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The Effect of a Sun Damage Simulation Photography App on the Skin-Protective Behavior Intentions of Women with Children Age 18 or Younger

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The Effect of a Sun Damage Simulation Photography App on the Skin-Protective Behavior
Intentions of Women with Children Age 18 or Younger

Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of Nursing
Practice at the University of Kentucky

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Lexington, KY

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Abstract

Background: Skin cancer is the most common form of cancer diagnosed in the U.S.

annually, despite being a largely preventable disease through the limitation of ultraviolet radiation exposure. Attempts to decrease its incidence have focused on appearance-based interventions. These have been effective at improving sun-protective behaviors among various subpopulations including people of color. Anecdotal observations suggest mothers more frequently utilize sun protection for their children than on themselves.

Purpose: The purpose of this project was to gain an understanding of the sun protection practices and beliefs of Caucasian and African American mothers, to assess the response to an appearance-based intervention for motivating sun-protective behaviors, and to educate mothers about skin cancer risks and prevention.

Methods: The project was comprised of multiple phases. First, a retrospective chart review was performed to assess the frequency of sun protection counseling at well-child visits for Caucasian and African American children between the ages of four and 18 years. In the intervention phase, mothers completed a survey about their attitudes towards tanning, sun protection, their current practices, and the practices they use for their children. Their actual melanoma risk was calculated using the Self-Assessment Melanoma Risk Score (SAMScore). Next, they used the Sunface App, a facial morphing smartphone application that simulates the effects of sun damage on facial photography. Then, they were provided an educational presentation consisting of the American Academy of Dermatology's Spot Skin Cancer campaign.

Results: The chart review indicated sun protection occurred at 44% of well-child visits ($n = 61$) with no significant differences between race, gender, or among the age of the patients. Survey results found no significant difference between racial groups with regards to sun protection beliefs, personal practices, and protection for their children ($n = 14$). Older mothers, and those that reported high

frequencies of personal sunscreen use were more likely to put sunscreen on their children ($r_s = .696$, $p < .05$; $r_s = .533$, $p = 0.050$, respectively). Having a higher actual risk for melanoma was not associated with more perceived risk of skin cancer by mothers ($F = .745$, $p > .05$). Sunface app reactions fell under three main themes: surprise or disbelief, negative feelings about their appearance, or motivation to increase sunscreen use.

Discussion: While few statistically significant results were found in the study, findings indicate a need for education to mothers about their risk for skin cancer development. Future research is needed to determine factors that may influence the inclusion of sun protection counseling at well-child visits including family histories or competing demands. The Sunface application shows promise as a convenient and effective tool to motivate mothers to improve sun protection practices. Qualitative follow-up survey responses ($n = 2$) indicated participants were motivated to increase sun protection practices following the intervention. Study results and sample size may have been limited by the Fall/Winter timing of the project as well as the percentage of international and low-income patient population at the project setting.

Conclusion: The Sunface application elicited powerful responses by participants and may motivate improved sun protection practices. Primary care providers are in prime, unique positions to counsel their patients on risks for skin cancer and its prevention. With limited visit times and competing demands, alternative methods of providing preventive counseling may need to be considered.

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Table of Contents

Acknowledgments.....	3
List of Tables.....	5
List of Figures	5
Introduction	6
Background	6
Review of Literature	8
Screening	9
Education	10
Innovations	12
Risk Perception Measurement	13
Motivation for Behavior Change	14
Self-Assessment of Melanoma Risk.....	14
Summary of Review	15
Theoretical Framework	15
Agency Description.....	17
Setting	17
Target Population.....	17
Mission, Values, and Strategic Plan	17
Key Stakeholders	18
Site Facilitators and Barriers	18
Project Design	19
Methods.....	20
Intervention	20
Procedures.....	21
Results.....	23
Retrospective Chart Review	23
Pre-Intervention Survey.....	23
Reactions to Sunface App.....	24
Post-Intervention Telephone Survey	25

Discussion	25
Implications.....	28
Limitations	30
Conclusion.....	31
References	32
Appendix 1: Chart Review Data Collection Tool.....	41
Appendix 2: Phase 2 Survey of Mothers.....	42
Appendix 3: Follow-Up Telephone Survey	48

List of Tables

Table 1. Demographic characteristics of the sample	40
Table 2. Survey responses by race	40

List of Figures

Figure 1. Sunface App Preview	47
Figure 2. SAMScore.....	50

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Introduction

Skin cancer is the most common form of cancer diagnosed in the U.S. annually, despite being a largely preventable disease through limitation of ultraviolet (UV) radiation exposure (Centers for Disease Control and Prevention, 2017; American Cancer Society, 2017). Attempts to decrease its incidence have focused on appearance-based interventions. These have been effective at improving sun-protective behaviors among various subpopulations including people of color (Guevara, 2015). The purpose of this project was to understand sun protection practices that Caucasian and African American mothers employ for themselves and their children. The use of an appearance-based smartphone application that simulated the effect of sun exposure was utilized. A retrospective chart review was also conducted on a random sample of children age four to 18 years to evaluate the frequency of education on sun protection during a well child exam.

Background

Skin cancer is an abnormal growth of skin cells, usually on areas of the body exposed to the sun's rays (American Academy of Dermatology, 2019). There are three main types: basal cell carcinoma, squamous cell carcinoma, and melanoma. Each type affects a different type of skin cell and presents differently from one another. Detection of skin cancers are often made through physical examination by a provider or skin self-exam by the patient. Diagnoses are made or confirmed through surgical excision and biopsy of suspicious skin lesions (American Academy of Dermatology, 2019).

Treatment for skin cancer depends on the type and stage of the disease. Various modalities are used including topical medications, surgery, radiation therapy, immunotherapy, and chemotherapy (American Academy of Dermatology, 2019). It is estimated that nearly five million patients are treated for skin cancers in the U.S. annually. The cost to treat has risen to approximately \$8.1 billion per year (Centers for Disease Control and Prevention, 2017; Guy et al., 2016).

Basal cell and squamous cell carcinomas are much more common than melanomas (AAD, 2019). These cancers are usually not life threatening, and are not likely to spread to other parts of the body (AAD, 2019). But, if left untreated, both these cancers can grow deeper, causing injury to tissues, blood vessels, nerves, or bone in their path (AAD, 2019). For this reason, early detection and treatment of these types of cancers is important.

Melanoma is the deadliest form of skin cancer. If not detected and treated early, it can be aggressive and metastasize to the lungs, liver, bone, or brain (Gnanasegaram, 2011). It is the most frequently diagnosed of all cancers among adults aged 25 to 29, and the second most frequent in those aged 15 to 19 (Falzone et al., 2017). Melanoma incidence rates in the state of Kentucky are higher than the national average, and have risen an estimated 2.1% annually from 2011 to 2015 (National Cancer Institute, n.d.). The American Cancer Society projects there to be over 1,300 new cases of melanoma in the state of Kentucky in the year 2020 and attributes melanoma as the cause of 130 deaths in the same year (American Cancer Society, 2020).

Skin cancers of all types predominantly affect the Caucasian race. Although people of color have a lower incidence of skin cancers, their prognosis is disproportionately worse than that of Caucasians (Higgins, Nazemi, Chow, & Wysong, 2018). Five-year survival rates of Caucasian patients with melanoma is 89.6%, 81.1% for Hispanics, and only 72.2% for African

Americans (Kailas et al., 2016). When detected in people of color, they are often at a later stage, present atypically, or are more likely to metastasize when compared to Caucasians (Higgins, Nazemi, Chow, & Wysong, 2018).

Reasons for the disparity in survival rates from melanoma have centered on providers having a low suspicion of skin cancer in those of color. Lunsford et al (2018) reports that providers, as well the non-white population, do not perceive a risk for skin cancer. (Lunsford, et al., 2018). Shah et al., (2017) examined sun-protective behaviors of racially diverse caregivers and found those that are African American are the least likely to apply sunscreen to their own children due to a lack of perceived risk.

Although incidence rates in the U.S. are rising, skin cancer is largely preventable. The current recommended prevention strategies focus on limiting UV exposure from the sun by avoidance, using sunscreens, and wearing protective clothing on a regular basis (Buller et al., 2016). These recommendations have been in place for many years, yet national rates of sun-protective behaviors continue to be low. Of interest is the use of sunscreen in childhood but the waning of its use in adolescence and adulthood (Patel et al., 2019).

Review of Literature

A systematic review of the literature was performed using PubMed, CINAHL, and Google Scholar. Key words used in the searches included: *adults, women, mothers, children people of color, skin neoplasms, skin cancer, melanoma, attitudes, risk perception, susceptibility, primary care, beliefs, education, screening, and self-assessment*. Inclusion criteria limited results to include publications available free in full text, published in the English language, peer reviewed primary studies, and published within the past ten years. Exclusion criteria further

limited results to omit publications focused on populations of special interests such as solid organ transplant recipients, hematopoietic stem cell transplant recipients, and those with pre-existing, noncancerous, disorders of the skin such as albinism, psoriasis, and vitiligo.

The literature review revealed several key themes. Notably, studies highlighted the controversy surrounding the United States Preventive Services Task Force's (USPSTF) recommendation on skin cancer screening, the need for targeted education for racially-diverse populations, and emerging technological innovations. Additionally, insight into variances among measuring risk perceptions, and factors that are most likely to lead to behavior change was noted.

Screening

In 2016, the USPSTF released a statement citing insufficient evidence to recommend screening for skin cancer in asymptomatic adults (HHS, 2016). This recommendation refers to visual skin examination by a clinician. It does not apply to patients who may be at increased risk for skin cancer such as those with a personal or family history, suspicious lesion, or severe sun damage. However, there is some concern that the statement from the USPSTF downplays the importance of skin cancer prevention and early detection (Linos, Katz, and Colditz, 2016). As a result, the American Academy of Dermatology (AAD) has issued comments to the task force suggesting they reconsider their statement and consider targeted recommendations for populations at high risk (Tuelya, 2016).

Despite the statement by the USPSTF, organizations including the Skin Cancer Foundation and the AAD continue to support screening for all adults. The Skin Cancer Foundation (2019) recommends patients examine their own skin monthly for new, changing, or worrisome lesions, and see a dermatologist at least once a year. Meanwhile, the AAD has

continued to offer free skin cancer screenings via a nation-wide, travelling public outreach campaign for the past 34 years (Tuelya, 2016; Linos, Katz, and Colditz, 2016). This campaign has reached all fifty states with nearly 3 million free skin cancer screenings performed. These screenings have detected over 270,000 suspicious skin lesions, and more than 30,000 suspected melanomas (AAD, 2020).

Education

Considering the insufficient evidence to screen for skin cancer, efforts to reduce mortality and morbidity are being shifted toward primary prevention. Evidence suggests most skin cancer cases are preventable through minimizing exposure to UV radiation. (Buller et al., 2016). This includes regular use of sunscreen, seeking shade, wearing protective clothing and sunglasses, and avoiding tanning in the sun or tanning beds. These recommendations are long-standing. However, skin cancer incidence rates continue to rise, and tanning bed use remains prevalent (National Cancer Institute, n.d.; Le Clair & Cockburn, 2016). This discrepancy lends further support to the need for education on skin cancer prevention.

Use of indoor tanning beds is associated with increased risk of both melanoma and non-melanoma skin cancers (Le Clair & Cockburn, 2016). There is a common misconception that indoor tanning beds are safer than outdoor tanning. However, tanning beds may emit UVR in amounts 10 to 15 times higher than that of the sun (Le Clair & Cockburn, 2016). Exposure to the radiation from tanning beds can directly cause photoaging of the skin, damage to skin cell DNA, and ocular melanomas (Le Clair & Cockburn, 2016). Efforts to regulate the use of tanning beds have been made. These include mandatory requirements for salons to post warnings of the effects of UVR exposure and state legislation requiring parental consent for underage users (Le Clair & Cockburn, 2016). In Kentucky, children under age 14 must be accompanied by a parent

or guardian in order to use a tanning bed (Northern Kentucky Health Department, 2020). Those between the ages of 14 and 18 must have a signed parental consent form on file at the salon (Northern Kentucky Health Department, 2020).

The USPSTF (2018) does support behavioral counseling for reducing UV exposure to fair-skinned patients aged 6 months to 24 years, and selectively to those over 25 years of age (grade B and C statements, respectively). They suggest behavioral counseling can increase sun protection behavior (Henrikson et al., 2018). Despite the recommendation, Holman, Qin, Gottschlich and Balk (2019) reported only about 48% of surveyed primary care providers said they regularly counseled on sun protection. Additionally, only 27% of providers regularly counseled against indoor tanning. Furthermore, most adult patients are unable to identify proper sunscreen recommendations including minimum sun protection factor (SPF) and application (Vasicek, Szpunar, & Manz-Dulac, 2018).

Knowledge of primary and secondary measures for skin cancer is lowest among people with low levels of education and lower socioeconomic status (Sieté, del Marmol, Moyal, & Friedman, 2017). People of color have not been consistently included in skin cancer education. This population, especially those with darker skin tones, are less likely to perceive a risk for skin cancer and are less knowledgeable of skin cancer prevention measures (Kailas et al., 2017; Gupta, Bharadwaj, & Mehrotra, 2016; Lundsford et al., 2018). However, educational interventions have been effective at increasing knowledge and improving preventive behavior. Counseling for people of color should include pictures of skin cancer lesions on various skin tones (Kailas et al., 2017). Lastly, this population should be counseled on skin self-examinations and the importance of assessing the palms of hands, soles of feet, and nail beds (Gupta, Bharadwaj, & Mehrotra, 2016).

Spot Skin Cancer is the AAD's public awareness campaign (AAD, 2019). It includes resources such as local dermatology searches, education for parents, children, adults, and providers, and occasional free skin cancer screening services. The educational resources, such as the "Skin Cancer: You Can Prevent It" presentation, are targeted at specific audiences and provide thorough background information as well as prevention and detection advice (AAD, 2019). This presentation includes information about the sun's UV rays as a cause of skin cancer, the three main types, and how to perform a skin self-examination. It describes optimal sunscreen selection and application, as well as other prevention methods (AAD, 2019). The thorough, all-inclusive nature of this presentation sets it apart from other awareness campaigns such as Australia's Slip, Slop, Slap campaign and the CDC's Skin Cancer Awareness campaign. The educational resources included in these campaigns are more specialized, separated by topics of prevention versus detection, as well as by target population (SunSmart Vicotria, 2020; CDC, 2020).

Innovations

Interventions that highlight the negative effects of the sun on one's appearance have shown to be effective at motivating sun-protective behaviors (Tuong & Armstrong, 2014). Personalized UV photography that reveals otherwise invisible sun damage has been used to elicit impactful responses from participants. However, the cost and practicality of required equipment has prevented wide use of this intervention (Tuong & Armstrong, 2014).

Advancements in mobile technology and telemedicine are providing the field of dermatology with new innovations for both skin cancer prevention and detection. Titus J. Brinker, a German dermatologist, developed the Sunface smartphone application (app). This app, which is available for free, uses facial morphing technology to simulate sun damage on facial

photographs of its users based on their skin type and UV ray exposure habits. When trialed among 25 German adults between the ages of 19 and 25 years-old, the majority of participants felt the app had the potential to increase motivation toward use of sun protection (92%), and it could change their perception that tanning makes one more attractive (76%). The app was also trialed among secondary school children in Germany, where over 60% of participants indicated that the app motivated them to avoid tanning (62%) and increase sun protection (63%) (Brinker et al., 2017). Unfortunately, these responses were less positive among participants with darker skin tones (Brinker et al., 2017). However, some evidence suggests people of color have stronger reactions to images of skin cancer when they appear on skin tones similar to their own (Guevara, 2015).

Risk Perception Measurements

Insight into possible explanations for varying results regarding measurements of risk perception was explored. The type of questions used to assess risk may influence patient responses (Janssen, van Osch, de Vries, & Lechner, 2011; Heckman, Handorf, Darlow, Yaroch, & Raivitch, 2017). Variations among the operational definition of perceived risk including absolute risk versus comparative risk produced different outcomes. Responses indicating conditional, affective likelihood and comparative risk were better associated with intentions to perform a specific behavior (Janssen, van Osch, de Vries, & Lechner, 2011; Heckman, Handorf, Darlow, Yaroch, & Raivitch, 2017). Therefore, when the goal is to motivate health behavior change, questionnaire items measuring comparative risk and conditional likelihood should be utilized.

Motivation for Behavior Change

Various strategies were found to be effective at motivating behavior change. The evidence suggests that targeted behavioral counseling, participation in interactive web-based educational programs, and awareness of a high-risk of skin cancer were all effective at motivating several skin-related health behaviors. These behaviors include skin self-examinations (SSEs), total body skin exams (TBSEs), and avoidance of tanning (Carciooppolo, 2016; Arnold & DeJong, 2015; Diao, & Lee, 2013; Rat et al., 2014; Rat et al., 2014). Interventions for improved skin-protective behaviors should be designed in accordance with these effective modalities.

Self-Assessment of Melanoma Risk

Lastly, this review of literature also included information regarding the use and effectiveness of risk assessment tools. One tool used to assess melanoma risk has demonstrated some effectiveness. The use, validity, and reliability of The Self-Assessment Melanoma Risk Score (SAMScore) is well documented (Quéreux et al., 2012; Davies et al., 2015; Rat et al., 2014). Developers based questionnaire items on established risk factors for melanoma as defined by available literature. The survey includes demographic data, skin type, sunburn history, and family history of melanoma to estimate an individual's risk of developing melanoma. Scores are generated by responses that meet one of three criteria: the presence of at least three of the seven risk factors assessed, the presence of more than 20 melanocytic nevi on both arms, or being over 60 years of age with freckling tendency. Internal validity was based on 5000 bootstrap samples and the analysis of receiver operating characteristic (ROC) curves (Quéreux et al., 2011). The SAMScore has been touted as an efficient way to identify patients with a high-risk of melanoma who may benefit from additional screening or examination by a practitioner. Quéreux et al.

(2012) report that the SAMScore reduces the number of patients that need to have a skin examination by a provider by eleven times (P=0.0016).

In 2014, Rat and colleagues reported efficacy of the SAMScore in their randomized controlled trial. High-risk patients were identified using the SAMScore, examined by a general practitioner, and then counseled and provided with educational leaflets. In comparison, the control group were not identified with the SAMScore and were able to view educational material displayed in the waiting rooms. Intervention participants were found to more correctly identify their risk of melanoma, less likely to sunbathe, and more likely to perform SSEs during the year following the intervention (Rat et al., 2014).

Summary of Review

This review of literature has provided insight into skin cancer prevention. Successful strategies for motivating skin-protective behaviors were identified. However, the review also highlights some of the challenges associated with this growing health problem. These challenges include the lack of recommendation for routine screening and the apparent need for improved education. As Advanced Practice Registered Nurses (APRNs) are growing in number among primary care practice and the field of dermatology, they must be at the forefront of addressing skin cancer prevention. APRNs could impact this issue through increasing access to care and taking every opportunity to educate their patients on skin cancer risk and prevention.

Theoretical Framework

The study of behaviors, including health behavior, has been an interest of theorists and social psychologists for nearly 100 years. However, in the 1970s, Albert Bandura introduced the Social Learning Theory, later known as Social Cognitive Theory. Bandura's theory asserts that

human behavior is a result of the interaction of personal, environmental, and behavioral influences (Glanz, Rimer, & Viswanath, 2008). It includes concepts that have been used to explain and influence behavior change.

Several of these concepts serve as the foundation for the methods used in this project. Outcome expectations, or beliefs about the value or risks engaging in a certain behavior, is described by Bandura as a psychological determinant of behavior (Glanz, Rimer, & Viswanath, 2008). In essence, an individual is likely to engage in a behavior if they perceive it will maximize benefits and minimize cost. Another key concept is self-efficacy. This is the belief about one's own ability to influence factors or perform actions that affect their life (Glanz, Rimer, & Viswanath, 2008). In terms of health behavior, a patient is more likely to engage in a specific behavior if they are confident they will be successful at it.

Observational learning is a central concept of Social Cognitive Theory. This concept describes the adaptation or learning of behaviors by observing the behaviors of others, particularly among children (Glanz, Rimer, & Viswanath, 2008). Children will often model the behaviors of other children, or others older than them, when faced with unfamiliar situations. Le Clair and Cockburn (2016) report a positive association between parental tanning behaviors and tanning among their children. They suggest indoor tanning prevention counseling should be directed toward adolescents and parents alike.

Using Bandura's theory, this project was designed to capture data on mothers' sun protective measures and those used for their children. The frequency of discussions of sun protection at well-child visits was assessed, and mothers were surveyed on their attitudes and practices. The educational portion of this project was intended to influence behavior by highlighting the benefits of using sun protection to prevent skin cancer. The intervention also

aimed to increase self-efficacy by providing easy-to-follow instructions for prevention methods. Additionally, the concept of observational learning is addressed by gathering data on mothers' current sun protection behaviors for themselves and for their children. To achieve these objectives, the study required a setting that offered a diverse demographic. This diversity would allow for convenient sampling of patients of varying ages and race. For this reason, an urban primary care clinic was selected.

Agency Description

Setting

This project took place at an urban primary care clinic, located in Lexington, KY. It provides primary care to racially-diverse patients of all ages who are of low socioeconomic status. Providers at the clinic consist of both physicians and APRNs. Services range from obstetrical care to general medicine.

Target Population

The target population for the current project included Caucasian and African American mothers who have children between the ages of four and 18 years. The clinic chosen for the project site had a diverse population. The patient volume and demographic variance facilitated convenient sampling of the population of interest.

Mission, Vision, and Strategic Plan

Part of a large, urban medical system, the clinic shares its mission and vision and strategic plan. The mission is based on the three pillars of academic healthcare: research, education, and clinical care. Its vision is to provide optimal, multidisciplinary care to the

population of Kentucky and surrounding regions. The organization's strategic plan is built on a foundation of patient-centered care and includes growing areas such as ambulatory care, primary care services, and community health partnerships (UKHC, n.d.). The current project was aligned with the values and goals of this organization in that it was focused on primary prevention of skin cancer. This project intended to serve as an early step in enhancing the care of adults in Kentucky and improve their health.

Key Stakeholders

Project stakeholders included various individuals including the clinic's health care providers, administrators, and primary care patients. Additionally, due to the nature of the data obtained, insurers and local dermatology providers were also considered stakeholders for this study. Approval and coordination of project implementation at the clinic was given by clinic administration.

Site Facilitators and Barriers

The clinic's uniquely diverse patient population was a considerable facilitator toward reaching the target population for this project. Along with a large volume of patients seen each day, this diverse population provided a convenient and statistically-effective sample of mothers. Additionally, the committee chair and academic adviser, Dr. Judith Daniels, is employed as a provider at the clinic and was instrumental in gaining buy-in from fellow providers, staff, and patients.

The chosen site presented several barriers to implementation of the project as well. First, due to the large volume of patients seen each day, the clinic is often very busy. Because of this, patient visits typically last only twenty minutes, and their exam rooms are filled and refilled

rapidly. This project intervention required approximately thirty minutes to complete and could not practically be completed in the patients' assigned exam room. Therefore, patients were escorted to a private room, dedicated to the project intervention.

Another barrier encountered at this location is the large portion of the patient population who do not speak English as their first language. While live translators and translation via telephone is often available for patient care, these staff are hired by the clinic and were not able to assist with project implementation. Additionally, survey and educational materials were printed in the English language only and were not suitable for a participant who did not speak English primarily. Because of this, the project was narrowed to focus on Caucasian and African-American women who speak English as their first language. This eliminated a large portion of the clinic's clients and an underserved population in general.

Project Design

This project was a dual-phase study to gather data on sun cancer prevention practices and evaluate intervention outcomes. The first phase was a retrospective chart review of 60 randomly-selected pediatric patients between the age of four and 18 years who presented to the primary care clinic for a well-child exam. The review included data on subjects' age, race, gender, personal history of skin cancer, family history of skin cancer, and inclusion of sun protection counseling during the visit.

Phase two of the study employed a quasi-experimental design. Pre-intervention surveys were completed by mothers with children aged four to eighteen years (see Appendix 1). The 28-item surveys included data regarding their current attitudes, self-protective practices, and the sun protection they use for their children. The last page of the survey consisted of the SAMScore

questionnaire and calculation. After the survey, subjects used a facial-morphing photography smartphone application to visualize themselves with simulated effects of sun damage on their faces, and were provided an educational verbal presentation. Post-intervention surveys were completed roughly two months after the intervention to assess the effect on behavior intentions and attitudes regarding sun protection.

Methods

Intervention

The interventions chosen for this project were the Sunface mobile application (app) and an educational session on skin cancer types and prevention recommendations. The Sunface app was chosen based on evidence that appearance-based interventions are effective at motivating sun-protective behavior (Guevara, 2015; Tuong and Armstrong 2014). The app offered a cost-effective and convenient method for utilizing this type of intervention. The changes to the facial image intensify with each setting, adding dark spots and wrinkles, representing age progression in blocks of 5 to 10 years. Additional settings included increased risk for melanoma and carcinomas which added simulated skin lesions to the image (see Appendix 2).

Subjects were given a brief description of the app, explaining its intention to show them what effects sun damage could have on their facial appearance without proper protection. After verbal permission was obtained, the principle investigator (PI) used the app to take a photograph of the subjects' face. Then, both the PI and the subject viewed the image in its original form and with the simulated changes made to it by the app. Initial verbal and nonverbal reactions were noted. Finally, participants were asked to express their thoughts about seeing their image with the simulated sun damage.

Each subject was educated briefly on the damaging effects of the sun's rays, the different types of skin cancer, and recommended screening and prevention methods. This education consisted of the PI's verbal presentation of the AAD's Spot Skin Cancer campaign. Each participant received a print-out of the presentation slides and the slides were used as visual aids throughout the presentation. After the presentation, time was allotted for final thoughts by the participant or to answer any questions they had.

Procedures

Sample. Inclusion criteria for phase one of the study included Caucasian and African American children aged four to eighteen years. Convenience sampling was used for the review. These patients had been seen in the primary care clinic for a well-child exam between April 2019 and October 2019. Each provider's schedule during this time period was reviewed and the first 30 Caucasian and first 31 African American subjects to meet the criteria were included. For phase two of the study, inclusion criteria was as follows: Caucasian or African American female, aged 18 to 50 years, spoke English as their first language, and had a least one child between the age of four and 18 years who was a patient at the same clinic. This phase also used convenience sampling as recruitment occurred from patients who presented to the clinic on days when the PI was present. A total of 14 participants completed phase two of the study.

Data Collection. Approval from the University of Kentucky's Institutional Review Board (IRB) was obtained prior to any access to medical records or data collection. For phase one, patient charts were accessed and screened to identify participants who met the inclusion criteria. Using a data collection tool (see Appendix 1) a retrospective chart review was conducted. Well child visit notes were opened and assessed for documentation of sun protection. Personal and family histories of skin cancer diagnoses were assessed with the patients' problem

lists. All data recorded by the PI was kept in an encrypted, password protected crosswalk table on the PI's personal laptop computer.

During phase two, providers were asked to identify mothers who met the inclusion criteria for the project and would be interested in participating in the study. Once the provider obtained verbal agreement from the mother, the PI approached the participant and obtained written informed consent. All project activities occurred in private and materials were kept confidential. After the session, photographs from the Sunface app were deleted from the PI's smartphone. Written surveys did not include identifiable information such as names, birthdates, or medical record numbers. They were kept confidential by the PI until such time that they were transcribed into the Research Electronic Data Capture program (REDCap), and then destroyed. REDCap is a secure, web-based platform for creating and managing online databases and surveys. Access to REDCap data was limited to the PI and statistician. The pre-intervention surveys, Sunface app intervention, and educational sessions were completed between December 2019 and January 2020. Post-intervention surveys (see Appendix 3) were conducted by telephone in February and March 2020.

Data Analysis. Data from both phases of the study were analyzed using SPSS Statistics software version 26. Phase one patient demographic data were analyzed using descriptive statistics including frequency distributions, means, and standard deviations. Tests for associations between demographic data and the inclusion of sun protection discussion was using either Chi-square or Independent samples t-tests. In phase two, demographic data was analyzed with descriptive statistics. Associations between demographic data and sun protection beliefs and practices were explored using either Chi-square, Independent samples t-tests, or paired t-tests. Qualitative responses to the Sunface app were synthesized and examined for overarching themes.

Results

The results from this project include the retrospective chart review, pre-intervention survey, reactions to the Sunface app, and the follow-up telephone survey. Data was analyzed using descriptive, correlational and qualitative measures. Significance was set at $p < .05$.

Retrospective Chart Review

The chart review was conducted for visits that occurred between April 2019 and August 2019. Sixty-One African American and Caucasian patients were included in the review. Both gender and ethnicity were equally distributed. Ages ranged from four to 15 years ($\bar{x} = 7$ years). A discussion of sun protection with sunscreen occurred at 44% of visits. There was no significant difference in age between visits that did not include this discussion and those that did ($t = 1.19, p > .05$). Fifty-three percent of visits for Caucasian patients included sun protection discussion compared with 35% of visits for African American patients. However, this difference was not significant ($\chi^2 (1, N = 61) = 1.969, p = > .05$). Sun protection discussion occurred during more male patient visits as opposed to female (56%, 44% respectively). But, the difference was not statistically significant ($\chi^2 (1, N = 61) = .788, p = > .05$). No patients included in review had documented personal or family history of skin cancer.

Pre-Intervention Survey

Phase two of the study yielded 14 completed pre-intervention surveys. The average age of participants was 37 years. Of the 14 participants, 57% ($n = 8$) were Caucasian while 43% ($n = 6$) were African-American (see Table 1). Most patients had at least one child between the ages of nine to 12 years (71%, $n = 10$), half had a child between the ages of four and eight years (57%, $n = 8$), and few had children over the age of 12 (21%, $n = 3$). Beliefs about tanning, self-reported

sun protection practices, and protection used for their children did not significantly differ between the two racial groups (see Table 2). However, higher frequency of personal sunscreen use was significantly correlated with use for their children ($r_s = .533, p = 0.050$). There were significant positive correlations between maternal age and their use of sunglasses ($r_s = .621, p < .05$) as well as their age and using or encouraging sunscreen for their children ($r_s = .696, p < .05$). Most participants could not recall having discussed sun protection with a provider for themselves (78.6%), nor for their child (71.4%). There was no relationship between ethnicity and discussions with providers about sun protection ($X^2 (1, N = 14) = .884, p > .05$; $X^2 (1, N = 14) = .117, p > .05$).

No relationship in SAMScores was found among those who perceived themselves to be at risk for skin cancer versus those who did not ($F = .745, p > .05$). Significantly different SAMScores were found between the two racial groups and among age. African American mothers had lower SAMScores than Caucasian mothers ($t = 5.34, p = 0.00$). A strong, positive correlation was found between age and SAMScore ($r = .703, p = .005$). These significant results are expected as the SAMScore is calculated based on factors including age and race (see Appendix 5).

Reactions to Sunface App

Immediate and requested reactions to the Sunface app were recorded for all 14 participants. While all reactions were unique, they generally fell under three main themes. The first of these themes was surprise or disbelief in their appearance. Specific reactions included “Oh, wow,” gasps, “I’m not going to look like that,” stating that the image was “shocking.” The second theme that emerged from these reactions was a negative response to their projected appearance. Examples included “I look awful,” “Ugly,” “Horrible,” “...the wrinkles...”

“Hopefully I won’t look that way.” Lastly, several participants indicated the app prompted them to wear sunscreen more often. One participant stated “I will never not wear sunscreen now. I saw how it ages you.” Other responses included “maybe I should start using sunscreen,” and “I might want to wear sunscreen more often.”

Post-intervention Telephone Survey

All 14 participants in the program agreed to be contacted two months after the educational session. Only two completed the telephone survey, despite repeated attempts to contact all participants at the follow-up two-month period. Both respondents of the follow-up survey were Caucasian. One participant stated that her participation in the project served as a reminder for her, as a mom, to make sure her children are protected from the sun’s rays. She stated she knew she was a risk for skin cancer, but was motivated to improve protection for her children. While she did not believe the project changed her perception of risk for skin cancer, she indicated it prompted her to be more consistent with her sunscreen use when going outdoors. She stated, “My husband and I went for a walk last week and, for the first time in months, I wore sunscreen on my face.”

The second respondent to the follow-up survey stated she was aware of her risk for skin cancer prior to the project. Her participation heightened and validated her beliefs about sun protection. Lastly, she indicated she is diligent with sunscreen use, but intends to seek shade more often when she is outdoors.

Discussion

The results from this project have provided insight into several aspects of the topic sun protection among patients and providers at the clinic setting. First, there is a need for increased

frequency of sun protection discussion by primary care providers. Documented sun protection counseling occurred at fewer than half of the well-child visits at this clinic setting. The child's race, gender, or age did not influence the inclusion, or exclusion of this discussion. According to Holman, Qin, Gottschlich and Balk (2019), sun protection discussion has been found to occur at 48% of visits. Though results from this project indicated a similar frequency of this counseling occurred at the project setting, there is still room for improvement. Well-child checks are a prime opportunity to discuss prevention and general health. The American Academy of Family Physicians (AAP) suggests well-child visits are the best times to deliver evidence-based preventive services (Lin, 2015). It is at those visits, parents expect information on health for their child. However, limited visit times and numerous prevention topics may hinder thorough counseling by providers (Lin, 2015).

The variance between whether sun protection was discussed at the well-child visit may be due to competing demands. For example, more attention may have been directed toward nutrition or school readiness, than could have been allocated for primary prevention and anticipatory guidance (Lin, 2015). Competing factors may have influenced time spent in the well-child visits included in this review. These factors were not examined in this project. Alternative ways to ensure inclusion of all relevant preventive counseling and anticipatory guidance should be explored.

While no patients in the sample had a recorded personal or family history of skin cancer, these factors could not be examined as an influence to include a discussion of sun protection. These are known risk factors for skin cancer development and may indicate the need for preventive counseling (Carr, Smith, and Wernberg, 2020). Illness prevention and health promotion discussions should be customized and prioritized for children and adolescents based

on parent-reported family histories (Tarini and McInerney, 2013; Boone, 2016). Sun protection counseling, including recommended skin cancer prevention methods, should be completed at annual visits for children and adults alike, especially those with personal or familial histories.

Surveys regarding sun protection attitudes and practices revealed no significant differences between Caucasian and African American mothers. Most of the mothers used sunscreen and encouraged their children to use sunscreen as well. Most of the mothers did not believe they were at risk for skin cancer. Mothers with higher actual risk for melanoma, as measured by the SAMScore, were no more likely to believe they were at risk for skin cancer than those with low SAMScores. There is evidence to suggest risk perception is positively correlated with sun protection behaviors, especially sunscreen use (de Vries, van Osch, Eijmael, Smerecnik, and Candel, 2012; Kiviniemi and Ellis, 2014). Education for patients should focus on the reality that anyone can get skin cancer despite their age, sex, or race.

The Sunface app served as a simple and convenient tool for generating meaningful responses to appearance-based effects of sun damage. Responses to the app included surprise and disbelief, emphasis on negative changes to facial photographs, and intentions to improve sunscreen use. Appearance-based interventions have shown to be effective at motivating sun-protective practices, especially among adolescents and young women. A randomized-controlled trial among high school students found that students exposed to an appearance-based educational intervention subsequently applied sunscreen more frequently than students who viewed a health-based video (Tuong and Armstrong, 2014). Pictorial messages were found to be more effective than text-based information at deterring indoor tanning among young women (Sontag and Noar, 2017).

Results from this project indicate that mothers who frequently apply sunscreen on themselves more frequently apply or encourage sunscreen for their children. Maternal age was also positively correlated with frequency of child sunscreen application. As suggested by Albert Bandura's Social Learning Theory, children model behaviors observed from their parents or caregivers (Glanz, Rimer, & Viswanath, 2008). Therefore, children of mothers who frequently use sunscreen for themselves and their children, are more likely to do the same in the future. However, these findings also indicate the need for education and motivation of health behaviors among young mothers, as they reported less frequent use of sunscreen for their children.

Implications

Several implications for practice, education, and future research emerged from the findings of this study. The Sunface app could be utilized in clinic waiting areas or other public areas for patients to use. The app's developer, Titus J. Brinker, trialed the use of the app in an outpatient clinic waiting area in a 2018 study. Over a 6-day period, more than 60% of patients (n= 165) who entered the clinic were exposed to the intervention. Among the participants who used the app and completed a follow-up questionnaire (n= 119), 88% indicated it motivated them to use sun protection and to avoid tanning beds (Brinker et al., 2018). Similarly, the app could be incorporated into the sun protection discussion by providers as it is available on any smart device that utilizes the iOS platform. Sunface can be used in less than one minute's time and may illicit motivation or awareness for sun protection and skin cancer prevention.

Improvements in obtaining family histories at well-child visits may be needed. Currently, at the project setting, this information is obtained by the clinical services technicians (CSTs) rather than by the providers themselves. They obtain the information verbally and input it into the patients' electronic health record. This information is vital for assessing risk for many health

conditions, including skin cancer. Research suggests many providers identify time as a major barrier for obtaining a comprehensive family history in primary care (Saul, Trotter, Sease, and Tarini, 2017). And, while most providers report they obtain a family history during their routine patient care, observations found that this practice occurs at an average of only 24% of visits (Tarini and McInerney, 2013). An alternative method may be to utilize a family history form. The caregiver could complete the form either upon registration or while waiting for their appointment. Additional recommendations for improving family history intake includes provider questioning at each visit, either based on the child's life stage, or acute health concern (Tarini and McInerney, 2013). A quality improvement project at the setting for this project may enhance the efficacy of family history intake.

To combat the constraints of visit time, alternative means of comprehensive health promotion counseling and anticipatory guidance must be explored. One way to meet this objective is the use of patient or parent education handouts. Bright Futures, the AAP's prevention and health promotion program, offers educational handouts for each recommended well-child visit, from birth to 21 years of age (AAP, 2020). Each handout is available in English and Spanish language. These handouts should be used in conjunction with traditional, verbal education and counseling. This would allow the parents to receive all the recommended general information for the well-child check despite the limited time allotted for the visit.

For future studies, adolescents may represent a unique population for evaluating sun protective practices, attitudes, and motivating factors. Adolescence is a time of tremendous change for patients with regards to both their physical and cognitive states. During this time, determinants of health may shift, from being heavily influenced by parents to peers and social media (Falzone et al, 2017; Viner et al., 2012). Also, appearance-based interventions to influence

sun protection practices among adults have been effective at reducing indoor tanning frequency (Falzone et al., 2017). These interventions, including the Surface app could be employed at adolescent well-child visits.

Limitations

The project had several limitations. The timeframe for the intervention component of this project occurred during late fall to early winter. This limited the sample size as neither providers nor parents felt the topic was timely. Typically, during autumn and winter months, the general population is not concerned with sun protection. Participants were encouraged to think back to summer months when surveyed about sun protection practices. However, more accurate results may have been obtained by surveying participants during summer months and asking them to report their sun protection behaviors over recent weeks. Additionally, follow-up surveys performed in summer months may have provided a better representation of the intervention effect by measuring an actual change in behavior rather than intention.

Further, participant recruitment was challenged due to the study setting. This clinic's clientele includes 48% international patients who do not speak English as their first language. There was also a large population of elderly, and very young patients who did not meet inclusion criteria. With only 14 completed pre-intervention surveys and two post-intervention responses, results from the study may not be representative of the larger population of interest.

Additionally, post-intervention responses from participants were not guaranteed utilizing the telephone call approach, and proved to be low in volume. Given the number of spam telephone calls patients receive, they may have been hesitant to answer a call from an unknown

number. Many of the mothers included in the sample may have had a limited number of minutes on their monthly telephone plan.

Because no patients included in the chart review had a documented family history of skin cancer, no assertion could be made about this risk factor influencing the inclusion of sun-protection counseling. Providers may have chosen to spend their time on other, more pertinent counseling and anticipatory guidance. Today, bullying, social media, and internet safety are important elements of the well-child visit for school-aged children and adolescents (AAP, 2020). Providers may need education about the importance of sun-protection counseling for patients with risk factors including fair skin type, family history of skin cancer, personal sunburn history, and those who play outdoor sports.

Conclusion

Skin cancers are a growing problem across the United States, and more so in the state of Kentucky (American Cancer Society, 2020). The lack of recommendation by the USPSTF for routine skin examinations, coupled with the lack of available access to dermatology, places primary care providers at the forefront of skin cancer prevention. Evidence suggest health behaviors learned in childhood are more likely to continue into adulthood (Glanz, Rimer, & Viswanath, 2008). Additionally, children's health behaviors are influenced by observing the behaviors of their caregivers. The data gathered in this project indicate the need for improved sun protection counseling for children and mothers at this clinic setting. Other methods of protection should be highlighted by providers as they are underutilized by patients. These protection measures may be enhanced when combined with a discussion of effects of the sun's rays on appearance. Due to competing demands placed on providers by the healthcare system, alternative means of preventive counseling must be explored to ensure sun protection is included.

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Table 1. Demographic characteristics of the sample (N=14)

Characteristics	Mean (SD) or n (%)
Age (years)	37.1 (8.5)
Race	
White, non-Hispanic	8 (57%)
Black, non-Hispanic	6 (43%)

Table 2. Survey responses by race (N = 14)

Surveyed item	Caucasian mean (SD) or n (%)	African American Mean (SD) or n (%)	Between Groups test statistic (p)
Tan is sign of health (Y/N)	No: 5 (63%) Yes: 3 (37%)	No: 5 (83%) Yes: 1 (17%)	.73 (.393)
Tan is sign of beauty (Y/N)	No: 7 (88%) Yes: 1 (12%)	No: 6 (100%) Yes: 0 (0%)	.81 (.369)
How often do you use sunscreen? (1-5)	3.5 (1.3)	3.7 (1.0)	.36 (.80)
How often do you wear protective clothing? (1-5)	3.0 (1.1)	2.7 (0.8)	.31 (.53)
How often do you wear sunglasses? (1-5)	3.4 (1.4)	3.0 (1.7)	.25 (.66)
How often do you stay in the shade? (1-5)	3.8 (.71)	4.0 (1.1)	.10 (.61)
Do you ever intentionally tan? (Y/N)	No: 6 (75%) Yes: 2 (25%)	No: 4 (67%) Yes: 2 (33%)	.12 (.733)
Do you believe you are at risk for skin cancer? (Y/N)	No: 5 (63%) Yes: 3 (37%)	No: 6 (100%) Yes: 0 (0%)	2.86 (.091)
Do you recall ever having discussed sun protection with your provider? (Y/N)	No: 7 (88%) Yes: 1 (2%)	No: 4 (67%) Yes: 2 (33%)	.88 (.347)
Have you ever had your skin examined by a provider? (Y/N)	No: 6 (75%) Yes 2 (25%)	No: 5 (83%) Yes: 1 (17%)	.14 (.707)
Did you use sun protection as a child? (1-5)	3.3 (1.4)	3.0 (.89)	1.11 (.71)
How often do you use/encourage sunscreen for your child? (1-5)	4.6 (.52)	3.5 (1.4)	3.2 (.054)
How often do you use/encourage protective clothing for child? (1-5)	3.5 (1.1)	2.8 (.98)	.64 (.256)
How often do you use/encourage sunglasses for your child? (1-5)	3.4 (1.5)	3.3 (1.4)	.27 (.958)
How often do you use/encourage shade for your child? (1-5)	3.9 (1.4)	4.0 (.89)	.42 (.849)
Do you recall ever having discussed sun protection for child with child's provider? (Y/N)	No: 6 (75%) Yes 2 (25%)	No: 4 (67%) Yes: 2 (33%)	.12 (.733)
SAMScore (0-9)	2.6 (1.1)	.17 (.41)	6.92 (.000)

Appendix 1

Chart Review Data Collection Tool

Pt number	Age (yrs)	Gender	Race	Sun Protection?	Hx Skin Cancer?	Fam. Hx. Skin Cancer?	Provider

Appendix 2.

Phase 2 Survey of Mothers

Thank you for participating in this study. Please answer the following questions as honestly as possible. Feel free to ask for clarification or any questions you may have about the survey. You may skip any question you are not comfortable answering and you may withdraw from the study at any point in time.

1.) Age: _____ years

2.) Race/Ethnicity:

- Non-Hispanic White/Caucasian
- Non-Hispanic Black/African American
- Other: _____

3.) How many Children do you have between the ages of:

- 4 years - 8 years _____
- 9 years - 12 years _____
- 13 years - 18 years _____

5.) Do you believe having a tan or color from the sun makes someone look healthy?

- Yes
- No

6.) Do you believe having a tan or color from the sun is a sign of beauty?

- Yes
- No

7.) Do you use sunscreen when you are going to be out in the sun?

- Never
- Rarely
- Sometimes
- Most of the time

Always

8.) Do you use protective clothing (long sleeves, long pants, wide-brimmed hat) when you are going to be out in the sun?

- Never
- Rarely
- Sometimes
- Most of the time
- Always

9.) Do you wear sunglasses when you are going to be out in the sun?

- Never
- Rarely
- Sometimes
- Most of the time
- Always

10.) Do you try to stay in the shade when you are outdoors when sunshine is high?

- Never
- Rarely
- Sometimes
- Most of the time
- Always

11.) Do you ever intentionally tan (in the sun or tanning bed)?

- Yes
- No

12.) Do you consider yourself at risk of getting skin cancer?

- Yes
- No

13.) Do you recall ever having discussed sun protection for yourself with your current provider (Doctor, Nurse Practitioner, or Physician's Assistant)?

- Yes
- No

14.) Have you ever had your skin examined by a provider for signs of sun damage or skin cancer?

- Yes
- No

15.) Did you use sun protection as a child?

- Never
- Rarely
- Sometimes
- Most of the time
- Always

16.) If you used sun protection as a child, what type did you use? (check all that apply)

- N/A
- Sunscreen
- Protective clothing
- Sunglasses
- Shade

17.) Do you use or encourage sunscreen on your child/children when they are going to be out in the sun?

- Never
- Rarely
- Sometimes
- Most of the time
- Always

18.) Do you use or encourage protective clothing on your children when they are going to be out in the sun?

- Never
- Rarely
- Sometimes
- Most of the time
- Always

19.) Do you use or encourage sunglasses on your children when they are going to be out in the sun?

- Never
- Rarely
- Sometimes
- Most of the time
- Always

20.) Do you encourage or instruct your child to stay in the shade when they are going to be outdoors when sunshine is high?

- Never
- Rarely
- Sometimes
- Most of the time
- Always

21.) Do you recall ever having discussed sun protection for your child/children with their current provider?

- Yes
- No

22.) What type of skin do you have?

- 1 Type I: very fair skin, blond or red hair, light eyes (blue or green), never tan and always sunburn after sun exposure
- 1 Type II: fair skin, blond or light-brown hair, light eyes (blue or green), usually sunburns
- 0 Type III: deep skin, brown hair, light to medium eye color
- 0 Type IV: olive skin, dark-brown hair, brown eyes
- 0 Type V: brown skin, black hair, black eyes
- 0 Type VI: black skin, black hair, black eyes

23.) Do you have freckles?

- 1 Yes
- 0 No

24.) How many moles do you approximately have on both arms?

- 3 More Than 20
- 0 Fewer Than 20

25.) Have you had one or more episodes of severe blistering sunburn during childhood or teenage years?

1 Yes

0 No

26.) Did you live more than one year in a country where sunshine is high (Africa, French West Indies, Country South of United States, Australia...)

1 Yes

0 No

27.) Have you been diagnosed with any type of skin cancer?

1 Yes

0 No

28.) Have any of your first-degree relatives (parents, children, brother or sister) ever had skin cancer?

1 Yes

0 No

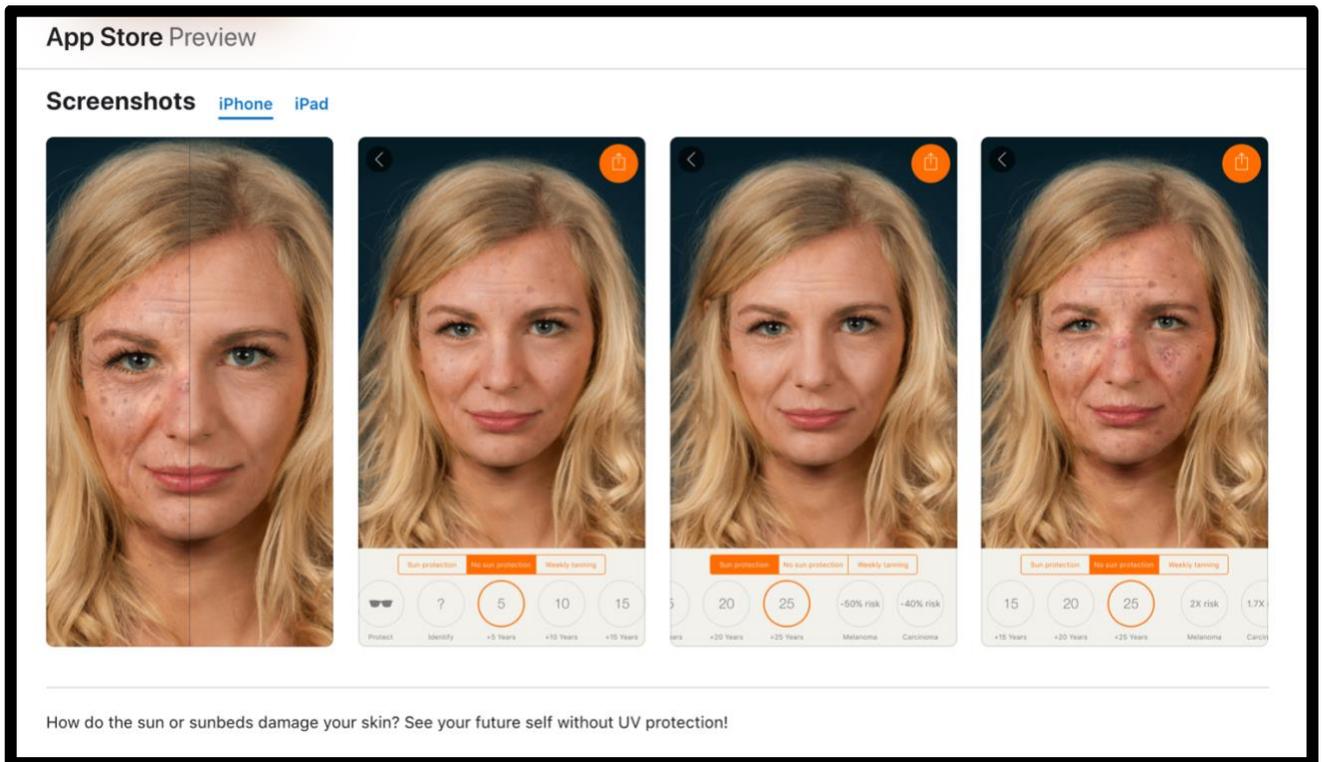
0 I Don't Know

See point value assigned to each response. Total number of points:

Score > 3 = May be at increased risk for skin cancer. Otherwise, not at increased risk

Telephone #: _____

Figure 1. Sunface App Preview



Appendix 3.

Follow-up Telephone Survey

Subject Age: _____

Race: _____

Hello, my name is Alex Bowlds. As you may recall we met at the Polk Dalton Clinic for a survey and brief education several months ago. This is the follow up phone call about if you've changed how you protect your/childs skin from the sun...

Do you remember participating in the skin cancer prevention study at the Polk-Dalton Clinic approximately 2 months ago?

- Yes
- No

If yes, continue to question 2. If no, briefly summarize study and ask again. If still no, conclude survey.

Thinking back to the study 2 months ago, which aspect stands out to you most?

After taking part in the study, did your belief about your risk of getting skin cancer change? Please Explain.

- Yes
- No

Since taking part in this study, what behaviors, if any, do you feel you are most likely to change? Please Explain.

Thank you for your participation in this survey. You will be entered into the raffle for a chance to receive a \$50 gift card to Wal-Mart. One participant will be chosen by random draw. Should you be chosen, you will be contacted to set up delivery/collection of the gift card.

Figure 2. SAMScore

Questionnaire:

1. How old are you?

2. Gender: Male Female

Answer each question by checking the corresponding square

3. What type of skin do you have?

Skin-type I: very fair skin, blond or red hair, light eyes (blue or green), never tan and always sunburn after sun exposure

Skin-type II: fair skin, blond or light-brown hair, light eyes (blue or green), usual sunburn

Skin-type III: deep skin, brown hair, light to medium eye colour

Skin-type IV: olive skin, dark-brown hair, brown eyes

Skin-type V: brown skin, black hair, black eyes

Skin-type VI: black skin, black hair, black eyes

4. Do you have freckles?

yes no

5. How many moles do you approximately have on both arms?

more than 20 fewer than 20

6. Have you had one or more episodes of severe blistering sunburn during childhood or teenage years?

yes no

7. Did you live more than one year in a country where sunshine is high (Africa, French West Indies, South of United States, Australia...)

yes no

8. Have you been diagnosed with melanoma in the past (it is a skin cancer, arising in melanocytes, skin cells that make skin pigment)?

yes no

9. Has any of your first-degree relatives (parents, children, brother or sister) ever had melanoma?

yes no don't know

Self-Assessment of Melanoma Risk Score: SAMScore

According to the SAMScore, a patient is considered at risk of melanoma if at least one of these 3 criteria is verified:

- First criterion: Presence of at least 3 risk factors among the 7 following risk factors: phototype I or II, freckling tendency, number of melanocytic naevi >20 on both arms, severe sunburn during childhood or teenage years, life in a country at low latitude, a history of previous melanoma, a history of melanoma in a first-degree relative
- Second criterion: A subject under 60 years of age and a number of melanocytic naevi >20 on both arms
- Third criterion: A subject of 60 years old or over and a freckling tendency

Questionnaire used for the self-assessment of melanoma risk factors and Self-Assessment of the Melanoma Risk Score.
