HHS Public Access

Author manuscript

Pediatr Dermatol. Author manuscript; available in PMC 2020 November 01.

Published in final edited form as:

Pediatr Dermatol. 2019 November ; 36(6): 882–886. doi:10.1111/pde.13984.

Sun Exposure and Protection Practices in Children after Allogeneic Hematopoietic Stem Cell Transplantation: A Survey-Based Cross-Sectional Cohort Study

Edward B. Li, PhD[1], **Johanna Sheu Song, MS, MD**[1,2,3], **Jennifer T. Huang, MD**[1,2,4], **Elena B. Hawryluk, MD, PhD**[1,2,3], **Wendy B. London, PhD**[1,4], **Dongjing Guo, MPH**[4], **Madhumitha Sridharan, BME**[4], **David E. Fisher, MD, PhD**[1,3], **Corinna J. Rea, MD, MPH**[1,6], **Leslie E. Lehmann, MD**[1,4,5], **Christine N. Duncan, MD**[1,4,5]

[1]Harvard Medical School, Boston MA

[2]Dermatology Program, Boston Children's Hospital, Boston MA

[3]Department of Dermatology, Massachusetts General Hospital, Boston MA

[4]Department of Pediatric Oncology, Dana-Farber Cancer Institute, Boston MA

[5]Department of Medicine, Hematology/Oncology Division, Boston Children's Hospital, Boston MA

[6]Department of Pediatrics, Boston Children's Hospital, Boston MA

Abstract

Background/Objective: Pediatric HSCT patients are at an increased risk for skin cancers. Sun exposure is a significant modifiable environmental risk factor. While patient education on sun protection and avoidance behaviors with regular dermatology evaluations are crucial for pediatric HSCT patients, the real-life practice of these sun protection recommendations in this patient population compared to their peers is unknown.

Methods: A survey-based cross-sectional cohort study was performed in pediatric HSCT patients seen at the Dana-Farber Cancer Institute and Boston Children's Hospital over a 1.5-year period compared with age/sex/Fitzpatrick skin phototype-matched healthy controls. Study participants were surveyed using the validated Glanz survey for pediatric sun protection behavioral research.

Results: Eighty-five pediatric HSCT patients and 85 controls completed the study. Pediatric HSCT patients more frequently used sunscreen, hats, umbrellas, and sunglasses and obtained full body skin exams compared to controls. No difference was observed in sun exposure during hours of peak sun intensity, frequency of purposeful tanning, tanning bed use, and the number of painful sunburns received between pediatric HSCT patients and controls.

Corresponding author: Edward B. Li, PhD, Harvard Medical School, 25 Shattuck Street, Boston, MA 02115, binghang_li@hms.harvard.edu.

IRB approval status: Approved by Boston Children's Hospital IRB; #13-241

Consent for publication: All authors are in agreement with the manuscript contents and consent for publication

Conflict of interest: D.E.F. has a financial interest in Soltego Inc., a company developing SIK inhibitors for topical skin darkening treatments that might be used for a broad set of human applications. The interests of D.E.F. were reviewed and are managed by Massachusetts General Hospital and Partners HealthCare in accordance with their conflict of interest policies.

Conclusions: Although pediatric HSCT patients practice more sun protection behaviors, they experienced harmful sunburns and intentional tanning behaviors at the same rate as their peers. Patient-directed counseling and strategies to improve patient adherence to optimal sun protection behaviors could have a significant impact on the dermatology quality of life in pediatric HSCT patients.

Keywords

pediatric; hematopoietic stem cell transplantation; sun protection; skin cancer; sunburn; tanning; general dermatology; quality improvement; Glanz survey; cross-sectional cohort study

Introduction

Advances in hematopoietic stem cell transplantation (HSCT) have led to improved disease-free survival and reduced morbidity from malignant and nonmalignant conditions. However, HSCT recipients are still at an elevated risk for long-term complications including graft-versus-host disease (GVHD) and skin cancer. While several adjunctive treatments with HSCT such as total body irradiation (TBI), long-term immunosuppression, and voriconazole use are risk factors for skin cancer, sun exposure remains a strong environmental risk factor for skin cancer development in this population.[1–3] Therefore, consistent sun avoidance and protection as well as regular dermatologic evaluations are important for HSCT recipients.[4] Few studies have examined the sun exposure and protection behaviors specific to pediatric HSCT patients. To address this gap in knowledge, we performed a survey-based cross-sectional cohort study of pediatric HSCT patients and matched controls to assess their sun protection behaviors and skin cancer surveillance practices.

Methods

Pediatric HSCT patients seen at the Dana-Farber Cancer Institute (DFCI) and Boston Children's Hospital were surveyed over a 1.5-year period (October 2013 to April 2015) under a DFCI IRB-approved protocol (#13–241). All patients and/or legal guardians signed an IRB-approved informed consent. HSCT patients were recruited at routine dermatology clinic visits. Control patients matched by age, sex, and Fitzpatrick skin phototype (FPT) were recruited at routine dermatology and primary care clinic visits. Inclusion criteria included a history of HSCT performed at ≤21 years of age and a timespan between transplantation and study visit of at least one year. Exclusion criteria included HSCT performed at an outside institution and relapse of underlying disease. All study participants underwent full skin examination by a pediatric dermatologist (JTH, EBH). Additional details regarding the inclusion/exclusion criteria, cross-sectional cohort study design, and outcomes on melanocytic nevi, skin cancers, and nonmalignant cutaneous changes were previously reported.[4,5]

Study participants were asked at their dermatology clinic visits to report average sun exposure, tan-seeking behavior, and sun protection practices over the prior 12 months using a standardized survey (Glanz) validated for pediatric sun protection behavioral research.[6]

Comparison of continuous variables between HSCT patients and controls were performed with the Wilcoxon rank sum test. Nominal data were compared with Fisher's exact test. Ordinal/categorical data regarding FPT and sun exposure/protection behaviors were compared with Chi-square linear-by-linear association. P-values less than 0.05 were considered statistically significant. Statistical analyses were performed using SPSS software (Version 25, IBM).

Results

Patient demographic and clinical characteristics are detailed in Table I. The median age of our HSCT cohort at the time of HSCT was 7.4 years (range 0.1–21.0) and 13.8 years (range 1.4–26.1) at the time of study visit/survey administration. The median time from HSCT to the study visit was 3.6 years (range 1.2–16.2). There was no statistical difference in sex, FPT, and patient-reported untanned skin color between HSCT patients and controls. Primary indications for HSCT included 61.2% (52/85) hematologic malignancy, 14.1% (12/85) bone marrow failure, 12.9% (11/85) immunodeficiency, 3.5% (3/85) other malignancy, and 8.2% (7/85) other nonmalignant disease. 36.5% (31/85) of HSCT patients in our study experienced acute or chronic GVHD, 67.1% (57/85) received TBI, and 52.9% (45/85) were exposed to voriconazole which has known photosensitizing effects that could predispose individuals to sunburns and skin cancers.

21.2% (18/85) of HSCT patients spent at least 3 hours per day outside during peak sun intensity hours (10am-4pm) on weekdays and 36.5% (31/85) of HSCT patients spent at least 3 hours per day outside during peak sun intensity hours on weekends (Table II). No significant differences were observed between HSCT patients and matched controls in practices of intentional sun exposure, including the amount of time spent outside on weekdays and weekends during peak sun intensity hours, frequency of time spent in the sun for the purpose of tanning, and frequency of tanning bed use. No significant difference was observed in the number of sunburns between HSCT patients and controls, with 25.9% (22/85) of HSCT patients reporting one or more red/painful sunburns over the past year compared to 27.1% (23/85) of controls ($p=0.87$).

Overall, HSCT patients practiced better sun protection behaviors than control patients, endorsing significantly more frequent use of sunscreen, hats, and sunglasses compared to controls (Table III). Furthermore, HSCT patients more frequently stayed in the shade or used an umbrella. However, there was no significant difference in the distribution of HSCT patients who wore shirts with sleeves that covered their shoulders compared to controls.

61.2% (52/85) of HSCT patients previously received a full body skin exam (FBSE) from a healthcare professional compared to only 4.7% (4/85) of controls ($p<0.001$). 42.4% (36/85) of HSCT patients reported self or partner skin examinations within the past year compared to 11.8% (10/85) of controls ($p<0.001$). Of note, 11.8% (10/85) of HSCT patients underwent self or partner skin examination more than 7 times a year.

Discussion

Our study found no significant differences in sun exposure practices among pediatric HSCT patients compared to matched controls, with more than one-third of HSCT patients spending over 3 hours per day outside during peak sun intensity hours on weekends. In addition, there were no differences in intentional indoor and outdoor tanning practices between groups. Similarly, a prior report of childhood cancer survivors found that 37% did not follow sun protection recommendations.[7] While this data may reflect that HSCT patients are not practicing adequate sun avoidance, it may also suggest that these long-term survivors are able to enjoy being outdoors as much as their peers and have a similar desire to have a tanned appearance. While a healthy and active lifestyle should be encouraged for all children, our results emphasize the need for pediatric HSCT survivors to be educated on their increased risk for UV-related skin cancers, counseled on avoidance of intentional tanning, and advised on the importance of sun protection behaviors in an effort to improve long-term outcomes.[8]

Children exposed to excessive UV radiation have an increased lifetime risk for skin cancers.[9,10] UV-related skin damage can be significantly reduced by effective sun protection behaviors including use of sunscreen and sun-protective clothing and avoidance of tanning.[11] HSCT patients in our study reported more frequent use of sunscreen, hats, umbrellas, and sunglasses compared to controls, suggesting that some patients and families are aware of this increased risk and are practicing sun protection measures. However, there was no significant difference in number of sunburns experienced by pediatric HSCT patients over the past year compared to controls, with 1 in 4 HSCT patients reporting at least one red or painful sunburn in the past year. These findings suggest that HSCT patients may have an increased tendency to sunburn, or that they are over-reporting sun protection behaviors based on prior counseling and knowledge of expected practices.

A 2015 consensus statement for cancer screening in HSCT patients recommended annual full body skin exam and counseling on skin cancer and sun protection awareness.[12] Our study found that pediatric HSCT patients were more likely to have had a FBSE by a healthcare professional and to have performed more self or partner skin examinations compared to controls. However, even at our institution where annual dermatologic evaluation is the standard-of-care, 38.8% (33/85) of HSCT patients had never previously had a FBSE at the time of study enrollment. Routine dermatology visits lead to improved patient education and earlier detection of skin cancer by promoting self-skin exams and timely presentation for evaluation.[13,14] In organ transplant recipients, educational interventions and dermatology clinic participation improve sun protection practices and skin cancer awareness.[15] Barriers to routine dermatologic care for this population should be further explored and addressed. In addition, while the pediatric patients in this study were not further stratified by age groups, sun exposure and protection behaviors of children could vary with age and the degree of parental/guardian supervision. Future studies aimed at identifying the most vulnerable patient age groups could provide valuable information for targeted sun protection education and awareness programs and help maximize their impact.

Limitations of our study include single-center design, reporter bias, and limited data on patients with darker FPTs. While dermatology evaluations are recommended to all pediatric HSCT patients at our institution, our cohort could be biased for patients with active dermatologic concerns and previous dermatology visits.

The increasing number of hematopoietic stem cell transplants being performed and improved long-term survival of pediatric HSCT patients signifies a growing patient population requiring dermatology care. Our study highlights the need to improve sun protection and avoidance practices in pediatric HSCT patients, a population at higher than average risk for skin cancer and other cutaneous complications. Patient-directed counseling and implementation of strategies designed to increase patient adherence to optimal sun protection behaviors could have a significant positive impact on the dermatologic quality of life of this growing population of transplant survivors.

Funding sources:

This work was supported by a Pilot Project Grant by the Society for Pediatric Dermatology and by a Career Development Award by the Dermatology Foundation. D.E.F. acknowledges grant support from NIH (2R01 AR043369) and the Dr. Miriam and Sheldon G. Adelson Medical Research Foundation.

References

1. Omland S, Gniadecki R, Hædersdal M, Helweg-Larsen J, Omland L. Skin cancer risk in hematopoietic stem-cell transplant recipients compared with background population and renal transplant recipients: a population-based cohort study. JAMA Dermatol. 2015;152(2):1–7.
2. Kuklinski LF, Li S, Karagas MR, Weng W-K, Kwong BY. Effect of voriconazole on risk of nonmelanoma skin cancer after hematopoietic cell transplantation. J Am Acad Dermatol. 2017;77(4):706–712. [PubMed: 28780363]
3. Buchanan N, Leisenring W, Mitby PA, et al. Behaviors associated with ultraviolet radiation exposure in a cohort of adult survivors of childhood and adolescent cancer. Cancer. 2009;115(S18): 4374–4384. [PubMed: 19731349]
4. Song JS, London WB, Hawryluk EB, et al. Risk of melanocytic nevi and nonmelanoma skin cancer in children after allogeneic hematopoietic stem cell transplantation. Bone Marrow Transplant. 2017;52(7):989–997. [PubMed: 28368380]
5. Huang JT, Song JS, Hawryluk EB, et al. Nonmalignant late cutaneous changes after allogeneic hematopoietic stem cell transplant in children. J Am Acad Dermatol. 2018;79(2):230–237. [PubMed: 29588248]
6. Glanz K, Yaroch AL, Dancel M, et al. Measures of sun exposure and sun protection practices for behavioral and epidemiologic research. Arch Dermatol. 2008;144(2):217–222. [PubMed: 18283179]
7. Mays D, Black JD, Mosher RB, Shad AT, Tercyak KP. Improving short-term sun safety practices among adolescent survivors of childhood cancer: A randomized controlled efficacy trial. J Cancer Surviv. 2011;5(3):247–254. [PubMed: 21359690]
8. Hall HI, McDavid K, Jorgensen CM, Kraft JM. Factors associated with sunburn in white children aged 6 months to 11 years. Am J Prev Med. 2001;20(1):9–14. [PubMed: 11137768]
9. Dennis LK, Vanbeek MJ, Freeman LEB, Smith BJ, Dawson DV, Coughlin JA. Sunburns and risk of cutaneous melanoma: does age matter? A comprehensive meta-analysis. Ann Epidemiol. 2008;18(8):614–627. [PubMed: 18652979]
10. Wehner MR, Shive ML, Chren M-M, Han J, Qureshi AA, Linos E. Indoor tanning and non-melanoma skin cancer: Systematic review and meta-analysis. BMJ. 2012;345:e5909. [PubMed: 23033409]

11. Henrikson NB, Morrison CC, Blasi PR, Nguyen M, Shibuya KC, Patnode CD. Behavioral counseling for skin cancer prevention: Evidence report and systematic review for the US Preventive Services Task Force. JAMA. 2018;319(11):1143–1157. [PubMed: 29558557]
12. Inamoto Y, Shah N, Savani B, et al. Secondary solid cancer screening following hematopoietic cell transplantation. Bone Marrow Transplant. 2015;50(8):1013–1023. [PubMed: 25822223]
13. Robinson JK, Turrisi R, Mallett KA, et al. Efficacy of an educational intervention with kidney transplant recipients to promote skin self-examination for squamous cell carcinoma detection. Arch Dermatol. 2011;147(6):689–695. [PubMed: 21339418]
14. Clowers-Webb HE, Christenson LJ, Phillips PK, et al. Educational outcomes regarding skin cancer in organ transplant recipients:Randomized intervention of intensive vs standard education. Arch Dermatol. 2006;142(6):712–718. [PubMed: 16785373]
15. Ismail F, Mitchell L, Casabonne D, et al. Specialist dermatology clinics for organ transplant recipients significantly improve compliance with photoprotection and levels of skin cancer awareness. Br J Dermatol. 2006;155(5):916–925. [PubMed: 17034519]

Table I:

Demographic characteristics of study participants

Characteristic	HSCT (n = 85) n (%)	Controls (n = 85) n (%)	P-value
Median age at transplant; years (range)	7.4 (0.1–21.0)	-	
Median age at study visit; years (range)	13.8 (1.4–26.1)	13.7 (1.0–27.3)	0.7[2]
Median time from HSCT to study visit; years (range)	3.6 (1.2–16.2)		
Sex			
Male	53 (62.3)	53 (62.3)	1.0[3]
Female	32 (37.7)	32 (37.7)	
Fitzpatrick skin phototype			
I/II	49 (57.6)	47 (55.3)	0.64
III/IV	30 (35.3)	30 (35.3)	
V/VI	6 (7.1)	8 (9.4)	
Color of untanned skin			
Very fair	16 (18.8)	12 (14.1)	0.25
Fair	43 (50.6)	36 (42.4)	
Olive	9 (10.6)	15 (17.6)	
Light brown	12 (14.1)	19 (22.4)	
Dark brown	4 (4.7)	3 (3.5)	
Very dark	1 (1.2)	0 (0.0)	
Primary disease			
Hematologic malignancy	52 (61.2)	-	
Bone marrow failure	12 (14.1)	-	
Immunodeficiency	11 (12.9)	-	
Other malignancy	3 (3.5)	-	
Other nonmalignant disease	7 (8.2)	-	
Acute GVHD of the skin	10 (11.8)	-	
Chronic GVHD of the skin	21 (24.7)	-	
Voriconazole use	45 (52.9)	-	
Total body irradiation exposure	57 (67.1)		

GVHD graft-versus-host disease; P-values are from Chi-square linear-by-linear association unless otherwise specified.

[2]P-value from Wilcoxon rank sum test;

[3]P-value from Fisher's exact test

Table II:

Comparison of sun exposure and tan-seeking behaviors

Risk factor	HSCT (n = 85) n (%)	Controls (n = 85) n (%)	P-value
Hours outside/day (weekdays 10am-4pm)			
0–1 hours	32 (37.6)	23 (27.0)	0.18
1–2 hours	18 (21.2)	18 (21.2)	
2–3 hours	17 (20.0)	19 (22.4)	
3–4 hours	8 (9.4)	14 (16.5)	
4–5 hours	6 (7.1)	7 (8.2)	
5–6 hours	4 (4.7)	4 (4.7)	
Hours outside/day (weekends 10am-4pm)			
0–1 hours	20 (23.5)	14 (16.5)	0.08
1–2 hours	22 (25.9)	19 (22.4)	
2–3 hours	12 (14.1)	12 (14.1)	
3–4 hours	16 (18.8)	16 (18.8)	
4–5 hours	9 (10.6)	14 (16.5)	
5–6 hours	6 (7.1)	10 (11.7)	
Number of red/painful sunburns in the past year			
0	63 (74.1)	62 (72.9)	0.87
1	15 (17.7)	15 (17.7)	
2	3 (3.5)	6 (7.0)	
3	3 (3.5)	0 (0.0)	
4	0 (0.0)	0 (0.0)	
5+	1 (1.2)	2 (2.4)	
How often do you spend time in the sun withthe purpose of getting a tan?			
Never	62 (72.9)	50 (58.8)	0.11
Rarely	13 (15.3)	22 (25.9)	
Sometimes	7 (8.3)	7 (8.2)	
Often	3 (3.5)	6 (7.1)	
Always	0 (0.0)	0 (0.0)	
Use of tanning bed			
Yes	1 (1.2)	6 (7.1)	0.12[3]
No	84 (98.8)	79 (92.9)	

P-values are from Chi-square linear-by-linear association unless otherwise specified.

[3]P-value from Fisher's exact test

Table III:

Comparison of sun protection and dermatologic surveillance practices

Protective factor	HSCT (n = 85) n (%)	Controls (n = 85) n (%)	P-value
How often do you wear sunscreen?			
Never	3 (3.5)	10 (11.8)	**<0.001**
Rarely	4 (4.7)	12 (14.1)	
Sometimes	9 (10.6)	24 (28.2)	
Often	18 (21.2)	14 (16.5)	
Always	51 (60.0)	25 (29.4)	
How often do you wear a hat?			
Never	4 (4.7)	18 (21.2)	**<0.001**
Rarely	19 (22.3)	25 (29.4)	
Sometimes	31 (36.5)	26 (30.6)	
Often	13 (15.3)	13 (15.3)	
Always	18 (21.2)	3 (3.5)	
How often do you stay in the shade or under an umbrella?			
Never	2 (2.4)	7 (8.2)	**0.03**
Rarely	12 (14.1)	20 (23.5)	
Sometimes	43 (50.6)	39 (45.9)	
Often	25 (29.4)	15 (17.7)	
Always	3 (3.5)	4 (4.7)	
How often do you wear a shirt with sleeves that cover your shoulders?			
Never	2 (2.3)	3 (3.5)	0.21
Rarely	5 (5.9)	7 (8.3)	
Sometimes	17 (20.0)	21 (24.7)	
Often	30 (35.3)	29 (34.1)	
Always	31 (36.5)	25 (29.4)	
How often do you wear sunglasses?			
Never	11 (12.9)	22 (25.9)	**<0.001**
Rarely	18 (21.2)	26 (30.6)	
Sometimes	26 (30.6)	23 (27.1)	
Often	18 (21.2)	10 (11.7)	
Always	12 (14.1)	4 (4.7)	
Have you ever had your skin checked for skin cancer from head to toe by a health professional?			
Yes	52 (61.2)	4 (4.7)	**<0.001**[3]
No	33 (38.8)	81 (95.3)	
Have you or a partner examined your entire body for skin cancer in the past year?			
Yes	36 (42.4)	10 (11.8)	**<0.001**[3]
No	49 (57.6)	75 (88.2)	
If yes, how many times?			
1	15 (41.6)	4 (40.0)	0.58

Protective factor	HSCT (n = 85) n (%)	Controls (n = 85) n (%)	P-value
2–6	11 (30.6)	4 (40.0)	
7–12	5 (13.9)	2 (20.0)	
12+	5 (13.9)	0 (0.0)	

P-values are from Chi-square linear-by-linear association unless otherwise specified.

[3]P-value from Fisher's exact test