



Scottish adolescents' sun-related behaviours, tanning attitudes and associations with skin cancer awareness: a cross-sectional study

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3 **SCOTTISH ADOLESCENTS' SUN-RELATED BEHAVIOURS, TANNING ATTITUDES AND**
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5 **ASSOCIATIONS WITH SKIN CANCER AWARENESS: A CROSS-SECTIONAL STUDY**
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ABSTRACT

Objectives: To describe Scottish adolescents' sun-related behaviours and tanning attitudes and assess associations with skin cancer awareness.

Design: Cross-sectional study.

Setting: 20 state secondary schools in one Scottish local authority (Glasgow City).

Participants: 2,173 adolescents (female: 50.7%, n=1,102) with a mean age of 12.4 (Standard Deviation = 0.55).

Outcome measures: Sun-related behaviour (suntan, sunbathing, sunburn, sunscreen use, sunbed use), tanning attitudes, skin cancer-related symptom and risk factor awareness.

Results: Adolescents reported poor sun-related practice: 51% of adolescents reported sunburn the previous summer and 38% indicated sunburn on more than one occasion. Skin cancer awareness was low: 45% recognised 'change in the appearance of a mole' as a cancer symptom, and 39% agreed that 'getting sunburnt more than once as a child' increased cancer risk. 42% and 26% of adolescents, respectively, reported that friends and family held pro-tanning attitudes. Compared to males, females were statistically significantly more likely to: report sunbathing ($p<0.001$), use of lotions or oil to aid tanning ($p<0.001$), and sunburn ($p<0.001$); know that changes in the appearance of a mole was a skin cancer symptom ($p=0.036$) and sunburn more than once as a child was a skin cancer risk factor ($p=0.005$); perceive their friends to hold pro-tanning attitudes ($p<0.001$) and indicate that a tan made them feel better about themselves ($p<0.001$), more attractive to others ($p=0.011$) and healthier ($p<0.001$).

Conclusions: Scottish adolescents had poor sun protection practice and low skin cancer awareness. Girls adopted riskier sun-related behaviour despite greater awareness of skin cancer-related risk. Urgent action is required to promote positive sun-related behaviour and increase skin cancer awareness among Scottish adolescents. However, further research is needed to inform the development of effective sun-safe interventions.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- This is the first study to describe Scottish adolescents' sun-related behaviours and tanning attitudes and assess associations with cancer symptom and risk factor awareness.
- Findings establish evidence to support on-going government initiatives to increase the proportion of people with early diagnosis, including the National Awareness and Early Diagnosis Initiative (NAEDI) in England and Detect Cancer Early (DCE) in Scotland.
- Adolescents in only one Scottish local authority area were surveyed and non-probabilistic sampling was used, although Glasgow was purposefully selected due to known high incidence of malignant melanoma in the Central Belt of Scotland, a densely populated urban region extending from Glasgow in the West to Edinburgh in the East.

KEYWORDS

Malignant melanoma, skin cancer, tanning attitudes, sunburn, sunbeds, sun protection, health-related behaviour, health promotion

WORD COUNT

3,512

INTRODUCTION

Rates of malignant melanoma are rising more rapidly than for any other cancer in the United Kingdom (UK) [1] and Scotland has above average incidence when compared to the rest of the UK.[2] Incidence of malignant melanoma in Scotland significantly increased by 51.4% ($p < 0.0001$) over the past decade.[3] Light skin colour, blonde or red hair, number of moles,[4] family history,[5] and excess exposure to ultraviolet radiation, particularly in childhood, are the main risk factors for malignant melanoma.[6] It is estimated that 86% of malignant melanoma cases in the UK can be attributable to excess exposure to UV radiation (Male = 90%, Female = 82%), and that these proportions are “very much greater at younger ages”.[7]

Malignant melanoma is the fifth most common teenage and young adult (TYA) cancer in the UK, accounting for 11% of the 2,200 average annual cases among those aged 15-24.[8] Almost twice as many females ($n=153$) than males ($n=73$) are diagnosed with malignant melanoma annually, making it the third and sixth most common cancer in young women and men, respectively.[8] Incidence of malignant melanoma significantly increased by 32% among young females between 1995 and 2009.[8]

Across the UK survival rates for malignant melanoma are high and increasing over time,[9] and in Scotland five-year survival rates rose by 21% over the past 20 years, from 64% in the period 1983-97 to 85% in 2003-07.[10] Survival is higher in younger people[10] and there is some evidence that longer time durations prior to diagnosis may be associated with poorer outcomes.[11-13] UK government health departments are therefore committed to improving awareness as part of a strategy to increase the proportion of people with early diagnosis.[14,15] Increasing adolescents’ awareness of skin cancer risk associated with UV exposure and encouraging sun protective practices may therefore have potential to reduce the burden of malignant melanoma both in adolescence and

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3 early adulthood, as well as later life through the establishment of protective health-related
4 behaviours. However, previous research has found that although adolescents' awareness of skin
5 cancer and its association with UV exposure is generally good [16,17] this knowledge does not
6 translate into sun-safe behaviour,[18,19] especially among young females.[19-21]
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12 Little evidence exists around the association between sun-related behaviours and cancer awareness
13 among adolescents in the UK. Only one UK study to date has examined the association between
14 sunscreen and sunbed use and cancer awareness, which found that female adolescents who used
15 sunbeds were statistically significantly more likely to agree that UV exposure was a cancer risk
16 factor.[21] Moreover, patterns of sun-related behaviours (i.e., sunbathing, sunburn) and protective
17 practices (i.e., sunscreen use) and tanning attitudes among Scottish adolescents have not previously
18 been described. This lack of evidence hampers development of interventions to increase cancer
19 awareness and change sun-related behaviours in support of government initiatives. Hence, the aims
20 of this study were to: 1) describe the sun-related behaviours and tanning attitudes among Scottish
21 adolescents; and 2) assess associations between sun-related behaviour, tanning attitudes and cancer
22 awareness.
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40 **METHODS**

41 **Study design**

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43 Data are drawn from the Adolescent Cancer Education (ACE) study, the design of which is described
44 in the published protocol.[22] Briefly, ACE is a cluster randomised controlled trial (RCT) to assess the
45 effectiveness of a school-based educational intervention on adolescents' and parents' cancer
46 awareness and communication. Data were collected at three time-points: baseline (prior to
47 intervention delivery), and at two-weeks, and six-month follow-up. This paper reports cross-
48 sectional analysis of baseline data.
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Setting and Sample

All 29 state secondary schools (excluding special schools) in the Glasgow City Council are were invited to participate, and the target of 20 schools (69.0%) were recruited. All 3,223 adolescents on the school register at the end of their first year (S1) of secondary education (age 12/13 years) in study schools were invited to participate in the study, of which 2,173 (67.4%) consented to data collection.

Recruitment and consent

Schools were recruited in May 2013 and adolescents in June 2013. School head teachers were contacted by letter, which was followed up with a telephone call and face-to-face meeting to invite participation in the study. Parents/carers were sent a letter and information sheet about the study, which included a form to be returned to school if they wished to opt their child out of the study. The opt-out method of parental consent has been found to be ethically acceptable.[23] Adolescents were provided with an information sheet at the time measurements were undertaken and also asked to give written consent to their participation in the study.

Survey instrument

Data were collected using a self-complete paper questionnaire administered by teachers to a whole class under exam conditions but students were informed that it was not a test. Teachers encouraged students to complete as much of the questionnaire as they could within the 50 or 55 minute lesson period.

The instrument incorporated validated questions on adolescents' sun-related behaviours and tanning attitudes,[19] the Cancer Awareness Measure (CAM),[24,25] and socio-demographic questions.

Sun-related behaviours and tanning attitudes

Adolescents' tanning attitudes and sun-related behaviours were assessed using items from an instrument developed in New Zealand.[19] Sun-related behaviours, including sunbathing, getting a suntan, use of sun beds and sun-protection practices were assessed through ten questions.

Attitudes towards tanning were assessed through five statements which used a five-point Likert scale to ask adolescents if a suntan made them 'feel healthier', 'more attractive to others' or 'better about themselves', and if friends and family thought that a suntan was a 'good thing'. For analysis, responses were dichotomised (i.e., 'yes' versus 'no'; 'strongly agree'/'agree' versus 'neither agree nor disagree'/'disagree'/'strongly disagree').

Skin cancer symptom and risk factor awareness

Adolescents' awareness of skin cancer related symptoms and risk factors were assessed through two questions in the CAM. Awareness of the cancer sign 'change in the appearance in a mole' was assessed alongside eight other cancer signs and symptoms through a recognition question.

Awareness of the skin cancer-related risk factor 'getting sunburnt more than once as a child' was assessed alongside ten other cancer risk factors on a five-point Likert scale. In accordance with previous practice,[21,25] responses were dichotomised for analysis (i.e., mole: 'Yes' versus 'No'/'Don't know'; sunburn: 'strongly agree'/'agree' versus 'not sure'/'disagree'/'strongly disagree').

Socio-demographic characteristics

Socio-demographic questions were included to gather data on: age, gender, ethnicity, and whether the student had been diagnosed with cancer or knew a relative or friend who had been diagnosed with cancer.

Data analysis

Descriptive statistics were calculated for demographic variables (i.e., age, gender, ethnicity, knowing someone with cancer), sun-related behaviours and tanning attitudes, and skin cancer related symptom and risk factor awareness. Pearson's chi-square (χ^2) tests were used to assess associations between: (1) sun-related behaviours and gender; (2) tanning attitudes and gender and sun-related behaviour; (3) skin cancer-related symptom and risk factor awareness and gender, sun-related behaviours, and tanning attitudes. Data were analysed using SPSS 19.0. Significance tests were two-sided; $p < 0.05$ was considered statistically significant.

Ethical considerations

Approval for the study was obtained from the Research Ethics Committee in the School of Nursing, Midwifery and Health, University of Stirling. Glasgow City Council, Planning, Performance and Research Unit approved the involvement of secondary schools. All General Practitioner (GP) practices in the research site were informed about the study.

RESULTS

Sample

The sample included 2,173 (female: $n=1,102$, 50.7%) adolescents with a mean age of 12.4 (Standard Deviation [SD] = 0.55) at the time of the survey. Socio-demographic characteristics of respondents are shown in Table 1.

[Insert Table 1 here]

Sun-related behaviours

Suntan

Around two-thirds (61.3%, n=1,333) of adolescents reported getting a suntan last summer. Slightly more girls than boys reported a suntan, although this difference was not statistically significant (Girls: 66.2% [n=700], Boys: 63.4% [n=616]; $\chi^2(1, 2030)=1.73, p=0.189$).

Sunbathing

Four in ten (42.2%, n=916) adolescents reported sunbathing regularly last summer to try to get a tan. Girls were statistically significantly more likely to report sunbathing (Girls: 57.8% [n=611], Boys: 30.4% [n=294]; $\chi^2(1, 2025)=152.86, p<0.001$). Of those who sunbathed, 44.2% (n=405) reported using oils or lotions to aid tanning. Girls who sunbathed were statistically significantly more likely than boys to report using oils or lotions to help get a tan (Girls: 47.4% [n=289], Boys: 38.1% [n=111]; $\chi^2(1, 901)=6.80, p=0.009$).

Sunburn

Half of adolescents (51.2%, n=1,112) reported getting sunburnt last summer, of whom around two-thirds (61.7%, n=686) reported getting sunburnt on one occasion, and over a third (38.3%, n=426) reported getting sunburnt on more than one occasion. Girls were statistically significantly more likely to report getting sunburnt last summer (Girls: 62.6% [n=625], Boys: 52.7% [n=476]; $\chi^2(1, 1902)=19.34, p<0.001$). Of girls who reported getting sunburnt (n=625), almost 1 in 10 (8.2%, n=51) said that their 'skin went red, sore and blistered', nearly 4 in 10 (39.0%, n=244) said their 'skin went red and sore'; 24.0% (n=150) reported their 'skin went red but not sore' and 27.7% (n=173) said their 'skin went pink or slightly red'. A greater proportion of boys than girls reported 'red, sore and blistered skin' (11.3%, n=54), although fewer reported that their 'skin went red and sore' (34.2%,

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3 n=163); 24.4% (n=116) reported their 'skin went red but not sore', and 27.9% (n=133) said their 'skin
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5 went pink or slightly red'.
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7 *Sunscreen use*

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9 Nearly a fifth of adolescents (16.8%, n=365) reported that they 'didn't usually use sunscreen'. Of
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11 those who reported using sunscreen (74.0%, n=1609), over half (52.6%, n=847) did not know the Sun
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13 Protection Factor (SPF) of the sunscreen they usually used. The greatest proportion of adolescents
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15 who could identify the SPF of their sunscreen used SPF >30 (19.7%, n=317), followed by: SPF30
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17 (15.2%, n=244); SPF15 (8.0%, n=129), and SPF <15 (4.5%, n=72).
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22 Of those who reported getting sunburnt (51.2%, n=1,112), 1 in 10 (11.6%, n=129) reported that they
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24 did not use sunscreen. Boys who got sunburnt were statistically significantly more likely to report
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26 not using sunscreen, with over 1 in 4 reporting that they did not use sunscreen (Boys: 27.9% [n=72],
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28 Girls: 15.4% [n=57]; $\chi^2(1, 629)=14.69, p<0.001$).
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32 *Sunbed use*

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34 1 in 20 (5.8%, n=127) adolescents reported using a sunbed in the last 12 months. There was no
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36 statistically significant gender difference in sunbed use (Girls: 6.3% [n=66], Boys: 6.3% [n=59]; $\chi^2(1,$
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38 1980)=0.003, p=0.959).
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42 **Tanning attitudes**

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44 Peers exerted the greatest influence on adolescents' attitudes towards tanning with two-fifths
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46 (42.3%, n=918) stating that they strongly agreed or agreed with the statement 'most of my friends
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48 think a suntan is a good thing'. A quarter of adolescents (26.1%, n=567) agreed that their family
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50 thought a suntan was a good thing. A fifth of adolescents agreed that a suntan made them feel
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52 better about themselves (22.7%, n=492) and that a suntan made them feel more attractive to others
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3 (18.8%, n=409). A tenth (12.3%, n=267) agreed that they liked to have a suntan because it made
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5 them feel healthier. Gender differences were investigated and are summarised in Table 2.
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10 *[Insert Table 2 here]*
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13 Adolescents of both sexes who reported sunbathing were statistically significantly more likely to
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15 agree with each of the five tanning attitude statements than those who did not report sunbathing
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17 (Table 3). Boys who reported using sunbeds were statistically significantly more likely to agree with
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19 four of the five statements, the exception being the statement 'most of my friends think a suntan is
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21 a good thing' for which there was no difference between boys who did and did not report sunbed
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23 use (Table 3).
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29 *[Insert Table 3 here]*
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32 **Sun-related behaviour and cancer awareness**

33 *Symptom awareness*

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36 Less than half (45.2%, n=982) of adolescents thought that change in the appearance of a mole could
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38 be a sign of cancer. Girls were statistically significantly more likely to recognise that a change in the
39
40 appearance of a mole was potentially a sign of cancer (Girls: 48.0% [n=524]; Boys: 43.5% [n=444];
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42 $\chi^2(1, 2112)=4.38, p=0.036$).
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48 The only statistically significant association between symptom awareness and sun-related behaviour
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50 was among females who reported getting sunburnt who were more likely to agree that a change in
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52 the appearance of a mole was potentially a sign of cancer (Table 4).
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55 *Risk factor awareness*

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3 Four in ten (39.1%, n=849) adolescents thought that getting sunburnt more than once as a child was
4 a risk factor of cancer. Girls were statistically significantly more likely to agree that getting sunburnt
5 more than once as a child was a cancer risk factor (Girls: 43.4% [n=469]; Boys: 37.3% [n=370]; $\chi^2(1,$
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10 2071)=7.95, p=0.005).

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14 There were no statistically significant associations between awareness of getting sunburnt more
15 than once as a child and sun-related behaviours, although adolescents of both sexes who reported
16 getting sunburnt were more likely to agree that sunburn was a cancer risk factor (Table 4).
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22 *[Insert Table 4 here]*
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26 **DISCUSSION**

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29 Scottish adolescents' awareness of the symptoms and risk factors associated with skin cancer was
30 low: less than half of adolescents identified 'change in the appearance of a mole' as a sign of cancer
31 and fewer than 40% agreed that 'getting sunburnt more than once as a child' increased cancer risk.
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33 This confirms findings from an earlier small-scale UK study [21] and suggests that awareness of skin
34 cancer symptoms and risks among Scottish adolescents compares unfavourably with adolescents
35 elsewhere in Europe. For example, the majority (97%) of Italian secondary school students (aged 15-
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21 years) had heard of skin cancer and 66% and 59%, respectively, correctly identified sun exposure
and sunburn as skin cancer risk factors [16]. Similarly, a study of Greek adolescents (aged 15-18
years) found that 89% were aware of the association between sun exposure and skin cancer risk
[17].

Adolescents also reported poor sun-protection practices with half (51%) reporting that they had
experienced sunburn last summer. Over a third (38%) of those reporting sunburn experienced
sunburn on more than one occasion and a tenth (10%) said that their skin went 'red, sore or

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3 blistered'. Sunscreen use was also notably poor with almost a fifth of adolescents reporting that
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5 they did not use sunscreen and less than half (47%) of those who did knew the SPF of the sunscreen
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7 used. Given the causal relationship between UV exposure and incidence of malignant melanoma,[7]
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9 our findings suggest that urgent action is required to reduce levels of sunburn among Scottish
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11 adolescents in order to reverse rising rates of malignant melanoma.
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16 In common with previous studies from the UK,[21] USA,[18] Sweden [20] and New Zealand,[19] our
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18 research also identified riskier sun-related behaviour among female adolescents despite their
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20 greater skin cancer symptom and risk factor awareness. Females in our study were significantly
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22 more likely than males to report intentional tanning, the use of lotions or oils to aid tanning, and
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24 sunburn, yet were also significantly more likely to agree that 'change in the appearance of a mole'
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26 was a cancer sign and 'getting sunburnt more than once as a child' was a cancer risk factor. Indeed,
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28 females who reported getting sunburnt during the previous summer were statistically significantly
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30 more likely to recognise that 'change in the appearance of a mole' was a cancer sign. However,
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32 compared to males, females were also significantly more likely to use sunscreen, confirming findings
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34 of a systematic review that concluded that females were both more likely to adopt sun-protection
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36 practices and more likely to engage in risky sun-related behaviours, and that this association was
37
38 most evident in adolescence and early adulthood.[26] Cognitive dissonance, denial and previous
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40 personal or vicarious experience have all been identified as pivotal factors in the relationship
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42 between adolescents' risk perception and risk behaviour.[27] Hence, health promotion in relation to
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44 sun safe practices needs to be underpinned by greater understanding of how adolescents balance
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46 harms and perceived benefits of tanning.
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53 External influences of friends and family exerted a stronger influence on tanning attitudes than
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55 associations with feeling better, more attractive, or healthier. More than two-fifths agreed that
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57 most of their friends thought that a tan was a good thing, yet around a fifth said it made them feel
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3 better and more attractive, and around a tenth that it made them feel healthier. The primacy of
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5 peer influences has also been found among similarly aged adolescents in Australasia. For example, a
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7 study in New Zealand found that 42% of females and 33% of males agreed that 'most of their friends
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9 think a suntan is a good thing',[19] and the majority (66%) of adolescents in an Australian study
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11 perceived friends to have pro-tanning attitudes.[28] Moreover, there is evidence from a Danish
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13 study that sunburn risk increases among adolescents (aged 13-17 years) whose parents hold positive
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15 attitudes towards tanning,[29] and the highest ranking source of sun protection information among
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17 young park-goers in London (aged 18-28 years) was 'parents and family'.[30] Further research is
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19 therefore required to assess peer and family influences on Scottish adolescents' tanning attitudes in
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21 order to determine the potential of peer-group and family-based interventions to reduce risky sun-
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23 related behaviours.
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29 Females in our study were statistically significantly more likely than males to report that their friends
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31 think a suntan is a good thing and that it made them feel better about themselves, healthier or more
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33 attractive to others. Tanning attitudes mediate the association between skin cancer knowledge and
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35 sun-related behaviour,[19,31] and more positive attitudes towards tanning among females are
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37 cosmetically and socially motivated.[20] Moreover, the influence of peers on tanning attitudes is
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39 known to increase as adolescents age.[19] In order to design age-appropriate sun safety
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41 interventions research is therefore required to better understand how the balance between social,
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43 cosmetic and health motivations changes over time, especially among young females.
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48 **Implications for future policy and research**

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50 Our research identifies an urgent need to develop sun safety interventions specifically for Scottish
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52 adolescents. However, our study also suggests that further research is required to ensure
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54 interventions overcome a number of challenges previously highlighted in the literature and
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56 confirmed by our own research. Research is required to assess how skin cancer knowledge, sun-
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3 related behaviour, and tanning attitudes – and the influence of peers and family on knowledge,
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5 behaviour and attitudes – changes as adolescents' age. Testing behaviour change techniques [32]
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7 which show promise such as those based on dissonance [33,34] to address the known discordance
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9 between sun protection intention and practice,[30,35] would also be useful. This research is vital
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11 because previous interventions to change sun-safe knowledge and practice have been disappointing
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13 [36] and it is not known which educational techniques are most effective.[37] Despite considerable
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15 challenges of effective intervention development for this age group, previous research has found
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17 that school-based educational interventions to raise adolescents' cancer awareness are effective,
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19 especially among females.[21,38] Hence, multi-component interventions that incorporate education
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21 alongside challenges to societal beliefs around tanning (e.g., the association between tanned skin,
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23 beauty and health) and environmental changes (e.g., provision of sunscreen, hats and shade in
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25 secondary schools) may encourage protective sun-related behaviours. Future research identified in
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27 support of intervention development has potential to have international impact on reducing the
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29 burden on skin cancer.
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35 **Strengths and limitations**

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37 This is the first study to describe Scottish adolescents' sun-related behaviours and tanning attitudes
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39 and assess associations with cancer awareness. It establishes an evidence-base to set the direction
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41 of future research and policy interventions through on-going initiatives such as Detect Cancer Early
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43 in Scotland and the National Awareness and Early Diagnosis Initiative (NAEDI) in England. However,
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45 our study has a number of limitations. First, our sample is drawn from only one Scottish local
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47 authority area (Glasgow City Council) and used purposive rather than probabilistic sampling. Thus,
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49 although 2,173 adolescents from 20 (out of a possible 29) secondary schools in Glasgow were
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51 surveyed, these findings may not be representative of the Scottish adolescent population. However,
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53 Glasgow was purposefully selected as a research site due to known high incidence of malignant
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55 melanoma in the Central Belt of Scotland, a densely populated urban region extending from Glasgow
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3 in the West to Edinburgh in the East.[2] Second, although validated instruments were used for data
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5 collection, results are contingent on adolescents' accurate recall of sun-related behaviour over the
6
7 past year. Previous studies among adolescents have, however, found recall of sun-related
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9 behaviours to be reliable and valid.[31] Finally, because data were gathered as part of a cluster
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11 RCT,[22] in order to enable completion of all instruments during a 55-minute class, a shortened
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13 version of an instrument to assess sun-related knowledge, behaviour and tanning attitudes[19] was
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15 used which meant that replication of analysis conducted elsewhere using the full instrument could
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17 not be conducted.[19] Future research is therefore required using a representative sample of
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19 Scottish adolescents using the full version of the sun instrument with additional items to gather data
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21 on known skin cancer risk factors to enable such analyses and more comprehensive comparison with
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23 studies of similarly aged secondary school students in New Zealand [19] and Australia [28] where
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25 this instrument has been used.
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31 **CONCLUSION**

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33 Scottish adolescents' awareness of skin cancer symptoms and risk factors was low and matched by
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35 poor sun protection behaviours, most apparent in the high prevalence of (often severe) sunburn
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37 during the previous summer. These findings suggest that if the continuing rise in incidence of
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39 malignant melanoma in Scotland is to be halted, urgent action is required to increase skin cancer
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41 awareness and promote positive sun-related behaviour among Scottish adolescents. Our study
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43 highlights that the relationship between risk knowledge and risk behaviour are complex and
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45 different for adolescent males and females. Thus, further research is needed to inform the
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47 development of effective sun-safe interventions.
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CONTRIBUTION STATEMENT

RGK designed and conducted data analysis. GH secured funding and ethical approval. IM and GH managed school and participant recruitment, and data collection. RGK and GH wrote the first draft of the paper, and LF, RDN, REO, and SH provided critical revision for important intellectual content. All authors read and approved the final manuscript.

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COMPETING INTERESTS STATEMENT

IM is employed by Teenage Cancer Trust. RGK, LF, RDN, REO, SH and GH declare that they have no conflicts of interest.

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31 TABLES

32
33 **Table 1:** Sample socio-demographic characteristics
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	n	%
<i>Gender</i>		
Male	1,032	47.5
Female	1,102	50.7
Missing	39	1.8
<i>Age</i>		
Mean (SD)	12.4	(0.55)
<i>Ethnicity</i>		
White	1,826	84.0
Mixed	75	3.5
Asian	131	6.0
Black	57	2.6
Chinese	15	0.7
Other	28	1.3
Missing	41	1.9
<i>Knew someone with cancer</i>		
Yes	1,266	58.3
No	783	36.0
Missing	124	5.7

Table 2: Tanning attitudes and gender

Statement	Female	Male	Significance*
% Strongly agree/agree (n)			
Most of my friends think a suntan is a good thing.	53.1 (554)	37.7 (355)	$\chi^2(1, 1985)=47.48$ p<0.001
Most of my family think a suntan is a good thing.	29.0 (301)	27.8 (260)	$\chi^2(1, 1974)=0.36$ p=0.548
I like to have a suntan because it makes me feel better about myself.	30.8 (320)	18.0 (169)	$\chi^2(1, 1978)=43.10$ p<0.001
A suntan makes me feel more attractive to others.	22.7 (235)	18.1 (169)	$\chi^2(1, 1969)=6.40$ p=0.011
I like to have a suntan because I feel healthier.	16.2 (169)	10.1 (95)	$\chi^2(1, 1980)=15.99$ p<0.001

Notes:

* Pearson's χ^2 test for 2x2 tables (i.e., strongly agree/agree vs. disagree/strongly disagree/don't know). Statistically significant associations at the p<0.05 level are emboldened.

Table 3: Tanning attitudes and sun-related behaviour

Statement	Female								
	Sunbathed			Sunburnt			Sunbed use		
	Yes	No	Significance*	Yes	No	Significance*	Yes	No	Significance*
% Strongly agree/agree (n)									
Most of my friends think a suntan is a good thing.	61.8 (371)	40.6 (177)	$\chi^2(1, 1036)=45.71$ p<0.001	60.1 (370)	42.7 (157)	$\chi^2(1, 984)=28.05$ p<0.001	62.1 (41)	52.1 (500)	$\chi^2(1, 1026)=2.50$ p=0.114
Most of my family think a suntan is a good thing.	35.7 (214)	19.9 (86)	$\chi^2(1, 1031)=30.44$ p<0.001	31.1 (191)	25.6 (94)	$\chi^2(1, 982)=3.31$ p=0.069	39.1 (25)	28.1 (269)	$\chi^2(1, 1021)=3.51$ p=0.061
I like to have a suntan because it makes me feel better about myself.	42.6 (255)	14.5 (63)	$\chi^2(1, 1032)=93.32$ p<0.001	38.0 (234)	20.6 (75)	$\chi^2(1, 980)=32.02$ p<0.001	33.3 (22)	30.4 (291)	$\chi^2(1, 1022)=0.24$ p=0.622
A suntan makes me feel more attractive to others.	31.3 (187)	10.9 (47)	$\chi^2(1, 1029)=59.62$ p<0.001	26.6 (163)	16.4 (60)	$\chi^2(1, 979)=13.55$ p<0.001	26.2 (17)	22.4 (213)	$\chi^2(1, 1018)=0.50$ p=0.478
I like to have a suntan because I feel healthier.	23.2 (139)	6.9 (30)	$\chi^2(1, 1035)=48.86$ p<0.001	18.0 (111)	12.4 (46)	$\chi^2(1, 986)=5.40$ p=0.020	19.7 (13)	15.6 (150)	$\chi^2(1, 1025)=0.76$ p=0.383
	Male								
	Sunbathed			Sunburnt			Sunbed use		
	Yes	No	Significance*	Yes	No	Significance*	Yes	No	Significance*
% Strongly agree/agree (n)									
Most of my friends think a suntan is a good thing.	54.8 (154)	30.3 (197)	$\chi^2(1, 932)=50.36$ p<0.001	41.9 (195)	34.5 (143)	$\chi^2(1, 880)=5.18$ p=0.023	37.9 (22)	38.0 (325)	$\chi^2(1, 914)=0.00$ p=0.996
Most of my family think a suntan is a good thing.	43.5 (121)	21.1 (137)	$\chi^2(1, 926)=48.49$ p<0.001	30.3 (139)	25.2 (104)	$\chi^2(1, 876)=2.55$ p=0.110	39.7 (23)	26.4 (225)	$\chi^2(1, 909)=4.78$ p=0.029
I like to have a suntan because it makes me feel better about myself.	32.9 (91)	11.7 (76)	$\chi^2(1, 928)=59.06$ p<0.001	21.6 (100)	13.8 (57)	$\chi^2(1, 876)=9.02$ p=0.003	29.3 (17)	17.0 (145)	$\chi^2(1, 911)=5.63$ p=0.018
A suntan makes me feel more attractive to others.	32.1 (88)	12.2 (79)	$\chi^2(1, 924)=51.88$ p<0.001	20.0 (93)	15.9 (66)	$\chi^2(1, 880)=2.59$ p=0.108	30.9 (17)	17.1 (145)	$\chi^2(1, 905)=6.74$ p=0.009
I like to have a suntan because I feel healthier.	19.8 (54)	5.8 (38)	$\chi^2(1, 928)=42.16$ p<0.001	12.0 (56)	7.2 (30)	$\chi^2(1, 884)=5.88$ p=0.015	25.0 (14)	9.0 (77)	$\chi^2(1, 926)=14.88$ p<0.001

Notes:
 * Pearson's χ^2 test for 2x2 tables (i.e., Strongly agree/agree vs. Strongly disagree/disagree/neither agree or disagree/don't know). Statistically significant associations at the p<0.05 level are emboldened.

Table 4: Associations between sun-related behaviour and cancer awareness

Symptom: 'change in the appearance of a mole' % Yes (n)	Sunbathed			Sunburnt			Sunbed use		
	Yes	No	Significance*	Yes	No	Significance*	Yes	No	Significance*
Female	50.1 (304)	46.0 (204)	$\chi^2(1, 1050)=1.67$ p=0.197	51.0 (317)	44.1 (163)	$\chi^2(1, 991)=4.54$ p=0.033	55.4 (36)	47.6 (461)	$\chi^2(1, 1033)=1.47$ p=0.225
Male	43.8 (127)	43.1 (289)	$\chi^2(1, 960)=0.036$ p=0.850	44.6 (210)	41.9 (178)	$\chi^2(1, 896)=0.67$ p=0.415	36.2 (21)	44.1 (386)	$\chi^2(1, 934)=1.37$ p=0.243
Risk factor: 'getting sunburnt more than once as a child' % Strongly agree/agree (n)	Sunbathed			Sunburnt			Sunbed use		
	Yes	No	Significance*	Yes	No	Significance*	Yes	No	Significance*
Female	43.9 (265)	42.4 (186)	$\chi^2(1, 1043)=0.24$ p=0.628	44.5 (276)	41.3 (151)	$\chi^2(1, 986)=1.00$ p=0.318	36.4 (24)	43.9 (422)	$\chi^2(1, 1027)=1.43$ p=0.231
Male	38.9 (112)	37.4 (244)	$\chi^2(1, 941)=0.20$ p=0.657	40.8 (189)	34.6 (144)	$\chi^2(1, 879)=3.59$ p=0.058	41.1 (23)	37.5 (321)	$\chi^2(1, 913)=0.29$ p=0.589

Notes:

* Pearson's χ^2 test for 2x2 tables (i.e., Symptom: Yes vs. No/Don't know; Risk factor: Strongly agree/agree vs. Strongly disagree/disagree/neither agree or disagree/don't know). Statistically significant associations at the p<0.05 level are emboldened.

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4 to 5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5 to 8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6 to 7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6 to 7
Bias	9	Describe any efforts to address potential sources of bias	15
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	8
		(b) Describe any methods used to examine subgroups and interactions	8
		(c) Explain how missing data were addressed	7
		(d) If applicable, describe analytical methods taking account of sampling strategy	N/A
		(e) Describe any sensitivity analyses	N/A
Results			

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Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	6
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8 and Table 1
		(b) Indicate number of participants with missing data for each variable of interest	8 and Table 1
Outcome data	15*	Report numbers of outcome events or summary measures	9 to 12
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9 to 12
		(b) Report category boundaries when continuous variables were categorized	N/A
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9 to 12
Discussion			
Key results	18	Summarise key results with reference to study objectives	12 to 14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15 to 16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12 to 14
Generalisability	21	Discuss the generalisability (external validity) of the study results	15
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	3

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Scottish adolescents' sun-related behaviours, tanning attitudes and associations with skin cancer awareness: a cross-sectional study

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3 **SCOTTISH ADOLESCENTS' SUN-RELATED BEHAVIOURS, TANNING ATTITUDES AND**
4
5 **ASSOCIATIONS WITH SKIN CANCER AWARENESS: A CROSS-SECTIONAL STUDY**
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ABSTRACT

Objectives: To describe Scottish adolescents' sun-related behaviours and tanning attitudes and assess associations with skin cancer awareness.

Design: Cross-sectional study.

Setting: 20 state secondary schools in one Scottish local authority (Glasgow City).

Participants: 2,173 adolescents (female: 50.7%, n=1,102) with a mean age of 12.4 (Standard Deviation = 0.55).

Outcome measures: Sun-related behaviour (suntan, sunbathing, sunburn, sunscreen use, sunbed use), tanning attitudes, skin cancer-related symptom and risk factor awareness.

Results: Adolescents reported poor sun-related practice: 51% of adolescents reported sunburn the previous summer and 38% indicated sunburn on more than one occasion. Skin cancer awareness was low: 45% recognised 'change in the appearance of a mole' as a cancer symptom, and 39% agreed that 'getting sunburnt more than once as a child' increased cancer risk. 42% and 26% of adolescents, respectively, reported that friends and family held pro-tanning attitudes. Compared to males, females were statistically significantly more likely to: report sunbathing ($p<0.001$), use of lotions or oil to aid tanning ($p<0.001$), and sunburn ($p<0.001$); know that changes in the appearance of a mole was a skin cancer symptom ($p=0.036$) and sunburn more than once as a child was a skin cancer risk factor ($p=0.005$); perceive their friends to hold pro-tanning attitudes ($p<0.001$) and indicate that a tan made them feel better about themselves ($p<0.001$), more attractive to others ($p=0.011$) and healthier ($p<0.001$).

Conclusions: Scottish adolescents had poor sun protection practice and low skin cancer awareness. Girls adopted riskier sun-related behaviour despite greater awareness of skin cancer-related risk. Urgent action is required to promote positive sun-related behaviour and increase skin cancer awareness among Scottish adolescents. However, further research is needed to inform the development of effective sun-safe interventions.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- This is the first study to describe Scottish adolescents' sun-related behaviours and tanning attitudes and assess associations with malignant melanoma symptom and risk factor awareness.
- Findings establish evidence to support on-going government initiatives to increase the proportion of people with early diagnosis, including Detect Cancer Early (DCE) in Scotland and the National Awareness and Early Diagnosis Initiative (NAEDI) in England.
- Adolescents in only one Scottish local authority area were surveyed and non-probabilistic sampling was used, although Glasgow was purposefully selected due to known high incidence of malignant melanoma in the Central Belt of Scotland, a densely populated urban region extending from Glasgow in the West to Edinburgh in the East.

KEYWORDS

Malignant melanoma, skin cancer, tanning attitudes, sunburn, sunbeds, sun protection, health-related behaviour, health promotion

WORD COUNT

3,586

INTRODUCTION

Rates of malignant melanoma are rising more rapidly than for any other cancer in the United Kingdom (UK) [1] and Scotland has above average incidence when compared to the rest of the UK.[2] Incidence of malignant melanoma in Scotland significantly increased by 51.4% ($p < 0.0001$) over the past decade.[3] Light skin colour, blonde or red hair, number of moles,[4] family history,[5] and excess exposure to ultraviolet radiation, particularly in childhood, are the main risk factors for malignant melanoma.[6] It is estimated that 86% of malignant melanoma cases in the UK can be attributable to excess exposure to UV radiation (Male = 90%, Female = 82%), and that these proportions are “very much greater at younger ages”.[7]

Malignant melanoma is the fifth most common teenage and young adult (TYA) cancer in the UK, accounting for 11% of the 2,200 average annual cases among those aged 15-24.[8] Almost twice as many females ($n=153$) than males ($n=73$) are diagnosed with malignant melanoma annually, making it the third and sixth most common cancer in young women and men, respectively.[8] Incidence of malignant melanoma significantly increased by 32% among young females between 1995 and 2009.[8]

Across the UK survival rates for malignant melanoma are high and increasing over time,[9] and in Scotland five-year survival rates rose by 21% over the past 20 years, from 64% in the period 1983-97 to 85% in 2003-07.[10] Survival is higher in younger people[10] and there is some evidence that longer time durations prior to diagnosis may be associated with poorer outcomes.[11-13] UK government health departments are therefore committed to improving awareness as part of a strategy to increase the proportion of people with early diagnosis.[14,15] Increasing adolescents' awareness of skin cancer risk associated with UV exposure and encouraging sun protective practices may therefore have potential to reduce the burden of malignant melanoma both in adolescence and early adulthood, as well as later life through the establishment of protective health-related

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3 behaviours. However, previous research has found that although adolescents' awareness of skin
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5 cancer and its association with UV exposure is generally good [16,17] this knowledge does not
6
7 translate into sun-safe behaviour,[18,19] especially among young females.[19-21]
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12 Little evidence exists around the association between sun-related behaviours and cancer awareness
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14 among adolescents in the UK. Only one UK study to date has examined the association between
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16 sunscreen and sunbed use and cancer awareness, which found that female adolescents who used
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18 sunbeds were statistically significantly more likely to agree that UV exposure was a cancer risk
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20 factor.[21] Moreover, patterns of sun-related behaviours (i.e., sunbathing, sunburn) and protective
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22 practices (i.e., sunscreen use) and tanning attitudes among Scottish adolescents have not previously
23
24 been described. This lack of evidence hampers development of interventions to increase cancer
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26 awareness and change sun-related behaviours in support of government initiatives. Hence, the aims
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28 of this study were to: 1) describe the sun-related behaviours and tanning attitudes among Scottish
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30 adolescents; and 2) assess associations between sun-related behaviour, tanning attitudes and cancer
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32 awareness.
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38 **METHODS**

39 **Study design**

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41 Data are drawn from the Adolescent Cancer Education (ACE) study, the design of which is described
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43 in the published protocol.[22] Briefly, ACE is a cluster randomised controlled trial (RCT) to assess the
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45 effectiveness of a school-based educational intervention on adolescents' and parents' cancer
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47 awareness and communication. Data were collected at three time-points: baseline (prior to
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49 intervention delivery), and at two-weeks, and six-month follow-up. This paper reports cross-
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51 sectional analysis of baseline data.
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Setting and Sample

All 29 state secondary schools (excluding schools for adolescents with special educational needs) in the Glasgow City Council area were invited to participate. Recruitment ended when the (pragmatic) target of 20 schools (69.0%) agreed to participate. All 3,223 adolescents on the school register at the end of their first year (S1) of secondary education (age 12/13 years) in study schools were invited to participate in the study, of which 2,173 (67.4%) consented to data collection.

Recruitment and consent

Schools were recruited in May 2013 and adolescents in June 2013. School head teachers were contacted by letter, which was followed up with a telephone call and face-to-face meeting to invite participation in the study. Parents/carers were sent a letter and information sheet about the study, which included a form to be returned to school if they wished to opt their child out of the study. The opt-out method of parental consent has been found to be ethically acceptable.[23] Adolescents were provided with an information sheet at the time measurements were undertaken and also asked to give written consent to their participation in the study.

Survey instrument

Data were collected in June 2013 (i.e., northern hemisphere summer) using a self-complete paper questionnaire administered by teachers to a whole class under exam conditions but students were informed that it was not a test. Teachers encouraged students to complete as much of the questionnaire as they could within the 50 or 55 minute lesson period.

The instrument incorporated validated questions on adolescents' sun-related behaviours and tanning attitudes,[19] the Cancer Awareness Measure (CAM),[24,25] and socio-demographic questions.

Sun-related behaviours and tanning attitudes

Adolescents' tanning attitudes and sun-related behaviours were assessed using items from an instrument developed in New Zealand.[19] Sun-related behaviours, including sunbathing, getting a suntan, use of sun beds and sun-protection practices during the previous summer (i.e., 2012) or past 12 months were assessed through ten questions. Attitudes towards tanning were assessed through five statements which used a five-point Likert scale to ask adolescents if a suntan made them 'feel healthier', 'more attractive to others' or 'better about themselves', and if friends and family thought that a suntan was a 'good thing'. For analysis, responses were dichotomised (i.e., 'yes' versus 'no'; 'strongly agree'/'agree' versus 'neither agree nor disagree'/'disagree'/'strongly disagree').

Skin cancer symptom and risk factor awareness

Adolescents' awareness of skin cancer related symptoms and risk factors were assessed through two questions in the CAM. Awareness of the cancer sign 'change in the appearance in a mole' was assessed alongside eight other cancer signs and symptoms through a recognition question. Awareness of the skin cancer-related risk factor 'getting sunburnt more than once as a child' was assessed alongside ten other cancer risk factors on a five-point Likert scale. In accordance with previous practice,[21,25] responses were dichotomised for analysis (i.e., mole: 'Yes' versus 'No'/'Don't know'; sunburn: 'strongly agree'/'agree' versus 'not sure'/'disagree'/'strongly disagree').

Socio-demographic characteristics

Socio-demographic questions were included to gather data on: age, gender, ethnicity, and whether the student had been diagnosed or knew a relative or friend who had been diagnosed with any cancer.

Data analysis

Descriptive statistics were calculated for demographic variables (i.e., age, gender, ethnicity, knowing someone with cancer), sun-related behaviours and tanning attitudes, and skin cancer related symptom and risk factor awareness. Pearson's chi-square (χ^2) tests were used to assess associations between: (1) sun-related behaviours and gender; (2) tanning attitudes and gender and sun-related behaviour; (3) skin cancer-related symptom and risk factor awareness and gender, sun-related behaviours, and tanning attitudes. Data were analysed using SPSS 19.0. Significance tests were two-sided; $p < 0.05$ was considered statistically significant.

Ethical considerations

Approval for the study was obtained from the Research Ethics Committee in the School of Nursing, Midwifery and Health, University of Stirling (reference: 13/14(83)). Glasgow City Council, Planning, Performance and Research Unit approved the involvement of secondary schools. All General Practitioner (GP) practices in the research site were informed about the study.

RESULTS

Sample

The sample included 2,173 (female: $n=1,102$, 50.7%) adolescents with a mean age of 12.4 (Standard Deviation [SD] = 0.55) at the time of the survey. Socio-demographic characteristics of respondents are shown in Table 1.

[Insert Table 1 here]

Sun-related behaviours

Suntan

Around two-thirds (61.3%, n=1,333) of adolescents reported getting a suntan last summer. Slightly more girls than boys reported a suntan, although this difference was not statistically significant (Girls: 66.2% [n=700], Boys: 63.4% [n=616]; $\chi^2(1, 2030)=1.73, p=0.189$).

Sunbathing

Four in ten (42.2%, n=916) adolescents reported sunbathing regularly last summer to try to get a tan. Girls were statistically significantly more likely to report sunbathing (Girls: 57.8% [n=611], Boys: 30.4% [n=294]; $\chi^2(1, 2025)=152.86, p<0.001$). Of those who sunbathed, 44.2% (n=405) reported using oils or lotions to aid tanning. Girls who sunbathed were statistically significantly more likely than boys to report using oils or lotions to help get a tan (Girls: 47.4% [n=289], Boys: 38.1% [n=111]; $\chi^2(1, 901)=6.80, p=0.009$).

Sunburn

Half of adolescents (51.2%, n=1,112) reported getting sunburnt last summer, of whom around two-thirds (61.7%, n=686) reported getting sunburnt on one occasion, and over a third (38.3%, n=426) reported getting sunburnt on more than one occasion. Girls were statistically significantly more likely to report getting sunburnt last summer (Girls: 62.6% [n=625], Boys: 52.7% [n=476]; $\chi^2(1, 1902)=19.34, p<0.001$). Of girls who reported getting sunburnt (n=625), almost 1 in 10 (8.2%, n=51) said that their 'skin went red, sore and blistered', nearly 4 in 10 (39.0%, n=244) said their 'skin went red and sore'; 24.0% (n=150) reported their 'skin went red but not sore' and 27.7% (n=173) said their 'skin went pink or slightly red'. A greater proportion of boys than girls reported 'red, sore and blistered skin' (11.3%, n=54), although fewer reported that their 'skin went red and sore' (34.2%, n=163); 24.4% (n=116) reported their 'skin went red but not sore', and 27.9% (n=133) said their 'skin went pink or slightly red'.

Sunscreen use

Nearly a fifth of adolescents (16.8%, n=365) reported that they 'didn't usually use sunscreen'. Of those who reported using sunscreen (74.0%, n=1609), over half (52.6%, n=847) did not know the Sun Protection Factor (SPF) of the sunscreen they usually used. The greatest proportion of adolescents who could identify the SPF of their sunscreen used SPF >30 (19.7%, n=317), followed by: SPF30 (15.2%, n=244); SPF15 (8.0%, n=129), and SPF <15 (4.5%, n=72).

Of those who reported getting sunburnt (51.2%, n=1,112), 1 in 10 (11.6%, n=129) reported that they did not use sunscreen. Boys who got sunburnt were statistically significantly more likely to report not using sunscreen, with over 1 in 4 reporting that they did not use sunscreen (Boys: 27.9% [n=72], Girls: 15.4% [n=57]; $\chi^2(1, 629)=14.69, p<0.001$).

Sunbed use

1 in 20 (5.8%, n=127) adolescents reported using a sunbed in the last 12 months. There was no statistically significant gender difference in sunbed use (Girls: 6.3% [n=66], Boys: 6.3% [n=59]; $\chi^2(1, 1980)=0.003, p=0.959$).

Tanning attitudes

Peers exerted the greatest influence on adolescents' attitudes towards tanning with two-fifths (42.3%, n=918) stating that they strongly agreed or agreed with the statement 'most of my friends think a suntan is a good thing'. A quarter of adolescents (26.1%, n=567) agreed that their family thought a suntan was a good thing. A fifth of adolescents agreed that a suntan made them feel better about themselves (22.7%, n=492) and that a suntan made them feel more attractive to others (18.8%, n=409). A tenth (12.3%, n=267) agreed that they liked to have a suntan because it made them feel healthier. Gender differences were investigated and are summarised in Table 2.

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3 [Insert Table 2 here]
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7 Adolescents of both sexes who reported sunbathing were statistically significantly more likely to
8 agree with each of the five tanning attitude statements than those who did not report sunbathing
9 (Table 3). Boys who reported using sunbeds were statistically significantly more likely to agree with
10 four of the five statements, the exception being the statement 'most of my friends think a suntan is
11 a good thing' for which there was no difference between boys who did and did not report sunbed
12 use (Table 3).
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22 [Insert Table 3 here]
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27 Sun-related behaviour and cancer awareness

28 Symptom awareness

29 Less than half (45.2%, n=982) of adolescents thought that change in the appearance of a mole could
30 be a sign of cancer. Girls were statistically significantly more likely to recognise that a change in the
31 appearance of a mole was potentially a sign of cancer (Girls: 48.0% [n=524]; Boys: 43.5% [n=444];
32 $\chi^2(1, 2112)=4.38, p=0.036$).
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41 The only statistically significant association between symptom awareness and sun-related behaviour
42 was among females who reported getting sunburnt, who were more likely to agree that a change in
43 the appearance of a mole was potentially a sign of cancer (Table 4).
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49 Risk factor awareness

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51 Four in ten (39.1%, n=849) adolescents thought that getting sunburnt more than once as a child was
52 a risk factor of cancer. Girls were statistically significantly more likely to agree that getting sunburnt
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3 more than once as a child was a cancer risk factor (Girls: 43.4% [n=469]; Boys: 37.3% [n=370]; $\chi^2(1,$
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5 2071)=7.95, p=0.005).
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10 There were no statistically significant associations between awareness of getting sunburnt more
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12 than once as a child and sun-related behaviours, although adolescents of both sexes who reported
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14 getting sunburnt were more likely to agree that sunburn was a cancer risk factor (Table 4).
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20 21 22 **DISCUSSION**

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24 Scottish adolescents' awareness of the symptoms and risk factors associated with skin cancer was
25
26 low: less than half of adolescents identified 'change in the appearance of a mole' as a sign of cancer
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28 and fewer than 40% agreed that 'getting sunburnt more than once as a child' increased cancer risk.
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30 This confirms findings from an earlier small-scale UK study [21] and suggests that awareness of skin
31
32 cancer symptoms and risks among Scottish adolescents compares unfavourably with adolescents
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34 elsewhere in Europe. For example, the majority (97%) of Italian secondary school students (aged 15-
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36 21 years) had heard of skin cancer and 66% and 59%, respectively, correctly identified sun exposure
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38 and sunburn as skin cancer risk factors [16]. Similarly, a study of Greek adolescents (aged 15-18
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40 years) found that 89% were aware of the association between sun exposure and skin cancer risk
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42 [17].
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48 Adolescents also reported poor sun-protection practices with half (51%) reporting that they had
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50 experienced sunburn last summer. Over a third (38%) of those reporting sunburn experienced
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52 sunburn on more than one occasion and a tenth (10%) said that their skin went 'red, sore or
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54 blistered'. Sunscreen use was also notably poor with almost a fifth of adolescents reporting that
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56 they did not use sunscreen and less than half (47%) of those who did knew the SPF of the sunscreen
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3 used. Given the causal relationship between UV exposure and incidence of malignant melanoma,[7]
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5 our findings suggest that urgent action is required to reduce levels of sunburn among Scottish
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7 adolescents in order to reverse rising rates of malignant melanoma.
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11 In common with previous studies from the UK,[21] USA,[18] Sweden [20] and New Zealand,[19] our
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13 research also identified riskier sun-related behaviour among female adolescents despite their
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15 greater skin cancer symptom and risk factor awareness. Females in our study were significantly
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17 more likely than males to report intentional tanning, the use of lotions or oils to aid tanning, and
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19 sunburn, yet were also significantly more likely to agree that 'change in the appearance of a mole'
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21 was a cancer sign and 'getting sunburnt more than once as a child' was a cancer risk factor. Indeed,
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23 females who reported getting sunburnt during the previous summer were statistically significantly
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25 more likely to recognise that 'change in the appearance of a mole' was a cancer sign. However,
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27 compared to males, females were also significantly more likely to use sunscreen, confirming findings
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29 of a systematic review that concluded that females were both more likely to adopt sun-protection
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31 practices and more likely to engage in risky sun-related behaviours, and that this association was
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33 most evident in adolescence and early adulthood.[26] Cognitive dissonance, denial and previous
34
35 personal or vicarious experience have all been identified as pivotal factors in the relationship
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37 between adolescents' risk perception and risk behaviour.[27] Hence, health promotion in relation to
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39 sun safe practices needs to be underpinned by greater understanding of how adolescents balance
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41 harms and perceived benefits of tanning.
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49 External influences of friends and family exerted a stronger influence on tanning attitudes than
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51 associations with feeling better, more attractive, or healthier. More than two-fifths agreed that
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53 most of their friends thought that a tan was a good thing, yet around a fifth said it made them feel
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55 better and more attractive, and around a tenth that it made them feel healthier. The primacy of
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57 peer influences has also been found among similarly aged adolescents in Australasia. For example, a
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3 study in New Zealand found that 42% of females and 33% of males agreed that 'most of their friends
4 think a suntan is a good thing',[19] and the majority (66%) of adolescents in an Australian study
5 perceived friends to have pro-tanning attitudes.[28] Moreover, there is evidence from a Danish
6 study that sunburn risk increases among adolescents (aged 13-17 years) whose parents hold positive
7 attitudes towards tanning,[29] and the highest ranking source of sun protection information among
8 young park-goers in London (aged 18-28 years) was 'parents and family'.[30] Further research is
9 therefore required to assess peer and family influences on Scottish adolescents' tanning attitudes in
10 order to determine the potential of peer-group and family-based interventions to reduce risky sun-
11 related behaviours.
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24 Females in our study were statistically significantly more likely than males to report that their friends
25 think a suntan is a good thing and that it made them feel better about themselves, healthier or more
26 attractive to others. Tanning attitudes mediate the association between skin cancer knowledge and
27 sun-related behaviour,[19,31] and more positive attitudes towards tanning among females are
28 cosmetically and socially motivated.[20] Moreover, the influence of peers on tanning attitudes is
29 known to increase as adolescents age.[19] In order to design age-appropriate sun safety
30 interventions, further research is therefore required to better understand how the balance between
31 social, cosmetic and health motivations changes over time, especially among young females.
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44 **Implications for future policy and research**

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46 Our research identifies an urgent need to develop sun safety interventions specifically for Scottish
47 adolescents. However, our study also suggests that further research is required to ensure
48 interventions overcome a number of challenges previously highlighted in the literature and
49 confirmed by our own research. Research is required to assess how skin cancer knowledge, sun-
50 related behaviour, and tanning attitudes – and the influence of peers and family on knowledge,
51 behaviour and attitudes – changes as adolescents' age. Testing behaviour change techniques [32]
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3 which show promise such as those based on dissonance [33,34] to address the known discordance
4 between sun protection intention and practice,[30,35] would also be useful. This research is vital
5 because previous interventions to change sun-safe knowledge and practice have been disappointing
6 [36] and it is not known which educational techniques are most effective.[37] Despite considerable
7 challenges of effective intervention development for this age group, previous research has found
8 that school-based educational interventions to raise adolescents' cancer awareness are
9 effective,[38] especially among females.[21,39] Hence, multi-component interventions that
10 incorporate education alongside challenges to societal beliefs around tanning (e.g., the association
11 between tanned skin, beauty and health) and environmental changes (e.g., provision of sunscreen,
12 hats and shade in secondary schools) may encourage protective sun-related behaviours. Future
13 research identified in support of intervention development has potential to have international
14 impact on reducing the burden on skin cancer.
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31 **Strengths and limitations**

32 This is the first study to describe Scottish adolescents' sun-related behaviours and tanning attitudes
33 and assess associations with cancer awareness. It establishes an evidence-base to set the direction
34 of future research and policy interventions through on-going initiatives such as Detect Cancer Early
35 in Scotland and the National Awareness and Early Diagnosis Initiative (NAEDI) in England. However,
36 our study has a number of limitations. First, our sample is drawn from only one Scottish local
37 authority area (Glasgow City Council) and used purposive rather than probabilistic sampling. Thus,
38 although 2,173 adolescents from 20 (out of a possible 29) secondary schools in Glasgow were
39 surveyed, these findings may not be representative of the Scottish adolescent population. However,
40 Glasgow was purposefully selected as a research site due to known high incidence of malignant
41 melanoma in the Central Belt of Scotland, a densely populated urban region extending from Glasgow
42 in the West to Edinburgh in the East.[2] Second, although validated instruments were used for data
43 collection, results are contingent on adolescents' accurate recall of sun-related behaviour during
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3 summer 2012, around 9 to 12 months previously. Previous studies among adolescents have found
4 recall of sun-related behaviours to be reliable and valid[31], although the possibility that recall bias
5 influences our findings cannot be discounted due to the length of time since the previous summer
6 (e.g., reporting of less severe sunburn, frequency of sunburn, or SPF of sunscreen used may be
7 particularly prone to bias). Finally, because data were gathered as part of a cluster RCT,[22] in order
8 to enable completion of all instruments during a 55-minute class, a shortened version of an
9 instrument to assess sun-related knowledge, behaviour and tanning attitudes[19] was used which
10 meant that replication of analysis conducted elsewhere using the full instrument could not be
11 conducted.[19] Future research is therefore required using a representative sample of Scottish
12 adolescents using the full version of the sun instrument with additional items to gather data on
13 known skin cancer risk factors to enable such analyses and more comprehensive comparison with
14 studies of similarly aged secondary school students in New Zealand [19] and Australia [28] where
15 this instrument has been used.
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33 CONCLUSION

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35 Scottish adolescents' awareness of skin cancer symptoms and risk factors was low and matched by
36 poor sun protection behaviours, most apparent in the high prevalence of (often severe) sunburn
37 during the previous summer. These findings suggest that if the continuing rise in incidence of
38 malignant melanoma in Scotland is to be halted, urgent action is required to increase skin cancer
39 awareness and promote positive sun-related behaviour among Scottish adolescents. Our study
40 highlights that the relationship between risk knowledge and risk behaviour are complex and
41 different for adolescent males and females. Thus, further research is needed to inform the
42 development of effective sun-safe interventions.
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CONTRIBUTION STATEMENT

RGK designed and conducted data analysis. GH secured funding and ethical approval. IM and GH managed school and participant recruitment, and data collection. RGK and GH wrote the first draft of the paper, and LF, RDN, REO, and SH provided critical revision for important intellectual content. All authors read and approved the final manuscript.

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COMPETING INTERESTS STATEMENT

IM is employed by Teenage Cancer Trust. RGK, LF, RDN, REO, SH and GH declare that they have no conflicts of interest.

DATA SHARING STATEMENT

Data collected using the Cancer Awareness Measure (CAM) for the purposes of this study will be available through the UK Data Archive in accordance with the conditions of use of the CAM.

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TABLES

Table 1: Sample socio-demographic characteristics

	n	%
<i>Gender</i>		
Male	1,032	47.5
Female	1,102	50.7
Missing	39	1.8
<i>Age</i>		
Mean (SD)	12.4	(0.55)
<i>Ethnicity</i>		
White	1,826	84.0
Mixed	75	3.5
Asian	131	6.0
Black	57	2.6
Chinese	15	0.7
Other	28	1.3
Missing	41	1.9
<i>Knew someone with cancer</i>		
Yes	1,266	58.3
No	783	36.0
Missing	124	5.7

Table 2: Tanning attitudes and gender

Statement	Female	Male	Significance*
% Strongly agree/agree (n)			
Most of my friends think a suntan is a good thing.	53.1 (554)	37.7 (355)	$\chi^2(1, 1985)=47.48$ p<0.001
Most of my family think a suntan is a good thing.	29.0 (301)	27.8 (260)	$\chi^2(1, 1974)=0.36$ p=0.548
I like to have a suntan because it makes me feel better about myself.	30.8 (320)	18.0 (169)	$\chi^2(1, 1978)=43.10$ p<0.001
A suntan makes me feel more attractive to others.	22.7 (235)	18.1 (169)	$\chi^2(1, 1969)=6.40$ p=0.011
I like to have a suntan because I feel healthier.	16.2 (169)	10.1 (95)	$\chi^2(1, 1980)=15.99$ p<0.001

Notes:

* Pearson's χ^2 test for 2x2 tables (i.e., strongly agree/agree vs. disagree/strongly disagree/don't know). Statistically significant associations at the p<0.05 level are emboldened.

Table 3: Tanning attitudes and sun-related behaviour

Statement % Strongly agree/agree (n)	Female			Sunburnt			Sunbed use		
	Sunbathed		Significance*	Sunburnt		Significance*	Sunbed use		Significance*
	Yes	No		Yes	No		Yes	No	
Most of my friends think a suntan is a good thing.	61.8 (371)	40.6 (177)	$\chi^2(1, 1036)=45.71$ p<0.001	60.1 (370)	42.7 (157)	$\chi^2(1, 984)=28.05$ p<0.001	62.1 (41)	52.1 (500)	$\chi^2(1, 1026)=2.50$ p=0.114
Most of my family think a suntan is a good thing.	35.7 (214)	19.9 (86)	$\chi^2(1, 1031)=30.44$ p<0.001	31.1 (191)	25.6 (94)	$\chi^2(1, 982)=3.31$ p=0.069	39.1 (25)	28.1 (269)	$\chi^2(1, 1021)=3.51$ p=0.061
I like to have a suntan because it makes me feel better about myself.	42.6 (255)	14.5 (63)	$\chi^2(1, 1032)=93.32$ p<0.001	38.0 (234)	20.6 (75)	$\chi^2(1, 980)=32.02$ p<0.001	33.3 (22)	30.4 (291)	$\chi^2(1, 1022)=0.24$ p=0.622
A suntan makes me feel more attractive to others.	31.3 (187)	10.9 (47)	$\chi^2(1, 1029)=59.62$ p<0.001	26.6 (163)	16.4 (60)	$\chi^2(1, 979)=13.55$ p<0.001	26.2 (17)	22.4 (213)	$\chi^2(1, 1018)=0.50$ p=0.478
I like to have a suntan because I feel healthier.	23.2 (139)	6.9 (30)	$\chi^2(1, 1035)=48.86$ p<0.001	18.0 (111)	12.4 (46)	$\chi^2(1, 986)=5.40$ p=0.020	19.7 (13)	15.6 (150)	$\chi^2(1, 1025)=0.76$ p=0.383
	Male								
	Sunbathed			Sunburnt			Sunbed use		
	Yes	No	Significance*	Yes	No	Significance*	Yes	No	Significance*
Most of my friends think a suntan is a good thing.	54.8 (154)	30.3 (197)	$\chi^2(1, 932)=50.36$ p<0.001	41.9 (195)	34.5 (143)	$\chi^2(1, 880)=5.18$ p=0.023	37.9 (22)	38.0 (325)	$\chi^2(1, 914)=0.00$ p=0.996
Most of my family think a suntan is a good thing.	43.5 (121)	21.1 (137)	$\chi^2(1, 926)=48.49$ p<0.001	30.3 (139)	25.2 (104)	$\chi^2(1, 876)=2.55$ p=0.110	39.7 (23)	26.4 (225)	$\chi^2(1, 909)=4.78$ p=0.029
I like to have a suntan because it makes me feel better about myself.	32.9 (91)	11.7 (76)	$\chi^2(1, 928)=59.06$ p<0.001	21.6 (100)	13.8 (57)	$\chi^2(1, 876)=9.02$ p=0.003	29.3 (17)	17.0 (145)	$\chi^2(1, 911)=5.63$ p=0.018
A suntan makes me feel more attractive to others.	32.1 (88)	12.2 (79)	$\chi^2(1, 924)=51.88$ p<0.001	20.0 (93)	15.9 (66)	$\chi^2(1, 880)=2.59$ p=0.108	30.9 (17)	17.1 (145)	$\chi^2(1, 905)=6.74$ p=0.009
I like to have a suntan because I feel healthier.	19.8 (54)	5.8 (38)	$\chi^2(1, 928)=42.16$ p<0.001	12.0 (56)	7.2 (30)	$\chi^2(1, 884)=5.88$ p=0.015	25.0 (14)	9.0 (77)	$\chi^2(1, 926)=14.88$ p<0.001

Notes:

* Pearson's χ^2 test for 2x2 tables (i.e., Strongly agree/agree vs. Strongly disagree/disagree/neither agree or disagree/don't know). Statistically significant associations at the p<0.05 level are emboldened.

Table 4: Associations between sun-related behaviour and cancer awareness

Symptom: 'change in the appearance of a mole' % Yes (n)	Sunbathed			Sunburnt			Sunbed use		
	Yes	No	Significance*	Yes	No	Significance*	Yes	No	Significance*
Female	50.1 (304)	46.0 (204)	$\chi^2(1, 1050)=1.67$ p=0.197	51.0 (317)	44.1 (163)	$\chi^2(1, 991)=4.54$ p=0.033	55.4 (36)	47.6 (461)	$\chi^2(1, 1033)=1.47$ p=0.225
Male	43.8 (127)	43.1 (289)	$\chi^2(1, 960)=0.036$ p=0.850	44.6 (210)	41.9 (178)	$\chi^2(1, 896)=0.67$ p=0.415	36.2 (21)	44.1 (386)	$\chi^2(1, 934)=1.37$ p=0.243
Risk factor: 'getting sunburnt more than once as a child' % Strongly agree/agree (n)	Sunbathed			Sunburnt			Sunbed use		
	Yes	No	Significance*	Yes	No	Significance*	Yes	No	Significance*
Female	43.9 (265)	42.4 (186)	$\chi^2(1, 1043)=0.24$ p=0.628	44.5 (276)	41.3 (151)	$\chi^2(1, 986)=1.00$ p=0.318	36.4 (24)	43.9 (422)	$\chi^2(1, 1027)=1.43$ p=0.231
Male	38.9 (112)	37.4 (244)	$\chi^2(1, 941)=0.20$ p=0.657	40.8 (189)	34.6 (144)	$\chi^2(1, 879)=3.59$ p=0.058	41.1 (23)	37.5 (321)	$\chi^2(1, 913)=0.29$ p=0.589

Notes:

* Pearson's χ^2 test for 2x2 tables (i.e., Symptom: Yes vs. No/Don't know; Risk factor: Strongly agree/agree vs. Strongly disagree/disagree/neither agree or disagree/don't know). Statistically significant associations at the p<0.05 level are emboldened.

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7 **SCOTTISH ADOLESCENTS' SUN-RELATED BEHAVIOURS, TANNING ATTITUDES AND**
8
9 **ASSOCIATIONS WITH SKIN CANCER AWARENESS: A CROSS-SECTIONAL STUDY**
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ABSTRACT

Objectives: To describe Scottish adolescents' sun-related behaviours and tanning attitudes and assess associations with skin cancer awareness.

Design: Cross-sectional study.

Setting: 20 state secondary schools in one Scottish local authority (Glasgow City).

Participants: 2,173 adolescents (female: 50.7%, n=1,102) with a mean age of 12.4 (Standard Deviation = 0.55).

Outcome measures: Sun-related behaviour (suntan, sunbathing, sunburn, sunscreen use, sunbed use), tanning attitudes, skin cancer-related symptom and risk factor awareness.

Results: Adolescents reported poor sun-related practice: 51% of adolescents reported sunburn the previous summer and 38% indicated sunburn on more than one occasion. Skin cancer awareness was low: 45% recognised 'change in the appearance of a mole' as a cancer symptom, and 39% agreed that 'getting sunburnt more than once as a child' increased cancer risk. 42% and 26% of adolescents, respectively, reported that friends and family held pro-tanning attitudes. Compared to males, females were statistically significantly more likely to: report sunbathing ($p<0.001$), use of lotions or oil to aid tanning ($p<0.001$), and sunburn ($p<0.001$); know that changes in the appearance of a mole was a skin cancer symptom ($p=0.036$) and sunburn more than once as a child was a skin cancer risk factor ($p=0.005$); perceive their friends to hold pro-tanning attitudes ($p<0.001$) and indicate that a tan made them feel better about themselves ($p<0.001$), more attractive to others ($p=0.011$) and healthier ($p<0.001$).

Conclusions: Scottish adolescents had poor sun protection practice and low skin cancer awareness. Girls adopted riskier sun-related behaviour despite greater awareness of skin cancer-related risk. Urgent action is required to promote positive sun-related behaviour and increase skin cancer awareness among Scottish adolescents. However, further research is needed to inform the development of effective sun-safe interventions.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- This is the first study to describe Scottish adolescents' sun-related behaviours and tanning attitudes and assess associations with [cancer-malignant melanoma](#) symptom and risk factor awareness.
- Findings establish evidence to support on-going government initiatives to increase the proportion of people with early diagnosis, including [Detect Cancer Early \(DCE\) in Scotland and the National Awareness and Early Diagnosis Initiative \(NAEDI\) in England](#) and [Detect Cancer Early \(DCE\) in Scotland](#).
- Adolescents in only one Scottish local authority area were surveyed and non-probabilistic sampling was used, although Glasgow was purposefully selected due to known high incidence of malignant melanoma in the Central Belt of Scotland, a densely populated urban region extending from Glasgow in the West to Edinburgh in the East.

KEYWORDS

Malignant melanoma, skin cancer, tanning attitudes, sunburn, sunbeds, sun protection, health-related behaviour, health promotion

WORD COUNT

[3,5123,586](#)

INTRODUCTION

Rates of malignant melanoma are rising more rapidly than for any other cancer in the United Kingdom (UK) [1] and Scotland has above average incidence when compared to the rest of the UK.[2] Incidence of malignant melanoma in Scotland significantly increased by 51.4% ($p < 0.0001$) over the past decade.[3] Light skin colour, blonde or red hair, number of moles,[4] family history,[5] and excess exposure to ultraviolet radiation, particularly in childhood, are the main risk factors for malignant melanoma.[6] It is estimated that 86% of malignant melanoma cases in the UK can be attributable to excess exposure to UV radiation (Male = 90%, Female = 82%), and that these proportions are “very much greater at younger ages”.[7]

Malignant melanoma is the fifth most common teenage and young adult (TYA) cancer in the UK, accounting for 11% of the 2,200 average annual cases among those aged 15-24.[8] Almost twice as many females ($n=153$) than males ($n=73$) are diagnosed with malignant melanoma annually, making it the third and sixth most common cancer in young women and men, respectively.[8] Incidence of malignant melanoma significantly increased by 32% among young females between 1995 and 2009.[8]

Across the UK survival rates for malignant melanoma are high and increasing over time,[9] and in Scotland five-year survival rates rose by 21% over the past 20 years, from 64% in the period 1983-97 to 85% in 2003-07.[10] Survival is higher in younger people[10] and there is some evidence that longer time durations prior to diagnosis may be associated with poorer outcomes.[11-13] UK government health departments are therefore committed to improving awareness as part of a strategy to increase the proportion of people with early diagnosis.[14,15] Increasing adolescents' awareness of skin cancer risk associated with UV exposure and encouraging sun protective practices may therefore have potential to reduce the burden of malignant melanoma both in adolescence and early adulthood, as well as later life through the establishment of protective health-related

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7 behaviours. However, previous research has found that although adolescents' awareness of skin
8 cancer and its association with UV exposure is generally good [16,17] this knowledge does not
9 translate into sun-safe behaviour,[18,19] especially among young females.[19-21]
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14 Little evidence exists around the association between sun-related behaviours and cancer awareness
15 among adolescents in the UK. Only one UK study to date has examined the association between
16 sunscreen and sunbed use and cancer awareness, which found that female adolescents who used
17 sunbeds were statistically significantly more likely to agree that UV exposure was a cancer risk
18 factor.[21] Moreover, patterns of sun-related behaviours (i.e., sunbathing, sunburn) and protective
19 practices (i.e., sunscreen use) and tanning attitudes among Scottish adolescents have not previously
20 been described. This lack of evidence hampers development of interventions to increase cancer
21 awareness and change sun-related behaviours in support of government initiatives. Hence, the aims
22 of this study were to: 1) describe the sun-related behaviours and tanning attitudes among Scottish
23 adolescents; and 2) assess associations between sun-related behaviour, tanning attitudes and cancer
24 awareness.
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36 37 **METHODS**

38 39 **Study design**

40 Data are drawn from the Adolescent Cancer Education (ACE) study, the design of which is described
41 in the published protocol.[22] Briefly, ACE is a cluster randomised controlled trial (RCT) to assess the
42 effectiveness of a school-based educational intervention on adolescents' and parents' cancer
43 awareness and communication. Data were collected at three time-points: baseline (prior to
44 intervention delivery), and at two-weeks, and six-month follow-up. This paper reports cross-
45 sectional analysis of baseline data.
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Setting and Sample

All 29 state secondary schools (excluding special-schools for adolescents with special educational needs) in the Glasgow City Council area were invited to participate. Recruitment ended when, and the (pragmatic) target of 20 schools (69.0%) were agreed to participate recruited. All 3,223 adolescents on the school register at the end of their first year (S1) of secondary education (age 12/13 years) in study schools were invited to participate in the study, of which 2,173 (67.4%) consented to data collection.

Recruitment and consent

Schools were recruited in May 2013 and adolescents in June 2013. School head teachers were contacted by letter, which was followed up with a telephone call and face-to-face meeting to invite participation in the study. Parents/carers were sent a letter and information sheet about the study, which included a form to be returned to school if they wished to opt their child out of the study. The opt-out method of parental consent has been found to be ethically acceptable.[23] Adolescents were provided with an information sheet at the time measurements were undertaken and also asked to give written consent to their participation in the study.

Survey instrument

Data were collected in June 2013 (i.e., northern hemisphere summer) using a self-complete paper questionnaire administered by teachers to a whole class under exam conditions but students were informed that it was not a test. Teachers encouraged students to complete as much of the questionnaire as they could within the 50 or 55 minute lesson period.

The instrument incorporated validated questions on adolescents' sun-related behaviours and tanning attitudes,[19] the Cancer Awareness Measure (CAM),[24,25] and socio-demographic questions.

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9 *Sun-related behaviours and tanning attitudes*

10 Adolescents' tanning attitudes and sun-related behaviours were assessed using items from an
11 instrument developed in New Zealand.[19] Sun-related behaviours, including sunbathing, getting a
12 suntan, use of sun beds and sun-protection practices [during the previous summer \(i.e., 2012\) or past](#)
13 [12 months](#) were assessed through ten questions. Attitudes towards tanning were assessed through
14 five statements which used a five-point Likert scale to ask adolescents if a suntan made them 'feel
15 healthier', 'more attractive to others' or 'better about themselves', and if friends and family thought
16 that a suntan was a 'good thing'. For analysis, responses were dichotomised (i.e., 'yes' versus 'no';
17 'strongly agree'/'agree' versus 'neither agree nor disagree'/'disagree'/'strongly disagree').
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27 *Skin cancer symptom and risk factor awareness*

28 Adolescents' awareness of skin cancer related symptoms and risk factors were assessed through two
29 questions in the CAM. Awareness of the cancer sign 'change in the appearance in a mole' was
30 assessed alongside eight other cancer signs and symptoms through a recognition question.
31 Awareness of the skin cancer-related risk factor 'getting sunburnt more than once as a child' was
32 assessed alongside ten other cancer risk factors on a five-point Likert scale. In accordance with
33 previous practice,[21,25] responses were dichotomised for analysis (i.e., mole: 'Yes' versus
34 'No'/'Don't know'; sunburn: 'strongly agree'/'agree' versus 'not sure'/'disagree'/'strongly disagree').
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44 *Socio-demographic characteristics*

45 Socio-demographic questions were included to gather data on: age, gender, ethnicity, and whether
46 the student had been diagnosed ~~with cancer~~ or knew a relative or friend who had been diagnosed
47 with [any](#) cancer.
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Data analysis

Descriptive statistics were calculated for demographic variables (i.e., age, gender, ethnicity, knowing someone with cancer), sun-related behaviours and tanning attitudes, and skin cancer related symptom and risk factor awareness. Pearson's chi-square (χ^2) tests were used to assess associations between: (1) sun-related behaviours and gender; (2) tanning attitudes and gender and sun-related behaviour; (3) skin cancer-related symptom and risk factor awareness and gender, sun-related behaviours, and tanning attitudes. Data were analysed using SPSS 19.0. Significance tests were two-sided; $p < 0.05$ was considered statistically significant.

Ethical considerations

Approval for the study was obtained from the Research Ethics Committee in the School of Nursing, Midwifery and Health, University of Stirling ([reference: 13/14\(83\)](#)). Glasgow City Council, Planning, Performance and Research Unit approved the involvement of secondary schools. All General Practitioner (GP) practices in the research site were informed about the study.

RESULTS

Sample

The sample included 2,173 (female: $n=1,102$, 50.7%) adolescents with a mean age of 12.4 (Standard Deviation [SD] = 0.55) at the time of the survey. Socio-demographic characteristics of respondents are shown in Table 1.

[Insert Table 1 here]

Sun-related behaviours

Suntan

Around two-thirds (61.3%, n=1,333) of adolescents reported getting a suntan last summer. Slightly more girls than boys reported a suntan, although this difference was not statistically significant (Girls: 66.2% [n=700], Boys: 63.4% [n=616]; $\chi^2(1, 2030)=1.73, p=0.189$).

Sunbathing

Four in ten (42.2%, n=916) adolescents reported sunbathing regularly last summer to try to get a tan. Girls were statistically significantly more likely to report sunbathing (Girls: 57.8% [n=611], Boys: 30.4% [n=294]; $\chi^2(1, 2025)=152.86, p<0.001$). Of those who sunbathed, 44.2% (n=405) reported using oils or lotions to aid tanning. Girls who sunbathed were statistically significantly more likely than boys to report using oils or lotions to help get a tan (Girls: 47.4% [n=289], Boys: 38.1% [n=111]; $\chi^2(1, 901)=6.80, p=0.009$).

Sunburn

Half of adolescents (51.2%, n=1,112) reported getting sunburnt last summer, of whom around two-thirds (61.7%, n=686) reported getting sunburnt on one occasion, and over a third (38.3%, n=426) reported getting sunburnt on more than one occasion. Girls were statistically significantly more likely to report getting sunburnt last summer (Girls: 62.6% [n=625], Boys: 52.7% [n=476]; $\chi^2(1, 1902)=19.34, p<0.001$). Of girls who reported getting sunburnt (n=625), almost 1 in 10 (8.2%, n=51) said that their 'skin went red, sore and blistered', nearly 4 in 10 (39.0%, n=244) said their 'skin went red and sore'; 24.0% (n=150) reported their 'skin went red but not sore' and 27.7% (n=173) said their 'skin went pink or slightly red'. A greater proportion of boys than girls reported 'red, sore and blistered skin' (11.3%, n=54), although fewer reported that their 'skin went red and sore' (34.2%,

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7 n=163); 24.4% (n=116) reported their 'skin went red but not sore', and 27.9% (n=133) said their 'skin
8 went pink or slightly red'.
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10 *Sunscreen use*

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12 Nearly a fifth of adolescents (16.8%, n=365) reported that they 'didn't usually use sunscreen'. Of
13 those who reported using sunscreen (74.0%, n=1609), over half (52.6%, n=847) did not know the Sun
14 Protection Factor (SPF) of the sunscreen they usually used. The greatest proportion of adolescents
15 who could identify the SPF of the sunscreen used SPF >30 (19.7%, n=317), followed by: SPF30
16 (15.2%, n=244); SPF15 (8.0%, n=129), and SPF <15 (4.5%, n=72).
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23 Of those who reported getting sunburnt (51.2%, n=1,112), 1 in 10 (11.6%, n=129) reported that they
24 did not use sunscreen. Boys who got sunburnt were statistically significantly more likely to report
25 not using sunscreen, with over 1 in 4 reporting that they did not use sunscreen (Boys: 27.9% [n=72],
26 Girls: 15.4% [n=57]; $\chi^2(1, 629)=14.69, p<0.001$).
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32 *Sunbed use*

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34 1 in 20 (5.8%, n=127) adolescents reported using a sunbed in the last 12 months. There was no
35 statistically significant gender difference in sunbed use (Girls: 6.3% [n=66], Boys: 6.3% [n=59]; $\chi^2(1,$
36 1980)=0.003, p=0.959).
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42 **Tanning attitudes**

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44 Peers exerted the greatest influence on adolescents' attitudes towards tanning with two-fifths
45 (42.3%, n=918) stating that they strongly agreed or agreed with the statement 'most of my friends
46 think a suntan is a good thing'. A quarter of adolescents (26.1%, n=567) agreed that their family
47 thought a suntan was a good thing. A fifth of adolescents agreed that a suntan made them feel
48 better about themselves (22.7%, n=492) and that a suntan made them feel more attractive to others
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7 (18.8%, n=409). A tenth (12.3%, n=267) agreed that they liked to have a suntan because it made
8 them feel healthier. Gender differences were investigated and are summarised in Table 2.
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16 Adolescents of both sexes who reported sunbathing were statistically significantly more likely to
17 agree with each of the five tanning attitude statements than those who did not report sunbathing
18 (Table 3). Boys who reported using sunbeds were statistically significantly more likely to agree with
19 four of the five statements, the exception being the statement 'most of my friends think a suntan is
20 a good thing' for which there was no difference between boys who did and did not report sunbed
21 use (Table 3).
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32 **Sun-related behaviour and cancer awareness**

33 *Symptom awareness*

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36 Less than half (45.2%, n=982) of adolescents thought that change in the appearance of a mole could
37 be a sign of cancer. Girls were statistically significantly more likely to recognise that a change in the
38 appearance of a mole was potentially a sign of cancer (Girls: 48.0% [n=524]; Boys: 43.5% [n=444];
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42 $\chi^2(1, 2112)=4.38, p=0.036$).
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46 The only statistically significant association between symptom awareness and sun-related behaviour
47 was among females who reported getting sunburnt, who were more likely to agree that a change in
48 the appearance of a mole was potentially a sign of cancer (Table 4).
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51 *Risk factor awareness*

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7 Four in ten (39.1%, n=849) adolescents thought that getting sunburnt more than once as a child was
8 a risk factor of cancer. Girls were statistically significantly more likely to agree that getting sunburnt
9 more than once as a child was a cancer risk factor (Girls: 43.4% [n=469]; Boys: 37.3% [n=370]; $\chi^2(1,$
10 2071)=7.95, p=0.005).
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16 There were no statistically significant associations between awareness of getting sunburnt more
17 than once as a child and sun-related behaviours, although adolescents of both sexes who reported
18 getting sunburnt were more likely to agree that sunburn was a cancer risk factor (Table 4).
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23 *[Insert Table 4 here]*
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26 27 **DISCUSSION**

28
29 Scottish adolescents' awareness of the symptoms and risk factors associated with skin cancer was
30 low: less than half of adolescents identified 'change in the appearance of a mole' as a sign of cancer
31 and fewer than 40% agreed that 'getting sunburnt more than once as a child' increased cancer risk.
32 This confirms findings from an earlier small-scale UK study [21] and suggests that awareness of skin
33 cancer symptoms and risks among Scottish adolescents compares unfavourably with adolescents
34 elsewhere in Europe. For example, the majority (97%) of Italian secondary school students (aged 15-
35 21 years) had heard of skin cancer and 66% and 59%, respectively, correctly identified sun exposure
36 and sunburn as skin cancer risk factors [16]. Similarly, a study of Greek adolescents (aged 15-18
37 years) found that 89% were aware of the association between sun exposure and skin cancer risk
38 [17].
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50 Adolescents also reported poor sun-protection practices with half (51%) reporting that they had
51 experienced sunburn last summer. Over a third (38%) of those reporting sunburn experienced
52 sunburn on more than one occasion and a tenth (10%) said that their skin went 'red, sore or
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7 blistered'. Sunscreen use was also notably poor with almost a fifth of adolescents reporting that
8 they did not use sunscreen and less than half (47%) of those who did knew the SPF of the sunscreen
9 used. Given the causal relationship between UV exposure and incidence of malignant melanoma,[7]
10 our findings suggest that urgent action is required to reduce levels of sunburn among Scottish
11 adolescents in order to reverse rising rates of malignant melanoma.
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18 In common with previous studies from the UK,[21] USA,[18] Sweden [20] and New Zealand,[19] our
19 research also identified riskier sun-related behaviour among female adolescents despite their
20 greater skin cancer symptom and risk factor awareness. Females in our study were significantly
21 more likely than males to report intentional tanning, the use of lotions or oils to aid tanning, and
22 sunburn, yet were also significantly more likely to agree that 'change in the appearance of a mole'
23 was a cancer sign and 'getting sunburnt more than once as a child' was a cancer risk factor. Indeed,
24 females who reported getting sunburnt during the previous summer were statistically significantly
25 more likely to recognise that 'change in the appearance of a mole' was a cancer sign. However,
26 compared to males, females were also significantly more likely to use sunscreen, confirming findings
27 of a systematic review that concluded that females were both more likely to adopt sun-protection
28 practices and more likely to engage in risky sun-related behaviours, and that this association was
29 most evident in adolescence and early adulthood.[26] Cognitive dissonance, denial and previous
30 personal or vicarious experience have all been identified as pivotal factors in the relationship
31 between adolescents' risk perception and risk behaviour.[27] Hence, health promotion in relation to
32 sun safe practices needs to be underpinned by greater understanding of how adolescents balance
33 harms and perceived benefits of tanning.
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50 External influences of friends and family exerted a stronger influence on tanning attitudes than
51 associations with feeling better, more attractive, or healthier. More than two-fifths agreed that
52 most of their friends thought that a tan was a good thing, yet around a fifth said it made them feel
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7 better and more attractive, and around a tenth that it made them feel healthier. The primacy of
8 peer influences has also been found among similarly aged adolescents in Australasia. For example, a
9 study in New Zealand found that 42% of females and 33% of males agreed that 'most of their friends
10 think a suntan is a good thing',[19] and the majority (66%) of adolescents in an Australian study
11 perceived friends to have pro-tanning attitudes.[28] Moreover, there is evidence from a Danish
12 study that sunburn risk increases among adolescents (aged 13-17 years) whose parents hold positive
13 attitudes towards tanning,[29] and the highest ranking source of sun protection information among
14 young park-goers in London (aged 18-28 years) was 'parents and family'.[30] Further research is
15 therefore required to assess peer and family influences on Scottish adolescents' tanning attitudes in
16 order to determine the potential of peer-group and family-based interventions to reduce risky sun-
17 related behaviours.

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29 Females in our study were statistically significantly more likely than males to report that their friends
30 think a suntan is a good thing and that it made them feel better about themselves, healthier or more
31 attractive to others. Tanning attitudes mediate the association between skin cancer knowledge and
32 sun-related behaviour,[19,31] and more positive attitudes towards tanning among females are
33 cosmetically and socially motivated.[20] Moreover, the influence of peers on tanning attitudes is
34 known to increase as adolescents age.[19] In order to design age-appropriate sun safety
35 interventions, further research is therefore required to better understand how the balance between
36 social, cosmetic and health motivations changes over time, especially among young females.

37 38 39 40 41 42 43 44 45 **Implications for future policy and research**

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47 Our research identifies an urgent need to develop sun safety interventions specifically for Scottish
48 adolescents. However, our study also suggests that further research is required to ensure
49 interventions overcome a number of challenges previously highlighted in the literature and
50 confirmed by our own research. Research is required to assess how skin cancer knowledge, sun-
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7 related behaviour, and tanning attitudes – and the influence of peers and family on knowledge,
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9 behaviour and attitudes – changes as adolescents' age. Testing behaviour change techniques [32]
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11 which show promise such as those based on dissonance [33,34] to address the known discordance
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13 between sun protection intention and practice,[30,35] would also be useful. This research is vital
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15 because previous interventions to change sun-safe knowledge and practice have been disappointing
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17 [36] and it is not known which educational techniques are most effective.[37] Despite considerable
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19 challenges of effective intervention development for this age group, previous research has found
20
21 that school-based educational interventions to raise adolescents' cancer awareness are
22
23 effective,[38] especially among females.[21,39] Hence, multi-component interventions that
24
25 incorporate education alongside challenges to societal beliefs around tanning (e.g., the association
26
27 between tanned skin, beauty and health) and environmental changes (e.g., provision of sunscreen,
28
29 hats and shade in secondary schools) may encourage protective sun-related behaviours. Future
30
31 research identified in support of intervention development has potential to have international
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33 impact on reducing the burden on skin cancer.
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35 **Strengths and limitations**

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37 This is the first study to describe Scottish adolescents' sun-related behaviours and tanning attitudes
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39 and assess associations with cancer awareness. It establishes an evidence-base to set the direction
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41 of future research and policy interventions through on-going initiatives such as Detect Cancer Early
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43 in Scotland and the National Awareness and Early Diagnosis Initiative (NAEDI) in England. However,
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45 our study has a number of limitations. First, our sample is drawn from only one Scottish local
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47 authority area (Glasgow City Council) and used purposive rather than probabilistic sampling. Thus,
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49 although 2,173 adolescents from 20 (out of a possible 29) secondary schools in Glasgow were
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51 surveyed, these findings may not be representative of the Scottish adolescent population. However,
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53 Glasgow was purposefully selected as a research site due to known high incidence of malignant
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55 melanoma in the Central Belt of Scotland, a densely populated urban region extending from Glasgow
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7 in the West to Edinburgh in the East.[2] Second, although validated instruments were used for data
8 collection, results are contingent on adolescents' accurate recall of sun-related behaviour during
9 summer 2012, around 9 to 12 months previously over the past year. Previous studies among
10 adolescents have, ~~however,~~ found recall of sun-related behaviours to be reliable and valid.[31],
11 although the possibility that recall bias influences our findings cannot be discounted due to the
12 length of time since the previous summer (e.g., reporting of less severe sunburn, frequency of
13 sunburn, or SPF of sunscreen used may be particularly prone to bias). Finally, because data were
14 gathered as part of a cluster RCT,[22] in order to enable completion of all instruments during a 55-
15 minute class, a shortened version of an instrument to assess sun-related knowledge, behaviour and
16 tanning attitudes[19] was used which meant that replication of analysis conducted elsewhere using
17 the full instrument could not be conducted.[19] Future research is therefore required using a
18 representative sample of Scottish adolescents using the full version of the sun instrument with
19 additional items to gather data on known skin cancer risk factors to enable such analyses and more
20 comprehensive comparison with studies of similarly aged secondary school students in New Zealand
21 [19] and Australia [28] where this instrument has been used.
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36 CONCLUSION

37 Scottish adolescents' awareness of skin cancer symptoms and risk factors was low and matched by
38 poor sun protection behaviours, most apparent in the high prevalence of (often severe) sunburn
39 during the previous summer. These findings suggest that if the continuing rise in incidence of
40 malignant melanoma in Scotland is to be halted, urgent action is required to increase skin cancer
41 awareness and promote positive sun-related behaviour among Scottish adolescents. Our study
42 highlights that the relationship between risk knowledge and risk behaviour are complex and
43 different for adolescent males and females. Thus, further research is needed to inform the
44 development of effective sun-safe interventions.
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CONTRIBUTION STATEMENT

RGK designed and conducted data analysis. GH secured funding and ethical approval. IM and GH managed school and participant recruitment, and data collection. RGK and GH wrote the first draft of the paper, and LF, RDN, REO, and SH provided critical revision for important intellectual content. All authors read and approved the final manuscript.

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COMPETING INTERESTS STATEMENT

IM is employed by Teenage Cancer Trust. RGK, LF, RDN, REO, SH and GH declare that they have no conflicts of interest.

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TABLES

Table 1: Sample socio-demographic characteristics

	n	%
<i>Gender</i>		
Male	1,032	47.5
Female	1,102	50.7
Missing	39	1.8
<i>Age</i>		
Mean (SD)	12.4	(0.55)
<i>Ethnicity</i>		
White	1,826	84.0
Mixed	75	3.5
Asian	131	6.0
Black	57	2.6
Chinese	15	0.7
Other	28	1.3
Missing	41	1.9
<i>Knew someone with cancer</i>		
Yes	1,266	58.3
No	783	36.0
Missing	124	5.7

Table 2: Tanning attitudes and gender

Statement	Female	Male	Significance*
% Strongly agree/agree (n)			
Most of my friends think a suntan is a good thing.	53.1 (554)	37.7 (355)	$\chi^2(1, 1985)=47.48$ $p<0.001$
Most of my family think a suntan is a good thing.	29.0 (301)	27.8 (260)	$\chi^2(1, 1974)=0.36$ $p=0.548$
I like to have a suntan because it makes me feel better about myself.	30.8 (320)	18.0 (169)	$\chi^2(1, 1978)=43.10$ $p<0.001$
A suntan makes me feel more attractive to others.	22.7 (235)	18.1 (169)	$\chi^2(1, 1969)=6.40$ $p=0.011$
I like to have a suntan because I feel healthier.	16.2 (169)	10.1 (95)	$\chi^2(1, 1980)=15.99$ $p<0.001$

Notes:

* Pearson's χ^2 test for 2x2 tables (i.e., strongly agree/agree vs. disagree/strongly disagree/don't know). Statistically significant associations at the $p<0.05$ level are emboldened.

Table 3: Tanning attitudes and sun-related behaviour

Statement % Strongly agree/agree (n)	Female								
	Sunbathed			Sunburnt			Sunbed use		
	Yes	No	Significance*	Yes	No	Significance*	Yes	No	Significance*
Most of my friends think a suntan is a good thing.	61.8 (371)	40.6 (177)	$\chi^2(1, 1036)=45.71$ p<0.001	60.1 (370)	42.7 (157)	$\chi^2(1, 984)=28.05$ p<0.001	62.1 (41)	52.1 (500)	$\chi^2(1, 1026)=2.50$ p=0.114
Most of my family think a suntan is a good thing.	35.7 (214)	19.9 (86)	$\chi^2(1, 1031)=30.44$ p<0.001	31.1 (191)	25.6 (94)	$\chi^2(1, 982)=3.31$ p=0.069	39.1 (25)	28.1 (269)	$\chi^2(1, 1021)=3.51$ p=0.061
I like to have a suntan because it makes me feel better about myself.	42.6 (255)	14.5 (63)	$\chi^2(1, 1032)=93.32$ p<0.001	38.0 (234)	20.6 (75)	$\chi^2(1, 980)=32.02$ p<0.001	33.3 (22)	30.4 (291)	$\chi^2(1, 1022)=0.24$ p=0.622
A suntan makes me feel more attractive to others.	31.3 (187)	10.9 (47)	$\chi^2(1, 1029)=59.62$ p<0.001	26.6 (163)	16.4 (60)	$\chi^2(1, 979)=13.55$ p<0.001	26.2 (17)	22.4 (213)	$\chi^2(1, 1018)=0.50$ p=0.478
I like to have a suntan because I feel healthier.	23.2 (139)	6.9 (30)	$\chi^2(1, 1035)=48.86$ p<0.001	18.0 (111)	12.4 (46)	$\chi^2(1, 986)=5.40$ p=0.020	19.7 (13)	15.6 (150)	$\chi^2(1, 1025)=0.76$ p=0.383
Statement % Strongly agree/agree (n)	Male								
	Sunbathed			Sunburnt			Sunbed use		
	Yes	No	Significance*	Yes	No	Significance*	Yes	No	Significance*
Most of my friends think a suntan is a good thing.	54.8 (154)	30.3 (197)	$\chi^2(1, 932)=50.36$ p<0.001	41.9 (195)	34.5 (143)	$\chi^2(1, 880)=5.18$ p=0.023	37.9 (22)	38.0 (325)	$\chi^2(1, 914)=0.00$ p=0.996
Most of my family think a suntan is a good thing.	43.5 (121)	21.1 (137)	$\chi^2(1, 926)=48.49$ p<0.001	30.3 (139)	25.2 (104)	$\chi^2(1, 876)=2.55$ p=0.110	39.7 (23)	26.4 (225)	$\chi^2(1, 909)=4.78$ p=0.029
I like to have a suntan because it makes me feel better about myself.	32.9 (91)	11.7 (76)	$\chi^2(1, 928)=59.06$ p<0.001	21.6 (100)	13.8 (57)	$\chi^2(1, 876)=9.02$ p=0.003	29.3 (17)	17.0 (145)	$\chi^2(1, 911)=5.63$ p=0.018
A suntan makes me feel more attractive to others.	32.1 (88)	12.2 (79)	$\chi^2(1, 924)=51.88$ p<0.001	20.0 (93)	15.9 (66)	$\chi^2(1, 880)=2.59$ p=0.108	30.9 (17)	17.1 (145)	$\chi^2(1, 905)=6.74$ p=0.009
I like to have a suntan because I feel healthier.	19.8 (54)	5.8 (38)	$\chi^2(1, 928)=42.16$ p<0.001	12.0 (56)	7.2 (30)	$\chi^2(1, 884)=5.88$ p=0.015	25.0 (14)	9.0 (77)	$\chi^2(1, 926)=14.88$ p<0.001

Notes:
* Pearson's χ^2 test for 2x2 tables (i.e., Strongly agree/agree vs. Strongly disagree/disagree/neither agree or disagree/don't know). Statistically significant associations at the p<0.05 level are emboldened.

Table 4: Associations between sun-related behaviour and cancer awareness

Symptom: 'change in the appearance of a mole' % Yes (n)	Sunbathed			Sunburnt			Sunbed use		
	Yes	No	Significance*	Yes	No	Significance*	Yes	No	Significance*
Female	50.1 (304)	46.0 (204)	$\chi^2(1, 1050)=1.67$ p=0.197	51.0 (317)	44.1 (163)	$\chi^2(1, 991)=4.54$ p=0.033	55.4 (36)	47.6 (461)	$\chi^2(1, 1033)=1.47$ p=0.225
Male	43.8 (127)	43.1 (289)	$\chi^2(1, 960)=0.036$ p=0.850	44.6 (210)	41.9 (178)	$\chi^2(1, 896)=0.67$ p=0.415	36.2 (21)	44.1 (386)	$\chi^2(1, 934)=1.37$ p=0.243
Risk factor: 'getting sunburnt more than once as a child' % Strongly agree/agree (n)	Sunbathed			Sunburnt			Sunbed use		
	Yes	No	Significance*	Yes	No	Significance*	Yes	No	Significance*
Female	43.9 (265)	42.4 (186)	$\chi^2(1, 1043)=0.24$ p=0.628	44.5 (276)	41.3 (151)	$\chi^2(1, 986)=1.00$ p=0.318	36.4 (24)	43.9 (422)	$\chi^2(1, 1027)=1.43$ p=0.231
Male	38.9 (112)	37.4 (244)	$\chi^2(1, 941)=0.20$ p=0.657	40.8 (189)	34.6 (144)	$\chi^2(1, 879)=3.59$ p=0.058	41.1 (23)	37.5 (321)	$\chi^2(1, 913)=0.29$ p=0.589

Notes:

* Pearson's χ^2 test for 2x2 tables (i.e., Symptom: Yes vs. No/Don't know; Risk factor: Strongly agree/agree vs. Strongly disagree/disagree/neither agree or disagree/don't know). Statistically significant associations at the p<0.05 level are emboldened.

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4 to 5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5 to 8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6 to 7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6 to 7
Bias	9	Describe any efforts to address potential sources of bias	15
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	8
		(b) Describe any methods used to examine subgroups and interactions	8
		(c) Explain how missing data were addressed	7
		(d) If applicable, describe analytical methods taking account of sampling strategy	N/A
		(e) Describe any sensitivity analyses	N/A
Results			

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Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	6
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	8 and Table 1
		(b) Indicate number of participants with missing data for each variable of interest	8 and Table 1
Outcome data	15*	Report numbers of outcome events or summary measures	9 to 12
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	9 to 12
		(b) Report category boundaries when continuous variables were categorized	N/A
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9 to 12
Discussion			
Key results	18	Summarise key results with reference to study objectives	12 to 14
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15 to 16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	12 to 14
Generalisability	21	Discuss the generalisability (external validity) of the study results	15
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	3

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.