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A novel educational intervention targeting melanoma risk and prevention knowledge among children with a familial risk for melanoma

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Abstract

Objective—To examine the acceptability of and preliminary effects associated with a novel educational intervention for children at elevated risk for melanoma. The intervention incorporated information on mechanisms through which melanoma preventive behaviors mitigate risk for melanoma and was delivered to parents and children concurrently.

Methods—Twenty-two parents (with a personal history of melanoma or spouse with a history of melanoma) and 33 children (mean age 11.8 years) were asked to complete questionnaires immediately prior to and after an educational session and at a one-month follow-up.

Results—Both parents and children endorsed that the educational materials were acceptable. Knowledge about melanoma risk and preventive and screening behaviors increased significantly. Children's perceived risk for melanoma increased significantly, while parents' perceptions of children's risk started at a higher level and remained constant. There were significant increases in reported engagement in sun protective behaviors.

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Conflicts of interest

Dr. Leachman serves on a Medical and Scientific Advisory Board for Myriad Genetics, for which she has received an honorarium. She collaborated with Myriad to validate an assay that is unrelated to research reported here. The other authors declare that there is no conflict of interest.

Conclusion—The educational intervention shows promise in terms of its acceptability and effects on participant knowledge, perceived risk, and engagement in melanoma preventive behaviors.

Practice implication—Children at elevated risk for melanoma and their parents may benefit from receiving educational information on their disease risk and strategies for prevention and screening.

Keywords

Melanoma; Prevention; Educational intervention; Children; families; Risk communication

1. Introduction

Children who have a familial risk for melanoma, such as those with a parent with a history of melanoma, are at increased risk for the disease. For instance, individuals who have a first-degree relative with a history of melanoma have a 2-fold risk for the disease, and individuals with inherited mutations in the principal melanoma predisposition gene *CDKN2A* have a 25–50% lifetime risk [1–4]. Melanoma preventive behaviors that reduce ultraviolet radiation (UVR) exposure and the occurrence of sunburns include use of sunscreen and/or protective clothing, minimizing UVR exposure during peak hours (10 am–4 pm), and avoidance of intentional tanning [5]. Implementation of such preventive behaviors during childhood, particularly among at-risk populations, is especially critical given that UVR exposure and sunburn occurrence early in life are modifiable risk factors for melanoma later in life [6–9].

Unfortunately, children who have a familial risk for melanoma are sub-optimally adherent to recommended melanoma preventive behaviors [10–12]. While approximately 70–79% of children at increased familial risk use sunscreen regularly, shade-seeking and protective clothing use occur less frequently (23–37% for shade-seeking; 8–33% for hat and sunglass use). In addition, parents reported that 28% of children at-risk for melanoma sustained sunburns in the last 6 months and 43–49% in the last year [10–12]. Some studies have begun to identify potential reasons for poor engagement in preventive behaviors, including older child age, lower parental intentions to protect children from the sun, and children's lack of knowledge or awareness about how preventive behaviors implemented during childhood could affect melanoma occurrence later in life [10–12].

The findings above highlight the need for melanoma preventive interventions targeting children who are at elevated risk for the disease, including interventions that communicate children's genetic risk for melanoma and the ways in which implementing preventive behaviors could mitigate familial risk [13]. The only intervention, to our knowledge, that has provided melanoma prevention information to children who have a familial risk for the disease was conducted by Gritz and colleagues [14,15]. Specifically, the intervention consisted of 3 postal mailings to melanoma survivors and their children under age 12. The materials included survivors' experiences with and modeling of sun protective behaviors with their children and an activity booklet for children on sun protective behaviors. The intervention led to improvements in sunscreen application 1-month post-intervention and wide-brimmed hat use 4-months post-intervention, but no significant improvements in other

behaviors. One potential method for building the intervention literature focused on this at-risk population is to provide families with education on the mechanisms through which melanoma preventive behaviors mitigate children's risk for the disease. Marteau and Weinman have hypothesized that provision of genetic risk information will have a larger impact on behavior change if the risk information is accompanied by information on the interactions between genetic and environmental factors contributing to disease [16].

The goals of the current study were to examine the acceptability of and preliminary effects associated with a novel educational intervention for children who have a familial risk of melanoma. The intervention was designed to provide developmentally appropriate information on children's elevated risk for the disease based on their family history and to demonstrate how melanoma preventive behaviors could mitigate this risk. We hypothesized that families would find the educational materials to be acceptable, and that the materials would lead to increased knowledge, perceptions of children's risk for melanoma, intentions to engage in melanoma preventive behaviors, and reported engagement in preventive behaviors over time.

2. Methods

2.1. Participants and procedures

Parents of children ages 8–17 years were invited to participate if they or the child's other parent had a history of melanoma, and thus their children had a 2-fold risk for melanoma. Children were eligible to participate if they were between the ages of 8–17 years (and had a parent with a history of melanoma). The 8–17 year age range was selected to enable children to complete self-reported measures and to maximize potential for their meaningful interaction with the educational content provided [17–22]. Eligible families were recruited through a registry from a prior study including parents with a history of melanoma and their children. Those families had largely been recruited from a comprehensive cancer center in the Mountain West. Of the 73 families contacted, 18 participated (recruitment rate = 25%), which included 22 parents and 33 children.

Families were invited to attend an in-person educational session in a university setting. Parents provided written informed consent and parental permission and children provided written assent. All participants were asked to complete study questionnaires immediately prior to and after reviewing the educational materials, and at a follow-up 1 month later (100% retention between the first and last timepoints). All study procedures were approved by the University of Utah Institutional Review Board (protocol 00086073).

2.2. Educational intervention

Two master's-level research assistants (each with a Master's in Public Health) delivered the single-session, in-person intervention (Melanoma Education and Risk Information Team, MERIT), lasting approximately 30 min to each family. MERIT provides information on melanoma risk and prevention, including foundational information on traits and the environment, DNA and genes, mutation, melanoma development, regulation of cell growth, genetic and environmental risk, and melanoma prevention and control [23]. MERIT consists

of visuals delivered through Power-Point and short videos, and the still visuals are accompanied by brief text. The educational materials were grounded in Protection Motivation Theory and Marteau and Weinman's expansion on the Common-Sense Model of Self-regulation and Illness [16,24], both models that have been applied to other pediatric populations [25,26]. Specifically, based on Protection Motivation Theory, the materials targeted perceived vulnerability and response efficacy, and based on the Common-Sense Model, the materials included information on the mechanisms underlying melanoma risk reduction [23].

2.3. Measures

Both parents and children were asked to complete questionnaires (available from the first author on request). Parents' and children's perceptions of the *acceptability* of the educational materials were assessed immediately after they viewed the educational materials using 17 items on a 5-point Likert scale ranging from "strongly disagree" to "strongly agree" adapted from prior studies [27–29]. Items assessing perceived exaggeration of risk and prevention information were created for the current study or adapted from prior work [30]. Items assessing personal applicability of the information provided were adapted from a prior study on melanoma prevention among high-risk families [31].

Children's and parents' *knowledge* was assessed using an investigator-designed questionnaire with 28 true/false items for parents and 29 items for children. Five knowledge subscales were developed: foundational concepts of DNA and mutation, development of melanoma, understanding of genetic and environmental risk, and prevention strategies. The knowledge items were designed by the research team to assess knowledge of the learning objectives covered in MERIT. Knowledge scores were calculated by assigning a "1" to correct answers and a "0" to incorrect answers, and summing the item scores.

Parents' and children's perceptions of children's risk for melanoma were assessed using 2 items [32] on absolute risk (i.e., lifetime risk for melanoma on a 5-point scale from "very unlikely" to "very likely") and relative risk (i.e., risk for melanoma compared to peers on a 5-point scale from "a lot less likely" to "very likely").

Parents and children were asked to report on their *intentions* for children to engage in melanoma preventive and screening behaviors. Intentions were assessed on a 5-point scale ("No, and I do not plan to start doing so in the next 6 months" to "Yes, I have been, but for more than 6 months") adapted from previous studies based on the Transtheoretical model [33,34].

We assessed children's *reported engagement in melanoma prevention and screening behaviors* based on parent- and child-report using a modified version of the Sun Habits Survey [35]. Parents and children were asked how often in the past month they engaged in nine preventive behaviors when they were outdoors for more than 15 min (on a 5-point Likert scale ranging from "never" to "always"). Screening behaviors (skin self-exam (SSE) frequency and thoroughness) were assessed with two items. Participants were asked the number of times in the past month that children had engaged in a SSE to check their skin for new or changes in moles. Children's *SSE frequency* was categorized as "adherent" (once a

month), “underscreened” (never, less than once per month) and “overscreened” (every day, every 2–3 days, 4 times a month, 2 times a month). To assess for *SSE thoroughness*, participants were provided a list of 15 body sites and asked to check off the sites examined in the past month [36].

To examine the potential effect of differing levels of UVR exposure due to seasonal changes, we utilized UVR monthly averages [37]. Baseline data collection occurred from February through June and follow-up data collection occurred from March through August.

2.4. Data analysis

Descriptive statistics were calculated to summarize participant demographic characteristics and acceptability of educational materials. Independent sample *t*-tests were conducted to examine potential differences between parent- and child-reported acceptability scores. Repeated-measures analyses of variance (ANOVAs) were conducted to examine changes in parent’s and children’s knowledge and intentions to engage in children’s melanoma preventive behaviors over time. Post-hoc pairwise comparisons with a Bonferroni correction were used to examine knowledge and intention changes between timepoints. Perceptions of children’s absolute and relative risk for melanoma across time points was examined using Friedman’s test. The Wilcoxon rank test was used in post-hoc analyses to examine changes in perceived risk. Repeated-measures ANOVAs were conducted to examine children’s reported engagement in preventive behaviors, and post-hoc pairwise comparisons using a Bonferroni correction were used to assess engagement between timepoints. Analyses involving photoprotection outcomes were also conducted controlling for monthly UVR index. McNemar’s test was used to examine changes in the proportion of children who completed SSEs monthly. Paired samples *t*-tests were conducted to examine potential change in SSE thoroughness.

3. Results

In total, 22 parents (15 mothers, 7 fathers) and 33 children (mean age = 11.8 years, *SD* = 2.9, Range: 8–17) participated (see Table 1 for demographic characteristics).

3.1. Acceptability

Parents and children reported that the MERIT educational materials were acceptable across several domains. On average, participants “agreed” to “strongly agreed” that the materials contained useful content, were comprehensible, and were appealing (see Table 2). Parents and children reported learning new information from the materials. Parents, in particular, noted that they expected the materials to motivate engagement in melanoma preventive and screening behaviors. Parents reported that the melanoma preventive behavior recommendations in the MERIT materials were not exaggerated. Both parents and children reported that the materials contained information about melanoma risk that was important and relevant to them. There were no significant differences in parent’s and children’s acceptability scores.

3.2. Knowledge

Both parents and children demonstrated significant increases in knowledge pre- to post-intervention. Notably, these significant increases in knowledge were observed across all knowledge domains (Table 3). Among parents, there were significant overall changes in knowledge across time ($F(2,42) = 51.7, p < 0.001$). Total knowledge scores increased significantly from baseline to immediately post-education and remained significantly higher at the 1-month follow-up compared to baseline scores. Parent's overall knowledge score decreased by an average of 1.2 points from immediately post education to 1-month follow-up but this decrease was not significant. Among children, there were significant changes in overall knowledge across time ($F(2,64) = 76.6, p < 0.001$). Total knowledge scores increased significantly from baseline to immediately post-education and from baseline to 1-month follow-up ($p < 0.001$). Children's overall knowledge scores and knowledge subscale scores for melanoma development and foundational concepts of DNA and mutation decreased significantly from immediately post-education to the 1-month follow-up, suggesting some declines in retention of information. Despite the decrease in children's scores from immediately post education to 1-month follow-up, knowledge scores at 1-month follow-up remained significantly higher than at baseline.

3.3. Perceived risk

3.3.1. Parent perceptions of children's risk—There was no significant change from baseline in parent-perceived absolute melanoma risk for children either immediately post-education or at 1-month follow-up ($\chi^2(2) = 1.0, p = 0.61$; Table 3). There was also no significant change in parent-perceived relative melanoma risk for children between baseline, immediately post-education and 1-month follow-up ($\chi^2(2) = 1.1, p = 0.62$; Table 2).

3.3.2. Children's perceptions of their own risk—Child-perceived absolute risk for melanoma significantly increased over time ($\chi^2(2) = 15.4, p < 0.0001$). Post-hoc tests indicated that from baseline to immediately post-education, there was a significant increase in perceived absolute risk (increase of 0.81 points; $Z = 3.0, p = 0.003$). There was no significant change from immediately post-session to the 1-month follow-up ($Z = 1.2, p = 0.21$). From baseline to 1-month follow-up, there was a significant increase in perceived absolute risk (0.58 points; $Z = 2.1, p = 0.03$). Child-perceived relative risk for melanoma significantly increased over time ($\chi^2(2) = 11.0, p = 0.004$). Post-hoc tests indicated that there was a significant increase in perceived relative risk (.61 points; $Z = 2.6, p = 0.008$) between baseline and 1-month follow up. From baseline to immediately post-education and from immediately post-education to 1-month follow-up, there was no significant change in child-perceived relative risk ($Z = 1.8, p = 0.06$; $Z = 1.5, p = 0.13$, respectively).

3.4. Intended engagement in preventive behaviors

We examined potential change in parents' and children's intentions for children to engage in melanoma preventive behaviors across the three time points (see Table 3 for means). The only significant changes were for parents' intent to have children wear a wide-brimmed hat and to avoid peak hours for UVR exposure. Specifically, there was a significant increase of 0.66 points in parents' intentions to have children wear hats from immediately post-

education to the 1-month follow-up ($F(2,76) = 3.62, p = 0.03$) from “I intend to start doing so in the next 6 months” to “I intend to start doing so in the next 30 days.” Season did not predict parents’ intentions to have children wear hats ($p = 0.81$). There was a significant increase in parents’ intentions to have children avoid peak UVR exposure hours from baseline to 1-month follow-up ($F(2,76) = 4.64, p = 0.01$) from “I intend to start doing so in the next 30 days” to “I have been, for less than 6 months.” Season did not predict parents’ intent to have children avoid peak UVR exposure hours ($p = 0.06$). Children reported no significant changes in their intended engagement.

3.5. Reported engagement in preventive and risk behaviors

Fig. 1 displays children’s reported engagement in preventive and risk behaviors in the past month, at baseline, and at 1-month follow-up. Parents reported a significant increase in children’s *sunscreen use* with an average increase of 0.70 from “Rarely” to “Sometimes” ($F(1,21) = 14.9, p < 0.05$). Season did not predict this change in parent-report of children’s sunscreen use ($p = 0.24$). Children also reported significant increases in their use of sunscreen from baseline to 1-month follow-up ($F(1,30) = 5.9, p < 0.05$). Frequency of sunscreen use was higher during months of high UVR ($F(2,28) = 11.9, p = 0.007$); yet, the increase in sunscreen use over time remained statistically significant when season was statistically controlled for ($p = 0.04$).

Next, we examined potential changes in children’s reported use of protective clothing. Parents reported significant decreases in children’s wearing of *long-sleeved shirts* ($F(1,21) = 19.9, p < 0.05$) and *long pants* ($F(1,21) = 10.1, p < 0.05$). Season did not predict these outcomes (p ’s > 0.05). Children reported no significant changes in long-sleeved shirt or long pants wearing over time. Neither parents nor children reported significant changes in children’s use of a *wide-brimmed hat* over time. Parents reported a 0.59 increase in children’s sunglass use from “Never” to “Sometimes” ($F(1,21) = 12.1, p < 0.05$). Season did not predict this finding ($p = 0.81$). Children similarly did not report any changes in their sunglass use.

Both parents and children reported significant increases in children’s *shade-seeking* across time ($F(1,21) = 24.1, p < 0.05$; $F(1,32) = 5.3, p < 0.05$, respectively). Season did not predict these findings (p ’s > 0.05). In addition, parents reported that children increased their *avoidance of peak UVR exposure* ($F(1,21) = 16.8, p < 0.05$). Season did not predict this finding ($p = 0.81$). Children did not report a change in their avoidance of peak UVR exposure ($F(1,31) = 0.11, p = 0.73$). Both parents and children reported no significant changes in children’s outdoor or indoor *tanning behavior* (p ’s > 0.05). Rates of intentional tanning behaviors were low at baseline, and thus there was little opportunity for improvement in these behaviors.

3.6. Reported engagement in SSE screening

SSE frequency: Parents reported that there was no significant change in the proportion of children who were conducting monthly SSEs (“adherent”) ($p > 0.05$). Specifically, at baseline, 13% of parents reported their children as adherent and 87% as “underscreened.” At 1-month follow up, 31% reported their child as “adherent”, 51% as “underscreened,” and

18% as “overscreened.” Based on child-report, there was no change in the proportion of “adherent” screeners (13% at baseline, 15% at 1-month follow-up; $p > 0.05$). At baseline, 70% of children reported they “underscreened” compared to 59% at 1-month follow up. At baseline, 18% of children reported “overscreened” compared to 26% at 1-month follow up.

SSE thoroughness: Parents reported that there was no significant change in the thoroughness of children’s SSE ($p > 0.05$). However, across the entire sample of children reported a significant change in their SSE thoroughness from baseline to 1-month follow-up ($t(33) = 3.8, p < 0.05$). Specifically, children reported checking an average of 2.5 more body sites from baseline to 1-month follow-up ($p < 0.05$). In particular, children reported significantly increasing the frequency of checking their ears, neck, arms, hands, legs, and tops of their feet (all p ’s < 0.05).

4. Discussion and conclusion

4.1. Discussion

This initial pilot study of a novel educational intervention for children at elevated risk for melanoma due to family history (MERIT) demonstrated that the intervention was acceptable to children and their parents and that the intervention was associated with positive effects across several domains, including participants’ knowledge, perceived risk, and children’s reported engagement in preventive behaviors. Improvements in preventive behavior implementation could be due, in part, to children’s increased perceptions that they are at higher risk for melanoma (both absolute and relative risk) pre- to post-intervention. In contrast, parents entered into the educational program with higher perceptions of children’s risk for melanoma, and these risk perceptions were maintained over time.

Educational health promotion interventions have been shown to be effective across areas relevant to pediatric populations, such as physical activity and nutrition [19,21]. Previous studies have also been shown to be effective at changing attitudes and behaviors over longer term periods (e.g., 12 months) [20,22]. Our findings add to the literature on behavioral interventions targeting melanoma preventive behavior implementation among children who have a family history of melanoma [14]. The preventive behavior changes associated with MERIT (i.e., sunscreen application, shade-seeking, sunglass use, avoidance of UVR exposure) were different than those in prior interventions (sunscreen re-application, hat use) [14]. If more rigorous tests of MERIT (e.g., through a randomized-controlled trial) confirm these differences, it could be useful to further explore what intervention components are particularly impactful in creating change for different preventive behaviors. It may also be useful to use qualitative methods to better understand differences in reported changes in children’s preventive behavior implementation. We observed significant decreases in protective clothing use (i.e., long-sleeved shirts and long pants), which could be due to increased use of sunscreen as a sun protection strategy. Future work could explore how parents and children choose between different sun protection strategies.

Additional tests of interventions such as MERIT could examine potential moderators (e.g., child and parent age, gender) and mediators of intervention effects. For example, studies could seek to identify the family processes (e.g., parental monitoring of preventive behavior

implementation, family communication about melanoma risk and prevention) that underlie improvements in children's implementation of preventive behaviors. Mediators of intervention effects could be integrated as specific targets of intervention. Interventions may also benefit from addressing particular prevention and screening behaviors for which we did not observe significant changes (e.g., use of a wide-brimmed hat, implementation of regular SSEs) and seeking to achieve clinically significant improvements in children's engagement in melanoma preventive behaviors. Brief educational programs such as MERIT could further be tested in the context of comprehensive interventions that provide families with specific guidance on strategies to implement the recommended prevention and screening behaviors and surmount potential barriers, such as child refusal or time limitations. Comprehensive interventions could seek to tailor risk information to individuals' existing knowledge, understanding about risk, and other factors (e.g., numeracy, existing engagement in preventive behaviors).

The current study had several strengths and limitations worth noting. Our study was able to include both child and parent perspectives on children's engagement in melanoma prevention and screening behaviors. Prior studies have focused on parents' perspectives, which, as seen in the current findings, can differ from children's. In addition, the MERIT materials pilot-tested in this study were novel in several ways, including that they were designed to be delivered to parents and children concurrently and provided specific education on children's elevated risk for melanoma, in addition to information on prevention and screening behaviors. Limitations include the small sample size, which could have detracted from the ability to detect significant effects and did not permit analysis of moderators or mediators. Also, due to the relatively small literature focused on children with a family history of melanoma, not all scales used were validated with the current population. The current study was conducted in a single geographic location, albeit one at high elevation and with a high rate of melanoma, had a recruitment rate of 25%, and included families with higher socioeconomic status and who were Caucasian, thus limiting the potential generalizability of the findings. Future multi-site studies are needed that include more socioeconomically and racially and ethnically diverse populations, and employ more rigorous designs. In addition, future studies could include longer-term follow-up to ensure that improvements in preventive behavior implementation are sustained over time, and thus remain clinically relevant to melanoma preventive efforts.

4.2. Conclusions

Children who are at elevated risk for melanoma due to a family history of the disease, together with their parents, may benefit from receiving educational information on their risk for the disease and strategies for prevention and screening. The educational program can be feasibly delivered to children and their parents. In addition, the program was acceptable to families and demonstrated initial evidence of benefit in desired areas, including knowledge and reported engagement in melanoma preventive behaviors. Such educational programs focused on risk reduction could help children establish good habits related to melanoma preventive behaviors and decrease their long-term risk for melanoma.

4.3. Practice implications

A diagnosis of melanoma in a parent presents a unique opportunity to provide risk-reduction interventions to their minor children. Families who could benefit from melanoma prevention educational interventions, such as the one tested in the current study, could be identified through primary care settings or through cancer treatment centers. Depending on the setting, preventive interventions targeting minor children could be delivered by health educators, social workers, or other healthcare providers, in person or via web-based strategies, or through more automated or self-paced formats.

I confirm all patient/personal identifiers have been removed or disguised so the patient/person(s) described are not identifiable and cannot be identified through the details of the story.

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References

1. Cho E, Rosner BA, Feskanich D, Colditz GA. Risk factors and individual probabilities of melanoma for whites. *J Clin Oncol*. 2005; 23:2669–2675. [PubMed: 15837981]
2. Bishop DT, Demenais F, Goldstein AM, Bergman W, Bishop JN, Bressacde Paillerets B, Chompret A, Ghiorzo P, Gruis N, Hansson J. Geographical variation in the penetrance of CDKN2A mutations for melanoma. *J Natl Cancer Inst*. 2002; 94:894–903. [PubMed: 12072543]
3. van der Rhee JJ, Krijnen P, Gruis NA, de Snoo FA, Vasen HF, Putter H, Kukutsch NA, Bergman W. Clinical and histologic characteristics of malignant melanoma in families with a germline mutation in CDKN2A. *J Am Acad Dermatol*. 2011; 65:281–288. [PubMed: 21570156]
4. Begg CB, Orlow I, Hummer AJ, Armstrong BK, Krickler A, Marrett LD, Millikan RC, Gruber SB, Anton-Culver H, Zanetti R. Lifetime risk of melanoma in CDKN2A mutation carriers in a population-based sample. *J Natl Cancer Inst*. 2005; 97:1507–1515. [PubMed: 16234564]
5. American Academy of Dermatology. [Accessed 30 November 2016] Prevent Skin Cancer. 2016. <https://www.aad.org/public/spot-skin-cancer/learn-about-skin-cancer/prevent>
6. Dennis LK, Vanbeek MJ, Beane Freeman LE, Smith BJ, Dawson DV, Coughlin JA. Sunburns and risk of cutaneous melanoma: does age matter? A comprehensive meta-analysis. *Ann Epidemiol*. 2008; 18:614–627. [PubMed: 18652979]
7. Oliveria SA, Saraiya M, Geller AC, Heneghan MK, Jorgensen C. Sun exposure and risk of melanoma. *Arch Dis Child*. 2006; 91:131–138. [PubMed: 16326797]
8. Pustisek N, Sikanic-Dugic N, Hirsl-Hecej V, Domljan ML. Acute skin sun damage in children and its consequences in adults. *Coll Antropol*. 2010; 34:233–237.

9. Wu S, Han J, Laden F, Qureshi AA. Long-term ultraviolet flux, other potential risk factors, and skin cancer risk: a cohort study. *Cancer Epidemiol Biomark Prev.* 2014; 23:1080–1089.
10. Glenn BA, Bastani R, Chang LC, Khanna R, Chen K. Sun protection practices among children with a family history of melanoma: a pilot study. *J Cancer Educ.* 2012; 27:731–737. [PubMed: 22610837]
11. Glenn BA, Lin T, Chang LC, Okada A, Wong WK, Glanz K, Bastani R. Sun protection practices and sun exposure among children with a parental history of melanoma. *Cancer Epidemiol Biomark Prev.* 2015; 24:169–177.
12. Tripp MK, Peterson SK, Prokhorov AV, Shete SS, Lee JE, Gershenwald JE, Gritz ER. Correlates of sun protection and sunburn in children of melanoma survivors. *Am J Prev Med.* 2016; 51:77–85.
13. Wu YP, Mays D, Kohlmann W, Tercyak KP. Pediatric predispositional genetic risk communication: potential utility for prevention and control of melanoma risk as an exemplar. *J Genet Couns.* 2017:1–7.
14. Gritz ER, Tripp MK, Peterson SK, Prokhorov AV, Shete SS, Urbauer DL, Fellman BM, Lee JE, Gershenwald JE. Randomized controlled trial of a sun protection intervention for children of melanoma survivors. *Cancer Epidemiol Biomark Prev.* 2013; 22:1813–1824.
15. Wu YP, Aspinwall LG, Conn BM, Stump T, Grahmann B, Leachman SA. A systematic review of interventions to improve adherence to melanoma preventive behaviors for individuals at elevated risk. *Prev Med.* 2016; 88:153–167. [PubMed: 27090434]
16. Marteau TM, Weinman J. Self-regulation and the behavioural response to DNA risk information: a theoretical analysis and framework for future research. *Soc Sci Med.* 2006; 62:1360–1368. [PubMed: 16162383]
17. Mellor D, Moore KA. The use of likert scales with children. *J Pediatr Psychol.* 2014; 39:369–379. [PubMed: 24163438]
18. Pearson N, Braithwaite R, Biddle SJH. The effectiveness of interventions to increase physical activity among adolescent girls: a meta-analysis. *Acad Pediatr.* 2015; 15:9–18. [PubMed: 25441655]
19. Kahn EB, Ramsey LT, Brownson RC, Heath GW, Howze EH, Powell KE, Stone EJ, Rajab MW, Corso P. The effectiveness of interventions to increase physical activity: a systematic review. *Am J Prev Med.* 2002; 22:73–107. [PubMed: 11985936]
20. van de Gaar VM, Jansen W, van Grieken A, Borsboom GJJM, Kremers S, Raat H. Effects of an intervention aimed at reducing the intake of sugar-sweetened beverages in primary school children: a controlled trial. *Int J Behav Nutr Phys Act.* 2014; 11:98. [PubMed: 25060113]
21. Stock S, Miranda C, Evans S, Plessis S, Ridley J, Yeh S, Chanoine J-P. Healthy buddies: a novel, peer-led health promotion program for the prevention of obesity and eating disorders in children in elementary school. *Pediatrics.* 2007; 120:1059–1068.
22. O'Dea JA, Abraham S. Improving the body image, eating attitudes, and behaviors of young male and female adolescents: a new educational approach that focuses on self-esteem. *Int J Eat Disord.* 2000; 28:43–57. [PubMed: 10800013]
23. Wu YP, Aspinwall LG, Nagelhout E, Kohlmann W, Kaphingst KA, Homburger S, Perkins RD, Grossman D, Harding G, Cassidy P, Leachman SA. Development of an educational program integrating concepts of genetic risk and preventive strategies for children with a family history of melanoma. *J Cancer Educ.* 2016:1–8.
24. Rogers RW. A protection motivation theory of fear appeals and attitude change. *J Psychol.* 1975; 91:93–114. [PubMed: 28136248]
25. Yan Y, Jacques-Tiura AJ, Chen X, Xie N, Chen J, Yang N, Gong J, MacDonell KK. Application of the Protection Motivation Theory in predicting cigarette smoking among adolescents in China. *Addict Behav.* 2014; 39:181–188. [PubMed: 24157424]
26. Huston SA, Houk CP. Common Sense Model of illness in youth with Type 1 diabetes or sickle cell disease. *J Pediatr Pharmacol Ther.* 2011; 16:270–280. [PubMed: 22768011]
27. Gwadry-Sridhar F, Guyatt GH, Arnold JMO, Massel D, Brown J, Nadeau L, Lawrence S. Instruments to measure acceptability of information and acquisition of knowledge in patients with heart failure. *Eur J Heart Fail.* 2003; 5:783–791. [PubMed: 14675857]

28. Kothe EJ, Mullan BA. Acceptability of a theory of planned behaviour email-based nutrition intervention. *Health Promot Int*. 2014; 29:81–90. [PubMed: 22942273]
29. Gage H, Grainger L, Ting S, Williams P, Chorley C, Carey G, Borg N, Bryan K, Castleton B, Trend P, Kaye J, Jordan J, Wade D. Specialist Rehabilitation for People with Parkinson's Disease in the Community: A Randomised Controlled Trial. NIHR Journals Library Southampton, UK. 2014
30. Witte K. Fear control and danger control: a test of the extended parallel process model (EPPM). *Commun Monogr*. 1994; 61:113–134.
31. Taber JM, Aspinwall LG, Stump TK, Kohlmann W, Champine M, Leachman SA. Genetic test reporting enhances understanding of risk information and acceptance of prevention recommendations compared to family history-based counseling alone. *J Behav Med*. 2015; 38:740–753. [PubMed: 26178773]
32. Aspinwall LG, Taber JM, Kohlmann W, Leaf SL, Leachman SA. Perceived risk following melanoma genetic testing: a 2-year prospective study distinguishing subjective estimates from recall. *J Genet Couns*. 2014; 23:421–437. [PubMed: 24322567]
33. Nigg CR, Burbank PM, Padula C, Dufresne R, Rossi JS, Velicer WF, Laforge RG, Prochaska JO. Stages of change across ten health risk behaviors for older adults. *Gerontologist*. 1999; 39:473–482. [PubMed: 10495586]
34. Velicer WF, Fava JL, Prochaska JO, Abrams DB, Emmons KM, Pierce JP. Distribution of smokers by stage in three representative samples. *Prev Med*. 1995; 24:401–411. [PubMed: 7479632]
35. Glanz K, Yaroach AL, Dancel M, Saraiya M, Crane LA, Buller DB, Manne S, O'Riordan DL, Heckman CJ, Hay J, Robinson JK. Measures of sun exposure and sun protection practices for behavioral and epidemiologic research. *Arch Dermatol*. 2008; 144:217–222. [PubMed: 18283179]
36. Aspinwall LG, Leaf SL, Dola ER, Kohlmann W, Leachman SA. CDKN2A/p16 genetic test reporting improves early detection intentions and practices in high-Risk melanoma families. *Cancer Epidemiol Biomark Prev*. 2008; 17:1510–1519.
37. National Weather Service Climate Prediction Center. [Accessed 30 November 2016] UV Index: Annual Time Series. 2016. http://www.cpc.ncep.noaa.gov/products/stratosphere/uv_index/uv_annual.shtml

Fig. 1.

Parent- and child-report on children's engagement in melanoma preventive and risk behaviors in the last month.

P=Parent-report, C=Child-report. 1 on the Y axis represents "never" and 5 represents "always" engaging in preventive behavior. *Indicates a statistically significant ($p<.05$) change between baseline and 1-month follow-up.

Table 1

Demographic Characteristics of Parents and Children.

Parents (N = 22)	N(%) Unless otherwise noted
Age of parent (M, SD)	41.7 (6.2)
Sex	
Male	7 (31.8)
Female	15 (68.2)
Relation of participating parent to child(ren)	
Mother	15 (68)
Father	7 (32)
Marital status	
Married or marriage-like	20 (90.9)
Divorced	1 (4.5)
Widowed	1 (4.5)
Level of education	
High school graduate or GED	3 (13.6)
Vocational or technical school	4 (18.2)
Some college, including 2 yr degree	4 (18.2)
Bachelor's Degree	7 (31.8)
Master's Degree	2 (9.1)
Doctoral Degree (PhD, MD, JD)	2 (9.1)
Personal cancer history	
None	5 (22.7) ^a
Melanoma	14 (63.6)
Other	3 (13.6)
Family history of melanoma	
Daughter	1 (4.5)
Grandmother	3 (13.6)
Grandfather	2 (9.1)
Aunt	1 (4.5)
Cousin	2 (9.1)
Other parent	4 (18.2)
Don't know	1 (4.5)
Color of untanned skin	
Very fair	3 (13.6)
Fair	16 (72.7)
Olive	3 (13.6)
Family income, median	\$85,000
Children (n = 33)	
Age of child (M, SD)	11.8 (2.9)
Sex	
Male	18 (54.5)

Parents (N = 22)	N(%) Unless otherwise noted
Female	15 (45.5)
Race/Ethnicity	
Non-Hispanic White	33 (100.0)
Has health insurance coverage	33 (100.0)
Color of untanned skin	
Vary fair	9 (27.3)
Fair	21 (63.6)
Olive	3 (9.1)
Eye color	
Blue	23 (69.7)
Green	4 (12.1)
Brown	6 (18.2)

^a Of the 5 parents who did not have a personal history of melanoma, 4 had a spouse with a history of melanoma who was still living, and 1 had a spouse with a history of melanoma who was deceased.

Table 2*Acceptability of Educational Materials.*

	Parents Mean (SD)	Children Mean (SD)
Content		
The materials made it easier to understand melanoma.	4.7 (0.5)	4.3 (0.7)
The materials apply to me and my life.	4.7 (0.5)	4.1 (0.9)
The materials included important information about melanoma and melanoma risk that I wanted.	4.5 (0.5)	4.1 (0.9)
The materials are helpful.	4.5 (0.5)	4.5 (0.5)
The materials were helpful in describing signs of melanoma.	4.5 (0.5)	4.3 (0.6)
Comprehension		
The materials make sense.	4.5 (0.5)	4.2 (0.7)
The materials are confusing.*	4.1 (0.4)	3.9 (0.9)
I was able to pay attention until the end of the educational session.	4.5 (0.7)	4.1 (1.0)
Appeal		
The materials are interesting.	4.5 (0.5)	4.4 (0.7)
The materials are too long.*	4.1 (0.4)	3.9 (0.9)
The materials are annoying.*	4.4 (0.9)	4.2 (0.9)
The materials were visually appealing.	4.6 (0.5)	4.2 (0.8)
Novelty of information learned		
I learned new things about melanoma genetic risk.	4.5 (0.9)	4.5 (0.7)
I learned new things about melanoma prevention.	4.2 (0.9)	4.4 (0.7)
Perceived effect on motivation		
The materials will motivate me to protect my skin from the sun.	4.6 (0.5)	4.3 (0.6)
The materials will motivate me to do skin self-exams.	4.6 (0.7)	4.0 (1.1)
The materials will motivate me to get a total body skin exam from a health care provider.	4.5 (0.7)	3.3 (1.1)
Perceived exaggeration of risk & prevention information		
The information about melanoma prevention was exaggerated.*	4.4 (0.5)	NA
The information about environmental risk was exaggerated.*	4.5 (0.5)	NA
The information about genetic risk was exaggerated.*	4.5 (0.5)	NA
Protecting my skin from the sun is not as important as some people say it is.*	4.8 (0.4)	4.4 (0.9)
Personal applicability of risk & prevention information		
Protecting my skin from the sun is important to me.	4.8 (0.4)	4.5 (0.5)
The information on melanoma prevention was important.	4.8 (0.4)	4.5 (0.5)
The information about melanoma prevention applied to me.	4.8 (0.4)	4.3 (0.6)
The information about melanoma prevention applied to my family.	4.5 (0.5)	4.2 (0.5)
The information about environmental risk was important.	4.5 (0.5)	4.4 (0.6)
The information about genetic risk was important.	4.4 (0.5)	4.3 (0.6)
The information about environmental risk applied to me.	4.5 (0.5)	4.1 (0.7)
The information about genetic risk applied to me.	4.3 (0.5)	4.1 (0.7)
The information about environmental risk applied to my family.	4.5 (0.5)	4.2 (0.6)

	Parents Mean (<i>SD</i>)	Children Mean (<i>SD</i>)
The information about genetic risk applied to my family.	4.5 (0.5)	4.2 (0.6)

Notes.

* Items were reverse coded. A higher mean score indicates greater disagreement with the statement.

Response options: 1. Strongly disagree, 2. Disagree, 3. Undecided, 4. Agree, 5. Strongly agree

Parent and Children's Knowledge and Children's Perceived Risk and Intended Engagement in Preventive Behaviors.

Table 3

	Possible Range	Baseline Mean (SD)	Immediately Post-Education Mean (SD)	1-Month Follow-up Mean (SD)	F-statistic	p-value
Knowledge (Total)					—	—
Parent knowledge	0–28	17.1 (4.5)	24.9 (1.1)	23.7 (1.9)	$F(2,42) = 51.7$	<0.001
Child knowledge	0–29	15.8 (5.2)	23.5 (4.6)	21.2 (4.5)	$F(2,64) = 76.6$	<0.001
Knowledge subscales						
Foundational concepts of DNA and mutation						
Parent	1–7	>2.4 (1.3)	5.7 (0.8)	5.2 (0.9)	$F(2,42) = 67.5$	<0.001
Child	1–8	2.6 (2.1)	5.8 (1.5)	4.8 (1.9)	$F(2,64) = 44.3$	<0.001
Melanoma development						
Parent	1–3	1.2 (0.9)	2.7 (0.5)	2.1 (0.6)	$F(2,42) = 34.8$	
Child	1–3	1.2 (0.7)	2.5 (0.6)	2.1 (0.8)	$F(2,64) = 42.2$	
Genetic and environmental risk						
Parent	1–9	6.9 (1.8)	8.7 (0.5)	8.5 (0.7)	$F(2,42) = 16.2$	<0.001
Child	1–10	5.3 (1.6)	7.6 (1.9)	6.6 (1.8)	$F(2,64) = 44.3$	<0.001
Prevention strategies						
Parent	1–9	6.7 (1.8)	7.8 (0.8)	7.9 (0.8)	$F(2,42) = 8.1$	<0.001
Child	1–8	5.7 (1.8)	6.8 (1.4)	6.5 (1.2)	$F(2,64) = 13.0$	<0.001
Perceived risk						
Absolute risk ^a	1–5					
Parent-report		3.5 (1.1)	3.7 (0.9)	3.4 (1.2)		
Child-report		2.8 (1.1)	3.6 (0.8)	3.4 (0.8)		
Relative risk ^b	1–5					
Parent-report		3.7 (1.0)	3.8 (0.7)	3.7 (0.8)		
Child-report		2.9 (1.1)	3.3 (0.9)	3.6 (0.6)		
Intended engagement in prevention & screening behaviors based on stages of change ^c						
Sunscreen use	1–5					
Parent-report		4.3 (1.4)	4.0 (1.1)	3.9 (1.4)		
Child-report		3.5 (1.6)	3.8 (1.4)	3.8 (1.5)		

	Possible Range	Baseline Mean (SD)	Immediately Post-Education Mean (SD)	1-Month Follow-up Mean (SD)	F-statistic	p-value
Wearing long pants/sleeves	1–5					
Parent-report		2.1 (1.6)	2.5 (1.6)	2.3 (1.3)		
Child-report		2.7 (1.7)	2.9 (1.6)	2.9 (1.8)		
Wearing a wide-brimmed hat	1–5					
Parent-report		2.8 (1.7)	2.4 (1.2)	3.1 (1.6)		
Child-report		2.8 (1.6)	2.8 (1.6)	3.1 (1.5)		
Avoiding 10 am–4 pm	1–5					
Parent-report		3.0 (1.9)	3.3 (1.4)	3.6 (1.6)		
Child-report		2.6 (1.6)	2.9 (1.6)	3.0 (1.7)		
Conducting skin self-exams	1–5					
Parent-report		3.8 (1.1)	3.6 (1.0)	3.7 (1.1)		
Child-report		2.5 (1.6)	3.0 (1.4)	3.0 (1.3)		

^aResponse options: 1. Very unlikely, 2. Somewhat unlikely, 3. Neither likely nor unlikely, 4. Somewhat likely, 5. Very likely.

^bResponse options: 1. A lot less likely, 2. Less likely, 3. About as likely, 4. More likely, and 5. Very likely.

^cResponse options: 1. No, and I do not plan to start doing so in the next 6 months, 2. No, but I intend to start doing so in the next 6 months, 3. No but I intend to start doing so in the next 30 days, 4. Yes, I have been, but for less than 6 months and 5. Yes, I have been, but for more than 6 months.