zomer et al, 2002 [19]	18	56.9	61% (11/18)	Pests or fleas	—	—	—	Pimozide	—
8	Nicolato et al, 2006 [20]	10	72.4	70% (7/10)	Parasites	Depression (n=2), dementia, (n=2), schizophrenia (n=1)	—	T2DM (n=2), hypertension (n=2), thyroid disease (n=3), COPD[c] (n=1), heart failure (n=2)	Risperidone, haloperidol, olanzapine, pimozide, quetiapine, rivastigmine	—
9	Ahmad and Ramsay, 2009 [21]	10	41.9	60% (6/10)	Insects, bugs, viruses, mites, black things	Depression (n=4)	History of scabies (n=7)	—	Pimozide, sulpiride	—
10	KenchaiaH et al, 2009 [22]	20	49.8	—	—	—	—	—	Haloperidol, risperidone olanzapine, fluoxetine, sertraline, imipramine	—
11	Coşar et al, 2012 [23]	10	61.7	80% (8/10)	—	—	—	Hypertension (n=4), COPD (n=2)	Pimozide, olanzapine, risperidone	—

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	Author, year	Size	Mean age (years)	Sex (% female, n/N)	Reported pathogens	Psychiatric history	Co-occurring dermatological conditions	Comorbid conditions	Treatments	Side effects of treatments
12	Bhatia et al, 2013 [24]	50	—	66% (33/50)	Insects (n=28, 56%)	Depression (n=5), dementia (n=2), trichotillomania (n=4)	Alopecia (n=3)	T2DM (n=2), leprosy (n=3)	Risperidone, olanzapine, amisulpride, quetiapine, aripiprazole, paliperidone, iloperidone, fluoxetine	—
13	MohandaS et al, 2017 [25]	28	54.6	71% (20/28)	Fibers, fungi, dust, bugs, grains, black dots, parasites	Depression (n=12), anxiety (n=7)	—	—	Risperidone, olanzapine	Olanzapine-induced weight gain (n=2)
14	Çınar et al, 2019 [26]	8	57.5	38% (3/8)	—	—	—	Hypertension (n=4)	Aripiprazole	None
15	Jerrom et al, 2019 [27]	6	—	50% (3/6)	Black bits, fibers	Anxiety and depression (n=2), PTSD (n=1)	—	None	Risperidone, aripiprazole	None

[a]Em dashes indicate “not reported.”

[b]T2DM: type 2 diabetes.

[c]COPD: chronic obstructive pulmonary disease.

Risk of Bias

The risk of bias assessment is presented in Table 2. Overall, the studies had a low risk of bias based on the NIH quality assessment tool. Out of the 15 included studies, 13 were rated “good” overall and 2 were rated “fair” based on the 9 criteria.

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Table 2. Risk of bias assessment using the National Institutes of Health quality assessment tool for case series studies.

Study	Author, year	Criteria									
		1. Was the study question or objective clearly stated?	2. Was the study population clearly and fully described, including a case definition?	3. Were the cases consecutive?	4. Were the subjects comparable?	5. Was the intervention clearly described?	6. Were the outcome measures clearly defined, valid, reliable, and implemented consistently across all study participants?	7. Was the length of follow-up adequate?	8. Were the statistical methods well-described?	9. Were the results well-described?	Overall rating (good, fair, poor)
1	Frithz, 1979 [13]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Good
2	Sheppard et al, 1986 [14]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Good
3	Srinivasa N et al, 1994 [15]	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Good
4	Räsänen et al, 1997 [16]	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Fair
5	Zanol et al, 1998 [17]	Yes	Yes	—[a]	Yes	Yes	Yes	Yes	—	Yes	Fair
6	Bhatia et al, 2000 [18]	Yes	Yes	Yes	Yes	Yes	Yes	—	Yes	Yes	Good
7	Zomer et al, 2002 [19]	Yes	Yes	Yes	Yes	Yes	Yes	—	Yes	Yes	Good
8	Nicolato et al, 2006 [20]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Good
9	Ahmad and Ramsay, 2009 [21]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Good
10	Kenchaia H et al, 2009 [22]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Good
11	Coşar et al, 2012 [23]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Good
12	Bhatia et al, 2013 [24]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Good
13	Mohandas et al, 2017 [25]	Yes	Yes	Yes	Yes	Yes	Yes	—	Yes	Yes	Good
14	Çınar et al, 2019 [26]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Good
15	Jerrom et al, 2019 [27]	Yes	Yes	Yes	Yes	Yes	Yes	—	Yes	Yes	Good

[a]Em dashes indicate "not applicable."

Study Characteristics

The 15 articles identified were all case series and included an overall total of 280 patients with primary delusional infestation. The mean age was 53.3 years and the patients were preponderantly female (170/260, 65.4%) (Table 1). The most commonly reported pathogens were insects, parasites, black specks, lice, and fibers. Across all 15 articles, psychiatric history was unreported in almost half of the studies (7/15, 47%); however, in articles that did report psychiatric history, anxiety had the highest reported rate (11/40, 27%), followed by depression (32/162, 19.8%), insomnia (2/6, 33%), posttraumatic stress disorder (1/6, 16%), social isolation (2/14, 14%), schizophrenia (1/10, 10%), dementia (9/112, 8.0%), and trichotillomania (7/102, 6.9%). A history of scabies or lice was noted in 43% (13/30) of patients. Family history and comorbidities were generally not reported. Pharmacological treatments included 2 antidepressants (fluoxetine and

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citalopram), 8 FGAs (pimozide, haloperidol, fluphenazine depot, trifluoperazine, flupentixol depot, chlorpromazine, perphenazine, and zuclopenthixol), and 9 SGAs (risperidone, olanzapine, aripiprazole, quetiapine, amisulpride, paliperidone, iloperidone, melperone, and sulpiride). Side effects of the treatments were generally not reported, with the exception of fluphenazine- and flupentixol-induced extrapyramidal symptoms in 7 patients, which was relieved with orphenadrine hydrochloride, reported in the paper by Frithz [13], and olanzapine-induced weight gain in 2 patients in the report by Mohandas et al [25].

Efficacy of FGAs

A summary of the pharmacological treatments for primary delusional infestation is outlined in Table 3. The 3 main classes of drugs were selective serotonin reuptake inhibitors (SSRIs) (n=2), FGAs (n=8), and SGAs (n=9). Across the 15 studies, 8 kinds of FGA were used by a total of 117 patients. The treatment duration ranged from 0.75 to 14 months and 47.9% (56/117) of patients achieved complete remission, 35% (41/117) achieved partial remission, and 17.1% (20/117) had no response or were nonadherent. Pimozide, haloperidol, and fluphenazine depot were the most common FGAs prescribed. A total of 80 patients received pimozide, with a dose ranging from 2 to 8 mg/d; 44% (35/80) achieved complete remission, while 34% (27/80) achieved partial remission and 23% (18/80) had no response. Haloperidol (dosage: 1 to 10 mg) led to 60% (6/10) complete remission and 40% (4/10) partial remission and fluphenazine depot (dosage: 7.5 to 25 mg/d) resulted in 70% (7/10) complete remission and 30% (3/10) partial remission, but both drugs were limited to a small sample size of 10 patients. The remaining FGAs were each used to treat fewer than 10 patients and included trifluoperazine, flupentixol depot, chlorpromazine, perphenazine, and zuclopenthixol (Table 3).

Table 3. Summary of pharmacological treatments for primary delusional infestation.

Drug	Dose (mg/d)	Total number of patients, N	Duration, months	Outcomes			
				Complete remission, n (%)	Partial remission, n (%)	No response, n (%)	Nonadherence, n (%)
First-generation antipsychotics (n=8)							
Total	—[a]	117	0.75-14	56 (47.9)	41 (35.0)	20 (17.1)	0 (0)
Pimozide	2-8	80	3-14	35 (44)	27 (34)	18 (23)	0 (0)
Haloperidol	1-10	10	0.75-14	6 (60)	4 (40)	0 (0)	0 (0)
Fluphenazine depot	7.5-25	10	3-12	7 (70)	3 (30)	0 (0)	0 (0)
Trifluoperazine	10, 15	6	0.75-2	3 (50)	2 (33)	1 (17)	0 (0)
Flupentixol depot	2-20	5	3-12	4 (80)	0 (0)	1 (20)	0 (0)
Chlorpromazine	150, 300	3	0.75-2	0 (0)	3 (100)	0 (0)	0 (0)
Perphenazine	4,12	2	—	1 (50)	1 (50)	0 (0)	0 (0)
Zuclopenthixol	6	1	—	0 (0)	1 (100)	0 (0)	0 (0)
Second-generation antipsychotics (n=9)							
Total	—	103	3-24	56 (54.4)	36 (35.0)	8 (7.8)	3 (2.9)
Risperidone	0.5-4	44	3-24	19 (43)	18 (41)	5 (11)	2 (5)
Olanzapine	2.5-10	22	3-24	12 (55)	9 (41)	1 (5)	0 (0)
Aripiprazole	10-15	14	3-24	11 (79)	2 (14)	0 (0)	1 (7)
Quetiapine	100, 400	7	6-24	4 (57)	3 (43)	0 (0)	0 (0)
Amisulpride	—	7	6-24	3 (43)	3 (43)	1 (14)	0 (0)
Paliperidone	—	5	6-24	4 (80)	1 (20)	0 (0)	0 (0)
Iloperidone	—	2	6-24	2 (100)	0 (0)	0 (0)	0 (0)
Melperone	50	1	—	1 (100)	0 (0)	0 (0)	0 (0)
Sulpiride	—	1	—	0 (0)	0 (0)	1 (100)	0 (0)
Selective serotonin reuptake inhibitors (n=2)							
Total	—	21	6-24	12 (57)	9 (43)	0 (0)	0 (0)
Fluoxetine	20	11	6-24	9 (82)	2 (18)	0 (0)	0 (0)
Citalopram	—	10	—	3 (30)	7 (70)	0 (0)	0 (0)

[a]Em dashes indicate “not reported”.

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Efficacy of SGAs

Overall, 9 kinds of SGA were used by 103 patients. The treatment duration ranged from 3 to 24 months, and 54.4% (56/103) of patients achieved complete remission, 35% (36/103) achieved partial remission, and 10.7% (11/103) had no response or were nonadherent (Table 3). The most common SGAs prescribed were risperidone, olanzapine, and aripiprazole. Of 43 patients on risperidone (dosage: 0.5 to 4 mg/d), 43% (19/44) achieved complete remission, 41% (18/44) achieved partial remission, and 16% (7/44) had no response. Of 22 patients on olanzapine (dosage: 2.5 to 10 mg/d), 55% (12/22) achieved complete remission, 41% (9/22) achieved partial remission, and 5% (1/22) had no response. Of 14 patients on aripiprazole (dosage: 10 to 15 mg/d), 79% (11/14) achieved complete remission, 14% (2/14) achieved partial remission, and 7% (1/14) were nonadherent. The remaining 6 SGAs were each used to treat fewer than 10 patients and included quetiapine, amisulpride, paliperidone, iloperidone, melperone, and sulpiride (Table 3).

Efficacy of SSRIs

Overall, 2 kinds of SSRI were used. Fluoxetine was used by 11 patients and citalopram was used by 10 patients. These SSRIs were used to treat comorbid depression, anxiety, and trichotillomania. Trichotillomania might also have been a secondary delusional infestation, although this was not specified in these studies. Treatments were effective, with an overall 57% (12/21) complete remission rate and 43% (9/21) partial remission rate (Table 3). Fluoxetine appeared to be more efficacious, with 82% (9/21) complete remission and 18% (2/21) partial remission, compared to citalopram with 30% (3/10) complete remission and 70% (7/10) partial remission.

Discussion

Principal Findings

We conducted a systematic review of studies on pharmacological treatments for primary delusional infestation. Psychiatric history was unreported by almost half the studies, but of the remaining studies, the most commonly reported psychiatric disorders were anxiety (11/40, 28%) and depression (32/162, 20%). The efficacy of the drug classes used in the studies varied; 57.1% (12/21) of patients who received SSRIs had complete remission and 42.9% (9/21) had partial remission, 54.4% (56/103) of patients who received SGAs had complete remission, 35% (36/103) had partial remission, and in 10.7% (11/103) of patients, the treatment was not effective, due to either nonresponse or nonadherence. Among patients (n=117) who received FGAs, 47.9% (56/117) had complete remission, 35% (41/117) had partial remission, and the treatment was not effective in 17.1% (20/117) of patients.

Although antipsychotics are the mainstay in the treatment of primary delusional infestation, no antipsychotics are approved for this use and there is no strong evidence suggesting that the use of any specific antipsychotic is more effective than any other [10,28,29]. We compared FGAs and SGAs and found that patients using SGAs had higher rates of complete remission and lower rates of noneffectiveness than patients using FGAs. A 2020 systematic review by McPhie and Kirchhof [12] similarly concluded there was no strong evidence to recommend any one antipsychotic over another, due to a low quality of evidence and study variability.

While the efficacy of both FGAs and SGAs is comparable, these agents vary in their side effect profiles. FGAs are known to produce extrapyramidal side effects, including parkinsonism, acute dystonia, akathisia, and tardive dyskinesia. While some of these side effects may be controlled with additional pharmacotherapy, extrapyramidal side effects can decrease quality of life, decrease compliance, lead to polypharmacy, and may even be permanent (eg, tardive dyskinesia) [30]. By contrast, SGAs generally have a lower incidence of extrapyramidal side effects, but their efficacy and side effect profiles vary widely based on the specific agent [31-33]. Given the higher rates of complete remission and lower rates of noneffectiveness that we found for SGAs compared to FGAs in this study, as well as the more variable side effect profiles of SGAs, SGAs may be more beneficial in the treatment of primary delusional infestation. However, all the studies included were case series, and in the absence of higher levels of evidence, such as that provided by randomized controlled trials, we can only draw conclusions and make recommendations with caution. Further studies should be conducted.

Risperidone is the most widely studied SGA, followed by olanzapine [12]. Although olanzapine had a higher complete remission rate and lower noneffectiveness rate compared to risperidone in our study, olanzapine is known to have a higher incidence of metabolic side effects, such as weight gain, relative to other SGAs [34]. Interestingly, we found that aripiprazole had the highest complete remission rate (11/14, 79%) compared to both risperidone (19/44, 43%) and olanzapine (12/22, 55%). Furthermore, aripiprazole is known to have a lower rate of metabolic side effects than other SGAs [35] and has the additional advantage of acting as a partial dopamine agonist [36], making it a useful adjunct in the treatment of depression, which is a common comorbidity in patients with delusional infestation. While these results are promising for the use of aripiprazole in delusional infestation, further studies are required before its use can be widely recommended.

Interestingly, the majority of patients treated with SSRIs had complete remission of delusional infestation, although this was limited to a sample size of 21 patients with comorbid depression, anxiety, or trichotillomania in 3 studies [18,24,25]. These patients were managed with fluoxetine or citalopram. This suggests that clinicians should obtain a full psychiatric history of patients with delusional infestation to identify underlying mood and anxiety disorders that might respond to SSRIs, thereby improving the management of this challenging illness.

Limitations

Due to the rarity of delusional infestation, there is a lack of clinical trials and cohort studies, and our analysis included only case series studies, all of which used subjective measures of treatment efficacy. In addition, we only assessed outcomes as complete remission, partial remission, no response, or nonadherence. Furthermore, it was challenging to separate

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patients with primary and secondary delusional infestation, because some studies combined analyses.

Conclusion

Delusional infestation is a rare and challenging illness to treat. While antipsychotics are considered the mainstay treatment for primary delusional infestation, we found that SGAs, such as aripiprazole and risperidone, as well as SSRIs, led to higher rates of full remission than FGAs, such as haloperidol and pimozide. We recommend that clinicians take a detailed psychiatric history of patients with delusional infestation, as comorbid depression, anxiety, and trichotillomania may be better managed with SSRIs. Larger studies, such as randomized controlled trials, are required to better evaluate the effectiveness of SSRIs, FGAs, and SGAs for the treatment of delusional infestation.

Conflicts of Interest

CWL has been a speaker or consultant to AbbVie, Altius, Amgen, Aralez, Arcutis, Bausch Health, Bayer, Boehringer Ingelheim, Bristol Myers Squibb, Celgene, Cipher, Dermavant, Eli Lilly, Fresnius Kabi, GSK, Innovaderm, Intega Skin, Janssen, Kyowa, La Roche Posay, LEO Pharma, L'Oreal, Medexus, Merck, Proctor & Gamble, Pediapharm, Regeneron, Roche, Sanofi Genzyme, Sentrex, Teva, Tribute, UCB, Valeant, and Viatris. CWL has been a principal investigator for AbbVie, Amgen, Aralez, Arcutis, Bausch Health, Bayer, Boehringer Ingelheim, Bristol Myers Squibb, Celgene, Cipher, Dermavant, Eli Lilly, GSK, Innovaderm, Janssen, Kyowa, LEO Pharma, L'Oreal, Merck, Pediapharm, Regeneron, Roche, Sanofi Genzyme, Tribute, UCB, and Valeant. PF has received honorarium or consulting or advisory boards or speaking fees for AbbVie, Altius, Amgen, Aralez, Bausch Health, Cipher, Galderma, Eli Lilly, L'Oreal, UCB, Janssen, Medexus Pharmaceuticals, Novartis, Pfizer, and Sanofi-Genzyme. JDL, RDG, and SV declare no conflicts of interest.

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Abbreviations

FGA: first-generation antipsychotic
NIH: National Institutes of Health
SGA: second-generation antipsychotic
SSRI: selective serotonin reuptake inhibitor

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Edited by R Dellavalle; submitted 18.10.21; peer-reviewed by L Iglesias, P Lepping; comments to author 19.11.21; revised version received 24.01.22; accepted 30.01.22; published 30.03.22.

Please cite as:
Lu JD, Gotesman RD, Varghese S, Fleming P, Lynde CW
Treatments for Primary Delusional Infestation: Systematic Review
JMIR Dermatol 2022;5(1):e34323
URL: https://derma.jmir.org/2022/1/e34323
doi:10.2196/34323
PMID:

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Research Letter

From the Cochrane Library: Interventions for Necrotizing Soft Tissue Infections in Adults

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(JMIR Dermatol 2022;5(1):e34578) doi:10.2196/34578

KEYWORDS

necrotizing soft tissue infections; therapy; intervention; systematic review; infections; management; evidence-based medicine; dermatology; skin infection

Necrotizing soft tissue infections (NSTIs) refer to severe life-threatening bacterial infections involving the dermis, subcutaneous tissue, fascia, or muscle. NSTIs can lead to serious morbidities and mortality. Diagnosis can be challenging, and a high index of suspicion is required. Useful clues include pain out of proportion to skin findings, manifestations of systemic toxicity, and lack of response to systemic antibiotics. While crepitus, hemorrhagic bullae, skin necrosis, skin anesthesia, and symptoms of sepsis are typical of NSTIs, confirming the diagnosis requires surgical exploration [1].

Management entails early surgical debridement coupled with empiric broad-spectrum intravenous antibiotics against both aerobic and anaerobic organisms in addition to intensive care support. Tissue hypoxia and necrosis induced by NSTIs limit the efficacy of systemic antibiotics, rendering surgical debridement the mainstay treatment [1].

A Cochrane review [1] investigated available interventions for NSTIs. The inclusion criteria specified randomized controlled trials of medical or surgical interventions in hospital settings for adults with NSTIs. Adjunctive hyperbaric oxygen therapy was addressed in a prior Cochrane review [2]. The primary outcome measures were mortality within 30 days and occurrence of serious adverse events, whereas the secondary outcomes were survival time as well as long‐term morbidity assessed via the Functional Impairment Scale [1].

The authors identified 3 trials comprising 197 participants (n=117, 62% men) with a mean age of 55 years. In all trials, patients received the standard of care (ie, surgical debridement, empiric antibiotics, and intensive care support). The used empiric antibiotics were vancomycin, clindamycin, ciprofloxacin, and piperacillin-tazobactam [1]. One trial compared 2 antibiotic treatments, moxifloxacin 400 mg once daily and amoxicillin‐clavulanate 3 g three times daily for at least 3 days, followed by 1.5 g three times daily [3]. Another trial evaluated the novel drug AB103, studied also for sepsis, which impairs T-cell activation by blocking the binding of superantigen exotoxins to the CD28 receptor on T‐helper1 lymphocytes [4]. Two doses (0.5 mg/kg and 0.25 mg/kg) were investigated against the placebo. The third trial assessed intravenous immunoglobulin at a dose of 25 g/day, given for 3 consecutive days, versus a placebo [5].

In all trials, no difference was detected between groups regarding the primary outcome measures. The quality of evidence was assessed as low to very low; this implies uncertainty in these results. Adverse events, secondary outcomes, and median survival times are summarized in Table 1. None of the trials assessed long-term morbidity as defined in the review protocol [1].

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Table 1. A summary of trials included in the Cochrane review [1].

Characteristic	Trials		
	MXF[a] vs AM-CL[b], Vick-Fragoso et al [3]	AB103 vs placebo, Bulger et al [4]	IVIG[c] vs placebo, Madsen et al [5]
Groups	1. MXF 400 mg once daily 2. AM-CL 3 g three times daily for at least 3 days followed by 1.5 g three times daily	1. AB103 0.5 mg/kg 2. AB103 0.25 mg/kg 3. Placebo Single intravenous dose within 6 hours after diagnosis	1. IVIG 25 g/day for 3 consecutive days 2. Placebo
Participants, n	54 (MXF group: n=36; AM-CL group: n=18)	43 (AB103 group: n=32; placebo group: n=11)	100 (IVIG group: n=50; placebo group: n=50)
Overall risk of bias	High (attrition, imbalance, performance, detection)	Moderate (attrition)	High (attrition, imbalance)
Primary outcomes			
Mortality within 30 days	No difference (RR[d] 3.00, 95% CI 0.39-23.0)	No difference (RR 0.34, 95% CI 0.05-2.16)	No difference (RR 1.17, 95% CI 0.42-3.23)
Certainty of evidence	Very low	Very low	Low
Proportion of patients who experienced serious adverse events	Not specified; no difference (RR 0.63, 95% CI 0.30-1.31)	Not specified; no difference (RR 1.49, 95% CI 0.52-4.27)	Acute kidney injury, allergic reactions, aseptic meningitis, hemolytic anemia, thrombi, and infections; no difference (RR 0.73, CI 95% 0.32-1.65)
Certainty of evidence	Very low	Very low	Low
Secondary outcomes			
Survival time (median time of death)	Shorter in the MXF group (10.5 days vs 42 days); no statistical analysis was possible	Not specified	Shorter in the IVIG group (25 days vs 49 days); no statistical analysis was possible
Assessment of long - term morbidity	Not specified	Not specified	No difference in the median physical component summary scores between groups (mean adjusted difference 1, 95% CI 7-10; *P*=.81)

[a]MXF: moxifloxacin.

[b]AM-CL: amoxicillin - clavulanate.

[c]IVIG intravenous immunoglobulin.

[d]RR risk ratio.

The quality of the evidence was negatively impacted by attrition bias, indirectness due to the lack of a definition of NSTIs, small sample size, and underpowered analysis. The lack of high-quality evidence for this serious condition necessitates the need for larger, well-designed studies. A recent randomized controlled trial evaluated the efficacy of AB103 0.5 mg/kg versus placebo when administered within 6 hours of NSTI diagnosis [6]. No significant improvement was found in the primary composite endpoint (28-day mortality, number of debridements, amputations after the first operation, and resolution of organ dysfunction) in intention to treat whereas there was in the per-protocol population [6]. Given the rarity of NSTIs and their complex diagnosis and management, prospective registries are encouraged to provide evidence for effective therapeutic approaches to improve morbidity and mortality.

Conflicts of Interest

BLA has served as a research investigator and/or scientific advisor to AbbVie and Skin Research Institute, LLC.

Editorial notice

The views expressed in this paper are those of the authors and in no way represent the Cochrane Library or Wiley.

This article is based on a Cochrane Review previously published in the Cochrane Database of Systematic Reviews 2018, Issue 5, DOI:10.1002/14651858.CD011680.pub2 (see www.cochranelibrary.com for information). Cochrane Reviews are regularly

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updated as new evidence emerges and in response to feedback, and Cochrane Database of Systematic Reviews should be consulted for the most recent version of the review.

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Abbreviations

NSTI: necrotizing soft tissue infection

Edited by R Dellavalle, T Sivesind; submitted 29.10.21; peer-reviewed by A Oganesyan, F Kaliyadan; comments to author 22.11.21; revised version received 26.11.21; accepted 28.11.21; published 21.01.22.

Please cite as:
Shakshouk H, Hua C, Adler BL, Ortega-Loayza AG
From the Cochrane Library: Interventions for Necrotizing Soft Tissue Infections in Adults
JMIR Dermatol 2022;5(1):e34578
URL: https://derma.jmir.org/2022/1/e34578
doi:10.2196/34578
PMID:

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Research Letter

From the Cochrane Library: Interventions for Hidradenitis Suppurativa

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(JMIR Dermatol 2022;5(1):e29966) doi:10.2196/29966

KEYWORDS

hidradenitis suppurativa; quality of life; outcome measures; heterogenetity in HS research; dermatology; comorbidities; treatment interventions; review

Hidradenitis suppurativa (HS) is a debilitating chronic inflammatory skin disorder with an estimated worldwide prevalence of 0.03% to 4% [1]. HS is strongly associated with metabolic and chronic inflammatory comorbidities [2], and there is increasing evidence demonstrating a link between HS and psychiatric comorbidities [2]. Psychiatric disorders are known to strongly affect patients' quality of life [2]. Despite the various treatment interventions—from oral antibiotics to systemic agents such as biologics—therapeutic management of HS continues to be a challenge, highlighting the need to incorporate an evidence-based review of the interventions available. A 2015 Cochrane review [3] and its 2017 updated version [4] offered a comprehensive overview of the evidence regarding treatment interventions of HS and the impact on patients through the use of a validated instrument, Dermatology Life Quality Index (DLQI). In this synopsis, we provide a summary integrating evidence derived from the original review (2015), along with its updated and abridged 2017 version [3,4].

A total of 12 randomized controlled trials (RCTs; n=612; mean trial period 16 weeks) met the authors' inclusion criteria, with the primary outcomes being DLQI and adverse events (AEs). Of 12 RCTs, 4 (33%) evaluated efficacy of anti–tumor necrosis factor (TNF) alpha (anti–TNF-α) agents, 1 (8.3%) assessed surgical intervention, and 3 (25%) discussed the efficacy of topical and oral medications; the remaining 4 (33%) studies explored utility of intense pulsed light (IPL), neodymium-doped yttrium aluminum garnet (Nd:YAG) laser, methylene blue topical gel photodynamic therapy, and staphage lysate. The quality of evidence was based on the *Grading of Recommendations, Assessment, Development and Evaluation* (*GRADE*) framework; the level of certainty for each included intervention is summarized in Table 1.

The level of certainty for infliximab (IFX), weekly adalimumab, and etanercept is moderate, while the level of certainty for biweekly adalimumab is high [3,4]. With regard to primary outcomes, all studies discussed, in varying degrees of detail, AEs—notably, AEs were difficult to assess in the included studies due to small numbers of participants and short study time frames. One study participant receiving biologic therapy with IFX experienced hypertension requiring hospitalization. Only 5 articles, which evaluated the efficacy of anti-TNF-α, provided DLQI results [3,4]. Among the remaining 8 studies [3], various scoring instruments (Participant/Physician Global Assessment, pain score, hidradenitis severity score, duration of remission) were used and were categorized by the authors as secondary outcomes.

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Table 1. Quality of evidence for the included trials.

Trial intervention	Quality of evidence
Anti–TNF[a]-α (biweekly adalimumab, etanercept, infliximab) vs placebo	Moderate quality
Weekly adalimumab	High quality
Gentamicin sponge prior to closure vs primary closure alone	Moderate quality
Oral ethinylestradiol/oral norgestrel vs oral ethinylestradiol/cyproterone acetate	Moderate quality
IPL[b] laser vs no treatment	Low quality
Nd:YAG[c] laser vs topical control	Very low quality
Niosomal methylene blue gel PDT[d] vs free methylene blue gel PDT	Low quality
Staphage lysate[e] vs placebo broth	Moderate quality

[a]TNF: tumor necrosis factor.

[b]IPL: intense pulsed light.

[c]Nd:YAG: neodymium-doped yttrium aluminum garnet.

[d]PDT: photodynamic therapy.

[e]Although there was moderate evidence for the use of staphage lysate, this form of intervention is not routinely available.

Weekly adalimumab (ADA) 40 mg appeared effective for the treatment of moderate-severe HS [2,3]. Compared to placebo, ADA resulted in a statistically significant improvement of DLQI. Although each study evaluating weekly ADA resulted in a significant improvement in DLQI of at least 5 points, the difference in DLQI score between those treated with ADA group versus placebo was only 2.8 (95% CI 3.67-1.95) [3]. As such, the improvement may not be clinically relevant, given that the minimal clinically important difference (MCID) of the DLQI is an improvement of 4 points from baseline. However, it is important to note that DLQI is not specific to HS, and the use of newly developed and validated HS-specific quality of life (QoL) instruments (eg, HiSQOL) may be better suited to capture changes in QoL among patients with HS.

Similar to weekly ADA, a single RCT evaluating the efficacy of 5 mg/kg IFX demonstrated a significant improvement in DLQI (8.4 points) compared to placebo (*P*=.03). Although these results are promising, they should be interpreted with caution given that the quality of evidence supporting the use of IFX for improving patients' quality of life is "moderate"—meaning that future studies will likely have an impact on the estimated effect. Biweekly ADA and etanercept 50 mg failed to improve DLQI among treated patients. Anakinra, an interleukin 1 (IL-1) antagonist, resulted in a significant reduction in disease activity score (*P*=.04). However, there was no significant improvement in DLQI (*P*=.08).

With the addition of its 2017 update, this Cochrane review [3,4] demonstrated the high-quality evidence that exists for the use of weekly ADA for the treatment of moderate to severe HS. Recently published data from the PIONEER studies provide further support for the safety and efficacy of weekly ADA [5,6]. Although DLQI was the primary end point in this study, there are limited studies that have explored its validity in HS [7]. As such, there is a need to adopt a validated core outcome set for HS when testing the safety and efficacy of new therapies in RCTs. Nevertheless, this review highlights the limited evidence, primarily due to underpowered studies, that exists for the use of other treatment modalities in patients with HS; thus, additional well-designed RCTs are warranted.

Conflicts of Interest

JI was a local principal investigator for an observational study sponsored by AbbVie prior to the publication of the original Cochrane review. He is Editor-in-Chief of the *British Journal of Dermatology* and is the author of two chapters covering hidradenitis suppurativa for *UpToDate*.

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 *CochraneCouncil*.

VP has received honoraria for speaker and/or advisory board member roles from AbbVie, Celgene, Janssen, Kyowa Kirin Co Ltd, LEO Pharma, Novartis, Pfizer, Sanofi, UCB, and Union Therapeutics. In his role as Department Division Director of Dermatology at the University of Toronto, VP has received departmental support in the form of unrestricted educational grants from AbbVie, Bausch Health, Celgene, Janssen, LEO Pharma, Lilly, L'Oréal, NAOS, Novartis, Pfizer, Pierre-Fabre, Sandoz and Sanofi in the past 36 months.

TS is a Section Editor for *JMIR Dermatology*.

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After the publication of the original Cochrane review, JI has acted as Consultant to UCB Pharma, Novartis, ChemoCentryx, and Boehringer Ingelheim, and attended Advisory Boards for Viela Bio, Kymera Therapeutics, and Insmed. He receives an editorial stipend from the *British Journal of Dermatology* and royalties from *UpToDate*.
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 (PI: RD), and fees for serving as a Medical Advisor and Investigator for Antedotum Inc.

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Edited by G Eysenbach; submitted 26.04.21; peer-reviewed by F Gomez, R Alhusayen, A Finstad; comments to author 21.07.21; revised version received 05.08.21; accepted 29.12.21; published 11.03.22.

Please cite as:
Maghfour J, Sivesind T, Piguet V, Dellavalle R, Ingram JR
From the Cochrane Library: Interventions for Hidradenitis Suppurativa
JMIR Dermatol 2022;5(1):e29966
URL: https://derma.jmir.org/2022/1/e29966
doi:10.2196/29966
PMID:

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Research Letter

Mortality Outcomes in Dermatology: An Exploration of Core Outcome Sets and Cochrane Skin Systematic Reviews

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(JMIR Dermatol 2022;5(1):e34140) doi:10.2196/34140

KEYWORDS

mortality; death; systematic reviews; outcomes; dermatology; Cochrane

Cochrane has been a trusted proponent of evidence-based medicine for over 20 years. Its dermatology-specific editorial team (Cochrane Skin Review Group) is the pre-eminent source of systematic reviews in dermatology [1]. Explicit standardized Cochrane review methods can minimize bias and maximize the reliability of reported outcomes, establishing benchmarks for decision-making. Mortality is one outcome where pronounced heterogeneity in reporting may affect its utility in clinical research. We therefore explored mortality outcome expression and execution in the Cochrane Skin portfolio and concurrently analyzed mortality in core outcome sets (outcomes that, at a minimum, should be measured in clinical trials) by searching dermatology studies registered in the COMET (Core Outcome Measures in Effectiveness Trials) database [2]. COMET contains text from core outcome sets publications, from which we extracted core outcomes and classified these according to the taxonomy developed by Dodd et al [3] for validated standardized annotation.

All Cochrane Skin Group reviews as of March 2021 were included and exported from the Cochrane Database of Systematic Reviews [1], allowing descriptive analysis and characterization of mortality reporting by category of mortality terminology (all-cause, cause-specific, infant/maternal, survival). All COMET database core outcome sets classified in the published "skin" research category as of August 23, 2021, were reviewed for reporting of mortality outcomes and categorized according to the mortality terminology previously described. Core outcomes specified in terms of "death" were included in the all-cause mortality category.

Of the 113 Cochrane Skin dermatology reviews, 13 reported mortalities as an outcome measure: 10 all-cause, 2 cause-specific, 5 survival, and 1 infant/maternal (Table 1).

Four reviews (4/13) reported more than one mortality outcome. More than one-third of the total reviews (5/13) were melanoma-related. Reviews of other dermatologic conditions reporting mortality included cutaneous squamous cell carcinoma (cSCC), nonmelanoma skin cancer, pemphigus vulgaris, pemphigus foliaceus, bullous pemphigoid, toxic epidermal necrolysis (TEN), necrotizing fasciitis, drug-induced skin rash, and topical steroids used during pregnancy. The time frame of mortality outcome reporting ranged widely, from 10 days to 10 years, but generally correlated appropriately with the condition (eg, 30 days for TEN capturing acute onset and progression vs 10-year survival for melanoma).

COMET database searches revealed 13 core outcome set studies of 13 skin conditions (Table 2); only 2 (15%) included mortality as a core outcome (survival for head and neck lymphatic malformations, death from cSCC).

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Table 1. Mortality reporting in Cochrane Skin Systematic Reviews as of March 2021.

Condition	Cochrane Systematic Review title	Authors	Year	DOI	PMID	Type of mortality reported	Time frame of mortality reporting
Toxic epidermal necrolysis	Interventions for Toxic Epidermal Necrolysis	Majumdar S, Mockenhaupt M, Roujeau J, Townshend A	2002	10.1002/14651858.CD001435	12519556	All-cause mortality	30-day follow-up time
Melanoma	Statins and Fibrates for Preventing Melanoma	Dellavalle RP, Drake A, Graber M, Heilig LF, Hester EJ, Johnson KR, McNealy K, Schilling L	2005	10.1002/14651858.CD003697.pub2	16235336	Disease-specific	≥7 years post-RCT[a]
Nonmelanoma skin cancers	Interventions for Preventing Nonmelanoma Skin Cancers in High-Risk Groups	Bath-Hextall F, Leonardi-Bee J, Somchand N, Webster A, Delitt J, Perkins W	2007	10.1002/14651858.CD005414.pub2	17943854	All-cause mortality	End of trial follow-up (1 year to 5 years for included RCTs)
Pemphigus vulgaris and pemphigus foliaceus	Interventions for Pemphigus Vulgaris and Pemphigus Foliaceus	Martin LK, Agero AL, Werth V, Villanueva E, Segall J, Murrell DF	2009	10.1002/14651858.CD006263.pub2	19160272	All-cause mortality	Variable, deaths only reported from 1 RCT over 4 weeks
Melanoma	Surgical Excision Margins for Primary Cutaneous Melanoma	Sladden MJ, Balch C, Barzilai DA, Berg D, Freiman A, Handiside T, Hollis S, Lens MB, Thompson JF	2009	10.1002/14651858.CD004835.pub2	19821334	All-cause mortality, survival, recurrence-free survival	5- and 10-year survival
Bullous pemphigoid	Interventions for Bullous Pemphigoid	Kirtschig G, Middleton P, Bennett C, Murrell DF, Wojnarowska F, Khumalo NP	2010	10.1002/14651858.CD002292.pub3	20927731	All-cause mortality	51 days (1 RCT), 10 days (1 RCT), 6 months and 3 years (1 RCT)
Cutaneous squamous cell carcinoma	Interventions for Nonmetastatic Squamous Cell Carcinoma of the Skin	Lansbury L, Leonardi-Bee J, Perkins W, Goodacre T, Tweed JA, Bath-Hextall FJ	2010	10.1002/14651858.CD007869.pub2	20393962	All-cause mortality	2 years
Melanoma	Interferon Alpha for the Adjuvant Treatment of Cutaneous Melanoma	Mocellin S, Lens MB, Pasquali S, Pilati P, Chiarion Sileni V	2013	10.1002/14651858.CD008955.pub2	23775773	Death, disease-free survival, overall survival	5 years
Melanoma	Sentinel Lymph Node Biopsy Followed by Lymph Node Dissection for Localized Primary Cutaneous Melanoma	Kyrgidis A, Tzellos T, Mocellin S, Apalla Z, Lallas A, Pilati P, Stratigos A	2015	10.1002/14651858.CD010307.pub2	25978975	All-cause mortality, disease-specific, disease-free survival	10 years

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Condition	Cochrane Systematic Review title	Authors	Year	DOI	PMID	Type of mortality reported	Time frame of mortality reporting
Pregnancy	Safety of Topical Corticosteroids in Pregnancy	Chi CC, Wang SH, Wojnarowska F, Kirtschig G, Davies E, Bennett C	2015	10.1002/14651858.CD007346.pub3	26497573	Fetal death	Not specified, variable
Necrotizing soft tissue infections	Interventions for Necrotizing Soft Tissue Infections in Adults	Hua C, Bosc R, Sbidian E, De Prost N, Hughes C, Jabre P, Chosidow O, Le Cleach L	2018	10.1002/14651858.CD011680.pub2	29851032	Mortality, survival	30-day mortality, 28-day and 30-day study periods for survival
Melanoma	Systemic Treatments for Metastatic Cutaneous Melanoma	Pasquali S, Hadjinicolaou AV, Chiarion Sileni V, Rossi CR, Mocellin S	2018	10.1002/14651858.CD011123.pub2	29405038	Overall survival, progression-free survival	1 year
Severe drug‐induced skin rash	Genetic Testing for Prevention of Severe Drug‐Induced Skin Rash	Alfirevic A, Pirmohamed M, Marinovic B, Harcourt-Smith L, Jorgensen AL, Cooper TE	2019	10.1002/14651858.CD010891.pub2	31314143	All-cause mortality	12-month follow-up post rash

[a]RCT: randomized controlled trial.

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Table 2. Mortality as an Outcome in COMET (Core Outcome Measures in Effectiveness Trials).

Condition	Study title	Authors	Year	URL	DOI	Mortality as an outcome (yes/no)	Type of mortality reported
Acne	Identifying What to Measure in Acne Clinical Trials: First Steps Towards Development of a Core Outcome Set	Layton AM, et al	2017	http://www.comet-initiative.org/Studies/Details/1221	http://dx.doi.org/10.1016/j.jid.2017.04.017	No	N/A[a]
Actinic keratosis	Core Outcome Set for Actinic Keratosis Clinical Trials	Reynolds KA, et al	2019	http://www.comet-initiative.org/Studies/Details/756	http://dx.doi.org/10.1001/jamadermatol.2019.4212	No	N/A
Cutaneous leishmaniasis	Harmonized Clinical Trial Methodologies for Localized Cutaneous Leishmaniasis and Potential for Extensive Network With Capacities for Clinical Evaluation	Olliaro P, et al	2018	http://www.comet-initiative.org/Studies/Details/1455	https://doi.org/10.1371/journal.pntd.0006141	No	N/A
Eczema	Core Outcome Domains for Controlled Trials and Clinical Recordkeeping in Eczema: International Multiperspective Delphi Consensus Process	Schmitt J, et al	2011	https://www.comet-initiative.org/Studies/Details/90	http://dx.doi.org/doi:10.1038/jid.2010.303	No	N/A
Head and neck lymphatic malformation	Standardized Outcome and Reporting Measures in Pediatric Head and Neck Lymphatic Malformations	Balakrishnan K, et al	2015	http://www.comet-initiative.org/Studies/Details/894	https://doi.org/10.1177/0194599815577602	Yes	Death
Hidradenitis suppurativa	A Core Domain Set for Hidradenitis Suppurativa Trial Outcomes: An International Delphi Process	Thorlacius L, et al	2018	http://www.comet-initiative.org/Studies/Details/934	http://dx.doi.org/10.1111/bjd.16672	No	N/A
Incontinence-associated dermatitis	Core Outcome Domains in Incontinence-Associated Dermatitis Research	Van den Bussche K, et al	2018	http://www.comet-initiative.org/Studies/Details/383	http://dx.doi.org/10.1111/jan.13562	No	N/A
Psoriasis	Identifying a Core Domain Set to Assess Psoriasis in Clinical Trials	Callis Duffin K, et al	2018	http://www.comet-initiative.org/Studies/Details/1464	Not available	No	N/A
Skin cancer	Development of a Core Outcome Set for Cutaneous Squamous Cell Carcinoma Trials: Identification of Core Domains and Outcomes	Reynolds KA, et al	2020	http://www.comet-initiative.org/Studies/Details/864	http://dx.doi.org/10.1111/bjd.19693	Yes	Progression-free survival, recurrence-free survival, disease-specific survival

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Condition	Study title	Authors	Year	URL	DOI	Mortality as an outcome (yes/no)	Type of mortality reported
Vascular malformations	Development of an International Core Outcome Set for Peripheral Vascular Malformations (OVAMA Project)	Horbach SER, et al	2018	http://www.comet-initiative.org/Studies/Details/767	http://dx.doi.org/10.1111/bjd.16029	No	N/A
Vasculitis (small-vessel/ ANCA[b]-associated)	Clinicians' Perspective on Key Domains in ANCA-Associated Vasculitis: a Delphi Exercise	Milman N, et al	2017	http://www.comet-initiative.org/Studies/Details/1041	http://dx.doi.org/10.1080/03009742.2016.1188980	No	Death discussed (from OMERACT[c], to which this study adds—but was not directly included in this study)
Vitiligo	Developing Core Outcome Set for Vitiligo Clinical Trials: International e-Delphi Consensus	Elefetheriadou V, et al	2015	http://www.comet-initiative.org/Studies/Details/357	http://dx.doi.org/10.1111/pcmr.12354	No	N/A
Vulval skin disorders	Outcome Measures for Vulval Skin Conditions: a Systematic Review of Randomised Controlled Trials	Simpson R, et al	2013	https://www.comet-initiative.org/Studies/Details/271	http://dx.doi.org/DOI:%2010.1111/bjd.12391	No	N/A

[a]N/A: not applicable.

[b]ANCA: antineutrophil cytoplasmic autoantibody.

[c]OMERACT: Outcome Measures in Rheumatoid Arthritis Clinical Trials.

Although limited in the number of studies appraised, our results illustrate substantial variability in the reporting and timing of mortality outcomes in Cochrane Skin reviews and COMET dermatology-related core outcome sets. Allowance of potentially unclear metrics (eg, "death") and fluctuations in the time frame considered (especially within studies of a particular disease) may be detrimental to the downstream harmonization and generalizability of research findings. Guidelines to assist researchers during trial design and registration would encourage the selection of clear metrics and facilitate consistent outcome reporting at the later stages. Increased guidance and communication among stakeholders in this area, including further refinement of reporting guideline statements such as CONSORT (Consolidated Standards of Reporting Trials) [4] and PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) [5], could promote much-needed standardization in mortality reporting, facilitating comparison across studies and helping decision makers effectively use dermatology research.

Acknowledgments

The authors wish to acknowledge Eve Tomlinson, Jordi Pardo, Susanna Dodd, Nicole Skoetz, and George Wells, whose contributions to a Cochrane health equity priority-setting pilot exercise laid the foundation for examining mortality outcomes across the entire Cochrane Library and provided the impetus for this smaller scale study of dermatology-related Cochrane reviews and core outcome sets.

Conflicts of Interest

RPD is Editor in Chief of the JMIR Dermatology, 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. TES is an

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Editorial Board Member-at-Large for JMIR Dermatology. RPD receives editorial stipends (JAAD, JID), royalties (UpToDate), and expense reimbursement from Cochrane Skin. TES receives fellowship funding from the Pfizer Global Medical Grant (58858477) Dermatology Fellowship 2020 (principal investigator RPD), and fees for serving as a Medical Advisor and Investigator for Antedotum Inc. MDS is a member of the Cochrane Collaboration.

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Abbreviations

COMET: Core Outcome Measures in Effectiveness Trials
CONSORT: Consolidated Standards of Reporting Trials
cSCC: cutaneous squamous cell carcinoma
JAAD: Journal of the American Academy of Dermatology
JID: Journal of Investigative Dermatology
PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses
TEN: toxic epidermal necrolysis

Edited by G Eysenbach; submitted 07.10.21; peer-reviewed by F Beyer, M Mahmic Kaknjo; comments to author 10.12.21; revised version received 17.12.21; accepted 20.12.21; published 01.02.22.

Please cite as:
Sivesind TE, Szeto MD, Hassan S, Tugwell P, Dellavalle RP
Mortality Outcomes in Dermatology: An Exploration of Core Outcome Sets and Cochrane Skin Systematic Reviews
JMIR Dermatol 2022;5(1):e34140
URL: https://derma.jmir.org/2022/1/e34140
doi:10.2196/34140
PMID:

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Research Letter

An Analysis of Skin of Color Content on TikTok

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(JMIR Dermatol 2022;5(1):e33340) doi:10.2196/33340

KEYWORDS

internet; social media; TikTok; skin of color; SoC; influencer; user engagement; hashtag; dermatologist

The US population has continually diversified in the past decade (2010-2019), with recent data estimating 40% of US citizens identify with a race or ethnic group other than White [1]. Social media is an impactful outlet for dissemination of dermatologic education. Most recently, TikTok has emerged as a leading social media platform, reaching over 1 billion users daily. Previous studies indicate a growing presence of dermatologists on TikTok, while also highlighting the need for increased involvement to combat the spread of misinformation [2]. Wells et al [3] previously evaluated skin of color (SoC) posts on the social media platform Instagram, with findings identifying that dermatologists are underrepresented among those producing SoC posts. Considering the exponential growth of TikTok, we aimed to perform a similar study evaluating the credentials of "influencers" who produce SoC dermatologic posts on TikTok.

Data were collected from TikTok in March 2021. General dermatology and SoC dermatology posts were identified by searching individual hashtags (Table 1). A list of SoC-specific terms was generated using common SoC pathologies from the Skin of Color Society website [4]. The top 10 posts associated with each hashtag, as determined by the TikTok algorithm, were analyzed. Posts not relevant to dermatology were excluded.

The user profile of each post was analyzed to classify the creator. Posts were also classified as advertisements, educational, or promotional. Posts were classified as advertisements if the post attempted to sell a specific dermatological product or service. Posts that provided educational information to the viewer without advertising were classified as educational. Posts were classified as promotional if they were self-promoting of the TikTok user/poster. User engagement (number of likes, comments, shares, and views) was also recorded for each post.

Dermatologists were responsible for 20% (32/160) of the SoC posts on TikTok, while influencers produced 36% (57/160) of SoC posts. Patients and physicians other than dermatologists each produced 14% (23/160) of the SoC posts, while hairstylists, estheticians, medical students, and naturopathic doctors produced 8% (13/160), 6% (10/160), 2% (3/160), and 2% (3/160) of SoC posts, respectively. Of the 16 SoC hashtags analyzed, only one (#skinofcolor) had dermatologists producing

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the majority of the posts. Patients, influencers, and hairstylists produced the highest percentage of the top posts for all other SoC hashtags. The hashtag #acne garnered the highest user engagement but the related posts were primarily personal and noneducational (Table 1).

Table 1. Skin of color (SoC) hashtag search terms and their top 10 posts' average user engagement, post type, and creator type on TikTok.

Hashtag	Average likes (IQR)	Average comments (IQR)	Average shares (IQR)	Average views (IQR)	Types of top 10 posts (E/P/A)[a]	Most common creator type (number of top 10 posts produced)
#skinofcolor	4416 (1192)	111 (56)	94 (103.0)	71,459 (83,000)	7/1/2	Dermatologist (4/10)
#acne	3,290,000 (1,200,000)	30,567 (26,475)	113,160 (97,350)	24,690,000 (14,525,000)	2/5/3	Patient (7/10)
#postinflammatoryhyper-pigmentation	1336 (914)	33 (26)	58 (17)	18,458 (12,845)	5/1/4	Influencer (7/10)
#PIH	15,194 (23,270)	281 (269)	186 (155)	160,130 (273,700)	4/1/5	Influencer (5/10)
#razorbumps	28,017 (15,275)	114 (103)	1032 (1238)	272,879 (157,125)	3/0/7	Influencer (5/10)
#melasma	89,470 (84,125)	2101 (516)	4997 (2923)	1,312,210 (781,450)	5/4/1	Influencer (3/10)
#keloid	106,240 (68,150)	1752 (1097)	2961 (2405)	1,089,230 (1,211,900)	5/5/0	Patient (7/10)
#tractionalopecia	2475 (2284)	67 (42)	161 (119)	32,507 (42,331)	3/4/2	Patient (7/10)
#eczema	149,120 (65,925)	1475 (893)	3675 (4564)	1,986,730 (1,410,100)	4/5/1	Patient (6/10)
#vitiligo	898,640 (520,700)	8286 (6504)	4637 (5994)	4,940,000 (3,350,000)	0/10/0	Patient (8/10)
#melanoma	51,400 (47,000)	545 (848)	1181 (1646)	564,960 (441,450)	4/6/0	Patient (4/10)
#psoriasis	97,520 (57,200)	2448 (2081)	1380 (1518)	859,840 (365,450)	1/7/2	Patient (8/10)
#sarcoidosis	3030 (1226)	109 (52)	66 (21)	78,842 (34,975)	4/6/0	Patient (8/10)
#seborrheicdermatitis	19,533 (7610)	294 (190)	591 (212)	299,320 (169,475)	5/5/0	Patient (6/10)
#dandruff	575,190 (468,925)	5388 (8669)	6670 (10,976)	3,558,520 (4,075,000)	4/4/2	Hairstylist (6/10)
#hairbreakage	44,7430 (32,601)	379 (353)	2929 (144)	592,610 (421,450)	6/3/1	Influencer (5/10)

[a]E/P/A: educational, promotional, advertisement.

Social media has been described as the new horizon for dermatological education [5]. However, our analysis reveals dermatologists have a small contribution (20%) to SoC posts on TikTok. This finding suggests patients with SoC using TikTok are obtaining dermatologic information from an alarming number of posts by socially recognized "influencers" who lack professional credentials, such as licensing or board certification, as a qualified medical doctor or clinician. Due to socioeconomic, cultural, and various other factors, patients with SoC in the United States have lower rates of in-person health service utilization when compared to White individuals [6].With the plethora of dermatologic information available on TikTok, lower rates of health service utilization may be perpetuated as patients with SoC use online resources for dermatologic care. Quality control is a major challenge associated with social media, which enables the circulation of inaccurate information. TikTok, however, offers a "duet" feature, which grants dermatologists the option to post public replies to and corrections of inaccurate videos. This feature is commonly used by dermatologists and other health care professionals on TikTok to reinforce professional medical advice and limit the spread of misinformation [2]. Limitations of our study include classifying creators based on TikTok profile descriptions without license/certification verification. Our study provides a mere snapshot of top creators for SoC dermatologic care due to the continually evolving nature of TikTok. Our study suggests TikTok is an important social media platform that dermatologists should consider using for educating and promoting correct dermatologic practice for patients with SoC.

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Acknowledgments

KP contributed to project conceptualization, methodology, data collection, writing of manuscript, and manuscript review and editing. AC and CP contributed to project conceptualization, writing of manuscript, and manuscript review and editing. JA contributed to methodology, statistical analysis, and editing. EC, CR, and KL contributed to review and editing. ML and MS contributed to methodology, statistical analysis, and manuscript review and editing. RD contributed to review and editing, project supervision, and project administration.

Conflicts of Interest

RD is Editor in Chief of JMIR Dermatology, 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. The other authors declare no conflicts of interest.

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Abbreviations

SoC: skin of color

Edited by G Eysenbach, T Leung; submitted 03.09.21; peer-reviewed by Q Wu, C Giraud-Carrier; comments to author 11.12.21; revised version received 02.01.22; accepted 18.01.22; published 01.03.22.

Please cite as:
Pulsipher KJ, Concilla A, Presley CL, Laughter MR, Anderson J, Chea E, Lim K, Rundle CW, Szeto MD, Dellavalle R
An Analysis of Skin of Color Content on TikTok
JMIR Dermatol 2022;5(1):e33340
URL: https://derma.jmir.org/2022/1/e33340
doi:10.2196/33340
PMID:

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Research Letter

Patterns of Promotional Content by Dermatology Influencers on TikTok

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(JMIR Dermatol 2022;5(1):e34935) doi:10.2196/34935

KEYWORDS

social media; TikTok; Instagram; promotion; conflicts of interest; influencer; dermatology; dermatologist

Research Letter

TikTok, a social media platform for sharing short videos, has become a source of dermatologic information for the general public [1,2]. Compared to other platforms, TikTok has high engagement rates (ratio of likes and comments to followers)—approximately 5 times those of Instagram [1]. The platform is rife with promotional content [1,2], potentially influencing public behavior and consumption, such as boosting CeraVe's sales in early 2021 [3]. Here, we sought to characterize promotional content among accounts with the most popular dermatology-related TikTok videos.

We analyzed 14 hashtags to identify the top dermatology TikTok videos for analysis of promotional content. Our hashtags were based on precedent social media studies and included the top 5 dermatology-related diagnoses and the top 5 dermatology procedures [4]. We also added 4 hashtags anecdotally found to be popular on TikTok (Table 1). The top 100 posts for each hashtag were queried on February 26, 2021, totaling 1400 posts. Based on the precedent for identifying Instagram influencers, we employed two criteria to define influencer status [4]. The first criteria required accounts to have ≥500,000 followers; the second required being featured in the top 100 posts across all hashtags ≥3 times. Promotional content was defined per the Federal Trade Commission: any disclosures (hashtags, text, or video content indicating advertisement, ambassadors, discounts, or tags) in the influencers' 9 most recent posts or biography [5]. Similarly, personal promotion was defined as disclosures promoting the influencers' own products or services.

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Table 1. Hashtags queried in the study and the change in the total number of views for each hashtag over 3 months (February 14 to May 14, 2021).

Hashtag	Views, n		Difference, n
	February 14, 2021	May 14, 2021	
#skincare	31,200,000,000	41,600,000,000	10,400,000,000
#dermatologist	1,600,000,000	2,700,000,000	1,100,000,000
#dermatology	457,500,000	640,800,000	183,300,000
#skincareroutine	7,000,000,000	8,900,000,000	1,900,000,000
#acne	6,800,000,000	9,500,000,000	2,700,000,000
#eczema	77,300,000	132,900,000	55,600,000
#psoriasis	85,900,000	137,900,000	52,000,000
#hairloss	496,800,000	736,100,000	239,300,000
#alopecia	1,100,000,000	1,500,000,000	400,000,000
#botox	669,000,000	1,100,000,000	431,000,000
#juvederm	31,700,000	37,100,000	5,400,000
#microneedling	133,000,000	179,700,000	46,700,000
#laserhairremoval	139,500,000	252,700,000	113,200,000
#dermalfillers	18,600,000	32,300,000	13,700,000
Total	49,809,300,000	67,449,500,000	17,640,200,000

From February 14 to May 14, 2021, TikTok videos with hashtags of interest accumulated 17.6 billion views (Table 1). Of the 1400 posts recorded, there were 1337 unique posts from 738 unique accounts. After excluding non-English–language posts and accounts with posts unrelated to dermatology, 112 accounts remained with ≥500,000 followers and 77 accounts featured ≥3 times in the top 100, totaling 162 accounts meeting one or both influencer criteria (Table 2). Of this total, 14 (8.6%) were dermatologists, with 8 out of 14 being board-certified. Over one-third (57/162, 35.2%) of these influencers had promotional content on their account, and 32.1% (52/162) had personal promotional content. Promotional status was undetermined in 15.4% (25/162) of accounts (non-English).

About 35% of dermatology influencers featured promotional content on TikTok, which raises concerns about conflicts of interest. Although dermatologists represent a fraction of influencers, a majority (8/14, 57.1%) featured promotional content. Noncredentialled, dermatology-related accounts had the highest rate of promotional content (22/28, 78.6%), which included skincare brand partnerships, product links, and personalized discount codes. Disclosures, which can be indicated using *#ad* in the video descriptions or explicitly mentioning conflicts in the videos, should be stated in user biographies, especially when providing product links with affiliate marketing incentives. Additionally, clearly stating a lack of conflict when recommending or reviewing products could reduce perceptions of conflict.

Given the prevalence of nondermatology and nonmedical influencers creating dermatology content, leveraging TikTok to counter misinformation may be essential to ensure patients and health consumers are provided accurate information. While new avenues to share educational content are important, the negative influence of promotional content remains a concern.

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Table 2. Characterization of TikTok influencer types and promotional content patterns.

Characteristic	Accounts, n (% of all influencers)	Accounts, n (% within subcategory)			
		Promotional	Personal promotion	None	Unknown (non-English)
Influencer category					
All	162 (100)	57 (35.2)	52 (32.1)	28 (17.3)	25 (15.4)
≥500,000 followers	112 (69.1)	45 (40.2)	31 (27.7)	20 (17.9)	16 (14.3)
≥3 times in the top 100	77 (60.2)	28 (36.4)	27 (35.1)	10 (13.0)	12 (15.6)
Account type					
Personal	66 (40.7)	16 (24.2)	23 (34.9)	22 (33.3)	5 (7.6)
Physician[a]	5 (3.1)	1 (20.0)	2 (40.0)	0 (0)	2 (40.0)
Board-certified[b]	1 (0.6)	1 (100)	0 (0)	0 (0)	0 (0)
Not board-certified[b]	1 (0.6)	0 (0)	1 (100)	0 (0)	0 (0)
International	3 (1.9)	0 (0)	1 (33.3)	0 (0)	2 (66.7)
Resident	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Dermatologist	14 (8.6)	8 (57.1)	4 (28.6)	1 (7.1)	1 (7.1)
Board-certified[b]	8 (4.9)	5 (62.5)	2 (25.0)	1 (12.5)	0 (0)
Not board-certified[b]	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
International	1 (0.6)	0 (0)	0 (0)	0 (0)	1 (100)
Resident	5 (3.1)	3 (60.0)	2 (40.0)	0 (0)	0 (0)
Plastic surgeon	4 (2.5)	1 (25.0)	3 (75.0)	0 (0)	0 (0)
Board-certified[b]	3 (1.9)	1 (33.3)	2 (66.7)	0 (0)	0 (0)
Not board-certified[b]	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
International	1 (0.6)	0 (0)	1 (100)	0 (0)	0 (0)
Resident	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Nurse, nurse practitioner, physician assistant, or advanced practitioner	7 (4.3)	2 (28.6)	3 (42.9)	2 (28.6)	0 (0)
Esthetician	5 (3.1)	2 (40.0)	2 (40.0)	0 (0)	1 (20.0)
Dermatology or skincare informational company account (no individual user identified)	5 (3.1)	1 (20.0)	2 (40.0)	1 (20.0)	1 (20.0)
Dermatology- or skincare-focused account with no credentials	28 (17.3)	22 (78.6)	6 (21.4)	0 (0)	0 (0)
Other	5 (3.1)	0 (0)	3 (60.0)	2 (40.0)	0 (0)
Unknown (non-English language)	23 (14.2)	4 (17.4)	4 (17.4)	0 (0)	15 (65.2)
Location					
United States	100 (61.7)	43 (43.0)	43 (43.0)	14 (14.0)	0 (0)
International	42 (25.9)	10 (23.8)	6 (14.3)	6 (14.3)	20 (47.6)
Unknown	20 (12.4)	4 (20.0)	3 (15.0)	8 (40.0)	5 (25.0)

[a]Physicians not including dermatologists or plastic surgeons.

[b]Per the American Board of Medical Specialties [6].

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Authors' Contributions

VKR had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Conflicts of Interest

JBL has served as a paid telemedicine consultant for Havas Life Medicom, and as a telemedicine advisor for AcneAway, a direct-to-consumer teledermatology start-up

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Edited by R Dellavalle, T Sivesind; submitted 14.11.21; peer-reviewed by J Yu, K Ashack; comments to author 30.01.22; revised version received 07.02.22; accepted 21.02.22; published 30.03.22.

Please cite as:
Ranpariya VK, Fathy R, Chu B, Wang S, Lipoff JB
Patterns of Promotional Content by Dermatology Influencers on TikTok
JMIR Dermatol 2022;5(1):e34935
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Letter to the Editor

The Dermatologist on Social Media: When the Pros Outweigh the Cons. Comment on "Risks and Benefits of Using Social Media in Dermatology: Cross-sectional Questionnaire Study"

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Related Article:

Comment on: https://derma.jmir.org/2021/1/e24737

(JMIR Dermatol 2022;5(1):e31943) doi:10.2196/31943

KEYWORDS

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

We applaud Bressler et al [1] for their cross-sectional study determining the risks and benefits of social media use by practicing dermatologists and dermatology residents. This study found that 93.8% of survey respondents used a variety of social media sites [1]. Respondents were stratified by employment, and usage patterns and perspectives were recorded. Here, we aim to reframe the findings of Bressler et al [1] as an opportunity to encourage dermatologists to use social media to combat misinformation, serve as public health advocates, and support patients' wellness.

While this study successfully characterizes opportunities for dermatologists to interact on social media (eg, patient education, care opportunities, improved quality of information), the gravity of these findings was not explored, as dermatologists are a significant minority of contributors to social media information. For example, Wells et al [2] found that board-certified dermatologists were responsible for only 12% (26/219) of analyzed Instagram content related to skin of color. Similarly, an analysis of psoriasis-related content on Twitter found that only 3% (17/574) of accounts belonged to dermatologists [3]. These findings show that dermatologists' contributions pale in comparison to nondermatologists, and highlight the need for dermatologists to expand their presence on social media.

An additional, unique aspect of Bressler et al's [1] study is the measure of dermatologists' perspectives. The study emphasizes that dermatologists were more pessimistic than optimistic on social media use, citing perceived risks of misinformation, poor substitution of care, and increased visibility of non–evidence-based products (P<.001) [1]. The juxtaposition between dermatologists' optimism and pessimism, in conjunction with a relative paucity of participation by dermatologists, is concerning. Dermatologists could embrace the opportunity to directly combat the spread of misinformation and poor patient care while simultaneously increasing access to health care, education, and up-to-date public health initiatives. Instagram, the "most valuable platform" (as determined by a single survey question), presents opportunities for interaction with the public via photos, videos, and reels. Presley et al [4], for example, recorded the metrics for the top TikTok (another video-based platform) posts and found that educational posts

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had the highest mean user engagement, supporting the utilization of social media for the dissemination of medical education.

Bressler et al [1] also highlight concern for professional education, privacy breaches, and the necessity of better guidelines for physicians to interact on social media. However, the American Medical Association provides guidelines, outlining that physician interactions on social media should parallel the interactions expected of them in person. Maintaining professionalism, patient confidentiality, and combating misinformation in a clear and respectful manner are pearls for physician conduct on social media platforms [5]. Users should avoid sharing or improperly storing patient health information (ie, tattoos, scars), state their conflicts of interest or affiliations, and include disclaimers with recommendations.

While dermatologists are minor contributors in the scheme of social media, it is more important than ever for this group to advocate for their patients and profession. While there are potential negatives with social media use, it is important that we recognize and face these barriers as a means to provide clear, accurate information to our patients while simultaneously providing greater access to high-quality care.

Conflicts of Interest

None declared.

Editorial Notice

The corresponding author of *"Risks and Benefits of Using Social Media in Dermatology: Cross-sectional Questionnaire Study"* declined to respond to this letter.

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Edited by T Leung; submitted 09.07.21; this is a non–peer-reviewed article;accepted 04.02.22; published 25.02.22.

Please cite as:
Concilla A, Laughter MR, Presley CL, Anderson J, Rundle CW
The Dermatologist on Social Media: When the Pros Outweigh the Cons. Comment on "Risks and Benefits of Using Social Media in Dermatology: Cross-sectional Questionnaire Study"
JMIR Dermatol 2022;5(1):e31943
URL: https://derma.jmir.org/2022/1/e31943
doi:10.2196/31943
PMID:

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