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Original Article

A state of the science on influential factors related to sun protective behaviors to prevent skin cancer in adults



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ABSTRACT

Skin cancer rates have risen over the past decades, making it imperative that adults understand the need for protection from sun exposure. Though some risk factors have been identified as predictive for skin cancers, there is a lack of synthesized information about factors that influence adults in their decisions to engage in sun protective behaviors. The purpose of this paper is to present the current state of the science on influential factors for sun protective behaviors in the general adult population. A rigorous literature search inclusive of a generally White, Caucasian, and non-Hispanic adult population was performed, and screening yielded 18 quantitative studies for inclusion in this review. Findings indicate that modifiable and non-modifiable factors are interdependent and play a role in sun protective behaviors. This study resulted in a proposed conceptual model for affecting behavioral change in sun protection including the following factors: personal characteristics, cognitive factors, family dynamics, and social/peer group influences. These factors are introduced to propose tailored nursing interventions that would change current sun protective behavior practice. Key implications for nursing research and practice focus on feasibility of annual skin cancer screening facilitated by advanced practice nurses, incorporating the identified influential factors to reduce skin cancer risk and unnecessary sun exposure. © 2017 Chinese Nursing Association. Production and hosting by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Background and significance

Sun exposure has been identified by the Centers for Disease Control and Prevention (CDC) as the most common risk factor for skin cancer in the United States [1]. Skin cancer rates have continued to steadily increase. In 2016, the American Cancer Society (ACS) reported that the prevalence of Melanoma skin cancer is 1:33 (3%) in males, and 1:52 (1.9%) in females with statistically significant trends increasing in survival rates over the past three decades (respectively, 82%; 88%; and 93%) [2]. In response, there have been public health initiatives designed to address pertinent risk factors for skin cancer. One example would be the Surgeon General's call to action to prevent skin cancer presented by the United States Department of Health and Human Services (USDHHS) in 2014 [3]. More recently, the USDHHS released a cancer

prevention progress report on surveillance of behavioral indicators highlighting data concerning outcome attainment including: environmental sun protection, sunburns and ultraviolet light exposure, indoor tanning, and vitamin D consumption [4].

In addition to gender concerns, age had been found to play a role in survival and mortality with skin cancer prevalence. In persons over 50 years of age, mortality rates have increased 0.6% per year since 1990, but in persons less than 50 years of age there is a reported decline in mortality of 2.6% per year since 1986. There is an estimated 10,130 predicted deaths to occur in 2016 alone [2]. A potential explanation for this finding could be that the potential decline in death rates of the younger population may be dependent upon intervention with sun prevention efforts, a decrease in sun exposure compared to the older generation, or perhaps greater accessibility to knowledge and protective efforts. Further research is needed in this area to address the gap in knowledge regarding the variables of age and treatment intervention.

An exploration of the physiology of sun exposure and how nursing can assist in assessing and intervening with protective behavior modification is essential. Prolonged exposure to

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ultraviolet radiation is known to have harmful effects on human skin, the most significant of which is skin cancer. From this perspective, non-Hispanic and Caucasian people have a larger chance for developing multiple skin cancers due to the absence of a particular gene that is essential in DNA repair, making it more difficult for the immune system to remove damaged cells [5]. Because human skin has no defense against a highly reactive oxygen species known as singlet oxygen, mechanisms must be put into place to provide artificial protection against ultraviolet radiation [5]. Two main types of UV rays are responsible for damaging skin: UVB rays which penetrate the epidermal layers causing sunburn, and UVA rays which penetrate the deeper dermal layers of skin. Fortunately, the third and most dangerous type known as UVC is blocked by the earth's ozone layer. Both natural and artificial sunlight emitted via tanning beds can increase the risk of sunburn resulting in the development of skin cancer; thus, recurring sunburns once every 2 years can triple one's risk of developing this disease [6]. According to a 2012 study performed by the [7] Centers for Disease Control (CDC) between 2000 and 2010, sun protective behaviors are considered actions involving the following: staying in the shade, wearing long clothing, wearing a wide-brimmed hat, wearing a long-sleeved shirt, and using sunscreen during sun exposure. This report emphasizes the need for public health efforts to facilitate sun protection, prevent sunburn, and evade increases in skin cancer occurrences, particularly in persons between the ages of 10 and 24 [7].

Identifying influential factors affecting sun protective behaviors are relevant to nursing practice because reducing patient morbidity and mortality in the population is very much a part of the foundation for professional practice. Sun exposure is the most common risk factor for skin cancer, and it is imperative that nursing identify what influential factors are related to sun protective behaviors in order to intervene, prevent, assist or modify the unhealthy behavior. To add to this significance, skin cancer is listed among the national priorities for the Healthy People 2020 Program. Objective C-8 is aimed at reducing the melanoma cancer death rate, which has the potential to result in a 10% improvement from baseline year 2000 [8]. Melanoma skin cancer is highly curable when detected in early stages; however, it is more likely to metastasize in comparison to other forms of cancer [2]. Therefore, it is critically important that health care providers understand what factors influence sun protective behaviors, as well as available risk management efforts, so that targeted interventions can be developed to improve sun protective behaviors to subsequently diminish the incidence, prevalence, and morbidity of skin cancer. Therefore, the purpose of this study is to report a state of the science on those influential factors that are related to sun protective behaviors to prevent skin cancer in the adult population.

The information in this review is foundational to the ongoing development of a conceptual model of influential factors for sun protection behavior (See Fig. 2).

2. Methods

A literature search and screening was conducted by the first author between the dates of August 29th, 2016 through October 31st, 2016 using the following databases: CINAHL, PubMed, Academic Search Complete, Health and Psychosocial Instruments, MEDLINE, PsychINFO, Cochrane Library, and the National Guideline Clearinghouse. The dates of the original search included publication years ranging from 1985 to 2016. Specific key terms with Boolean operators included 'skin cancer behaviors', 'factors affecting skin cancer', 'skin cancer protection behaviors', and 'skin cancer prevention'. Two-hundred and thirty six studies were initially identified that matched the search criteria. When relevant

sources cited original research from earlier publication dates, this data was considered in the overall state of the science for the paper. These earlier studies focused on theory application related to skin cancer prevention, and were considered when developing the foundation for this work. Out of the original 240 articles identified, 34 duplicate articles were eliminated. The remaining 206 abstracts were reviewed for the following inclusion criteria: 1) adults aged 18 years or older, 2) White, Caucasian, non-Hispanic male and female genders, 3) those persons with a personal and/or familial history of skin cancer; and, 4) all-inclusive social determinants of health (e.g. socioeconomic status, geographical location, living conditions). After reviewing full-text articles, 169 were eliminated for failure to meet inclusion criteria. Those studies focusing only on special interest populations, cultural determinants of health, or current skin cancer diagnosis at time of publication were excluded. The literature screening process resulted in 18 articles being acceptable for inclusion in the review. The [9] Rosswurm and Larrabee critique worksheet was utilized to evaluate each article for bias, validity, and interpretation for clinical practice and future research. The original screening was performed by one author, and full-text articles were read, confirmed, and validated for authenticity and applicability by 2 co-authors for study inclusion. These articles are representative of both genders, and the majority of study designs were quantitative, non-experimental and cross-sectional in nature. Fig. 1 and Table 1 presents details of the literature search and screening process.

3. Results

The included 18 studies identified modifiable and non-modifiable factors that influence sun protective behaviors. Some studies evaluated intervention effectiveness in regard to sun protection outcomes. Modifiable factors are those behaviors and/or activities that can be changed, or modified, to produce a positive health outcome. Modifiable factors identified from the review included both behavioral and psychosocial characteristics. Non-modifiable influential factors included female gender, socioeconomic status, and inherited risk or genetic predisposition for developing a skin cancer. Both the modifiable and non-modifiable influential factors for sun protection behaviors are presented, as well as interventions examining sun protective factors.

3.1. Modifiable influential factors affecting sun protection

Modifiable factors are those that can potentially be changed or altered to elicit a desired response. In the included study reports, themes of cognitive, psychosocial, and affective determinants of positive sun protective behaviors were identified. From a cognitive perspective, the capacity to self-regulate one's own behavior was examined in relation to predicting sunscreen use and it was determined that behavioral intention positively correlates with the behavior ($r = 0.24$, $p < 0.01$) [10]. In this same study, intention ($r = 0.49$), past behavior ($r = 0.48$), and habit ($r = 0.64$) positively correlated with sun protection behavior, surmising that the more one has intended on carrying out past behavior, the more likely he or she is to perform the behavior in the future [10]. It was noted that an individual's planning ability, cognitive flexibility, or impulsivity were not significant in moderating the relationship between intention and behavior but greater cognitive flexibility was associated with an increased likelihood of intention to perform past and future sun protection behaviors [10].

Additional cognitive and psychosocial variables, including attitudes, beliefs, norms for exposure, and self-efficacy have been examined in relation to skin protection, sun exposure, and indoor tanning intentions [11]. Skin damage distress, self-efficacy, and

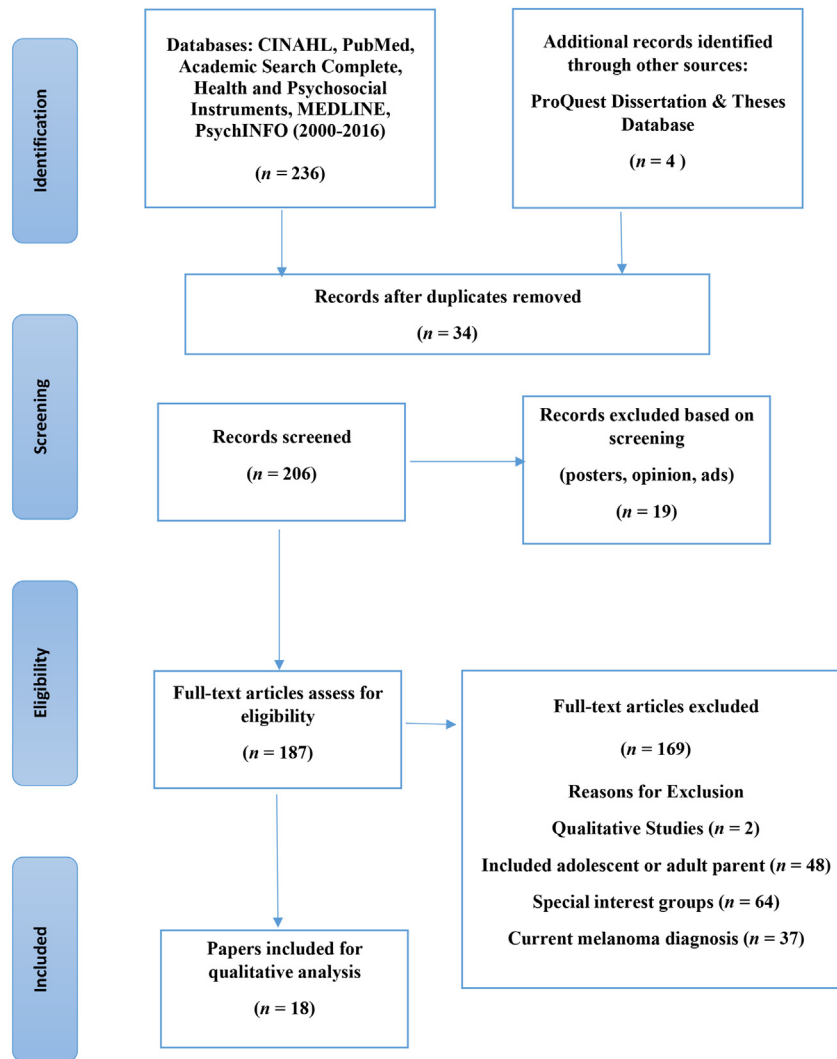


Fig. 1. Literature search and screening process.

perceived control were independent predictors of variability in skin protection intention ($p < 0.001$) [11]. UV exposure outcome beliefs and self-efficacy of sun exposure avoidance were inversely related to sun exposure intention ($p < 0.001$); however, self-efficacy control did not significantly contribute independently to indoor tanning intention [11]. In one study of the predictive value of self-efficacy for sunbathing intention and behavior, correlations were found between the following: behavior and self-efficacy ($r = 0.56$), behavior and attitude ($r = -0.46$), intention and attitude ($r = -0.47$), intention and self-efficacy ($r = 0.44$), and subjective norm and self-efficacy ($r = 0.43$) with $p < 0.01$ and $p < 0.001$ respectively [12]. These findings suggest that the application of sunscreen and days sunbathing positively affected a person's confidence in his or her ability to perform the task. Also, the more a person engages in sun protective behavior, the less likely the attitude toward using a high-factor protective sunscreen; and the same inverse correlation is seen with intention to use a high-factor sunscreen and the attitude toward using it. These findings continue to show an increase intent to use a high-factor sunscreen correlated with personal higher self-efficacy in the performance of the task. Finally, self-efficacy was reported as the best predictor of behavior ($p < 0.001$), and perceived control did not predict sun protection behavior nor intention [12].

Both implicit (unconscious awareness) and explicit (conscious awareness) motives have been used to examine effects on sun protection behaviors. For example [13], Aspden, Ingledew and Parkinson (2012) examined the following motives on sun exposure and protection behavior: health preservation, appearance enhancement, well-being, social conformity, and power life goals. Positive correlations were found with health preservation and appearance preservation motives for sun protection ($r = 0.37$), but health preservation motive inversely correlated with appearance enhancement motives for sun exposure ($r = -0.17$) [13]. Appearance enhancement motives were positively correlated with social conformity motives for sun exposure behavior ($r = 0.47$) [13]. Well-being motives for exposure were positively correlated with both appearance enhancement motives ($r = 0.23$) and social conformity motives ($r = 0.18$) [13]. However, participatory motives (such as appearance enhancement, social-conformity, well-being, appearance preservation, social pressure, and health preservation) have been shown to strongly predict exposure behavior, and moderately predict protection behavior [14].

Knowledge, attitude, and risk-awareness are factors associated with sun protection [15]. Hedges and Scriven (2010) found knowledge of risks associated with sun exposure to be high, citing specific knowledge sources on skin cancer prevention to be

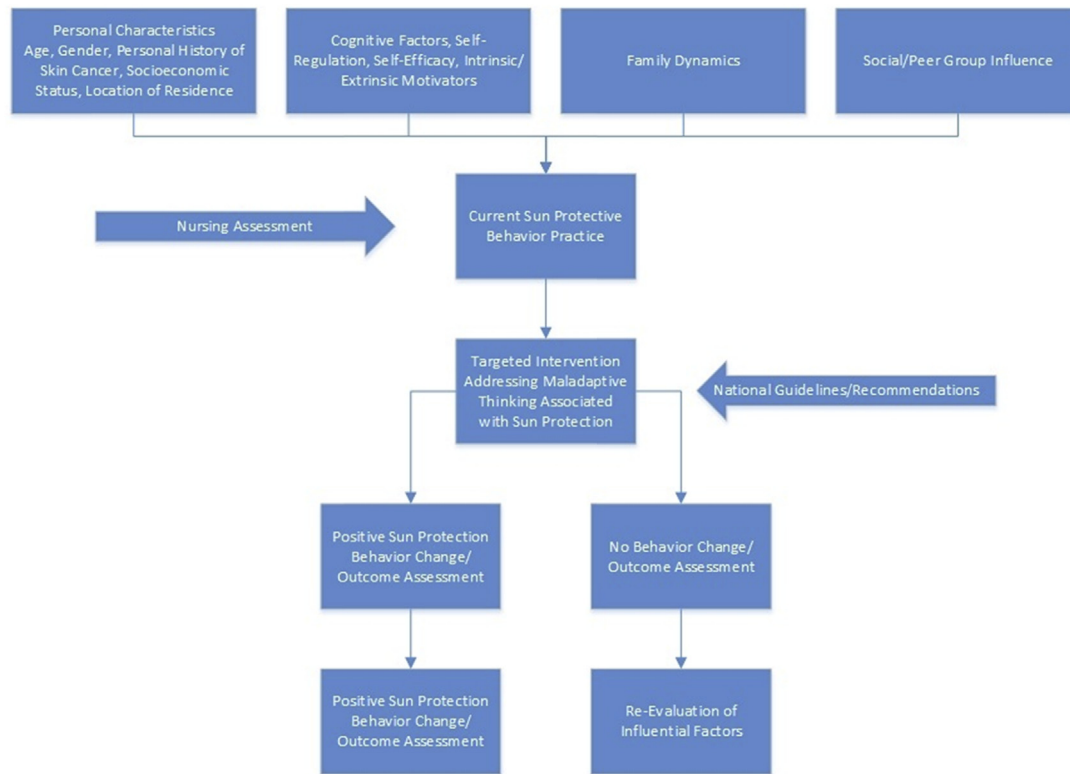


Fig. 2. Proposed conceptual model for effecting behavioral change in sun protection through nursing intervention.

obtained mostly from parents and family (28%), followed by television, then magazines and newspapers (52% total), with school education reported at 4%. Attitude toward having a suntan was higher in males than females (93% vs 73%), and 91% of females reported that a having a suntan makes them look healthier [15]. More barriers were cited with those participants aged 25–28, with cosmetics, comfort, and convenience noted as concerns for sun protection [16]. Stanton, Moffatt, and Clavarino (2005) examined community members' perceptions of adequate skin protection looking at such relevant influential factors as intrapersonal, social, and attitudinal influences. This study revealed four reasons as to why people protect themselves from the sun including: health, personal risk, norms, and exposure level; and, seven sets of reason as to why people do not protect themselves: anti-authority, hedonism, disbelief, apathy, image, prevention, and family history [16]. Social and attitudinal predictors of perceived adequacy of skin protection activities here show an association between high self-esteem and perceptions of skin protection behavior in those with high prevention behavior [16].

[17] Uniquely, Manne, Coups, & Kashy (2016) reported on the use of an interdependence theory in evaluating the role of relationship factors in the performance of skin self-examination (SSE), benefits, barriers, and relationship-centered motivations. Findings revealed that couples discussing SSE together are more likely to engage in SSE and find it beneficial [17]. Key findings support that cancer worry and perceived SSE benefits are significantly and positively associated with relationship centered motivations ($p < 0.01$); therefore, husbands and wives adopting greater relationship-centered motivation are more likely to discuss and engage in SSE [17].

Voluntary participation in outdoor sports and engagement in physical activity have shown some effects on sun protection behaviors [18]. Janssen, van Kann, de Vries, Lechner, and van Osch (2015) reported that snow sports participants did not use

sunscreen adequately (40%), and these results were comparable to summertime sunscreen usage. The strongest correlate of sunscreen use during snow sports was attitude toward usage ($r = 0.21$), followed by self-efficacy ($r = 0.16$), intention ($r = 0.13$), and weather conditions ($r = 0.11$) [18]. Individuals participating in any level of activity outdoors have been significantly shown to report an increase in sunburn, and every hour of sun exposure gives a modest increase in odds of sunburn experience both over 12 months (OR 1.02, 95% CI: 1.010–1.037) and weekends (OR 1.04, 9% CI: 1.023–1.065) [19]. These findings support the need for sun protective interventions when considering any outdoor physical activity.

3.2. Non-modifiable influential factors affecting sun protection

Several sociodemographic characteristics have been identified as related to sun protection or occurrence of skin cancer. These factors are largely non-modifiable. Young age, race or ethnicity, place of residence, first degree relative with melanoma, personal history of melanoma, and male gender have all been identified as important to assess when providing care to prevent skin cancer.

Age is a determinant of sunburn and sun protection behavior [20]. Holman, Berkowitz, Guy, Hartman, and Perna (2014) examined the association between demographic and sunburn in US adults and found that the highest prevalence of sunburn occurred between those that were 18–29 years of age (52%), and this prevalence decreased with aging ($p < 0.001$).

Race or ethnicity may not be a deterrent for sun exposure. Prevalence of sunburn was common with frequent burns and freckling (45.9%), among white, non-Hispanic individuals (44.3%), and those with a family history of Melanoma (43.9%) [20].

Geographical region of residence is also related to sunburn. Over 36% of sunburns occur in the south and 40.4% in the Midwest [20]. This may be due to these geographical areas having more sunny

Table 1
The list of included studies.

Author/Year/Purpose	Design	Influential factor	Results/Behavior
Allom et al. (2013) Closing intention-behavior gap for sunscreen use and sun protection behaviors.	Quantitative, Non-experimental, Cross-sectional	Self-regulatory capacity predicting sunscreen use; Regulatory capacity's influence on intention and behavior;	<ul style="list-style-type: none"> • Intention accounted for 7.1% variance in sunscreen use. • No self-regulation measures accounted for behavior. • Intention, self-regulatory capacity, and habit accounted 56.1% variance in sun protective behavior. • Habit moderated intention-behavior gap.
Aspden et al. (2012) Implicit motives prediction of health related behavior (e.g. sun protection) over explicit motives.	Quantitative, Non-experimental, Cross-sectional	Health preservation motive, appearance enhancement, well-being, social conformity power life goals, and social pressure motives on sun protection behavior and/or exposures.	<ul style="list-style-type: none"> • Power life goal predicted sun exposure behavior • Altruism life goal predicted sun protection behavior. • Implicit dispositional achievement inversely predicted sun exposure behavior • Implicit dispositional motives somewhat predict health-related behaviors.
Bowen et al. (2012) Melanoma survivors' perceived risk for re-developing melanoma and cancer worry.	Quantitative, Experimental, Randomized Controlled Trial	Melanoma survivors' deliberate performance of comprehensive SSE, sun protection behaviors (e.g. clothing, sunscreen use, head coverage, seeking shade), and primary care provider screening during a routine visit.	<ul style="list-style-type: none"> • Sun protection behaviors: long-sleeved shirt: 59%; long pants or skirts: 80%; wear sunscreen 15 + SPF • Cancer worry: 12% reported 'high cancer worry' • Risk perception of developing Melanoma again: Much lower than avg to avg ($N = 80$; 26%) Higher than avg to much higher than avg ($N = 232$; 74%) • Summer season people 2× likely to report sunscreen use (95% CI = 1.06–4.51)
Dixon et al. (2007) Solar UV forecasts and supporting communications on excessive weekend sun exposure.	Quantitative, Non-experimental, Cross-sectional	Workplace email and Internet access Random allocation to 3 treatment groups: Standard forecast (no UV), Standard forecast + UV, Standard forecast + UV + sun protection message.	<ul style="list-style-type: none"> • Third control group higher perceived risk (Tukey's HSD: $p = 0.001$; $p < 0.001$). • Group 1 less likely to report forecasting to better protect themselves (19%), compared to Group 2 (23%), and Group 3 (25%). • Factors reported to most likely influence weekend sun protection behavior: weather (59%), personal habits (34%), forecast alone (7%). • No significant differences in sunburn rates for the groups. • Variables contributing independently to variability in skin protection intention: Skin damage distress, self-efficacy for skin protection, and perceived control over skin protection ($p < 0.001$). • Variables independently contributing to sun exposure intention: UV exposure outcome beliefs, and sun exposure avoidance self-efficacy (inverse relationship) ($p < 0.001$) • Variables independently contributing to indoor tanning intention: Skin damage, outcome evaluations, indoor tanner prototype, and norms for exposure ($p < 0.001$) • Only significant demographic predictor of intentions was family history of skin cancer (lower intention to sun expose).
Heckman et al. (2011) Fishbein's Integrative Model (IM) constructs for UV exposure and skin protection intentions.	Quantitative, Non-experimental, Cross-sectional	Key IM constructs: Background/individual variables, attitudes, beliefs, norms, and self-efficacy. Behavior predictors: Skin protection, sun exposure, and indoor tanning intentions.	<ul style="list-style-type: none"> • Knowledge of sun protection methods ↑ in females. • Attitudes of having a suntan ↑ in females (93% v 73%) • Knowledge sources on skin cancer prevention: parents and family (28%), television, magazines and newspapers (52% total). School education 4%. • Barriers in 25–28 age group: cosmetics, comfort, and convenience. • Highest prevalence of sunburn: 18–29 yrs (52%), prevalence ↓ with age ($p < 0.001$). • Sunburn common with frequent burns and/or freckling (45.9%), whites (44.3%), family hx Melanoma (43.9%). • Sunburn varied by US region: South 36.5%; Midwest 40.4% ($p = 0.001$) • Sunburn positively associated with indoor tanning device use (44.1%) physical activity (41.7%), alcohol consumption (39.8%), and being overweight/obese (39.9%, all 95% CI, $p < 0.001$)
Hedges et al. (2010) Knowledge, attitude, and behavior of park users in two London parks.	Quantitative, Non-experimental, Cross-sectional	Skin type of participants; knowledge of risk awareness, attitudes toward sun exposure risk, sun protection behaviors; and, sources of information on sun protection knowledge	<ul style="list-style-type: none"> • Knowledge of sun protection methods ↑ in females. • Attitudes of having a suntan ↑ in females (93% v 73%) • Knowledge sources on skin cancer prevention: parents and family (28%), television, magazines and newspapers (52% total). School education 4%. • Barriers in 25–28 age group: cosmetics, comfort, and convenience. • Highest prevalence of sunburn: 18–29 yrs (52%), prevalence ↓ with age ($p < 0.001$). • Sunburn common with frequent burns and/or freckling (45.9%), whites (44.3%), family hx Melanoma (43.9%). • Sunburn varied by US region: South 36.5%; Midwest 40.4% ($p = 0.001$) • Sunburn positively associated with indoor tanning device use (44.1%) physical activity (41.7%), alcohol consumption (39.8%), and being overweight/obese (39.9%, all 95% CI, $p < 0.001$)
Holman et al. (2014) Demographic, behavioral characteristics, and sunburn among US adults.	Quantitative, Non-experimental, Cross-sectional	Demographic characteristic (e.g. Sex, age, race, marital status, etc.) Behavioral characteristics (e.g. sun protection, indoor tanning device use, ever had a skin exam, etc.)	<ul style="list-style-type: none"> • Barriers in 25–28 age group: cosmetics, comfort, and convenience. • Highest prevalence of sunburn: 18–29 yrs (52%), prevalence ↓ with age ($p < 0.001$). • Sunburn common with frequent burns and/or freckling (45.9%), whites (44.3%), family hx Melanoma (43.9%). • Sunburn varied by US region: South 36.5%; Midwest 40.4% ($p = 0.001$) • Sunburn positively associated with indoor tanning device use (44.1%) physical activity (41.7%), alcohol consumption (39.8%), and being overweight/obese (39.9%, all 95% CI, $p < 0.001$)

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Table 1 (continued)

Author/Year/Purpose	Design	Influential factor	Results/Behavior
Ingledeew et al. (2010) Role of motives in determining exposure and protection behavior.	Non-experimental, Cross-sectional, Descriptive	Participatory motives (e.g. appearance enhancement, social conformity, well-being, etc.) Dispositional motives (e.g. fame, wealth, image, etc.)	<ul style="list-style-type: none"> • Participatory motives influenced behavior • Participatory motives strongly predict exposure behavior, moderately predict protection behavior. • Exposure positively influenced by appearance enhancement and well-being motives • Appearance enhancement positively influenced by fame and image life goals
Janssen et al. (2015) Sun protection behavior in snow sports participants, and associated psychosocial factors.	Quantitative, Non-experimental, Longitudinal	Level of knowledge, risk perception, worry, attitude, social influence, self-efficacy, and intention	<ul style="list-style-type: none"> • 40% did not use sunscreen during holiday • Reported more sunburns during holiday: Men ($\chi^2 = 5.70$; $p < 0.05$), younger ($t = 4.64$; $p < 0.01$), sunny weather conditions ($\chi^2 = 25.61$; $p < 0.01$, and infrequent sunscreen use ($\chi^2 = 11.14$; $p < 0.01$) • Predisposing factors to sunscreen use: older and female (0.20, 0.19) $p < 0.001$, age (0.19), gender (0.10), weather condition 0.10), knowledge (0.13), affective likelihood (0.19), and comparative severity (0.12). • Attitude strongest association with sunscreen use (0.21), followed by self-efficacy (0.16), intention 0.13), and weather condition (0.11). • Any level of phys. activity significantly more likely to report sunburn (54.0%; 9.8%) • Highest proportion of sunburn with ≥ 7 h phys.activity in past 12 months or sunburn on previous weekend. • More sun protection use, darker skin type, \uparrow age, female, unemployed/retired, living in major cities significantly associated with \downarrow sunburn odds in last 12 months • Each extra hour phys.activity associated with 2% \uparrow in odds of sunburn. • Intention to avoid unprotected sun exposure significantly related to age and female gender only; unrelated to education level. • In order, participants reported greatest health media exposure and attention to Internet, television, magazines and newspapers. • Internet use was unrelated to unprotected sun exposure behavioral intentions ($r = 0.04$, $p = 0.13$). • More negative social attitudes with magazine usage, and less perceived control to decrease unprotected sun exposure.
Jardine et al. (2012) Relationship (Queensland Self-Reported Health Status (SHRS) survey) b/n physical activity and sunburn.	Quantitative, Non-Experimental, Multiple Logistic Regression Analysis.	Relationship b/n physical activity and sunburn.	<ul style="list-style-type: none"> • Couples that discuss SSE together are more likely to engage in SSE. • Couples that consider benefits of engaging in SSE for relationship are more likely to discuss and engage in SSE. • H and W adopting greater relationship-centered motivation more likely to discuss and engage in SSE. • Women reported higher SSE benefits and greater relationship-centered motivation for SSE compared to men
Lovejoy et al. (2015) Health-related mass media use and intentions to avoid unprotected sun exposure.	Quantitative, Non-experimental, Cross-sectional	Two-part: health media usage to avoid unprotected sun exposure; Health Behavior Theory (HBT) constructs r/t mediation of relationship b/n health media use and intentions to avoid unprotected sun exposure.	<ul style="list-style-type: none"> • Risk-reduction practices relatively low in FDRs • Most common sun protection behavior: sunglasses, least common: shirt with sleeves • FDRs never having had a TCE: 45%; 13.4% reported no exam ≤ 3 yrs, no SSE performance in past year: 28%; 22% conducting SSE $\geq 10 \times$ in past yr • FDRs w/TCE engaged in more sun protection, and performing ≥ 1 SSE in past yr engaged in more sun protection
Manne et al. (2016) Interdependence theory and relationship factors in skin self-examination (SSE)	Quantitative, Non-experimental, Cross-sectional	Demographic factors, measures of skin cancer worry, skin self-examination benefits and barriers, relationship-centered motivations for skin self-examination, discussions about skin self-examination; and, skin self-examination practices in the past year.	<ul style="list-style-type: none"> • Subjects engaging in regular sun protection = 23%; comprehensive SSE $1 \times / 2$ mos = 17% • SSE use associated with the presence of moles and higher self-efficacy. • Regular sun protection r/t older age, and being female. • Regular sun protection r/t higher self-efficacy
Manne et al. (2004) Correlates of sun protection, total cutaneous exam (TCE), and skin self-exam (SSE) among first degree relatives (FDR) of those diagnosed with malignant Melanoma (MM).	Quantitative, Non-experimental, Cross-sectional	First Degree Relatives (FDR), and their measures of engagement in TCE, SSE, and habitual sun protection behaviors. Measure of knowledge and attitudes about all 3 behaviors.	
Mujumdar et al. (2009). Skin self-examination (SSE) and sun protection practices in melanoma survivors.	Quantitative, Non-experimental, Cross-sectional	Behavioral adherence with SSE and sun protection, self-efficacy in performing behaviors; and, perceived risk developing another skin cancer.	

Myers et al. (2006) Self-efficacy and perceived control correlates with sunbathing behavior.	Quantitative, Non-experimental, Cross-sectional	Self-efficacy and perceived control as predictors of sunbathing intention and behavior.	<ul style="list-style-type: none"> • Correlations found between: behavior and self-efficacy ($r = 0.56$), behavior and attitude ($r = -0.46$), intention and attitude ($r = -0.47$), and intention and self-efficacy ($r = 0.44$) • Attitudes and self-efficacy significant predictors of intention. • Best predictor of behavior was self-efficacy ($p < 0.001$). • Self-efficacy predicted sun protection behavior.
Robinson et al. (2016) Tanned media images and recreational sportswomen's sun protection decisions.	Quantitative, Experimental Randomized Controlled Trial	Group and image norms of young recreational sportswomen.	<ul style="list-style-type: none"> • Self-efficacy predicted sun protection behavior. • Group Norm: sportswomen engaged in more sun-protective behaviors in the supportive norm condition over non-supportive group • Non-sporting women perceived to engage in more sun-protective behaviors in non-supportive condition over supportive condition group • Image Norm: perceived model as being more tanned than pale image norm condition • Two-week follow-up: moderate level of sun protection among sportswomen with average amount of engaged sun-protective behavior
Stanton et al. (2005) Community members' skin protection and risk factors with decision making, and influential variables.	Quantitative, Non-experimental, Cross-sectional.	Perceptions of doing enough skin protection including: intrapersonal, social, and attitudinal influences.	<ul style="list-style-type: none"> • Four sets of reasons emerged as 'why people protect from sun': health, risk, norms, and exposure level. • Seven sets of reasons emerged as 'why people do NOT protect themselves from sun': anti-authority, hedonism, disbelief, apathy, image, prevention; and, family history. • Association b/n high self-esteem and perceptions of skin protection behavior for those with high prevention behavior. • Social and Attitudinal Predictors of Perceived Adequacy of Skin Protection Activities: grouped as behavior, intention; and, beliefs. • More positive responses from participants perceiving habits from other peers on boat. • Peers: did not enjoy exposing unprotected skin to sun, believed sunburn is not an acceptable risk, wore sunglasses on the trip, and wore a wide-brimmed hat along with a long-sleeved shirt and sunscreen • Peers did not report reasons neglecting sun protection usage
Woolley et al. (2009) Peer group protective practices during recreational boat trip, and attitudes and behaviors of individuals on same boat.	Quantitative, Non-experimental, Cross-sectional	Peer group involvement on boat trip.	

*Abbreviations listed in alphabetical order. (avg = average; b/n = between; FDRs = first degree relatives; H = husband; HBT = health behavior theory; IM = integrative model; MM = malignant melanoma; mos = months; r/ t = related to; SPF = sun protection factor; SSE = skin self-examination; TCE = total cutaneous exam; UV = ultraviolet; v = versus; W = wife; yr = year; yrs = years; ↑ = increase; ↓ = decrease.

days per calendar year or more adults in outside work settings. Overall, sunburn was less common in those residents living less than 10 years in the US, as compared to those that were US born or having greater than a 10 year residency (9.5%; 33.4%; $p < 0.001$) [20].

Some people are genetically at higher risk for skin cancers like Melanoma [21]. Manne et al. (2004) examined first degree relatives (FDR) of those diagnosed with malignant Melanoma, studying engagement in total cutaneous examination (TCE), skin self-examination (SSE), and habitual sun protective behaviors. In this sample, there was low engagement in sun protection practices, with the most common prevention behavior as wearing sunglasses [21]. Forty five percent of FDRs had never had a TCE, and only 13% of those indicating a prior exam reported no exam in the last 3 years [21]. Twenty eight percent of FDRs reported no SSE performance within the past year, and only 22% conducted SSEs more than 10 times in the past year [21]. Therefore, the correspondence among TCE, SSE, and sun protection show significant associations ($X^2 = 13.0$, $p < 0.001$), with FDRs performing TCE engaging in more sun protection behaviors ($F = 34.35$, $p < 0.001$) [21]. Conclusively, though FDRs may have a higher non-modifiable genetic predisposition to melanoma, it is known that risk-reduction practices may be relatively low in FDRs.

A second study of SSE and sun protection practices among Melanoma survivors (non-modifiable personal history of skin cancer) examined behavioral adherence, self-efficacy in performance of SSE, and perceived risk in developing another skin cancer [22]. Twenty three percent of the subjects reported engaging in regular sun protection, while only 17% reported a comprehensive SSE once in 2 months [22]. Using SSE was related to the presence of moles (OR = 4.2, 95% CI: 1.1–15) and higher self-efficacy (OR = 14.4, 95% CI: 1.9–112), and the regular use of sun protection was related to older age (>60 yrs; OR = 3.3, 95% CI: 1.3–8.7) and being female (OR = 2.8, 95% CI: 1.1–7.3) [22]. In addition, regular sun protection were related to higher self-efficacy levels (OR = 5.0, 95% CI: 1.4–18), more so than personal history of melanoma.

A study from Ref. [23] Bowen, Jabson, Haddock, Hay, and Edwards (2012) examined Melanoma survivors' perceived risk for developing another Melanoma diagnosis, cancer worry, and how physician's screening behaviors influenced his or her skin protection behaviors. Wearing long pants or skirts (80%) was the most popularly reported sun protection behavior, with the lowest wearing a hat with a brim (16%) [23]. Eighty nine percent were not worried about getting skin cancer again; however, the risk-perception of this group was reportedly higher than average ($N = 232$; 74%) [23]. Sunscreen was predicted by gender, with males 94% less likely to engage in prevention behaviors (95% CI: 0.03–0.13, $p < 0.001$), and season with people reporting two times the usage of sunscreen in summer months (95% CI: 1.06–4.51) [23].

3.3. Interventions examining sun protection factors

Several studies of interventions reported outcomes of sun protection behaviors. For example [24], Dixon, Hill, Karoly, Jolley, and Aden (2007) evaluated the effectiveness of implementing solar UV forecasts using workplace email and internet access to assess behavior change for sun protection. When comparing intervention and control groups, those in the intervention group (forecast + UVI + sun protection message) reported significantly higher perceived risk compared to those in control ($p < 0.001$); and, among all groups, factors reported to most likely influence weekend sun protection behavior were: weather (59%), followed by personal habits (34%), and forecast alone (7%) [24]. Although internet usage proved to be feasible for timely prompting, dissemination of forecasting, and UV information, the results of the

intervention did not support enhanced sun protection or reduced exposure [24].

In a similar study [25], Lovejoy, Riffe, and Lovejoy (2015) examined the relationship between health media usage and intentions to avoid unprotected sun exposure. Participants reported greatest health media exposure and attention to the Internet (mean exposure = 2.7 days, mean attention = 3.0 days), television (me = 1.6, ma = 2.5), magazines (me = 1.2, ma = 2.1), and newspapers (me = 1.1, ma = 2.0). However, internet use was unrelated to unprotected sun exposure behavioral intentions [25]. It was reported that magazine usage was associated with more negative social attitudes regarding sun protective behavior, and less perceived control to decrease unprotected sun exposure ($p < 0.05$, $p < 0.001$) [25].

Finally, in a third study, a randomized controlled trial was implemented to study group-based social influences compared to tanned media images in a sample of younger recreational sports women [26]. Results indicated that stronger peer group association influenced behavior as opposed to direct intention. These findings are consistent with the findings from Ref. [27] Woolley and Buettner (2009) who studied protective practices of peers on a recreational boat trip. Respondents on the boat reported performing positive sun protection practices when observing those behaviors in the peer group ($p < 0.001$). Discoveries here suggest that sun protective factors implemented in a peer setting may be effective for promoting sun protective behaviors.

3.4. Theoretical perspectives on behavioral intention and sun protection

Factors affecting behavioral intention have been identified in the theoretical literature. One influential model that was designed to enhance understanding of factors instrumental to behavior change is the Theory of Planned Behavior (TPB) [28]. The TPB focuses on intention to perform an identified behavior and perceived behavioral control. When applying the TPB, evaluation of internal and external control factors of an individual is performed, in relation to potential behavior change [12]. Several studies have evaluated the use of the TPB model for effectiveness when predicting sun protective behaviors [12,25,29,30,31,32]. In a meta-analysis conducted by Ref. [33] Starfelt and White (2016), 38 samples were identified as measuring sun-protective intentions and/or prospective behavior using the TPB as a conceptual framework. Results indicate moderate to strong effects in regard to attitude, with the strongest association to intention ($r^+ = 0.494$), then perceived behavioral control ($r^+ = 0.494$), and finally subjective norms ($r^+ = 0.419$) [33]. The Health Belief Model (HBM) is another theoretical framework that has been used in health and social science projects to enhance understanding of how individual personal beliefs influence health behaviors [34,35]. The HBM has been useful in several studies that examined sun protection factors and skin cancer prevention [36–40]. Interdependence theory has been used to study the role of relationship factors in the performance of skin self-examination (SSE), benefits, barriers, and relationship-centered motivations [17]. This theory is known as a social exchange theory explaining how the costs and rewards related to one's interpersonal relationships work together with one's expectations from them; thus, a systematic classification of how each person can affect the other's actions during a social interaction [41].

4. Discussion

Sun protective measures are essential for the prevention of skin cancer. Given the varied nature of cognitive, psychological, affective, and sociodemographic factors that influence sun protection

behaviors, a comprehensive approach is warranted to effectively enhance sun protective behaviors and diminish skin cancer risk. Since the factors influencing sun protection behaviors in adult populations are modifiable, non-modifiable, and interrelated; understanding the interdependence of these influential factors could lead to a more effective intervention for sun protection behaviors.

Cognitive factors like self-regulatory capacity, behavioral intention, past behaviors, habit, self-efficacy, individual motivation, and self-perception of risk all contribute significantly to intention to engage in sun protective behaviors. This means that it is very important for care providers to evaluate the intrinsic characteristics of an individual. Appearance enhancement and social conformity play a large role in sun protection engagement so it is therefore important for clinicians to assess patient values related to appearance and social norms when providing care.

The findings regarding age and gender are concerning. Since younger adults are more likely to experience sunburn, it is important that sun protection behaviors be embraced at a younger age. It may be necessary to incorporate school-based or community-based interventions which could incorporate peer influence and include parents, aiming to alter behavior at younger ages. The findings regarding gender are conflicting. Knowing that women exhibited a higher intention to seek indoor tanning, but were more accepting of sunscreen and UV protection measures [2], warrants more investigation. Addressing the diminished likelihood that men would use sunscreen is also important. Because age and gender are not modifiable, educational interventions should be individually tailored and risk assessments made readily available for this population.

It is also important to be aware of how impoverished or underserved populations may engage in sun protection behaviors. Lower socioeconomic status individuals and underserved populations are more likely to engage in behaviors that increase cancer risks, and less likely to survive after diagnosis due to advanced stage detection. To make matters more complex, the newer FDA approved immunotherapy targeted drugs are costly and potentially inaccessible to this population [2]. Knowing that those with first degree relatives diagnosed with skin cancer will not necessarily adhere to sun protective measures makes it even more critical that nursing be involved.

This review supports that the most common knowledge sources of sun protection behavior are parents and family, which lends evidence that decision-making could be significantly influenced by one's first exposure to a value and belief system. Other assumptions supporting this finding are the connections seen with relationship centered motivation with married couples engaging in skin self-examination, and social peer-group conformity to predict sun protection behaviors. It would be interesting to evaluate the peer group conformity with the context of outdoor physical activity and sports programs where there are increased sun exposure.

5. Implications for nursing practice

The US Preventive Services Task Force is reviewing their recommendation for skin cancer screening due to insufficient evidence of the balance of benefits and harms of clinical whole body examination for the early detection of skin cancer [42]. However, both the systematic evidence reviewed for the guideline and the Surgeon General's call to action to prevent skin cancer recognize personal risk assessments for the disease. Risks include; family history of skin cancer, considerable history of sun exposure and sunburn, fair-skinned men and women over the age of 65 years, persons with atypical moles, and those with mole numbers greater than fifty [3]. Nurses have the unique holistic skill set, based on their educational preparation, to develop and implement a prevention based approach to skin cancer. The potentially modifiable

behavioral influential factors for skin cancer fall within the purview of the discipline of nursing, meaning that nurses could play a key role in the development and evaluation of interventions that would increase engagement in sun protective behaviors. Furthermore, ongoing educational campaigns about the non-modifiable influential factors for skin cancer, such as female gender, Caucasian race, and lower socioeconomic status (SES) associated with higher cancer incidence, death rates, and decreased survival after diagnosis [2], would also be appropriate for nursing or interprofessional initiatives linked with public health.

A conceptual model has been developed and is presented in Fig. 2. The model is based on the findings from this review and therefore incorporates influential factors, personal decision-making, and sun protection behaviors. The interrelationships among identified demographic factors, psychosocial patterns of behavior, and personal/familial history need to be explored to formulate interventions. Nurse practitioners in rural communities can meet the needs of underserved populations by thoroughly assessing risks, knowledge, and through the completion of clinical skin examinations. The feasibility of implementing annual skin cancer screening with advanced practice nurses has been examined in a medically underserved population at a free clinic [43]. Results indicated that a significant number of worrisome lesions were discovered, lending credibility to the nurse practitioner role in performing total body exams on a regular basis [43]. In addition, a systematic review examined the advanced practice nurse's skin assessment skills in relation to barriers of performance, abilities to recognize suspicious lesions, and skin cancer detection training activities [44]. It was concluded that targeted training for advanced practice nurses would assist with skin lesion recognition [44]. In summary, nursing interventions must be individually tailored to support positive sun protective behavior change with the understanding that all interrelated influential factors need to be considered before the acceptance of a need for change can proliferate. More research is needed on the use of technology, particularly use of the internet and media messaging, for reducing sun exposure.

Approaching the complexities of incorporating factors influencing sun protective behavior into an effective intervention will require the application culturally competent nursing care. When providing culturally competent nursing care, the nurse works within the cultural context of the individual's environment in an attempt to achieve desired healthcare goals and outcomes [45]. In order to do this, one must apply the knowledge of cultural awareness to the identified population with an understanding of ethnic differences and ways of life that influence decision-making desires and capabilities. This is particularly important when addressing the issue of sun protection practices since it is known that knowledge limitations and implicit biases exist regarding race, ethnicity, and sun protection [1].

6. Limitations

The population selected for this paper included studies of persons with the following attributes: adults aged 18 years or older, both male and female biological gender, white, Caucasian/non-Hispanic ethnicity, history of the disease (familial and personal), and all-inclusive social determinants of health (e.g. socioeconomic status, geographical location). Studies that reported only on special cultural populations, special interest groups, or unique gender preferences were not included due to limitations in generalizability of findings.

7. Conclusion

Factors that influence engagement in sun protective behaviors

are multifaceted and include sociodemographics, and cognitive, behavioral, psychosocial, family, and peer concepts. The literature emphasizes that values and norms from culture, family, and community may also influence sun protective behaviors. There is substantial need for nursing intervention development after consideration of these factors. Future research would support specific nursing actions that influence sun protective behaviors to evaluate intervention effectiveness. National guidelines support counseling and educational measures; however, it is likely that a more complex intervention that incorporates components that contribute to rethinking behavioral intentions would be more effective based on these findings. Future research that includes outcomes related to self-regulation, behavioral intention, and self-efficacy would further build knowledge about behavior change and sun protection.

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