Knowledge and practice of sun protection in schools in South Africa where no national sun protection programme exists

Caradee Y. Wright[1*], Anthony I. Reeder[2] and Patricia N. Albers[3]

[1] Environment and Health Research Unit, South African Medical Research Council, 1 Soutpansberg Road and Department of Geography, Geoinformatics and Meteorology, University of Pretoria, Pretoria, South Africa. Tel: +27 12 339 8543. Email: cwright@mrc.ac.za.

[2] Cancer Society Social & Behavioural Research Unit, Department of Preventive and Social Medicine, Dunedin School of Medicine, University of Otago, PO Box 913, Dunedin, 9054, New Zealand. Tel: +64 3 479 7257; Email: tony.reeder@otago.ac.nz.

[3] Environment and Health Research Unit, South African Medical Research Council, 1 Soutpansberg Road, Pretoria, South Africa. Tel: +27 12 339 8543. Email: patricia.albers@mrc.ac.za.

*Corresponding author. Caradee Wright, Environment & Health Research Unit, South African Medical Research Council, Pretoria, South Africa. Email: cwright@mrc.ac.za

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Abstract

Interventions in primary schools that increase sun-protective behaviours and decrease ultraviolet radiation exposure, sunburn incidence and skin cancer risk can be effective. SunSmart School Accreditation Programmes (SSAP) are recommended. Prior to SSAP implementation in South Africa, we explored the feasibility of obtaining national baseline information, and investigated possible associations between strategies regarding sun protection in schools and students' responses to a questionnaire. Principals from randomly-selected urban government schools in all

nine South African provinces completed a questionnaire and 679 students were surveyed. The mean sun-related knowledge and behaviour scores of students were 4 (range: 1-7) and 3 (range: 0-8) out of 9, respectively. The mean school sun protection effort score was 4 out of 14. There were no statistically significant correlations between students' knowledge or behaviour scores and their school score. The World Health Organization recommends an SSAP to address policy, practice and curriculum changes to support sun protection of students. This cross-sectional study demonstrates the feasibility of, and need for, a larger baseline study with longitudinal, multi-variable follow-up which includes other influential factors, such as parent support. Such research could quantify the impact of the SSAP and identify which key factors influence the sun-related knowledge and behaviours of students.

Keywords: sun protection, skin cancer prevention, schools, children, policy

Introduction

Excessive exposure to solar ultraviolet radiation (UVR) during childhood and adolescence is positively associated with the development of melanoma and non-melanoma skin cancer in adulthood [1, 2]. The United States (US) Community Preventive Services Task Force reported 'strong evidence' for the effectiveness of skin cancer interventions in primary and middle schools; specifically, programmes which combine education and policy approaches to increase sun protective practices of children to reduce the incidence of sunburn and the development of new melanocytic moles [3, 4]. The World Health Organization (WHO) recommends a comprehensive approach to sun protection policy and practices at school that includes teaching, parent and teacher education and an award system, such as a SunSmart School Accreditation Programme (SSAP), to acknowledge school efforts in relation to sun protection and safe sun practices [5]. In Australia, SSAP-accredited schools have higher levels of policy and practice

than non-accredited schools, and written policy sun protection aspects were linked to corresponding practice, in particular student protective hat use, except for shade adequacy [6, 7, 8]. In New Zealand, there is also "before and after" evidence of increased accreditation criteria scores after SSAP implementation [9].

In addition, in the contexts of primary care, the US Community Preventive Services Task Force recommended that counselling about minimising solar UVR exposure in order to reduce the risk of skin cancer be targeted towards those of 10 to 24 years of age who have fair skin [10]. Since children spend a significant proportion of their time at school, those institutions, school teachers and caregivers potentially play important direct and indirect roles in lessening the risk of skin cancer. Other school-based sun safety interventions with proven effectiveness (based on 20 studies between 1966 and 2000 and 13 studies between 2000 and 2011) [4] include teaching about sun safety and the effects of solar UVR, increasing the availability of sun-protective items at school, such as sunscreen dispensers in classrooms, and adding sun-protective features to the physical environment, e.g. shade structures [3, 4]. These interventions have shown improved use of sunscreen, hats, clothing, shade and sunglasses for student sun-protective behaviours [4] and subsequently consistent evidence of decreased solar UVR exposure, sunburn incidence and new mole formation [4].

In South Africa, approximately 11 million students attended public / government primary schools in 2012. Equivalent numbers for private schools remain largely unknown, but have been estimated at 400 000 [11]. The Cancer Association of South Africa (CANSA) is mandated to implement sun protection awareness programmes and skin cancer prevention interventions in South Africa. Although the health promotion officers of CANSA sporadically visit schools to promote sun protection, South Africa does not have a SSAP unlike, for example, in Australia,

New Zealand and Canada. Accreditation programmes include policy, environmental, teaching, behavioural practices and awareness raising components in schools. The reinstatement of the South African National Cancer Registry in 2011 ensures that skin cancer data will be carefully and accurately recorded. In tandem, information on sun protection in school children is needed to assess the long-term effectiveness of school-based interventions in relation to population skin cancer trends.

The present exploratory study was commissioned by CANSA to investigate strategies in South African government primary schools regarding sun protection, prior to the implementation of an SSAP. Students attending these schools were questioned about their sun-related knowledge and behaviours. Here, we further report on the feasibility of obtaining such baseline information, and we present the results of an investigation into whether existing school sun protection efforts in these schools are related to the children's responses to the questionnaire. Such information is important for guiding public health sun awareness campaigns.

Methods

Study design

This descriptive cross-sectional feasibility study took place during the third South African school term (August – October 2012) at the end of winter / beginning of spring, according to the prescribed requirements of the Department of Education (i.e. no research may take place in schools in South Africa during the fourth school term), as laid out in their research ethics clearance letter (available on request). Self-completion questionnaires were issued to the principal and to the teacher of one Grade 7 class for students to complete at schools randomly selected in each of the nine South African provinces (see Table I).

Table I. Sample descriptive statistics by province ranked by number of children participating in each province

Province (number of schools in province)	**Schools invited**	**Schools participating**		**Participating children in participating schools**	
	n	***n***	***% of total participating***	***n***	***% of total participating***
Eastern Cape (4206)	4	4	17.4	113	16.6
Limpopo (2706)	4	3	13	96	14.1
Mpumalanga (1466)	4	3	13	92	13.5
North-West (1446)	4	3	13	91	13.4
Free State (1544)	4	3	13	87	12.8
KwaZulu-Natal (4655)	4	2	8.7	67	9.8
Northern Cape (510)	4	2	8.7	66	9.7
Gauteng (1417)	4	2	8.7	53	7.8
Western Cape (1164)	4	1	4.3	14	2
Total	36	23	100[a]	679	100[a]

[a]Subject to rounding.

Once the schools were defined, the principals were contacted via telephone and invited to participate in the study. When a school chose not to participate, the next randomly selected school in the same province was contacted until the total of 36 schools (4 schools per province) was reached. All 36 schools agreed, however, only 24 schools returned completed questionnaires, and only 23 schools returned both principal and child questionnaires. Ethical clearance (35/2012) was obtained from the Council for Scientific and Industrial Research (CSIR) Research Ethics Committee on 27 June 2012. Provincial approval was obtained from all nine provinces. School principals gave informed consent for the study prior to the students being

contacted. The parents/guardians/caregivers of the students completed an informed consent form and students gave assent prior to completing the questionnaire.

Study Sample

The study sample size was based on the project budget and the cost of couriering questionnaires to and from schools throughout South Africa. Schools were randomly selected from the Department of Basic Education schools database. They were eligible for inclusion in the study if they had a Grade 7 class of students (modal age 13 years), were public schools and situated in an urban setting. Rural schools were excluded due to access challenges since many South African rural schools are located in remote areas with no telephone access (for principal recruitment) and with minimal or no road access thereby making it very difficult for couriers to deliver and collect the questionnaires. Schools where either English or Afrikaans was the main spoken and written language were included. Private, correspondence, and home-based schools as well as schools for children with special needs were excluded because they require a different research methodology. Schools having Grade 7 classes with less than 10 students were excluded to optimize returns for the study budget.

Since most analyses for this descriptive feasibility study involved logistic regression, and given budget constraints, it was determined that the estimate of approximately 10 participants per variable would be a realistically obtainable sample [12]. With the inclusion of 40 variables, a sample of no less than 400 would be required. The researchers envisaged approximately 20 responses from each of the 36 schools, resulting in a sample of 720.

Questionnaire instruments

The school principals' questionnaire was based on a similar instrument used in New Zealand [13, 14] but adapted to local conditions. It comprised sections on sun-related policies, practices such as enforcing hat wearing, curriculum content, planning of school breaks to avoid peak UVR times and providing sunscreen in classrooms, scheduling of outdoor activities such as sports activities and sun protection information provision (see Table II for the fourteen measures). A non-weighted summative score (based on one point per criterion in place/achieved by the school) based on questions from the principal questionnaire was calculated for the SSAP policy and practice components using the criteria and scoring system presented in Table II.

Table II. Criteria for SunSmart School Accreditation: percentage and number of schools attaining each criterion during Terms 1 (January to March) and 4 (October to December)

Theme	**Criterion (14 points)**	**Schools attaining**	
		n	**%**
Policy	1. There is a sun protection policy in place	0	0.0
Hats	2. Hat wearing is enforced	3	12.5
Play in the shade	3. Children not wearing hats must 'play in the shade'	0	0.0
Sunscreen	4. Children are actively encouraged to wear sunscreen	16	66.6
	5. Sunscreen is available at school	2	8.3
Clothing	6. Children are allowed to wear sun protective clothing	15	62.5
	7. The school uniform has sun protective options	3	12.5
Role modelling	8. Staff are expected to wear sun protective clothing	5	20.8
Curriculum	9. Teaching about sun protection is at all levels at least once every year	18	75.0
Planning	10. Sunscreen is available in classroom for child use while outdoors	2	8.3
	11. School breaks are scheduled to avoid peak UVR times	2	8.3
Scheduling	12. Sports activities are scheduled for before 11 a.m. and after 4 p.m.	13	54.1
	13. Children can stay indoors on fine/sunny days during breaks	5	20.8
Information	14. Messages about sun protection are given regularly at school	13	54.1
	Maximum score = 14		

The children's questionnaire was based on previously tested instruments [15, 16] and adapted for local differences (this entailed removing a question on the use of oils and lotions to aid in getting a suntan, and altering the names of the population groups to those used by Statistics South Africa). Three general sections included measures for obtaining information on: (1) demographics (Table III), (2) children's knowledge of the health impacts of the sun and sun

Table III. Demographic profile of participating children based on self-reported questionnaire data

Variable	Category	n	%[c]
Gender	Male	259	38.3
	Female	416	61.6
	Missing	4	
Age (y)	11	6	0.9
	12	161	23.8
	13	416	61.5
	≥14	94	13.9
	Missing	2	
Skin colour of inner, upper arm[a]	White	140	20.7
	Light brown	373	55.2
	Brown	102	15.1
	Dark brown	42	6.2
	Black	19	2.8
	Missing	3	
Ethnic group[b]	Black	310	45.6
	White	58	8.5
	Indian/Asian	207	30.4
	Coloured	153	22.5
	Don't know/missing	27	

[a]Children identified their own skin colour on their inner, upper arm.

[b]Children were able to choose more than one ethnic group.

[c]Percentages within each of the categories may not add to 100% because of 'rounding'.

Table IV. Knowledge of school students regarding variables affecting the risk of skin cancer: scoring and frequency distributions

Knowledge variables	Score for each item[a]	Agree %	Disagree %
To reduce the risk of skin cancer			
1. Avoid getting sunburnt	Disagree = 0, agree = 1	65.6	34.3
2. Stay out of the summer sun during the hours around midday	Disagree = 0, agree = 1	47.8	52.1
3. Cover up with clothing	Disagree = 0, agree = 1	46.5	53.5
4. Use sunscreen	Disagree = 0, agree = 1	65.5	34.4
5. Go to a sun bed clinic	Disagree = 1, agree = 0	15.0	84.9
6. Eat the right foods	Disagree = 1, agree = 0	37.7	62.3
Would you agree or disagree with the following statement			
7. Melanoma is a form of skin cancer	Disagree = 0, agree = 1	74.2	25.8
	Maximum score = 7		

[a]The lack of a correct response was scored as zero.

protection (Table IV); and (3) the outdoor sun protection behaviour of children (Table V). The two questions for knowledge measures were: (1) “To reduce the risk of skin cancer, one should (select all applicable options): avoid getting sunburnt, stay out of the summer sun during the hours around midday, cover up with clothing, use sunscreen, go to a sun bed clinic and eat the right foods; and (2) Would you agree or disagree with the following statement: “Melanoma is a form of skin cancer” (agree is the correct answer). Behaviour questions included: (1) “Last summer, I got a suntan”; (2) “Last summer, I sunbathed regularly to get a suntan”; and (3) “Last

Table V. Behaviour of school students regarding variables affecting the risk of skin cancer: scoring and frequency distributions

Behaviour variable	**Score for each item**	**Percentages/n**		
		Agree	**Disagree**	***n*** **Missing**
Last summer				
1. I got a suntan	No = 1, Yes = 0	58.6	41.3	2
2. I sunbathed regularly to get a suntan	No = 1, Yes = 0	22.1	77.8	1
3. I got sunburnt	No = 1, Yes = 0	41.0	58.9	0[a]
		Sometimes/ most of the time/ always	Never	*n* Missing
Last summer to prevent getting sunburnt				
4. I used sunscreen	Never = 0; Sometime, Most of the time, Always = 1	65.3	34.4	1
5. I stayed inside	Never = 0; Sometime, Most of the time, Always = 1	74.9	24.5	3
6. I stayed in the shade	Never = 0; Sometime, Most of the time, Always = 1	86.2	13.7	2
7. I wore clothing (not a hat)	Never = 0; Sometime, Most of the time, Always = 1	56.0	43.9	3
8. I wore a hat or cap	Never = 0; Sometime, Most of the time, Always = 1	74.1	25.8	3
9. I wore a broad brimmed hat, bucket hat or cap with flaps	Never = 0; Sometime, Most of the time, Always = 1	51.2	48.7	6
	Maximum score = 9			

[a]For this question the n = 46 respondents who reported that they either ‘don’t/can’t remember’ were excluded from the reported distribution.

summer, I got sunburnt". Questions (4) - (9) asked whether "Last summer to prevent getting sunburnt", (4) "I used sunscreen"; (5) "I stayed inside"; (6) "I stayed in the shade"; (7) "I wore clothing (not a hat)"; (8) "I wore a hat or cap"; and (9) "I wore a broad brimmed hat, bucket hat or cap with flaps". Possible responses for Questions (4) – (9) were "Never", "Sometime", "Most of the time" or "Always". Item 1 in the knowledge section was designed as a list whereby respondents selected only those items they agreed with. A response was coded as missing when a respondent did not select any item on the list. "Disagree" was only coded for items that a respondent did not agree with. Responses for items 4 – 9 on the behavioural scale were collapsed into disagree (never) and agree (sometime, most of the time and always), in order to strengthen the analysis as a result of low numbers across the categories.

Procedures

The child questionnaire was piloted at two schools in Gauteng province, translated into Afrikaans (one of the official languages used in South African schools), tested for internal consistency and posted to all participating schools together with the principals' questionnaire, information sheets and consent forms. A school teacher was responsible for administering the information sheets, consent forms and questionnaires to the students. Standard instructions were provided to each teacher to ensure children completed the questionnaire and to minimise problematic responses. Once completed, they were returned to the researcher in a pre-paid, pre-addressed courier bag. Three telephonic reminders were made to schools to maximise response rates and the cut-off date for return of completed questionnaires was set as the first week of the fourth school term.

Statistical analyses

All questionnaire data were coded and entered (double entry) into an electronic database using Microsoft Excel. These data were then prepared and imported into Stata 11.0 statistical analysis software (StataCorp, Stata Statistical Software: Release 13, College Station, Texas, StataCorp LP). Summary descriptive statistics, including observed frequencies for all variables in both questionnaires, were calculated. The scores for each of the seven knowledge and nine behavioural items were summed to construct non-weighted knowledge and behaviour scores, respectively. Cronbach's Alpha was used to assess the internal consistency of these scales. A reliability coefficient of 0.70 or higher is considered acceptable. Where low Alpha values were returned, factor analysis was used to improve the models.

Bivariate analyses included examination of all variables by reported sex and skin colour. Odds ratios (OR) and 95% confidence intervals (CI) were determined to identify any associations. Statistical significance was assessed using $p \leq 0.05$ for Chi-squared tests or, in cases where cells had less than five observations, the Fishers Exact test. Self-reported skin colour was used here because skin colour or pigmentation varies significantly within ethnic group, making the latter an unreliable proxy for skin colour.

Linear regression was used to investigate the relationships between the school score and child knowledge and behaviour scores.

All statistical analysis was conducted using survey weighting. This weighting accounts for the different probabilities for an individual's inclusion based on their province and school, although school selection was random.

Results

Table I provides the descriptive statistics of the schools in each South African province. Twenty-four schools participated in the study, but only 23 principals completed the school questionnaire. These 23 schools and their participating students (n=679) were included in the analyses.

School, knowledge and behaviour scale testing

A Cronbach's alpha of 0.67 was obtained for the school SSAP scale, factor analysis was not undertaken on this scale as the Alpha value is only very slightly below the acceptable cut-off of 0.7, and the researchers deemed all 14 items as necessary for inclusion.

The Cronbach's alpha for the knowledge scale was 0.38. This model was then tailored using principal component factor analysis; the items were best modelled in a one factor model comprising 5 items (1, 2, 3, 4 and 6). The Cronbach's alpha for this model was improved to 0.42.

The Cronbach's alpha for the behaviour scale was 0.41 and was improved to 0.50, using principal component factor analysis. The 9 item scale was also best fitted to a one factor model, comprising 5 of the 9 items (1, 3, 4, 5 and 6). Although, the alpha values for both these models are low (0.70 considered acceptable), they represented modest improvements.

SSAP scores

The percentages of schools attaining each accreditation criterion are presented in the fourth column of Table II.

Teaching of sun protection was the criterion achieved by the most schools followed by actively encouraging sunscreen use by students (Table II). Few schools enforced the wearing of hats, had sun protective options for uniforms, made sunscreen available for students and scheduled breaks to avoid peak UVR hours. The arithmetic and geometric means (CI in parentheses) for the school scores were 4.3 (CI: 4.2-4.5) and 3.9 (CI: 3.8-4.1), respectively. A total of 79.2% of schools scored 5 or less points. The highest score attained was 8 out of possible total of 14 points.

Child questionnaire item responses

More females than males (as a result of class gender status quo) participated in the study and completed the child questionnaire (Table III). Students were mostly 13 years of age, reported having light brown skin on their inner, upper arm (a site usually unexposed to the sun) and self-defined themselves as belonging to the Black South African ethnic group (several students selected more than one option).

Knowledge

Boys were more likely than girls to agree that it is safe to get sunburnt once or twice a year and that a suntan protects against skin cancer (Table IV). Students with light / light brown skin, compared to students with brown / dark brown / black skin, were more likely to agree that using sunscreen was a means to avoid getting skin cancer (see Tables VI and VII).

Behaviours

With respect to behaviours last summer (Table V), 59% percent of students said that they got a suntan, but only 22% said that they sunbathed regularly to get a suntan, nevertheless, 41% said that they had been sunburnt (once or more than once). Girls were significantly more likely than

Table VI. Summary statistics for main effects of children's gender on key outcome variables

	Total	**Weighted proportion**	**Male**	**Male weighted proportion**	**Female**	**Female weighted proportion**	**OR**	**OR from weighted sample**	**χ^2 P values**	**χ^2 P values from weighted sample**
	n (%)	**% (95% CI)**	**n (%)**	**% (95% CI)**	**n (%)**	**% (95% CI)**	**OR (95% CI)**	**OR (95% CI)**		
A. Knowledge (seven items)										
To try and not get skin cancer										
1. Avoid getting sunburnt	444 (65.6)	66.4 (62.4–70.4)	169 (65.2)	67.7 (61.1–74.3)	274 (56.8)	65.5 (60.2–70.7)	0.9 (0.7–1.3)	0.5 (0.4–0.6)	0.87	0.607
2. Avoid the summer sun	325 (48.0)	51.0 (46.5–55.5)	117 (45.1)	47.7 (40.3–55.2)	207 (49.7)	53.2 (47.5–5)	0.8 (0.6–1.1)	0.7 (0.6–0.8)	0.246	0.255
3. Cover up with clothing	315 (46.6)	49.1 (44.8–53.4)	128 (49.4)	51.7 (44.4–59.0)	186 (44.7)	47.4 (42.0–52.9)	1.2 (0.8–1.6)	0.8 (0.7–0.9)	0.233	0.369
4. Use sunscreen	443 (65.5)	67.1 (63.0–71.2)	165 (63.7)	64.6 (57.7–71.5)	278 (66.8)	68.6 (63.4–73.9)	0.8 (0.6–1.2)	0.5 (0.4–0.6)	0.407	0.366
5. Go to a sunbed clinic	102 (15.0)	16.1 (12.8–19.5)	41 (15.8)	16.0 (10.6–21.4)	61 (14.6)	16.4 (12.0–20.7)	1.0 (0.7–1.6)	1.3 (1.2-1.4)	0.681	0.919
6. Eat the right foods	254 (37.5)	36.2 (31.8–40.6)	95 (36.6)	34.5 (27.4–41.5)	159 (38.2)	37.1 (31.5–42.8)	0.9 (0.6–1.2)	1.0 (0.9-1.1)	0.69	0.564
7. Melanoma is a form of skin cancer	94 (13.9)	13.8 (10.8–16.8)	34 (13.1)	12.0 (7.7–16.4)	56 (13.4)	14.3 (10.3–18.3)	0.9 (0.6–1.5)	1.3 (1.2–1.4)	0.139	0.453
B. Behaviour (nine items)										
1. I got a suntan	394 (58.4)	62.3 (58.0–66.6)	142 (54.8)	59.1 (52.1–66.0)	253 (61.1)	64.4 (58.9–69.9)	1.2 (0.9–1.7)	0.9 (0.9–1.0)	0.107	0.238
2. I sunbathed regularly	150 (22.2)	20.9 (17.6–24.2)	52 (20.1)	21.3 (15.3–27.2)	98 (23.5)	20.9 (16.8–25.0)	1.2 (0.8–1.7)	0.3 (0.2–0.3)	0.302	0.922
3. I got sunburnt	370 (54.7)	56.4 (52.0–60.8)	125 (48.2)	51.1 (43.8–58.4)	245 (58.8)	59.3 (53.7–64.9)	1.5 (1.1–2.1)	1.7 (1.4–2.0)	0.024	0.177
4. I used sunscreen	442 (65.4)	65.3 (61.1–69.5)	159 (61.3)	62.9 (55.8–70.0)	283 (68.1)	66.7 (61.3–72.2)	1.3 (0.9–1.8)	1.0 (0.9–1.1)	0.071	0.407

	Total	Weighted proportion	Male	Male weighted proportion	Female	Female weighted proportion	OR	OR from weighted sample	χ^2 P values	χ^2 P values from weighted sample
	n (%)	% (95% CI)	n (%)	% (95% CI)	n (%)	% (95% CI)	OR (95% CI)	OR (95% CI)		
5. I stayed inside	507 (75.2)	75.7 (71.9–79.5)	184 (71.3)	73.1 (66.6–79.6)	322 (77.7)	77.3 (72.4–82.1)	1.4 (0.9–2.0)	1.2 (1.1–1.3)	0.059	0.313
6. I stayed in the shade	582 (86.3)	88.3 (85.8–90.9)	213 (82.2)	84.3 (79.3–89.2)	369 (88.9)	90.9 (88.0–93.8)	1.7 (1.1–2.7)	1.4 (1.3–1.5)	0.014	0.017
7. I wore clothing (not a hat)	378 (56.1)	59.4 (55.1–63.7)	139 (54.0)	56.3 (49.0–63.6)	238 (57.3)	61.1 (55.8–66.5)	1.1 (0.8–1.5)	0.9 (0.8–1.0)	0.407	0.296
8. I wore a hat or cap	499 (74.1)	70.3 (66.1–74.6)	189 (73.2)	70.9 (64.0–77.8)	308 (74.4)	69.7 (64.3–75.1)	1.0 (0.7–1.5)	1.1 (1.0–1.2)	0.743	0.784
9. I wore a broad brimmed/ bucket hat or cap with flaps	345 (51.4)	49.4 (44.8–53.9)	127 (49.2)	46.0 (38.8–53.3)	218 (53.0)	51.9 (46.1–57.6)	1.1 (0.8–1.5)	0.7 (0.7–0.8)	0.336	0.217

OR = odds ratio.

Note. NS, main effect for demographic variable non-significant, P > 0.05. No degrees of freedom calculated since data were categorical.

boys to report the experience of sunburn, but were also more likely to stay in the shade in order to protect themselves from getting sunburnt (Table VI). Students with white / light brown skin were significantly more likely to report that they got sunburnt and used sunscreen last summer compared to students with brown / dark brown / black skin (Table VII). With respect to ways to achieve protection against getting sunburnt, students with white / light brown skin were more likely to stay in the shade but less likely to use clothing than students with brown / dark brown / black skin.

Table VII. Summary statistics for main effects of children's skin colour on key outcome variables

	Total	**Frequency light/light brown skin**	**Light/light brown skin weighted proportion**	**Frequency brown/dark brown/black skin**	**Brown/dark brown/black skin weighted proportion**	**OR**	**OR from weighted sample**	**χ^2 P values**	**χ^2 P values from weighted sample**
	n (%)	**n (%)**	**% (95% CI)**	**n (%)**	**% (95% CI)**	**OR (CI)**	**OR (CI)**		
A. Knowledge (seven items)									
To try and not get skin cancer:									
1. Avoid getting sunburnt	444 (65.6)	100 (61.3)	69.0 (64.6–73.5)	344 (67.0)	57.2 (48.0–66.5)	0.7 (0.5–1.1)	0.4 (0.3–0.4)	0.181	0.021
2 Avoid the summer sun	325 (48.0)	90 (55.2)	50.2 (45.1–55.3)	235 (45.8)	54.5 (44.9–64.0)	1.4 (1.0–2.0)	0.6 (0.5–0.7)	0.036	0.437
3 Cover up with clothing	315 (46.6)	79 (48.4)	49.4 (44.5–54.3)	236 (46.0)	48.1 (38.7–57.4)	1.1 (0.7–1.5)	0.6 (0.5–0.7)	0.583	0.802
4 Use sunscreen	443 (65.5)	91 (55.8)	69.1 (64.4–73.9)	352 (68.6)	60.2 (51.2–69.3)	0.5 (0.4–0.8)	0.4 (0.3–0.4)	0.003	0.085
5 Go to a sunbed clinic	102 (15.0)	25 (15.3)	17.1 (13.1–21.1)	77 (15.0)	13.2 (7.1–19.3)	1.0 (0.6–1.6)	1.0 (1.0–1.1)	0.919	0.325
6. Eat the right foods	254 (37.5)	71 (43.5)	34.2 (29.3–39.2)	183 (35.6)	42.2 (33.7–51.7)	1.3 (0.9–1.9)	0.8 (0.7–0.9)	0.07	0.135
7. Melanoma is a form of skin cancer	94 (13.9)	13 (7.9)	15.0 (11.5–18.5)	81 (15.8)	9.0 (3.4–14.5)	2.1 (1.1–3.9)	1.1 (1.0–1.1)	0.013	0.113
B. Behaviour (nine items)									
1. I got a suntan	394 (58.4)	86 (52.7)	64.2 (59.4–69.1)	308 (60.2)	55.1 (45.5–64.6)	1.3 (0.9–1.9)	0.8 (0.7–0.8)	0.09	0.089
2. I sunbathed regularly	150 (22.2)	40 (24.6)	19.6 (15.9-23.3)	110 (21.4)	25.7 (17.6–33.7)	0.8 (0.5–1.2)	0.2 (0.2–0.3)	0.386	0.168
3. I got sunburnt	370 (54.7)	65 (39.8)	60.8 (55.9–65.7)	305 (59.4)	40.8 (31.4–50.3)	2.3 (1.5–3.3)	1.4 (1.1–1.6)	0	0
4. I used sunscreen	442 (65.4)	90 (55.2)	67.3 (62.5–72.1)	352 (68.7)	58.4 (48.9–67.9)	1.7 (1.2–2.5)	0.8 (0.7–0.9)	0.002	0.091
5. I stayed inside	507 (75.2)	122 (75.3)	75.4 (71.0–79.7)	385 (75.2)	76.7 (68.8–84.6)	0.9 (0.6–1.5)	0.9 (0.9–1.0)	0.977	0.773
6. I stayed in	582 (86.3)	130 (79.7)	90.0 (87.3–92.8)	452 (88.4)	82.8 (76.2–89.4)	1.9 (1.2–	1.1 (1.0–1.2)	0.005	0.026

	Total	Frequency light/light brown skin	Light/light brown skin weighted proportion	Frequency brown/dark brown/black skin	Brown/dark brown/black skin weighted proportion	OR	OR from weighted sample	χ^2 P values	χ^2 P values from weighted sample
	n (%)	n (%)	% (95% CI)	n (%)	% (95% CI)	OR (CI)	OR (CI)		
the shade						3.1)			
7. I wore clothing (not a hat)	378 (56.1)	102 (62.9)	58.3 (53.4–63.1)	276 (54.0)	63.3 (53.9–72.7)	0.6 (0.4–0.9)	0.7 (0.7–0.8)	0.045	0.353
8. I wore a hat or cap	499 (74.1)	122 (76.2)	69.9 (65.0–74.7)	377 (73.4)	71.9 (62.7–81.1)	0.8 (0.5–1.3)	0.9 (0.8–0.9)	0.486	0.703
9. I wore a broad brimmed hat, bucket hat or cap with flaps	345 (51.4)	85 (52.8)	49.8 (44.7–54.9)	260 (51.0)	48.5 (38.8–58.3)	0.9 (0.6–1.3)	0.6 (0.5–0.7)	0.704	0.821

OR = odds ratio.

Note. NS, main effect for demographic variable non-significant, P > 0.05. No degrees of freedom calculated since data were categorical.

Summary child knowledge and behaviour scores

The seven knowledge and nine behaviour variables, for which the scoring criteria and frequency distributions are presented in Tables IV and V, respectively, were tailored using principal component factor analysis, then summed to calculate non-weighted knowledge and behaviour scores for each child. The arithmetic and geometric means for these scores (CI in parentheses) were 2.9 (2.8-3.0) and 2.6 (2.5-2.7) for knowledge, and 3.06 (3.0-3.1) and 2.9 (2.8-3.0) for behaviour.

School scores in relation to child scores for knowledge and behaviour

Regression analysis between child behaviour and child knowledge, showed no correlation shown in Table VIII, which reports the Prob > F (p-value associated with the F-statistic - the

Mean Square Model divided by the Mean Square Residual) and the R-squared (where 1 represents excellent strength of association).

There was also no correlation between the school scores and either the students' knowledge or behaviour scores, this improved only slightly when including both knowledge and behaviour in a multiple regression model.

Table VIII. Regression between school score, child knowledge and behaviour

Regression variables	P > F	R^2
Child knowledge on behaviour	0.9276	0.0000
School score on child knowledge	0.0121	0.0093
School score on child behaviour	0.1352	0.0033

Discussion

This study had two aims. The first aim of this study was to report a) frequency distributions for school sun protection practices and b) student knowledge and behaviours by gender and skin type. There is at least some evidence to suggest that, despite South African urban government schools doing little to create sun protective environments and support, some South African primary school students do know something about sun protection and do practice some positive sun behaviours. However, the reported occurrence of sunburn, a risk factor for skin cancer, was relatively high. This is similar to that found for more than half of all Swiss students of similar age who experienced at least one sunburn during the year preceding their study [17]. Girls in South Africa were more likely than boys to report getting sunburnt, as was the case in a New Zealand study [18], even though most knew that it is not safe to get sunburnt.

The second aim was to investigate whether or not school sun protection efforts were associated with student responses to sun-related knowledge and behaviour questions prior to the implementation of a national SSAP. Schools were scored according to their compliance with the proposed SSAP criteria (Table II) and these scores were compared with the knowledge and

behaviour scores of students attending each school. Overall, while 76% of schools said that they taught at least once a year about sun protection, most schools were doing little to address sun protection in the school environment itself. This is not an uncommon situation – a similar case existed in New Zealand prior to the implementation of a SSAP when no school met all 12 accreditation criteria [13]. This can also, in part, be explained in that the majority of the South African population has brown and dark brown skin with relatively high melanin content thereby reducing the perceived need for sun protection. As expected, skin cancer incidence is highest among South Africans with fair skin (mean age-standardised annual incidence of reported cutaneous melanoma for males and females between 2000 and 2004 for White South Africans was male: 20.5 and female: 16.5), followed by Coloured (male: 5.9 and female: 4.1), Indian/Asian (male: 0.7 and female: 1.1) and Black South Africans (male: 1.0 and female: 1.2) [19]. Unverified data suggests that for 2009 the estimated incidence rate for the White population living in the Western Cape Province was 69 new cases per year per 100 000 population [20]. While skin cancer is not a relatively significant health problem in the country as a whole, cataracts of the eyes and oculocutaneous albinism (OCA), a condition in which individuals lack melanin and are highly susceptible to the harmful effects of the sun, are common [21]. Wearing adequate eye protection and sunhats can help reduce excess sun exposure associated with cataracts. Skin and eye protection are essential for children with OCA.

It is important to acknowledge that several other factors may influence a child's sun-related knowledge and behaviour. The theories of reasoned action and planned behaviour have been applied to understand child sunscreen use where intention, attitudes and peer beliefs were important factors [22]. There is evidence that, for younger children at least, child sun protection is best predicted by parents' own protection [23]. A Spanish study that investigated sun protection knowledge, attitudes and behaviours among parents and their children found that,

despite parental knowledge being relatively high, sun protection among their children was still inadequate [24]. Those students exerted some assertiveness when asked to make use of sun protection and sometimes refused, whereas in studies of mothers and their infants or young children, child compliance with sun protection may be higher, as a result of age [25, 26].

The school system organisational factors (e.g. demographics, size, district, rural versus urban etc.) may also influence SSAP implementation and subsequently child sun-related knowledge and behaviours [4, 27]. Efforts to promote adoption at a higher organizational level, such as school districts, may lead to fewer school-level organizational barriers to sun protection interventions, for example. Furthermore, school teaching of sun protection in a sun safety curriculum has been found to be effective for improving children's sun safety [28].

In this study, we focussed on the potential influence of the school in light of the importance placed on the SSAP advocated by the WHO. An Australian study found that having a national SSAP in place was associated with the adoption of a written sun protection policy [8]. In turn, it was also associated with increased hat use among students (to 85%), but not necessarily increased sunscreen use. Since there is presently no national SSAP in place in South Africa, the lack of any positive association between school policy and student practices in our study was not unexpected. However, this may also be interpreted as an opportunity such that the implementation of a SSAP, given the Australian evidence, may have a significant positive influence in South Africa by encouraging schools to adopt sun protection policies and potentially increasing the frequency of appropriate sun-protective behaviours among vulnerable, South African primary school students, especially children with fair skin and children with OCA. We could find no evidence in the literature of positive relationships between the presence

of a national SSAP, school accreditation status and student sun-related knowledge. This may be a topic for future research.

Although a focus here has been on the potential role of schools in supporting students to be 'SunSmart', there is evidence to suggest that the most effective way to influence attitudes and behaviour in a sustainable way is through comprehensive and continuous sun awareness programmes in multiple sites and settings [3]. This is the case in Australia where the Cancer Council Victoria has led a sun protection programme for more than twenty years, and a fall in skin cancer incidence rates among young people has been attributed, at least in part, to resulting greater sun protection use [29]. The Victorian SunSmart programme is multicomponent, including such interventions as developing health and safety guidelines for outdoor workers, having local government authorities adopt sun protection policies in their municipal health plans and reporting the Ultraviolet Index values on media weather reports, in addition to implementing a national SSAP. While CANSA does implement a skin cancer prevention campaign, due to, among other factors, its relatively modest budget and small reach, its impact is unknown. Although there is evidence that an SSAP, alone, may improve students' sun-related behaviours, it would be reinforced by being part of a comprehensive, multicomponent community-wide programme.

This cross-sectional study presents preliminary evidence in an area that needs further investigation. Several study limitations were identified. The school survey was based on self-report by the school principal and on-site verification would be needed when a random national survey is commissioned in order to confirm reports of positive practices. The knowledge and behaviour reliability estimates for the questionnaire measures were relatively low. Further testing of these measures is necessary to confirm the psychometrics of those variables and their

ability to validly assess knowledge and sun safe behaviour. This study was conducted during the third school term at the end of winter / beginning of spring as the Department of Education does not allow any research studies in schools during the fourth term. This timing may have influenced responses to behavioural questions. The use of a self-reported questionnaire among students has been defended as a reliable means for collecting information [30, 31]. In this study, the questionnaire was designed to have a 'be unsure' response for some questions and several students repeatedly chose this option, thereby contributing data that are difficult to interpret. Information bias is also a concern, since students and principals may have felt obligated to respond in a particular way for a given question, i.e. provide the 'correct' sun behaviour answer rather than the answer reflecting their true behaviour, or perhaps could not accurately recall information about their behaviour "last summer". The Cronbach's alpha tests for internal consistency returned low scores for knowledge and behaviour and test-retest reliability of the questionnaire should be carried out in future studies.

In summary, we demonstrated the feasibility of obtaining comprehensive baseline information about sun protection efforts in South African government schools by means of survey instruments mailed out to a national sample of schools in which all provinces were represented. It is also possible to create summary scores for assessing school sun protection practices and student knowledge and behaviour, although it would be desirable to improve alpha values. Results suggest that when schools do little in terms of sun protection, the range in sun-related knowledge, attitudes and behaviours of primary school students may be broad, but the knowledge of most students is likely to be insufficient and their practice of safe sun behaviours inadequate. While we cannot be certain that the implementation of an SSAP, alone, will lead to improvements in child knowledge and behaviours, there is systematic review evidence to

support that expectation, and if, in addition, an SSAP is part of a comprehensive suite of sun protection activities it is reasonable to anticipate a positive impact.

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