

# Sun exposure among teenage and young adult cancer survivors in the United Kingdom

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## Abstract

Skin cancers are a common form of second malignant neoplasm among teenage and young adult cancer survivors (TYACS). The Children's Oncology Group specifies that TYACS should adhere to safe sun practices and be screened for skin cancer annually. Cross-sectional self-report data collected by our group indicate over a third of TYACS ( $n = 229$ ; mean age: 19.8 years) intentionally sunbathe, with many reporting sunburn. TYACS sunbathing, sunburn, and sunbed use are similar to the general population ( $P > 0.05$ ). These data suggest TYACS require intervention to limit sun exposure and improve their sun safety habits.

## KEYWORDS

secondary cancer prevention, survivorship, UV exposure

## 1 | INTRODUCTION

In the United Kingdom, the cancer survival rate among teenagers and young adults (TYA) exceeds 80%.<sup>1</sup> However, TYA cancer survivors (TYACS) are at risk of developing second primary skin cancer.<sup>2-4</sup> Immunosuppression and treatment with high-dose radiotherapy have been identified as specific risk factors for developing a later skin cancer.<sup>4-6</sup> Data from the Childhood Cancer Survivor Study indicate among those diagnosed with second primary nonmelanoma skin cancer 46% had multiple occurrences and 38% reported returning to hospital more than twice to have the carcinoma treated or surgically removed.<sup>7</sup>

Due to the high incidence and burden of secondary skin cancer among TYACS, the Children's Oncology Group (COG) specifies that TYACS should adhere to safe sun practices (i.e., wearing sunscreen and protective clothing), avoid UV exposure (sunbathing, tanning and sunbed use), and be screened for skin cancer annually.<sup>8,9</sup> These guidelines are based on evidence that skin damage induced from excessive sun exposure is linked to the development of skin cancer and that early diagnosis of skin cancer can lead to smaller tumors, potentially less

intensive treatment, and better outcomes.<sup>10</sup> However, data on TYACS' sun exposure in the United Kingdom are nonexistent. Therefore, the aim of this study was to explore the incidence of, and factors associated with, sunbathing, sunburn, and indoor tanning among TYACS and general population controls (GP-TYAs) in the United Kingdom. This information is crucial for developing interventions aimed at improving sun protection and skin screening among TYACS.

## 2 | METHODS

TYACS and GP-TYAs, aged between 13 and 24 years, were invited to complete a health and lifestyle questionnaire that contained three survey items assessing the incidence of sunbathing and sunburn last summer and the use of indoor sunbeds over the past year. TYACS both on (i.e., receiving active cancer treatment) and off treatment were eligible to participate and were recruited online via CLIC Sargent or through outpatient clinics at University College London Hospital. GP-TYAs were recruited in two waves through online channels, schools, and UCL participation networks. These items were taken from a sun health behavior instrument previously used to assess sun-related behaviors in Scottish adolescents.<sup>11</sup> The full contents of the health and lifestyle questionnaire have been published elsewhere.<sup>12</sup>

Abbreviations: COG, Children's Oncology Group; GP-TYAs, general population controls; TYA, teenagers and young adults; TYACS, teenage and young adult cancer survivors

**TABLE 1** Demographic characteristics and sun health behaviors

	TYA cancer survivors On treatment <i>n</i> = 76 % ( <i>n</i> )	TYA cancer survivors Off treatment <i>n</i> = 149 % ( <i>n</i> )	General population TYAs <i>n</i> = 311 % ( <i>n</i> )	Difference
Age (mean ± SD)	19 ± 3.02	20.0 ± 2.85	17 ± 3.18	2.70 ± 0.26 <sup>a</sup> <i>P</i> < 0.001
<b>Gender</b>				
Females	58 (44)	62.4 (93)	78.1 (243)	
Males	42 (32)	37.6 (56)	21.9 (68)	
<b>Cancer diagnosis</b>				
Lymphoma	24 (18)	36.2 (54)	-	
Leukemia	34 (26)	23.5 (35)	-	
Bone tumor	6.6 (5)	12.1 (18)	-	
Soft-tissue sarcoma	17 (13)	5.4 (8)	-	
CNS tumor	12 (9)	6.7 (10)	-	
Germ cell tumor	0 (0)	4.7 (7)	-	
Carcinoma	3.9 (3)	4.7 (7)	-	
Melanoma	1.3 (1)	0.7 (1)	-	
Other	3.9 (3)	8.1 (12)	-	
Age at diagnosis (mean ± SD)	17.44 ± 3.21	16.47 ± 4.1		0.97 ± 0.57 <i>P</i> = 0.09
0–12 years	5.3 (4)	12.7 (19)	-	
13–18 years	48 (34)	53.0 (79)	-	
19–24 years	38 (29)	28.8 (43)	-	
Missing data	12 (9)	5.4 (8)	-	
<b>Treatment<sup>b</sup></b>				
Surgery	56 (32)	54.6 (59)	-	
Radiotherapy	51 (28)	46.2 (48)	-	
Chemotherapy	94 (67)	97.1 (134)	-	
Hormone therapy	5 (2)	5.9 (5)	-	
Active surveillance	2.6 (1)	8.2 (7)	-	
Other	7.8 (6)	14.0 (21)	-	
<b>Time since treatment<sup>c</sup></b>				
<3 months from finishing treatment	-	14.8 (22)	-	
4–11 months since finishing treatment	-	18.8 (28)	-	
1–5 years since finishing treatment	-	47.0 (70)	-	
>5 years since finishing treatment	-	4 (6)	-	
On active surveillance	-	11.4 (17)	-	
I don't know	-	0.7 (1)	-	
Missing data	-	3.4 (5)	-	
<b>Sun health behaviors</b>				
Sun-bathed regularly last summer to get a tan	36 (27)	45.6 (68)	49.8 (155)	<i>P</i> = 0.68
Suffered sunburn or erythema (pinkness/redness from being in the sun)				<i>P</i> = 0.79
Yes, only on one occasion	30 (22)	29.5 (44)	34.4 (107)	
Yes, on more than one occasion	13 (10)	12.1 (18)	13.2 (41)	
Used a sunbed in the past 12 months	6.6 (5)	6 (9)	8.4 (26)	<i>P</i> = 0.63

<sup>a</sup>Comparison between TYACS and GP-TYACS. Mean difference in age between TYACS-OT and TYACS-OFT was 1.03 ± 0.41 years (*P* = 0.12).

<sup>b</sup>Where percentages do not equal 100%, this was due to participants selecting all that applied.

<sup>c</sup>Data from those off treatment only (*n* = 149).

<sup>d</sup>Chi-square test output.

**TABLE 2** Adjusted and unadjusted odds ratios for the association between treatment status and health behavior

	Proportion meeting current COG guidelines on sun exposure <sup>a</sup> % (n)	Unadjusted		Adjusted	
		Odds ratio (95% CI)			
Sun safety (n = 536)					
GP-TYAs	19.9 (62)	1		1	
OFT-TYA	27.5 (41)	0.65 (0.41–1.03)	1	0.76 (0.45–1.29)	1
OT-TYA	34.2 (26)	0.47 (0.27–0.83)	0.94 (0.51–1.74)	0.56 (0.31–1.04)	1.03 (0.55–1.93)

Abbreviations: TYA, teenager and young adult; GP-TYAs, general population TYAs; OFT-TYAs, off-treatment TYAs, OT-TYAs on treatment TYAs. Odds ratios adjusted for age and gender; all regressions  $P < 0.005$ .

<sup>a</sup>Not meeting current COG guidelines on sun exposure was classified as reporting one or more of sunbathing, sunburn, or indoor sunbed use. Sunbathing refers to sunbathing regularly last summer to get a tan (i.e., intentionally staying out in the sun with the desire for skin to go browner or more golden in color), sunburn refers to skin going red or pink due to being in the sun.

Descriptive statistics were produced to determine the proportion of TYACS and GP-TYAs in each group reporting intentional tanning, sunburn, or sunbed use and the proportion meeting current COG sun-safety lifestyle guidelines on UV exposure. Statistical comparisons between each group were made using chi-square tests and logistic regression analysis for categorical variables and ANOVAs for continuous variables. Multivariable models were adjusted for age and gender. Only data from wave 1 of GP-TYA recruitment were available for analysis.

### 3 | RESULTS

From the original sample ( $n = 295$  TYACS;  $n = 370$  wave 1 GP-TYAs), complete data on sun exposure were available from 229 TYACS ( $n = 76$  on treatment;  $n = 149$  off treatment) and 311 GP-TYAs. Participant characteristics and sun-exposure behaviors are reported in Table 1. Over a third of TYACS (35.5%,  $n = 27$  on treatment; 45.6%,  $n = 68$  off treatment) and GP-TYAs (49.8%,  $n = 155$ ) reported intentionally tanning with approximately 40% reporting sunburn (pinkness/redness from being in the sun) in the past year (42.1%,  $n = 32$  on treatment; 41.6%,  $n = 62$  off treatment) and 47.6% ( $n = 148$ ) of GP-TYAs. Very few young people within any group used sunbeds (6.6%, 6%, and 8.4%, respectively). As shown in Table 2, less than a third of participants were meeting COG sun safety guidelines on UV exposure. After adjusting for age and gender, there were no significant differences ( $P > 0.05$ ) in the behaviors of young people on cancer treatment, off cancer treatment, and in the general population.

### 4 | DISCUSSION

This study demonstrates TYACS in the United Kingdom have a similar sun-exposure behaviors to GP-TYAs in that they often sunbathe and burn in the sun. Encouragingly (given that it is illegal for under 18s to use indoor tanning booths in the United Kingdom) very few young reported using indoor sunbeds.

These findings reflect studies of childhood cancer survivors in the United States, which indicate high levels of sun exposure is common.<sup>13,14</sup> For example, data from project REACH indicate 60% of

TYACS ( $n = 153$ , mean age: 26 years, time since diagnosis: 14 years) report more than 8 hours of sun exposure per week with very little or no use of protection.<sup>14</sup> Deliberate tanning and sunburn among TYACS and GP-TYAs is concerning given existing data that indicate that neither group are particularly adherent to sun protection.<sup>14,15</sup> There are data that indicate that young people counteract skin protection behaviors by purposely sunbathing and that TYACS treated with radiotherapy (despite acknowledging their increased risk of skin cancer) do not perceive UV exposure as a risk factor for skin cancer.<sup>13</sup> These data signify psychoeducational interventions that highlight TYACS increased risk of skin cancer, and the importance of sun-protection habits is warranted. A randomized controlled trial group-based educational day intervention that included risk counseling demonstrated a positive effect on sun safe practices among 75 adolescent survivors of childhood cancer.<sup>16</sup> Whether health messages aimed at increasing TYACS awareness of secondary skin cancer and perceived benefit of skin protection could be feasibly incorporated into routine survivorship care, for example, long-term follow-up clinics appointments, remains to be explored.

However, while increasing TYACS knowledge of the risks of sun exposure is a necessity, intentional tanning among GP-TYAs is driven by a number of physical, attitudinal, and environmental factors.<sup>11,17,18</sup> Interventions targeting sun exposure among TYACS should incorporate principles of behavioral science and consider existing interventions conducted in the general population that have shown promise. For example, appearance-based interventions,<sup>19</sup> mass-media campaigns,<sup>20</sup> community-based interventions,<sup>21</sup> and policy changes.<sup>22</sup> Such interventions tailored to TYACS should be formally tested and be accompanied by robust outcome measures in order to effectively determine the impact upon behavior and health.

This study has a number of limitations: (i) Data gathered were self-reported and therefore subject to recall bias and inaccuracies due to under- and overreporting; (ii) TYACS and GP-TYA groups differed significantly, therefore limiting the validity of comparisons; and (iii) the external validity of the results should also be interpreted with caution. As participation was voluntary, selective bias is present as it is highly likely that TYACS who participated in this study are engaged in leading a healthy lifestyle. Furthermore, only data on sun exposure were gathered. Future studies should aim to gather both objective and self-report data on the sun-protection habits (sunscreen

use, wearing protective clothing, wearing a hat, wearing sunglasses, and shade-seeking), tanning attitude, and skin cancer awareness of TYACS. Thought must also be given to when sun-protection interventions should be initiated among TYACS. The finding that TYACS receiving cancer therapy still report sunbathing and sunburn suggests interventions introduced early during treatment may be beneficial.

The results of this study demonstrate there is a need to intervene in limiting sun exposure among TYACS. A recent review of National Institute of Health grant funding indicates that intervention research that targets dermatologically clinically relevant outcomes (primarily sunburn and tanning) across all points of the cancer continuum from prevention to survivorship is required.<sup>23</sup> Our data demonstrate the need for such intervention research among TYACS within the United Kingdom.

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## CONFLICTS OF INTEREST

The authors declare that there are no competing interests.

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