Sun Protection Habits Among Adolescent Athletes

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DNP 704: Principles Evidence-Based Care

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Introduction: Most melanoma cases are directly related to harmful ultraviolet exposure (UV). An adolescent athlete spends close to four hours per day outdoors, which equates to over one thousand hours of sun exposure every year. Athletes are typically unaware that extended periods of UV exposure can cause melanoma and therefore an education regarding sun safety is needed. The Social Cognitive Theory depicts the studied behaviors for this project showcasing external factors that may contribute to an adolescent not using proper sun protection.

Methods: Athletes on the swim team at a Phoenix High School (n=6) were surveyed to determine their current sun protection habits. An education intervention about sun safety and melanoma risk/identification was then implemented. The student athletes were then re-surveyed two weeks post intervention to determine if their sun protection habits and melanoma knowledge had changed. Descriptive statistics were run to compare the pre- and post-survey results.

Results: There was no change between baseline and post-intervention sun safety/melanoma knowledge when descriptive statistics were run. Amongst the six athletes, sun safety habits and knowledge identifying melanoma did not change after the education intervention.

Discussion: Adolescents are unaware of the consequences their lack of safe sun habits can cause on their skin. Most adolescents do not have the proper education from schools or sporting teams to teach them about the dangers of poor sun safety practices. Education alone cannot serve as the sole influence as to whether adolescent athletes increase sun protection habits.

Keywords: *sun, sun safety, melanoma, athletes, ultraviolet radiation*

Sun Protection Habits Among Young Adult Athletes: Background and Significance

Adolescents participating in outdoor sports embody a group of individuals at increased risk for excessive exposure to harmful ultraviolet (UV) radiation. According to the Skin Cancer Foundation (SCF) (2021), 86% of all melanoma cases are directly related to harmful UV exposure. A college athlete spends close to four hours per day outdoors, which equates to over one thousand hours of sun exposure every year (Bagatti et al., 2016). There is a seven-fold increase in the risk of being diagnosed with melanoma between 15 and 19 years of age (Bagatti et al., 2016). Daily sunscreen use decreases the risk of sun damage and can significantly reduce the risk of melanoma, especially in those adolescents who are outdoors for an extended period (SCF, 2021). Children and teens can use sunscreen at school, but the number of student-athletes that use sunscreen before a sporting event or practice outdoors is often unknown.

Problem Statement

During childhood and adolescence, the risk for melanoma increases with every overexposure to UV radiation and sunburn (Centers for Disease Control [CDC], 2020). On average, a person can increase their risk of melanoma by having had more than five sunburns in their lifetime (SCF, 2021). One of the best defenses to UV radiation is sunscreen use, preferably a sun protection factor (SPF) of 15 or higher (CDC, 2020). Young athletes did not report increased sun protection measures, such as SPF, hats, and shade, during their time outdoors at practices or games (Orsimarsi, 2019). Most young athletes did not apply sunscreen before participating in outdoor sports, and those that do, fail to reapply in an appropriate time frame (Orsimarsi, 2019). In a study conducted by Bagatti et al. (2016), 83.3% of female athletes at a college in Pennsylvania, did not report any skin-related care while outdoors. According to the Arizona Department of Health Services (ADHS), younger age groups are more likely to be

diagnosed with invasive forms of melanoma and are at the greatest risk for a late-stage melanoma diagnosis (ADHS, 2017). Arizona's invasive melanoma rates have also increased to 19%, which surpasses the United States age-adjusted rate of a 2% increase in invasive melanoma cases (ADHS, 2017). Specifically, to those under 18 years old, education is an important first step in promoting sun safety precautions and bringing awareness to melanoma risks in the pediatric population.

Purpose and Rationale

In the U.S., more people are diagnosed with skin cancer than all other cancers combined (SCF, 2021). In the adolescent athlete population, proper education regarding sun safety should be delivered to equip young adults with the tools to protect themselves against harmful UV radiation. The purpose of this paper is to review the current literature and data to establish the need for sun safety education for young adult athletes who practice and play sports outdoors to reduce their risk of melanoma.

Background and Significance

The SCF 2021 has defined skin cancer as an atypical uninhibited growth of skin cells. Taking the appropriate measures to protect oneself, such as wearing sunscreen with an SPF of 15 or higher, is one of the first steps in reducing the risk of all types of skin cancers (CDC, 2020). Pediatric melanoma has unique clinical presentations and can often be overlooked by a primary provider (Moustafa et al., 2020). In the pediatric population, invasive cancers in those 15-19 years of age make up 79% of all skin cancer cases (Moustafa et al., 2020). A melanoma may present in a pediatric patient as an amelanotic macule, papule, or nodule, and therefore there have been many delays in diagnosing melanoma in the pediatric population (Merkel et al., 2018).

Skin cancer focused programs and campaigns are needed to help change the culture of sun protection and raise awareness of the harmful effects of UV overexposure (Bagatti et al., 2016; Orsimarsi, 2019). In a study conducted by Bagatti et al. (2016), female athletes were given a pre-test, education, and post-test about their knowledge of skin cancer facts, definitions of melanoma and related skin terms, harmful effects of UV overexposure, prevention methods to UV radiation, and skin self-examination techniques. After this study, it was reported that 79.2% of female athletes would start using sunscreen before going outside compared to the 23.6% that reported using sunscreen before the education was given (Bagatti et al., 2016). Student-athletes are at the highest risk for UV overexposure due to their long hours in the sun for sports and school hours in peak sunlight (Ally et al., 2020; Carter et al., 2016).

The Clever in the Sun and Shade Program (CSSP) was created in a study to help encourage positive attitudes towards UV protection in schools (Stolzel et al., 2020). This program was developed to provide teachers and coaches with education regarding beliefs over risk factors for skin cancer, barriers to prevent UV radiation, and stigmas towards sun protection (Stolzel et al., 2020). CSSP created videos, posters, and lectures to teach young athletes about skin cancer and had many of their participants favor fondly towards the education (Stolzel et al., 2020). The state of Arizona has also begun a sun safety program called SunWise which provides training on UV protection and how to reduce skin cancer risk for those students kindergarten-eighth grade (ADHS, 2020). Adolescents are often more receptive to education in communication forms that they use most often, such as text messaging, e-mail, and video (Horsham et al., 2020; Hubbard et al., 2020). In a controlled trial that was conducted among teenagers 13-15 years old, smartphone technology was used to deliver text message reminders to students about sun safety measures for seven weeks after an in-person education program to try

and determine the feasibility of educating adolescents about sun safety in a school setting (Hubbard et al., 2020). This study proved that it is possible to implement education programs in schools so that adolescents will respond to and learn from, rather than just a formal lecture format for the material. Another group of authors evaluated at how to best deliver sun safety information in a study using photoaged photographs to show future sun damage among female adolescents. Female adults and adolescents both pose a greater risk of being diagnosed with melanoma than males, revealing that a suntan may be more desirable to females than males (Bagatti et al., 2016; Eastabrook et al., 2018). Adolescents between 16 and 17 years old were interviewed before and after seeing their photoaged photograph. Most participants stated that they did not realize the amount of damage they had already done to their skin by trying to change their skin tone (Eastabrook et al., 2018). Not only does gender come into play when it comes to sun protection knowledge, but where a person lives. In a study conducted by Nagelhout et al. (2019), high school students in rural settings reported fewer sun protection measures than urban students. Geography, gender, and information delivery methods should all be considered when educating adolescents regarding the importance of skin cancer prevention.

Adolescent Athletes Risk for UV Overexposure

According to the Arizona Melanoma Profile, younger age groups are more likely to be diagnosed with invasive melanoma and have the highest proportion of late-stage diagnosis cases (ADHS, 2017). In a study conducted by Eastabrook et al. (2018), overarching themes among adolescent participants between 16 and 17 years of age, were that “brown skin tone is nicer than pale,” “people think darker skin is more attractive,” “I feel better about myself when I am tan,” and “celebrities all have brown skin tone.” The adolescent demographic has a strong desire to be bronzed, leading to harmful behaviors such as increased sunburns, indoor tanning, and a lack of

sunscreen use (Bagatti et al., 2016; Eastabrook et al., 2018). Many high school athletes are unaware of the damage they have already done to their skin, evidenced by the lack of knowledge of skin protection measures, facts about melanoma, and harmful effects of UV radiation overexposure (Orsimarsi, 2019).

Education Intervention for Sun Safety Awareness

Education regarding sun safety is lacking among the adolescent age group. Reports show lack of knowledge regarding sun-safety habits, skin cancer risk factors, and skin self-examination techniques (Bagatti et al., 2016; Eastabrook et al., 2018; Orsimarsi, 2019). When provided with education, whether in the forms of lecture, poster, text-message, or photoaged photographs, most adolescent age groups responded favorably towards the information with a better understanding of skin cancer prevention statistics and prevention methods (Bagatti et al., 2016; Eastabrook et al., 2018; Hubbard et al., 2020; Stolzel et al., 2020).

Current Educational Practice

The current practice for educating adolescents on sun safety allows each school to determine how it wants to educate its students about UV protection (The World Health Organization [WHO], 2020, as cited in Stolzel et al., 2020). For the state of Arizona, the SunWise program is available to schools, coaches, and other educators at no cost (ADHS, 2020). As evidenced by results from multiple studies, an education program given to adolescents to help increase their awareness of skin cancer risks can significantly improve their sun safety health promotion (Bagatti et al., 2016; Eastabrook et al., 2018; Hubbard et al., 2020; Nagelhout et al., 2019; Stolzel et al., 2020).

Future State of Skin Cancer Awareness

Changing the culture of skin protection to promote sun-safe habits is at the heart of sun safety education. Lack of basic knowledge about skin cancer and UV prevention warrants the need for education among the adolescent athlete population (Orsimarsi, 2019). Education regarding improved behaviors, knowledge, and attitudes towards melanoma can help adolescent athletes recognize their skincare deficits and improve sun safety awareness (Bagatti et al., 2016).

Melanoma is the most common skin cancer in the pediatric population and presents most frequently in adolescents aged 15-19 (Moustafa et al., 2020). Adolescent athletes who participate in sports outdoors spend around 10-15 hours per week in the sun, often without proper shade, clothing, and sunscreen (Bagatti et al., 2016; Orsimarsi, 2019). Many education programs have proven beneficial in teaching student-athletes about melanoma risk factors, sun protection methods, and skin self-examination (Bagatti et al., 2016, Eastabrook et al., 2018; Orsimarsi; Stolzel et al., 2020). Due to the lack of participation in protective measures by adolescent athletes, education about sun safety is necessary for this age group to prevent harmful damage that could cause skin cancer.

Internal Evidence

The Arizona Department of Health Services identifies melanoma as the fifth diagnosed cancer in males and the seventh diagnosed cancer in females (ADHS, 2017). For those students in North Canyon High School in Phoenix, AZ, there are currently no guidelines or education towards sun safety for their student-athletes. According to Athletic Director Jacob Kluch, the student-athletes at his school are not given any education regarding the importance of sun safety. Jacob Kluch believes that most students participate in outdoor sporting events at an average of 2 hours per day and close to 10 hours per week. This inquiry has led to the clinically relevant PICOT question,

"In high school athletes who practice outdoors, does an education program regarding sun safety compared to no education program in schools affect the use of sunscreen over an athletic season?"

Search Strategy

An expansive review took place over three databases, PubMed, CINAHL, and PsychInfo, to help answer the PICOT question. These databases were selected for their focus on healthcare, nursing, psychological significance, and impactful contributions to the medical community. All three databases were searched using key terms that addressed relevant areas of the PICOT question. Key terms used in the search included: *adolescents, sun, sun exposure, melanoma, athletes, and sunscreen*. Key terms also included specific sports with outdoor sun exposure, such as *football* and *soccer.* The outcome was specified using terms *education* and *program* to narrow down an intervention closely related to the PICOT question. Filters that were applied included a publication date of within five years (2016-2021), English language, randomized controlled trials, and systematic reviews. Boolean terms in the databases were used to expand the search.

The results yielded 94 articles in PubMed, 1751 in PsychInfo, and 1208 in CINAHL. PsychInfo and CINAHL searches were narrowed down using specific terms to yield more precise articles related to the PICOT. A more narrowed and filtered search specifying the adolescent population were added to the CINAHL and PsychInfo searches. Narrowing of terms in CINAHL and PubMed lowered the yield results to 64 and 445, respectively.

Reviewing the titles and abstracts of the articles yielded 32 relevant studies for the PICOT questions. The studies were printed in full text, and a total of 15 studies were relevant to the topic. A final ten articles were chosen using rapid critical appraisals, giving preference to articles with higher levels of evidence.

Critical Appraisal and Synthesis of Evidence

Quality of studies was determined using the rapid critical appraisal (RCA) tool. Although both quantitative and qualitative studies were applicable for this PICOT, qualitative studies provided more in-depth knowledge into the sun safety habits of adolescent athletes (see Appendix A, Table A1). Quantitative studies provided data regarding specific education plans (see Appendix A, Table A2), however, did not often provide insight into reasons why sun safety practices are lacking in the adolescent population. To compare both the qualitative insights behind reasoning for lack of sun safety practices and specific education platforms, qualitative and quantitative studies were compared using a synthesis table (see Appendix A, Table A3).

Among all studies, age groups ranged from school-aged children to college athletes and most of the studies were performed in the US or Australia. Majority of the participants were Caucasian. All the studies focused on either behavior leading to poor sun safety practices, outcome of education on sun safety, pediatric skin cancer risk, or specific education protocols that increase sun safety practices. Measurement tools among the studies involved interviews, focus groups, and surveys. Majority of the studies had significant value in changing the attitudes and behaviors of the participants in their sun safety practices. One study showed participants did not believe sun safety was applicable based on the climate in which they lived.

Conclusions

The need for educating adolescents, especially those who spend a great deal of time outdoors, is based off the high quality of evidence gathered from the literature search. Adolescents are unaware of the consequences that their poor sun safety habits can cause on their skin. Most adolescents do not have the proper education from schools or sporting teams to teach them about the dangers that can occur from lack of sun safety practices. Education plans, in

multiple forms, can bring awareness to the dangers of increased UV exposure and also change habits related to sun protection. Reducing UV exposure and sunburns can significantly reduce the risk of pediatric melanoma; therefore, strategic education programs should be implemented to prevent early sun damage in the adolescent population.

Theory Application

A person's beliefs about what society portrays as "attractive" and beautiful" can be greatly influenced by others. The unique emphasis on social influence and external reinforcement for this project directly relates to the social cognitive theory. Evidenced by the number of articles that relate to an adolescent's image of what their skin should look like, the social cognitive theory is a theory that best depicts the behavior studied for this PICOT (see Appendix B, Figure 1). The social cognitive theory considers the unique way in which an individual acquires and maintains a behavior (LaMorte, 2019). The social cognitive theory also considers a person's past experiences, which also factors into whether a certain behavior will occur (LaMorte, 2019). The cornerstone of the social cognitive theory is reciprocal determinism. This key concept refers to the interactions of a person with their environment, past experiences, and current behavior to achieve a goal (LaMorte, 2019). In the synthesis of research, the social cognitive theory was most used (see Appendix, Table A3). From the literature review, adolescents are under the assumption that tan skin is more desirable, and these thoughts often come from their environment and peer groups. Looking at personal experiences, behavior, and the environment, adolescent sun safety practices can be altered by providing education over the dangers of these social beliefs that influence one's actions. The social cognitive theory will guide the focus of this project and help address behavior changes in the adolescent population.

Implementation Framework

The model chosen to guide this framework is the Iowa Model. The Iowa model provides guidance for clinicians to help them make clinical decisions that affect healthcare outcomes (Melynk & Fineout-Overholt, 2019). For this project, the Iowa Model is the best choice since it will help guide clinicians, coaches, and school administrators to identify opportunities for education. Often, this model is used when clinicians want to highlight an opportunity for questioning current practice standard and promote new initiatives (see Appendix B, Figure 2). In the beginning of this model, a question is asked that clearly states the purpose of the project (Melynk & Fineout-Overholt, 2019). This question should give clear purpose and boundaries. This is often done with a PICOT question. The next step of the Iowa model is the topic priority, meaning that the topic should include a high-risk, high-volume, or high-cost focus (Melynk & Fineout-Overholt, 2019). After a topic is classified as a priority, assembling and appraising the evidence is begun (Melynk & Fineout-Overholt, 2019). Sufficient evidence would be collected, and an RCA tool would be used to determine high levels of research. Designing and piloting the study would come after the appraisal of evidence and outcomes would be achieved in a controlled environment (Melynk & Fineout-Overholt, 2019). This small pilot of an implementation is key to determine if a project can be rolled-out into a larger scale without any issues (Melynk & Fineout-Overholt, 2019). Piloting a project under this model also means planning for implementation and evaluation. Evaluation of the structure, process, and the outcomes all need to be completed before implementing a whole practice change (Melynk & Fineout-Overholt, 2019). After the change has been determined as appropriate for practice, the project is integrated and sustained and sustainability is often promoted by site champions (Melynk & Fineout-Overholt, 2019). Once a project has been fully implemented, tracking and evaluating results are key to promoting and adopting changes in the healthcare system. For this

project, the priority topic is adolescent athletes that practice outdoors. The design/pilot program will be an education program over sun safety conducted at a local Arizona high school. The data from this project will help create process improvements and promote change regarding sun safety in local area high schools and among adolescent sporting programs.

Implications for Practice Change

The evidence has shown the need for adolescent education over sun safety is necessary to help prevent pediatric melanoma rates. Adolescent athletes, who spend their time being exposed to excessive UV radiation, are lacking proper sun safety practices before being educated (Bagatti et al., 2016; Orsimarsi, 2019). Often, adolescents have an idea of beauty as bronzed skin, leading to spending long hours in the sun to achieve a tan (Bagatti et al., 2016; Eastabrook et al., 2018). To implement change, education over sun safety for the adolescent population should begin with those who spend the most time outdoors, such as athletes. Those who teach high school athletes are at the forefront of educating their students over proper sun safety practices. Student athletes at a local high school in Phoenix, AZ currently do not have an education program in place that educates athletes over sun safety when practicing outdoors. The project would consist of a pre-survey, education program regarding safe sun practices, and a post-survey. The data collected would give insight into whether an education program would impact sun safety practices for student athletes. Pre and post survey data would confirm or deny the evidence that states adolescents are more inclined to participate in sun safety practices after being educated over the effects of harmful UV radiation.

Potential Outcomes

The potential outcome for the proposed study is an increase in sunscreen use among adolescent athletes who practice outdoors. With an education program designed to teach

adolescents about the dangers of UV radiation and potential melanoma risk, an increase in sun protective behaviors is a hopeful outcome. This education program can be given by a school nurse, athletic coach, athletic trainer, or athletic director. Adolescent athletes who practice outdoors represent a vulnerable population that are not properly educated on the harmful effects of sun damage. With a proper education program given to student athletes before a season begins, sunscreen use will increase to help protect their skin from UV damage.

Setting and Stakeholders

The setting of this project is a high school in Arizona that has student-athletes that participate in outdoor sporting events. The main stakeholder for this project is the athletic director for the high school. The athletic director ensures that all student-athletes are supported in all aspects of athletics including academics, health, safety, and sport-related concerns. The other main stakeholder in this project is the athletes, who will benefit from this project. The athletes will likely decrease unhealthy sun behaviors and increase sun protection methods. This will prevent sunburns and decrease the chances of developing pediatric melanoma. Pediatric primary care providers and pediatric dermatologists are important stakeholders in this project due to the nature of educating this special patient population most at highest risk for sun damage. These providers are often tasked providing initial sun safety education to patients in their office and this program will augment that information in an additional setting. Last, the parents of the athletes will also benefit from this project. Parents will be able to trust that their children are participating in sun safety behaviors at school while engaging in sporting events outdoors.

Project Description

This project evaluated whether an educational program, developed to teach safe sun habits, directly impacts increased sun safety habits and melanoma awareness among high school

athletes during their fall sports season. Internal Review Board acceptance was obtained before starting the project through Arizona State University. Once approval for the project had occurred, consent was obtained by the athlete and their parent before project implementation. The athletes were chosen during the fall sports season and participated in a pre-survey at the beginning of their season to determine their baseline knowledge of sun safety measures. The athletes then engaged in an education program using a PowerPoint presentation that contains specific data related to sun safety protocols and pediatric melanoma rates. This educational PowerPoint included multiple forms of learning such as written text, audio, photos, and graphics. The athletes were then followed up with two weeks later and provided a post-survey to determine if the education tool increased their use of sun safety habits while playing outdoors as well as increasing knowledge over melanoma. With an education program designed to teach adolescents about the dangers of UV radiation and their potential melanoma risk, an increase in sun-protective behaviors was a desired outcome.

Participants and Recruitment

The participants in this project were high school athletes on the varsity swim team. The fall sports season was chosen due to the hot climate of Arizona during this season. The fall sports season is played during some of Arizona's hottest months and athletes are easily overexposed to UV radiation in a short amount of time. The participants identified as female or male. If the participant played on multiple teams, the participant engaged in the survey and education program once. The athletic director helped facilitate meeting times with the swim coach and during these meeting times, the coaches will have the entire team be introduced to the project idea, by myself, and the athletes can decide if they would like to obtain consent from their parents and sign consent themselves. Inclusion was screened by the coaches to ensure that the

athlete is a member of the sports team and the only exclusion criteria included being a non-fall athlete, a participant that does not want to consent, a child of a parent who does not sign a consent, and a participant who has been diagnosed with melanoma currently or in the past. Exclusion was screened by listing exclusions on the consent form to be read by both the participant and their parent or guardian. Once consent was obtained by a parent, the athlete could also sign consent.

Data Collection and Analysis

Analysis of the athletes' surveys took place after the conclusion of the project. All surveys were kept in a secure location until data analysis was started. The baseline pre-survey was compared against the post-survey to determine if any sun safety or melanoma knowledge had increased. The demographic information was also analyzed to conclude if certain genders or grade levels responded to the education more than others. The pre- and post-survey were the same questions to better compare answers from before and after the education. Descriptive statistics were used to compare pre- and post-surveys to determine which categories were statistically significant. The Intellectus Statistics program was used to input data and run descriptive statistics on the pre- and post-surveys. No funding was given for this project.

Results

This project showed that adolescent athletes on a fall sports team did not have a good understanding of sun safety habits at baseline. The students spent an average of four hours per day in the sun for their respective sport and a majority of the students did not practice sun safety habits, such as wearing sunscreen, finding shaded areas, and wearing hats. The majority of students were also unable to distinguish a melanoma skin lesion from a benign one in the pre-survey. The post survey did not show a statistical significance in the sun safety habits of the

athletes across the two-week post education period. The post survey also showed no statistical significance in identifying melanoma lesions. The post survey did show that after the education, all student athletes were able to identify that sunscreen was the best way to protect against UV radiation and melanoma was the deadliest form of skin cancer. This project did not have the intended outcome of increasing sun safety habits among adolescent athletes; however, it did show that student athletes are able to be educated about UV overexposure and pediatric melanoma. The intervention can be sustained by creating an education program that is taught at all grade levels for all sport seasons. Repetitive education might be better digested by the students than a one-time education and coaches of sports teams can also encourage sun safety behaviors with their athletes.

Discussion

This project has shown that adolescent athletes need proper education about sun safety habits and melanoma risk. Although the athletes did not increase their sun safety habits, the students' understood sunscreen was the best defense to UV overexposure and melanoma is the deadliest form of skin cancer. Different forms of education or repetitive education may be a better solution to having athletes increase sun safety habits than a one-time education program. Limitations to this project include small sample size (n=6), loss of a participant, and lack of diversity among fall sports. A learning barrier for the students was the environment where the education took place. The education was given outdoors before their swim practice began and it may not have been the best place to conduct education due to many distractions. Challenges included reminding students to obtain parental consent if they wanted to participate and coordinating times to give the surveys and education. The findings of this project relate to previous research in the areas of education and hours spent in the sun. According to Bagatti et al.

(2016), the average athlete spends about 4 hours per day in the sun for their prospective sport. This matched the survey data of the swim team athletes spending close to 4 hours per day in the sun. The research also stated that forms of education for athletes might best be given in text message format (Bagatti et al., 2016; Eastabrook et al., 2018). Recommendations for future studies would be to include more sports teams in the project to get a better understanding of baseline sun safety habits among multiple groups of athletes. Education in the forms of photographs, audio, and reminder text messages may also be a better way to remind students to engage in safety behaviors. Repetitive education would also be helpful in allowing the students to better retain the information and more capable of identifying cancerous lesions. Sun safety habits and melanoma identification among adolescent athletes is a vital way to prevent UV overexposure and increase risk of melanoma in the pediatric population as well as adulthood. Education should be in multiple formats and language of education should be easy to understand. With more education and participation from schools and athletic coaches, impacts on decreasing melanoma in the adolescent age group can be done.

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Appendix A

Evaluation and Synthesis Tables

Table A1

Evaluation Table for Qualitative Studies

Citation	Theory/Conceptual Framework	Design/ Method	Sample/Setting	Major Themes & Definitions	Measurement/ Instrumentation	Data Analysis	Findings/Themes	Level/ Quality of Evidence; Decision for practice/ application to practice
Bagatti et al., 2016 Assessing behavior, knowledge, and attitudes about melanoma: An educational intervention for female college athletes. United States No funding Bias- convenience sample of predominately white, college-age, females at one university; no established reliability for the pre-test in	None listed but unconscious thoughts and ideas are brought to subjects' attention	Quasi-experimental 1-group pretest/posttest design Evaluate the knowledge, behaviors, and attitudes of college athletes regarding skin cancer	n= 72 female college athletes who represented the rowing, soccer, and lacrosse teams. Study conducted at a small, private, liberal arts university in Western Pennsylvania. All subjects were at least 18yo and active in a collegiate sport	Research questions were specific to behaviors, knowledge, and attitudes regarding sun safety.	Pre-test questionnaire and post-test questionnaire. Pre-test included a 28-item questionnaire to assess risk, knowledge, and behaviors related to sun safety. Also included four images of normal and abnormal nevi to assess subject's ability to identify abnormal skin lesions.	Descriptive statistics Chi-square Paired t-tests McNemar test	Pre-intervention behaviors included high sun exposure, poor attitude and concern over sun safety, and no care related to skin. Post-test results showed significant improvement in behaviors, attitudes, and knowledge.	Level II Changing the culture of sun protection and addressing college athletes about the problems with increased sun exposure can help reduce the burden of melanoma on this population

Key Terms: CI- confidence interval; CSSP- Clever in Sun and Shade Program; CT- controlled trial; DV- dependent variable; GLMM- generalized linear mixed modeling; h-hours; II- Level 2; IV- independent variable; N- total number of participants; n- number of participants; NCAA- National Collegiate Athletic Association; PPP- participatory program planning; QE- quasi-experimental; Qual- Qualitative; RF-rural females; RM- rural males; RS- rural students; SMS- short messaging system; SR- shadow rule UF- urban females; UM- urban males; US- urban students; UVR- ultraviolet radiation

Citation	Theory/Conceptual Framework	Design/ Method	Sample/Setting	Major Themes & Definitions	Measurement/ Instrumentation	Data Analysis	Findings/Themes	Level/ Quality of Evidence; Decision for practice/ application to practice
Americans. No validity for post-test.								
Taylor et al., 2016 Using UV photoaged photography to better understand Western Australian teenagers' attitudes towards adopting sun-protective behaviors Australia Funding- none Bias- Small scale sample size	Social Theory	Determine whether viewing a personal photoaged photograph had the capacity to alter Western Australian teenagers' pro-tanning attitudes	Female n=10 Male n=5 N=15 All 15 years old Lived in Perth, Australia	Five questions were aimed at eliciting data on participants existing attitudes on sun protective behaviors Seven questions on how theses perceptions changed once they viewed their UV photoaged photograph	Interviews	Transcribed interviews Inductive reasoning to refine interviews into themes and subthemes	Teenagers had the existing attitude that is important to use sunscreen, but they often forget After viewing their photo, the results did not alter their desire to remain tan	Level II Greater effort needs to be focused on increasing teenagers' understanding of how sun-damage occurs

Key Terms: CI- confidence interval; CSSP- Clever in Sun and Shade Program; CT- controlled trial; DV- dependent variable; GLMM- generalized linear mixed modeling; h-hours; II- Level 2; IV- independent variable; N- total number of participants; n- number of participants; NCAA- National Collegiate Athletic Association; PPP- participatory program planning; QE- quasi-experimental; Qual- Qualitative; RF-rural females; RM- rural males; RS- rural students; SMS- short messaging system; SR- shadow rule UF- urban females; UM- urban males; US- urban students; UVR- ultraviolet radiation

Citation	Theory/Conceptual Framework	Design/ Method	Sample/Setting	Major Themes & Definitions	Measurement/ Instrumentation	Data Analysis	Findings/Themes	Level/ Quality of Evidence; Decision for practice/ application to practice
Eastabrook et al., 2018 Melanoma risk: adolescent females' perspectives on skin protection pre/post-viewing a ultraviolet photoaged photograph of their own facial sun damage Australia No funding Bias- study limited to small sample size of specific, age, gender, and race.	Social Theory	Interpretative phenomenological analysis	n= 10 All participants are female, between 16-17yo, Caucasian, resided in Western Australia	Intentional UVR exposure is known to accelerate the ageing of skin Study to help adolescents understand their won perspectives on sun tanning and attitudes towards adopting sun safety behaviors both pre/post viewing a UV photoaged photo of their face	Interviews (pre/post) 1 normal flash picture 1 photoaged picture	Interpretive phenomenological analysis using coding of recurring patterns with the interview data.	Four major themes and nine subthemes were extracted from the interviews Overarching themes included: having a tan and looking good in the short term is okay, however, in the longer-term you can end up looking far worse, but still a tan is worth it.	Level II Skin protection interventions that lessen the belief of invincibility around adolescent females' understanding of their risk of melanoma is vital to lessen the incidence of melanoma.

Key Terms: CI- confidence interval; CSSP- Clever in Sun and Shade Program; CT- controlled trial; DV- dependent variable; GLMM- generalized linear mixed modeling; h-hours; II- Level 2; IV- independent variable; N- total number of participants; n- number of participants; NCAA- National Collegiate Athletic Association; PPP- participatory program planning; QE- quasi-experimental; Qual- Qualitative; RF-rural females; RM- rural males; RS- rural students; SMS- short messaging system; SR- shadow rule UF- urban females; UM- urban males; US- urban students; UVR- ultraviolet radiation

Citation	Theory/Conceptual Framework	Design/ Method	Sample/Setting	Major Themes & Definitions	Measurement/ Instrumentation	Data Analysis	Findings/Themes	Level/ Quality of Evidence; Decision for practice/ application to practice
Carter et al., 2016 Testing children's ability to correctly use the "Shadow Rule" for sun protection. Australia No funding Bias- Small sample size; one age group	Piaget's Theory of Cognitive Development	Questionnaire Shadow Simulator Estimate sun-cast shadow length relative to their height and whether this meant they should seek shade	n=76 10-year-old children in fifth grade 48% were female	The "Shadow Rule" is an immediate indicator of sunburn risk following the mnemonic "short shadow? Seek shade!" Questions over a person's ability to discern when their shadows are short vs long	Education session Response sheet- "longer, "same length" or "shorter" Tested their own shadow and 30cm tall doll	One- sample t test	Children experienced greatest difficulty judging their shadows' lengths when they were equal to their height. At all other angles they demonstrated a 92% accuracy and could correctly interpret the SR	Level II 10-year-old children are capable of applying the SR. Further education needed to determine if understanding the SR would translate into sun protection behavior changes.
Stozel et al., 2020 UV Protection for young athletes: using participatory program	Health Action Process Approach Social Learning Theory	PPP groups were conducted with students, teachers, coaches, and school administrators to	2 schools Total: Students n= 115	CSSP aims at enforcing positive attitudes toward UVR protection	Interviews	Frequency of adjectives were collected- word clouds	Less than 50% of school administrators and coaches expressed positive attitudes	Level II CSSP promotes positive attitudes towards UVR protection. PPP is

Key Terms: CI- confidence interval; CSSP- Clever in Sun and Shade Program; CT- controlled trial; DV- dependent variable; GLMM- generalized linear mixed modeling; h-hours; II- Level 2; IV- independent variable; N- total number of participants; n- number of participants; NCAA- National Collegiate Athletic Association; PPP- participatory program planning; QE- quasi-experimental; Qual- Qualitative; RF-rural females; RM- rural males; RS- rural students; SMS- short messaging system; SR- shadow rule UF- urban females; UM- urban males; US- urban students; UVR- ultraviolet radiation

Citation	Theory/Conceptual Framework	Design/ Method	Sample/Setting	Major Themes & Definitions	Measurement/ Instrumentation	Data Analysis	Findings/Themes	Level/ Quality of Evidence; Decision for practice/ application to practice
planning to develop a sports school program Germany Funding: German Cancer Aid in the campaign "Clever in Sun and shade"; Program for development of interdisciplinary oncology centers of excellence in Germany Bias: Small sample size; may be biased by social desirability		test CSSP program feasibility and acceptance	Teachers n= 5 School administrators n=4 Coaches n=5	and supporting school sports in establish UVR protection strategies		Positive vs negative Descriptive Analysis	toward UVR protection, less than 10% reported appropriate UVR behavior. After CSSP program, 80-86% of participants expressed positive adjectives to describe the importance of UVR protection	valuable in allowing tailored messages to meet schools' needs.

Key Terms: CI- confidence interval; CSSP- Clever in Sun and Shade Program; CT- controlled trial; DV- dependent variable; GLMM- generalized linear mixed modeling; h-hours; II- Level 2; IV- independent variable; N- total number of participants; n- number of participants; NCAA- National Collegiate Athletic Association; PPP- participatory program planning; QE- quasi-experimental; Qual- Qualitative; RF-rural females; RM- rural males; RS- rural students; SMS- short messaging system; SR- shadow rule UF- urban females; UM- urban males; US- urban students; UVR- ultraviolet radiation

Appendix A

Evaluation and Synthesis Tables

Table A2

Evaluation Table for Quantitative Studies

Citation	**Theoretical/ Conceptual Framework**	**Design/ Purpose**	**Sample/Setting**	**Variables**	**Measure/ Instrument**	**Data Analysis**	**Findings**	**LOE/ Application to practice/Generalization**
Nagelhout et al., 2019 Differences in reported sun protection practices, skin cancer knowledge, and perceived risk for skin cancer between rural and urban high school students. United States	None listed but social theory is inferred	Survey Evaluate differences in sun protection practices, skin cancer knowledge, and perceived risks between rural and urban high school students	Total n=1570 students. Non-Hispanic white (n=863) Hispanic (n= 341) Male (n= 735) Female (n= 812)	**IV:** *Sun safety information* **DV1:** *Adolescents in rural areas* **DV2:** *Adolescents in Urban areas* Assessing sun protection and intentional tanning, sunburn occurrence, skin cancer knowledge, perceived risk	Questionnaire-Sun Habits Survey using Likert Scale	Descriptive Statistics Chi-squared Logistic regression GLMM	US vs RS: Rural students had lower odds of wearing sunscreen (95% CI, p= 0.022), re-applying sunscreen (95% CI, p=0.002), wearing long sleeves (95% CI, p=0.004), and seeking shade compared to urban students (95%CI, p=0.005). RS also had higher number of reported sunburns than US. RM in rural areas had higher odds of wearing pants, hats, and sunglasses than UM. RF had lower odds	Level II **Strengths:** First study to compare skin cancer prevention knowledge and risk factors between rural and urban adolescents. **Weaknesses:** Demographics were mainly white non-Hispanics. Variability in socioeconomic factors

Key Terms: CI- confidence interval; CSSP- Clever in Sun and Shade Program; CT- controlled trial; DV- dependent variable; GLMM- generalized linear mixed modeling; h-hours; II- Level 2; IV- independent variable; N- total number of participants; n- number of participants; NCAA- National Collegiate Athletic Association; PPP- participatory program planning; QE- quasi-experimental; Qual- Qualitative; RF-rural females; RM- rural males; RS- rural students; SMS- short messaging system; SR- shadow rule UF- urban females; UM- urban males; US- urban students; UVR- ultraviolet radiation

Citation	Theoretical/ Conceptual Framework	Design/ Purpose	Sample/Setting	Variables	Measure/ Instrument	Data Analysis	Findings	LOE/ Application to practice/Generalization
Funding: Undergraduate Research Opportunities Program at the University of Utah Bias: Self-reporting may cause bias			Family history of skin cancer (n=444) Attended rural school (n=485) Attended urban school (n=1085) All schools based in Utah- 11 schools participated located in three counties- one urban and two rural. Mean age is 15.7	for skin cancer, and demographic information. Rural vs Urban High school students- frequency of sun protection methods along with skin cancer related knowledge			of wearing sunglasses than UF. RS had lower perceived knowledge of skin cancer risks tanning between RS and US.	Use of sun protection was self-reported and may be biased **Application to Practice:** Geographical and gender differences should be considered when developing skin cancer prevention programs or education for adolescents.

Key Terms: CI- confidence interval; CSSP- Clever in Sun and Shade Program; CT- controlled trial; DV- dependent variable; GLMM- generalized linear mixed modeling; h-hours; II- Level 2; IV- independent variable; N- total number of participants; n- number of participants; NCAA- National Collegiate Athletic Association; PPP- participatory program planning; QE- quasi-experimental; Qual- Qualitative; RF-rural females; RM- rural males; RS- rural students; SMS- short messaging system; SR- shadow rule UF- urban females; UM- urban males; US- urban students; UVR- ultraviolet radiation

Citation	Theoretical/ Conceptual Framework	Design/ Purpose	Sample/Setting	Variables	Measure/ Instrument	Data Analysis	Findings	LOE/ Application to practice/Generalization
Hubbard et al., 2020 Sun protection education for adolescents: a feasibility study of a wait-list controlled trial of an intervention involving a presentation, action planning, and SMS messages and using objective measurement of sun exposure United Kingdom Funding- Chief Scientist Office of Scotland Bias- small number of mainly Caucasian adolescents; Study conducted in a country with inclement weather.	Common Sense Model of Illness Representation and Self-regulation Health Action Process Approach	Mixed Methods Feasibility study of a wait-list controlled trial with five schools allocated to the research team and one school to a wait-list control group. The last school recruited was allocated to the control group. Study was not randomized Assess the feasibility and acceptability of a sun protection education intervention with an additional intervention-SMS	Males and females ages 13-15 from 6 schools across different parts of Scotland n= 487 students intervention group= 385	**IV:** Sun protection education **DV:** Melanin and erythema measurements Qualitative- adolescent view of overall education programs and value in sun safety protection measures	Mexameter to measure melanin and erythema levels Qualitative- focus groups	Descriptive Statistics Paired analysis Cross-tabulations Qualitative: transcripts	Melanin increased Erythema decreased 68% of students read the booklet, 92% listened to the presentation, and 39% received text messages. 27% of students did all three. Focus groups: Adolescents did not see the relevance of sun protection in the UK for their age group	Level II **Strengths:** Objective measurements of melanin is feasible in schools and acceptable in adolescents **Weaknesses:** mainly white adolescents; study conducted in a country with mostly inclement weather **Application to practice:** Can objectively measure erythema and melanin levels in students before and after a school holiday. Possible to implement sun protection education interventions
Ally et al., 2017 Promoting sunscreen use and sun-protective practices in NCAA athletes: Impact	Social Theory	Measure impact of educational intervention on sun protection	n= 846 NCAA athletes surveyed in September 2012	**IV:** Sunsport education	Survey	Wilcoxon rank-sum test	Significant increase in sunscreen use 4 or more days per week by student	Level II Strength: further confirmed previous studies in which sun

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Citation	Theoretical/ Conceptual Framework	Design/ Purpose	Sample/Setting	Variables	Measure/ Instrument	Data Analysis	Findings	LOE/ Application to practice/Generalization
of SUNSPORT educational intervention for student-athletes, athletic trainers, and coaches United States Funding: None Bias: Recall bias		beliefs and practices of student athletes		**DV:** sun safety and skin cancer risk		Chi-square Fisher's	athletes (26% to 39%, p=.02). Increase in students being spoken to by their coaches about sun safety (26% to 57%, p=.0001) Student athlete's recognition of higher skin cancer risk (54% to 67%, p= .04)	safety behaviors increase with education programs Weakness: One university surveyed; Some student surveyed did not practice outdoors Application to Practice: Education for student athletes, coaches, and athletic trainers can greatly impact sun protective practices.
Orsimarsi, 2019 Skin cancer knowledge and prevention practices among young adult athletes Funding: none Bias: none	Health Promotion Model	Systematic Review	PubMed Science Direct Within the past five years 8 studies	Searched with terms: skin cancer, melanoma, prevention, young adults, athletes, behaviors, attitudes, knowledge	Questionnaires RCTs Quasi-experimental Surveys	Descriptive statistics t-tests	Most results showed that young athletes do not report an increased use of sun protection methods, such as sunscreen or protective clothing, although they are frequently exposed to the sun	Level II Young athletes participating in outdoor sports are at an increased risk for developing skin cancer due to excessive UVR while practicing and competing Results from the 8 studies show that frequent sun exposure does not impact young athletes use of protective

Key Terms: CI- confidence interval; CSSP- Clever in Sun and Shade Program; CT- controlled trial; DV- dependent variable; GLMM- generalized linear mixed modeling; h-hours; II- Level 2; IV- independent variable; N- total number of participants; n- number of participants; NCAA- National Collegiate Athletic Association; PPP- participatory program planning; QE- quasi-experimental; Qual- Qualitative; RF-rural females; RM- rural males; RS- rural students; SMS- short messaging system; SR- shadow rule UF- urban females; UM- urban males; US- urban students; UVR- ultraviolet radiation

Citation	Theoretical/ Conceptual Framework	Design/ Purpose	Sample/Setting	Variables	Measure/ Instrument	Data Analysis	Findings	LOE/ Application to practice/Generalization
								clothing or preventative measures.
Moustafa et al., 2020 Trends in pediatric skin cancer USA Funding- The Dermatology Foundation and the Harvard Medical School Eleanor and Miles Shore Fellowship award Bias- none	None listed but Health Promotion Model inferred	Systematic Review	Identify pediatric cancer characteristics, underlying genetic drivers, and options for melanomas arising in childhood and adolescence 66 studies	Key terms- melanoma, oncology, skin cancer, pediatrics, treatment	Case studies Clinical Trials	Descriptive Statistics	Melanoma in pediatric patients differs from conventional adult melanoma. Pediatric patients with melanoma should be screened for predisposing risk factors. More research is needed for treatments on those in the pediatric population that are used for adults.	Pediatric melanoma is rare and can occur in a variety of presentations. More research is needed on therapeutic treatments.

Key Terms: CI- confidence interval; CSSP- Clever in Sun and Shade Program; CT- controlled trial; DV- dependent variable; GLMM- generalized linear mixed modeling; h-hours; II- Level 2; IV- independent variable; N- total number of participants; n- number of participants; NCAA- National Collegiate Athletic Association; PPP- participatory program planning; QE- quasi-experimental; Qual- Qualitative; RF-rural females; RM- rural males; RS- rural students; SMS- short messaging system; SR- shadow rule UF- urban females; UM- urban males; US- urban students; UVR- ultraviolet radiation

Table A3

Synthesis Table

Study	Ally et al., 2017	Bagatti et al., 2016	Carter et al., 2016	Eastabrook et al., 2018	Hubbard et al., 2020	Moustafa et al., 2020	Orsimarsi et al., 2019	Nagelhout et al., 2019	Stozel et al., 2020	Taylor et al., 2016
Design/LOE	CT; II	QE; II	Qual; II	Qual; II	MM; II	SR; I	SR; II	MM; II	Qual; II	Qual; II
Sample										
n subjects	846	72	76	10	487	66	8	1570	115	15
Country	USA	USA	Australia	Australia	United Kingdom	USA	USA	USA	Germany	Australia
Measurement Tools										
Survey	X	X	X					X		
Interview				X					X	X
Focus Group					X					
Various						X	X			
Framework										
Social theory	X	X		X				X	X	X
Piaget's Theory of Cognitive Development			X							
Common Sense Model					X					

Key Terms: CI- confidence interval; CSSP- Clever in Sun and Shade Program; CT- controlled trial; DV- dependent variable; GLMM- generalized linear mixed modeling; h-hours; II- Level 2; IV- independent variable; N- total number of participants; n- number of participants; NCAA- National Collegiate Athletic Association; PPP- participatory program planning; QE- quasi-experimental; Qual- Qualitative; RF-rural females; RM- rural males; RS- rural students; SMS- short messaging system; SR- shadow rule UF- urban females; UM- urban males; US- urban students; UVR- ultraviolet radiation

Study	Ally et al., 2017	Bagatti et al., 2016	Carter et al., 2016	Eastabrook et al., 2018	Hubbard et al., 2020	Moustafa et al., 2020	Orsimarsi et al., 2019	Nagelhout et al., 2019	Stozel et al., 2020	Taylor et al., 2016
of Illness Representation										
Health Action Process					X				X	
Health Promotion Model						X	X			
IV										
Sunsport Education	X									
Shadow Rule Education			X							
UV aged photograph				X						X
Sun protection education					X		X	X	X	X
Pediatric Skin Cancer						X				
DV										
Sun safety and skin cancer risk	X				X		X	X		
Melanin and Erythema Measurements					X					

Key Terms: CI- confidence interval; CSSP- Clever in Sun and Shade Program; CT- controlled trial; DV- dependent variable; GLMM- generalized linear mixed modeling; h-hours; II- Level 2; IV- independent variable; N- total number of participants; n- number of participants; NCAA- National Collegiate Athletic Association; PPP- participatory program planning; QE- quasi-experimental; Qual- Qualitative; RF-rural females; RM- rural males; RS- rural students; SMS- short messaging system; SR- shadow rule UF- urban females; UM- urban males; US- urban students; UVR- ultraviolet radiation

Study	Ally et al., 2017	Bagatti et al., 2016	Carter et al., 2016	Eastabrook et al., 2018	Hubbard et al., 2020	Moustafa et al., 2020	Orsimarsi et al., 2019	Nagelhout et al., 2019	Stozel et al., 2020	Taylor et al., 2016
Therapeutic Pediatric Cancer Treatments						X				
Outcomes										
Education improves knowledge of sun safety behaviors	X	X	X	X	X		X	X	X	X
Increase in sunscreen use	X	X		X						
Increase knowledge of skin cancer risk	X	X		X	X				X	
Coaches educate athletes	X								X	
Ability to know when to seek shade based on shadow length			X							
Screening is necessary to reduce						X	X			

Key Terms: CI- confidence interval; CSSP- Clever in Sun and Shade Program; CT- controlled trial; DV- dependent variable; GLMM- generalized linear mixed modeling; h-hours; II- Level 2; IV- independent variable; N- total number of participants; n- number of participants; NCAA- National Collegiate Athletic Association; PPP- participatory program planning; QE- quasi-experimental; Qual- Qualitative; RF-rural females; RM- rural males; RS- rural students; SMS- short messaging system; SR- shadow rule UF- urban females; UM- urban males; US- urban students; UVR- ultraviolet radiation

Study	Ally et al., 2017	Bagatti et al., 2016	Carter et al., 2016	Eastabrook et al., 2018	Hubbard et al., 2020	Moustafa et al., 2020	Orsimarsi et al., 2019	Nagelhout et al., 2019	Stozel et al., 2020	Taylor et al., 2016
pediatric skin cancer risk										
Themes										
Sun safety behaviors increase with proper education	X	X	X	X	X		X	X	X	
Pre-Intervention included poor sun safety attitudes and behaviors	X	X	X	X	X		X	X	X	X
Young female adolescents believe having tan is a measure of beauty				X		X	X			X
Education over sun safety did not change tanning behavior										X

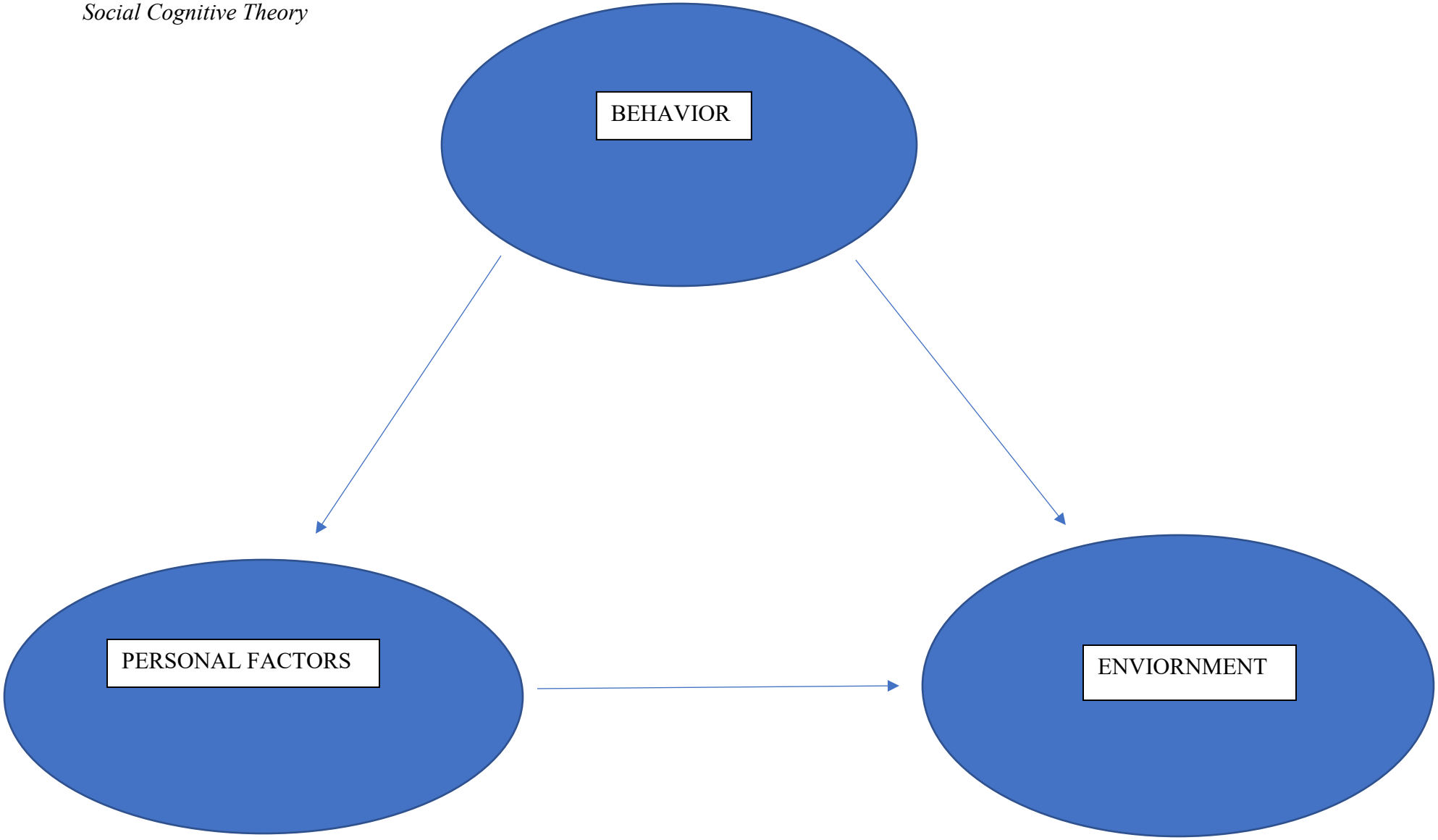
Key Terms: CI- confidence interval; CSSP- Clever in Sun and Shade Program; CT- controlled trial; DV- dependent variable; GLMM- generalized linear mixed modeling; h-hours; II- Level 2; IV- independent variable; N- total number of participants; n- number of participants; NCAA- National Collegiate Athletic Association; PPP- participatory program planning; QE- quasi-experimental; Qual- Qualitative; RF-rural females; RM- rural males; RS- rural students; SMS- short messaging system; SR- shadow rule UF- urban females; UM- urban males; US- urban students; UVR- ultraviolet radiation

Appendix B

Theory Application and Implementation Framework

Figure B1

Social Cognitive Theory

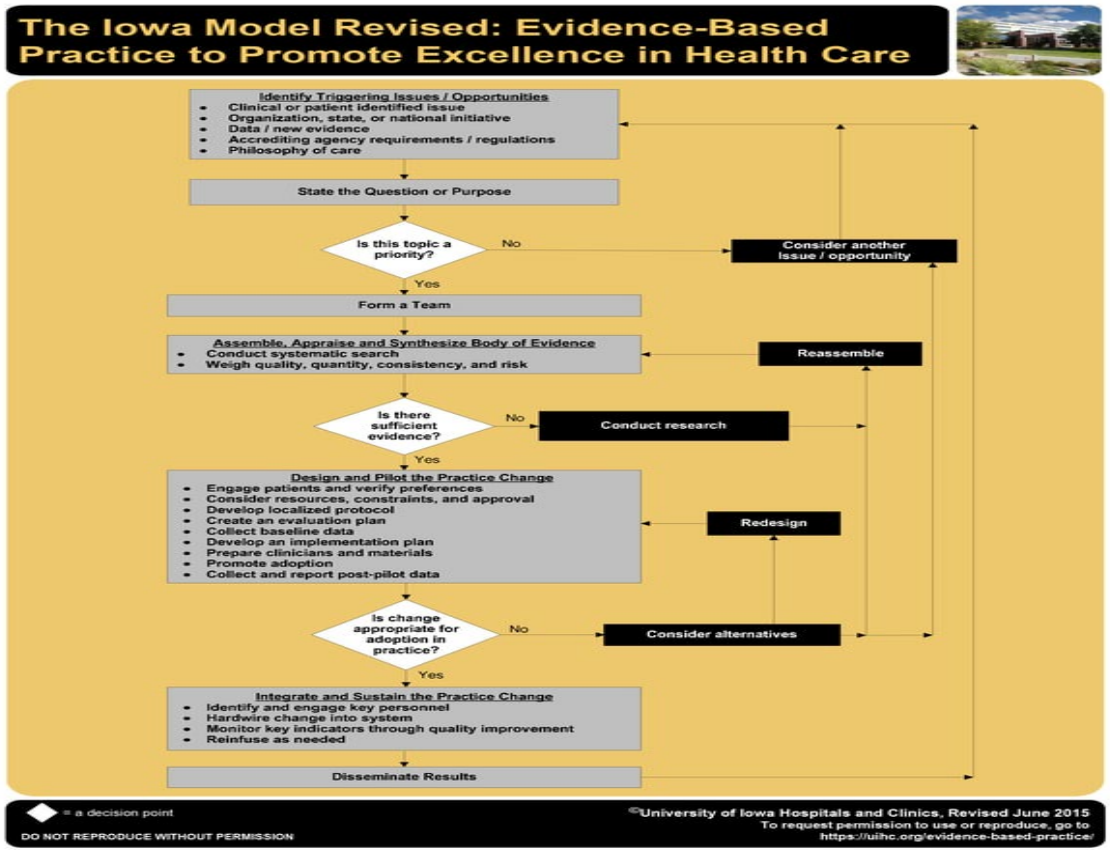


Appendix B

Theory Application and Implementation Framework

Figure B2

The Iowa Model



(Iowa Model Collaborative, 2017)