

# Geographical differences in primary schoolchildren's key sun-related behaviours: an exploratory, feasibility study

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South Africa receives high levels of solar ultraviolet radiation (UVR). Exposure to UVR has beneficial and harmful effects, the most common of which are vitamin D synthesis and skin cancer, respectively. Acute exposure during childhood is a known risk factor for melanoma. In South Africa where skin cancers account for a third of all histopathologically diagnosed cancers, information on behaviour patterns and protection use is needed to inform awareness campaigns. Hence, this article aimed to perform an exploratory, feasibility study on the sun-related behaviours of urban primary schoolchildren by province. In general, use of sun protection was inconsistent and 52% of children reported sunburn. Generally, children from schools in the eastern part of the country self-reported higher incidence of suntan and sunburn compared to the western half. Similarly, children in Limpopo, Eastern Cape, Mpumalanga and North-West tended to use sun protection more often compared to the remaining provinces, although hat/cap usage and clothing were comparably high in the Northern Cape and KwaZulu-Natal, respectively. Children in the Western Cape had a high incidence of sunburn and amongst the lowest use of sun protection; this province is also known to have skin cancer incidence rates as high as those in Australia. While results are not representative of all of South Africa, they provide some indication that there is much to be done to raise levels of sun-related knowledge and tailor safe sun behaviours.

**Keywords:** sun protection; sun exposure; South Africa; schoolchildren; behaviour

## Introduction

Due to its latitude, topography and relatively cloudless skies, for example on the Highveld, South Africa receives high solar ultraviolet radiation (UVR) almost all year round. The Global Solar UV Index (UVI) is a simple measure of the solar UVR level at the Earth's surface and is an indicator of the potential for skin damage. The UVI is defined as  $40 \times UV_{Ery}$  in units of  $W m^{-2}$  (i.e.  $J m^{-2} s^{-1}$ ). A UVI of greater than 11 is extreme, 8–10 is very high, 6–7 is high, 3–5 is moderate and 1–2 UVI is low. In South Africa, levels range significantly depending on latitude, altitude, time of day and cloud cover. [Figure 1](#) shows the solar UVR levels in UVI units for the 11 December 2009 for Cape Point and Durban South African Weather Service sites. The midday UVI for Cape Point is 10 UVI while Durban's midday UVI is 4, indicative of cloudy conditions in Durban suppressing ambient solar UVR levels.

South Africa's multi-ethnic population has varying degrees of response to sun exposure. Ocular effects of excess sun exposure, such as cataracts – a leading cause of blindness in Africa, are prevalent among all ethnic groups, while skin cancer incidence is

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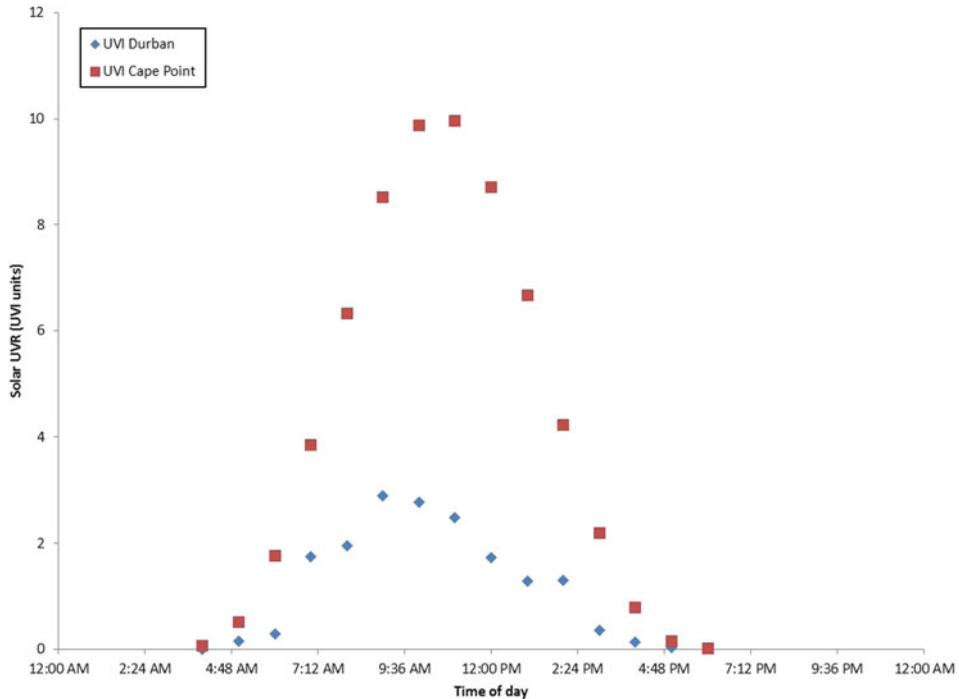


Figure 1. Solar UVR levels (UVI units) at Cape Point and Durban on 11 December 2009 (data from the South African Weather Service).

highest amongst White and Coloured groups (Norval, Kellet, & Wright, 2014; Wright, Albers, Oosthuizen, & Phala, 2013). Black South Africans with oculocutaneous albinism are at great risk of skin cancer given their low melanin content and susceptibility to burn; given that the incidence of albinism in South Africa is about 1 in every 4000 (Hong, Zeed, & Repacholi, 2006), this is cause for concern. Given the range of health effects from excess sun exposure in South Africa, the need for public health efforts to raise awareness about sun protection is evident. International experience confirms that introducing positive sun behaviours early in life is more likely to lead to life-long positive patterns of sun exposure and protection (Oliveria, Saraiya, Geller, Heneghan, & Jorgensen, 2006). Furthermore, environments which children frequent need to be supportive of these behaviours. For example, schools should provide adequate shady play areas and encourage hat use. The Community Preventive Services Task Force found that sun protection awareness and intervention programmes implemented in primary schools are effective and can increase sun-protective behaviours, and decrease sun exposure, sunburn incidence and formation of new moles, thereby reducing the risk of adverse health effects from occurring later in life (Saraiya et al., 2004).

Since sun-related behaviours had never before been analysed for a South African primary school sample, a study was commissioned in 2012 by the Cancer Association of South Africa to do so. The results of this study have been considered by looking at the practices of the schools themselves which showed that, of the 24 urban government primary schools sampled, none had a sun protection policy in place (Wright, Davids, Summers, & Norval, 2013). They have also shown that generally primary schoolchildren do not have sufficient positive sun-related behaviours, thereby explaining why the

self-reported incidence of sunburn was relatively high (52%) (Wright, Albers, Oosthuizen, & Phala 2014). In this exploratory, feasibility study, we have considered the study results in a geographic manner by province in South Africa. Therefore, we used the measures of the study to test whether they may be considered geographically and whether such information is useful. It is imperative that a larger study be carried out in the future if provincial differences by independent variables such as skin colour are considered worthy of analysis for planning and policy development. This was not pursued in this study due to the relatively small sample size per province.

## **Methods**

A cross-sectional epidemiological study took place during the third school term in South Africa between August and October 2012 in accordance with the requirements of the Provincial Departments of Education. Four schools from each of the nine provinces (except for the Northern Cape where one extra school was invited) were randomly selected from the Department of Basic Education schools database and invited to participate. The number of schools per province was determined by the project budget for payment of couriering materials to and from schools across South Africa. Primary schools were included if they had Grade 7 children that were government (public) schools in urban areas, as defined by the Department of Basic Education, where English or Afrikaans was the main spoken and written language and the class size was greater than 10 children. Private schools, correspondence schools, home schools and special needs schools were excluded.

Questionnaires were posted to the schools for the schoolchildren to complete. Ethical clearance for this study was provided by the Council for Scientific and Industrial Research Ethics Committee (35/2012). Provincial approvals were granted by the following departments: KwaZulu-Natal Department of Education; Northern Cape Department of Education; Eastern Cape Department of Education; Department of Education: Mpumalanga; Western Cape Department of Education; Department of Education Free State; North-West Department of Basic Education; Gauteng Department of Education and Limpopo Department of Education. School principals gave informed consent for the study prior to contacting the children. Children's parents/guardians/caregivers completed an informed consent form and children gave assent prior to completing the questionnaire.

The questionnaire was based on an instrument developed by the Anti-Cancer Council of Victoria during the 1990s that included items used in the South Australian Health Omnibus surveys, the South Australian Triennial Sun Exposure Survey and the 2003–2004 National Sun Protection Survey as well as similar instruments that have been developed for use among children in other countries (Reeder & Jopson, 2006, 2012) but adjusted to local conditions, cultural differences and observed or reported sun-related behaviours specific to South Africa following piloting. Questions focussed on (1) attitudes towards sun exposure, sun tan and sun protection; (2) knowledge of beneficial and harmful effects of the sun and sun protection; (3) behaviour when outdoors, i.e. hat use, sunscreen use, clothing for sun protection, sunburn experience, sun tanning experience, etc. and (4) demographic data, i.e. sex, age, skin type, etc. The questionnaire was pre-tested, translated into Afrikaans and piloted to achieve optimum comprehension and acceptability. In this paper, we report on the key behaviour responses of the children who completed the questionnaire.

## **Unweighted analysis**

All questionnaire data were coded and entered into an electronic database that was then imported into STATA version 11.0 for statistical analysis. Summary descriptive statistics

included observed frequencies. Maps based on the number of children in each province replying ‘yes’ to each question as a percentage of total replies per province for that question were created using ArcGIS 9.1. These provincial percentages were spatially allocated (via a table join) to the province shapefile which was retrieved from the Municipal Demarcation Board website.

### Weighted analysis

As a result of the survey design of this study, participants were selected on two levels, province and school. Schools in each province were assigned a weight in order to account for their contribution to the larger South African population. Further, participants in each school were also assigned a weight in order to account for their contribution to the larger population in that particular school. These weights were taken into account when examining proportions using a survey design model. The results obtained from this model provide estimated proportions for the population based on a theoretical sample calculated using the weights.

The survey design of this study, whereby participants were selected based on province and school, was taken into account in all of the data analysis. Although the selection was random, the probability for inclusion would likely be different by province and school, and therefore a weighting estimate was assigned based on both these probabilities. This allows for more accurate estimates and standard errors (SE) to be calculated and also accounts for the clustering effect of each school.

## Results

### Sample demographics

A total of 24 schools out of 37 invited schools participated in the study representing a 64.8% school response rate. A total of 707 schoolchildren completed the questionnaire: 269 boys and 434 girls (four children did not report their gender) (Table 1). The average response rate for the number of children who responded as a percentage of the number of Grade 7 learners in the school was 37.4% which aligns with our objective of surveying one class in Grade 7 at each school (assuming each school has on average three classes in Grade 7 with approximately 30–35 learners per class). Many children (60.7%) were 13 years of age and the majority were Black, followed by White, Coloured and Indian (Table 2) based on Statistics South Africa categories. Children’s self-reported skin colour, shown in Table 3, was mostly self-identified as light brown, followed by white, brown, dark brown and black.

Tables 1–3 also show the three factors of gender, ethnic group and skin colour by province. In all provinces, except the Eastern Cape, there were more female respondents than males. Limpopo, KwaZulu-Natal and North-West had the highest number of Black

Table 1. Number of children who participated in the study by self-identified gender and province.

Gender	Mpumalanga	Limpopo	Western Cape	Free State	KwaZulu-Natal	Eastern Cape	Northern Cape	Gauteng	North-West	Total (n)
Male	34	31	15	41	22	56	23	13	34	269
Female	57	65	27	46	45	56	42	39	57	434
Total	91	96	42	87	67	112	65	52	91	703

Note: Four children did not report their gender.

Table 2. Number of children who participated in the study by self-identified ethnic group and province.

Category	Mpumalanga	Limpopo	Western Cape	Free State	KwaZulu-Natal	Eastern Cape	Northern Cape	Gauteng	North-West	Total (n)
Black	32	74	5	35	41	22	23	14	66	312
Indian/Asian	9	2	2	2	26	9	2	1	6	59
White	43	8	4	41	4	50	10	38	11	209
Coloured	5	15	36	12	6	44	45	4	10	177
Other	2	0	0	4	1	2	2	1	2	14
Do not know	3	3	0	0	0	3	1	0	9	13
Total	94	102	47	94	78	130	83	58	104	784

Note: Children could belong to more than one ethnic group.

respondents, while Mpumalanga, Free State, Eastern Cape and Gauteng had the highest number of White respondents. The Western Cape and Northern Cape had the highest number of Coloured respondents. For self-identified skin colour, light brown was the most frequently selected choice in all provinces.

### *Key behaviours by province*

Unweighted, self-reported responses by children for key sun-related behaviours by province are given in Figures 2–10. Figure 2 shows, by province, the percentage of children replying ‘yes’ to the question, ‘Did you get a suntan last summer’ as a percentage of all replies from that province for this question. The Western Cape, Gauteng and Mpumalanga were the provinces with the highest percentage of children replying yes to this question. This was similar to the results for the question, ‘Did you sunbathe regularly last summer to try to get a suntan’, where children from the Free State, Mpumalanga and Gauteng reportedly sunbathed regularly compared to other provinces, although most percentages of ‘yes’ replies were relatively low at approximately 30% or less, except for the Free State which was higher.

Very few children reportedly used a sunbed (Figure 4); the highest percentage of children replying ‘yes’ to this question was for the Eastern Cape (9.73%) and all percentages were less than 10%. Regarding sunburn, 80.95% of children responding in the Western Cape reportedly experienced sunburn during the previous summer, followed by

Table 3. Number of children who participated in the study by self-identified skin colour and province.

Category	Mpumalanga	Limpopo	Western Cape	Free State	KwaZulu-Natal	Eastern Cape	Northern Cape	Gauteng	North-West	Total (n)
White	23	8	13	23	4	35	16	15	15	152
Light brown	46	66	17	44	47	44	35	34	51	384
Brown	9	12	9	6	14	26	11	3	17	107
Dark brown	11	8	2	6	1	5	3	1	5	42
Black	1	2	1	8	1	2	1	0	3	19
Total	90	96	42	87	67	112	66	53	91	704

Notes: Children were asked to select one response only. Three children did not report their skin colour.

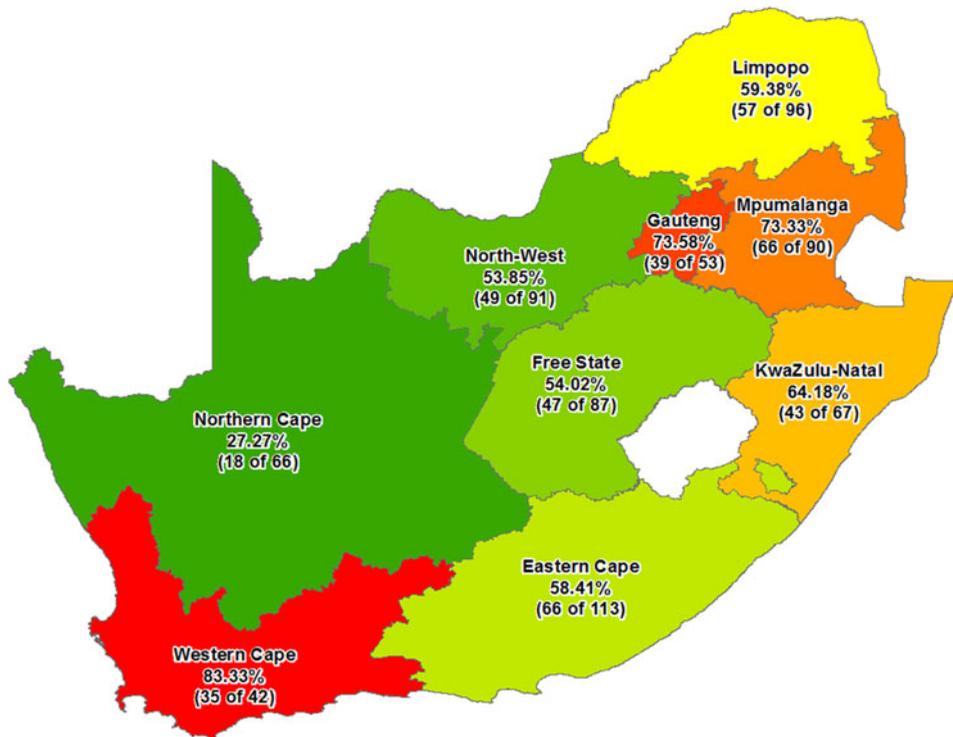


Figure 2. By province, unweighted percentage of children replying 'yes' to the question, 'Did you get a suntan last summer' as a percentage of all replies from that province for this question.

Mpumalanga (71.74%) and Gauteng (69.81%). Overall, the incidence of sunburn was 52% for all children who responded in the study (Wright et al., 2014).

For typical sun-protective behaviours, children were asked to reply to questions that asked, 'How often when you were outside last summer did you ...' and 'yes' was coded as 'sometimes/most of the time/always' combined. For shade use, children in KwaZulu-Natal, Limpopo, North-West and the Western Cape reportedly made use of available shade most frequently (Figure 6). No percentages of use of shade were less than 78%. For self-reported hat and cap use, western/northern most provinces had the highest percentage of 'yes' responses, namely, the Northern Cape, North-West and Limpopo, which was the same for broad-brimmed hat, a bucket hat or a cap with flaps, except for the North-West who dropped out of the top three and was replaced by the Free State. For all types of hats used, the lowest percentage of children reportedly making use of hats was in the Western Cape. Children in KwaZulu-Natal, Limpopo and the North-West reportedly used clothing other than a hat to cover up more than the other provinces. For sunscreen use, most frequent use was reported in Gauteng and the Free State, and the most infrequent use was in the Northern Cape and KwaZulu-Natal.

### **Weighted results**

Weighted frequencies of responses by question for each province are given in Tables 4 and 5. Standard error and 95% confidence intervals (CI) were also calculated for each set of responses. Results with a small SE and narrow CI were scrutinised. For example, for the

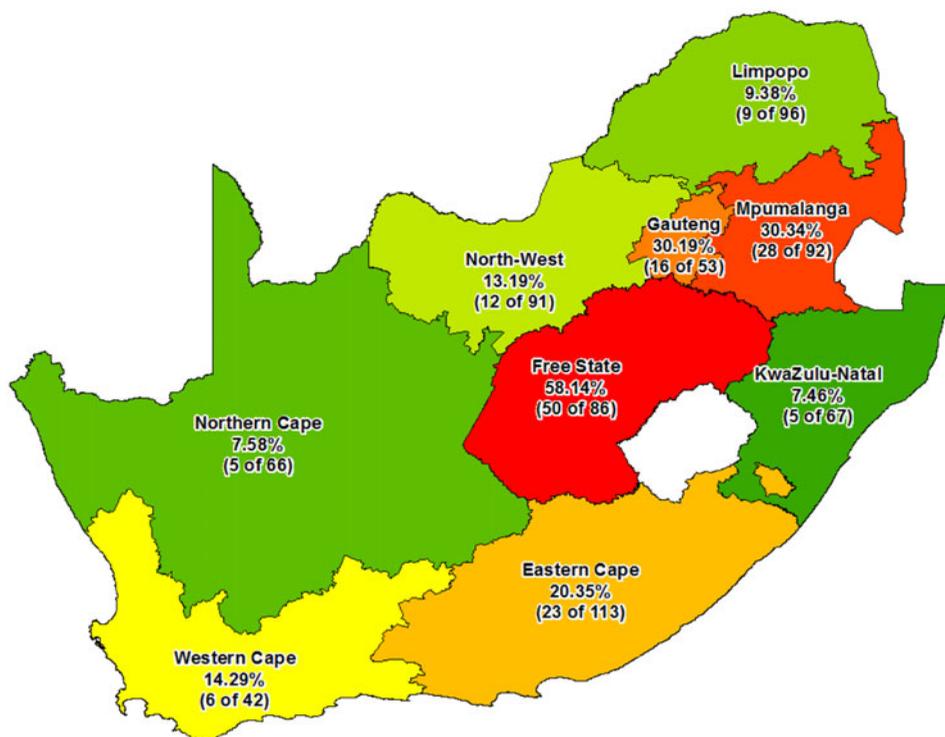


Figure 3. Unweighted percentage of children replying ‘yes’ to the question, ‘Did you sunbathe regularly last summer to try to get a suntan’ as a percentage of all replies for this question per province.

question about obtaining a suntan last summer, the weighted percentage of ‘yes’ replies for the Western Cape was 55.29% (SE: 5.74; CI: 44.01–66.56), reduced from the 83.33% reported in Figure 1 for unweighted results. The SE and CI suggest that this is not a highly reliable result and warrants further investigation through additional research. There was a similar situation for the question on sunbathing last summer where weighted frequencies for the Free State, North-West and KwaZulu-Natal changed compared to unweighted frequencies; however, the SE was moderate and CI relatively wide.

A result of interest was the weighted frequency for use of shade in the Free State, changing from 78.19% unweighted to 97.52% weighted. The small SE of 1.75 and narrow CI of 94.08–100.96 are noteworthy. Similarly, for use of hat or caps in the Western Cape, the unweighted frequency was 41.46% compared to the weighted frequency of 92.94%. Here there was a small SE of 2.26 and a narrow CI of 88.5–97.38. Finally, for use of sunscreen, the percentage of ‘yes’ replies increased from 46.27% unweighted to 78.0% weighted with a relatively small SE of 3.95 and a moderately narrow CI.

## Discussion

This is the first study in South Africa to assess primary schoolchildren’s self-reported sun-related behavioural patterns. Such information is needed to tailor sun awareness and sun protection information to South Africans, and a geographical analysis provides insight into provincial differences. The existence of these differences suggests that a nationwide, ‘one-

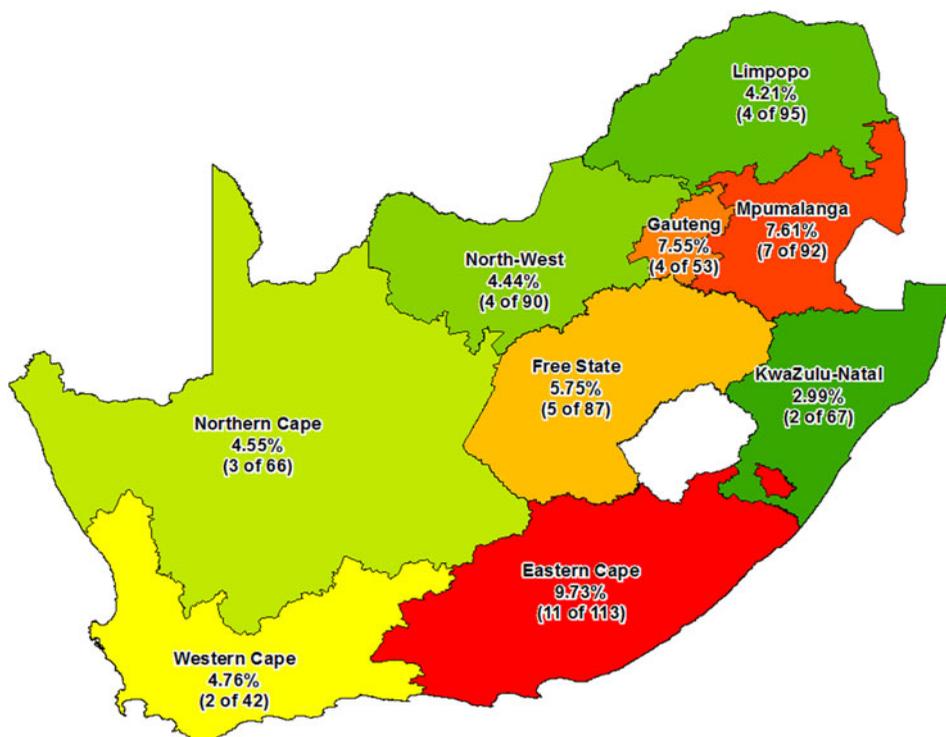


Figure 4. By province, unweighted percentage of children replying 'yes' to the question, 'Have you ever used a sunbed' as a percentage of all replies for this question per province.

size-fits-all' approach may not be appropriate, since provinces differ greatly by, for example, ethnic group majority, predominant skin colour, etc. However, in this paper, these factors were isolated at a provincial level since the primary aim of this geographic analysis was to generate knowledge that could be used to devise appropriate intervention plans and policies at a provincial level (e.g. by the relevant Provincial Department of Education). From the self-completed questionnaires completed by Grade 7 students in the study, data showed that most children tended to define their skin colour as 'light brown' despite representation from the four main ethnic groups of South Africa that have a range in skin colours. Such a finding has implications for sun protection messages. Perceived skin colour is likely to determine the choice of advice regarding sun protection; a child with fair skin [deemed white in the Fitzpatrick skin classification system (Fitzpatrick, 1988)] who perceives his/her skin colour to be light brown, is likely to use less sun protection than they should because they believe they have more natural protection from melanin than they actually do have. A formal evaluation of skin photosensitivity (that encompasses all necessary phenotypic characteristics beside only skin colour) by a medical practitioner or health promotion officer may be important to ensure that a child has the correct information about his/her individual sensitivity to the sun and the appropriate behavioural responses in terms of protection.

While results are not a true reflection of an entire province given the small sample per province, a descriptive evaluation of key sun exposure and protection questions showed that differences in responses by province for the schools sampled did exist. Based on our unweighted results, the self-reported incidence of obtaining a suntan was relatively high,

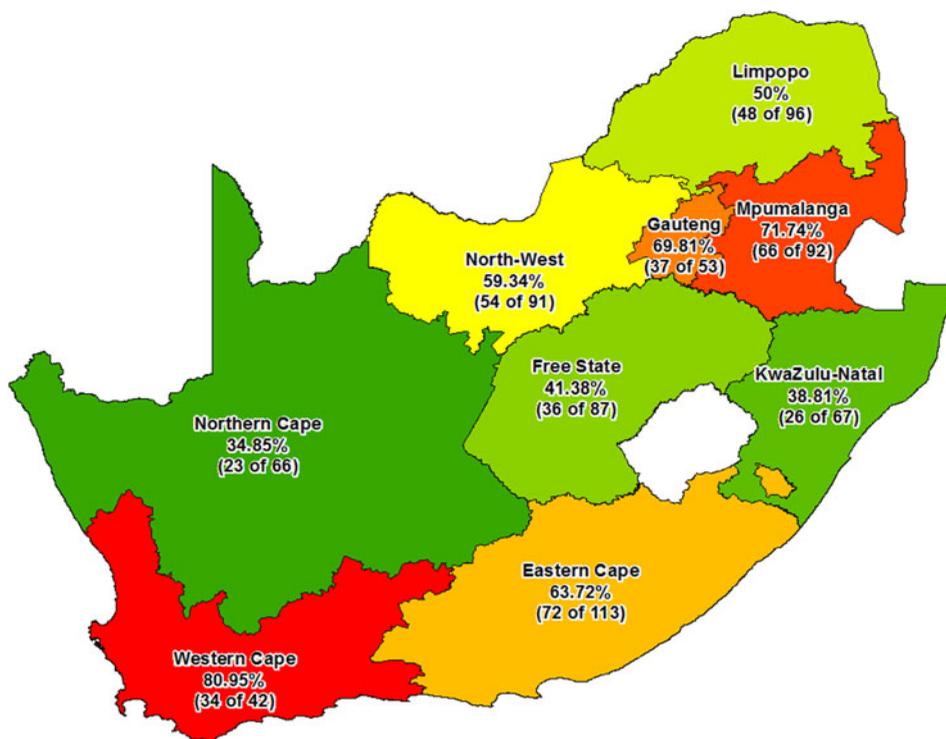


Figure 5. By province, unweighted percentage of children replying 'yes' to the question, 'Last summer, did you get sunburnt after being in the sun' as a percentage of all replies for this question.

particularly in the Western Cape, Gauteng and Mpumalanga. In Gauteng and Mpumalanga, the most number of children identified with the White ethnic group among whom it is probably more common that a suntan is appealing compared to Black and Indian children, but this needs to be better elucidated. In the Western Cape, where obtaining a suntan was also relatively high, the most number of children identified with the Coloured ethnic group; this poses an interesting question regarding whether Coloured children also get suntanned, or perceive that they get suntanned and whether it is accidental or purposeful. There may also be varying degrees of misinterpretation of the word 'suntan' and how it is acquired among South African primary schoolchildren. The reported incidence of sunbathing to obtain a suntan was also relatively low, suggesting that perhaps most suntan acquired by South African children reporting to get a suntan is through accidental exposure, such as while playing sport or visiting the beach, rather than purposefully laying in the sun and sunbathing.

The top three provinces where the most number of children reportedly obtained a suntan last summer were the same top three provinces where children reportedly got sunburnt after being in the sun. Parts of the Western Cape experience relatively lower levels of ambient solar UVR (mainly due to latitude effects, but differences in altitude could lead to high UVI levels inland in the province) compared to Gauteng and Mpumalanga; however, wind and cooler ambient temperatures may lead to children spending long periods of time outdoors, unprotected, and resulting in sunburn. In contrast, solar UVR levels in Gauteng and Mpumalanga may be high almost all year round, in particular 2 h around midday, due to their altitude and latitude and relatively cloudless

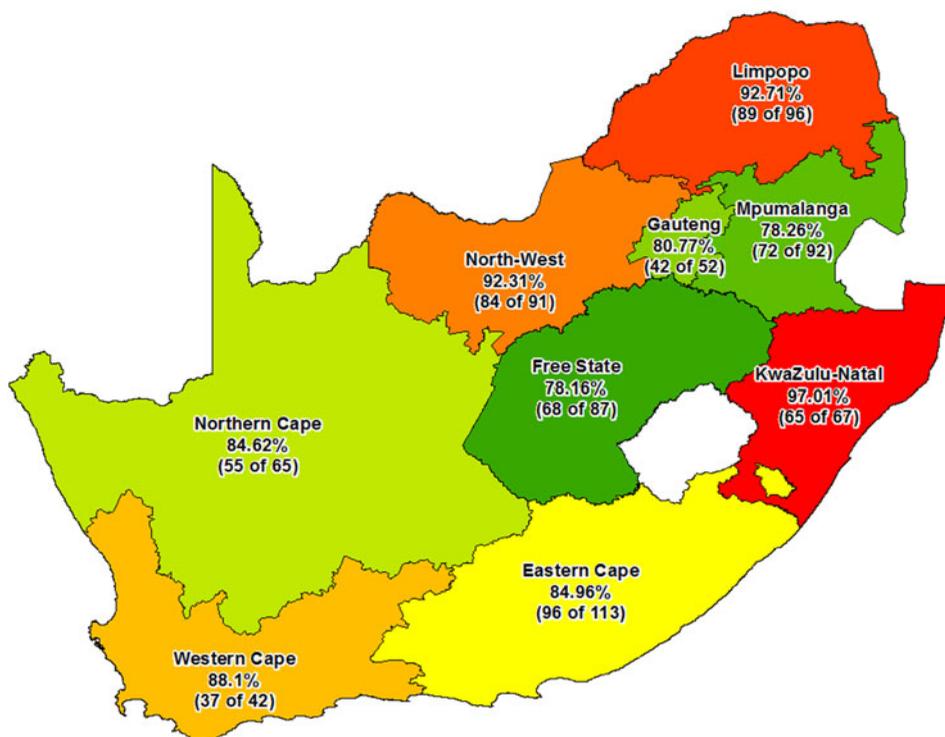


Figure 6. By province, unweighted percentage of children replying ‘sometimes/most of the time/always’ to the question, ‘How often when you were outside last summer did you choose to stay in the shade to protect yourself from getting sunburnt’ as a percentage of all replies for this question.

skies, putting children at risk of sunburn depending on the timing and duration of time spent outdoors, levels of sun protection and natural melanin content. This may be particularly important during winter when weather is fine and clear and people spend more time in the sun to warm up without considering solar UVR levels.

In terms of sun protection, there were several interesting findings for use of shade, clothing, hats and sunscreen. Surprisingly, self-reported shade use was very high in all provinces ranging between 78% and 97%. Shade comprises natural shade, for example trees, and built shade, for example awnings and shade sails. Reasons for seeking shade may be a combination of wanting relief from high temperatures as well as avoiding direct sunlight, for example avoiding glare effects on the eyes, darkening of natural melanin content, and burning of the skin (erythema or sunburn). It would be useful to know the types of shade used predominantly in each of the provinces as this may help better determine the types of shade children will willingly make use of. In contrast to shade use which tended to be highest in the eastern parts of the country, hat and cap use was highest in the north and north-western parts of the country and lowest in the Western Cape. It may be useful to consider wind strength and frequency in relation to solar UVR levels and hat use, since it is difficult to wear a hat when it is exceptionally windy. The use of a hat or cap was also higher than the more sun-protective hats promoted by the Cancer Association of South Africa, i.e. a broad-brimmed hat, bucket hat or cap with flaps. The latter provide far more sun protection than that which a cap provides because a cap leaves the ears and the back of the neck largely unprotected. Given that no school included in this study had a sun protection policy in place,

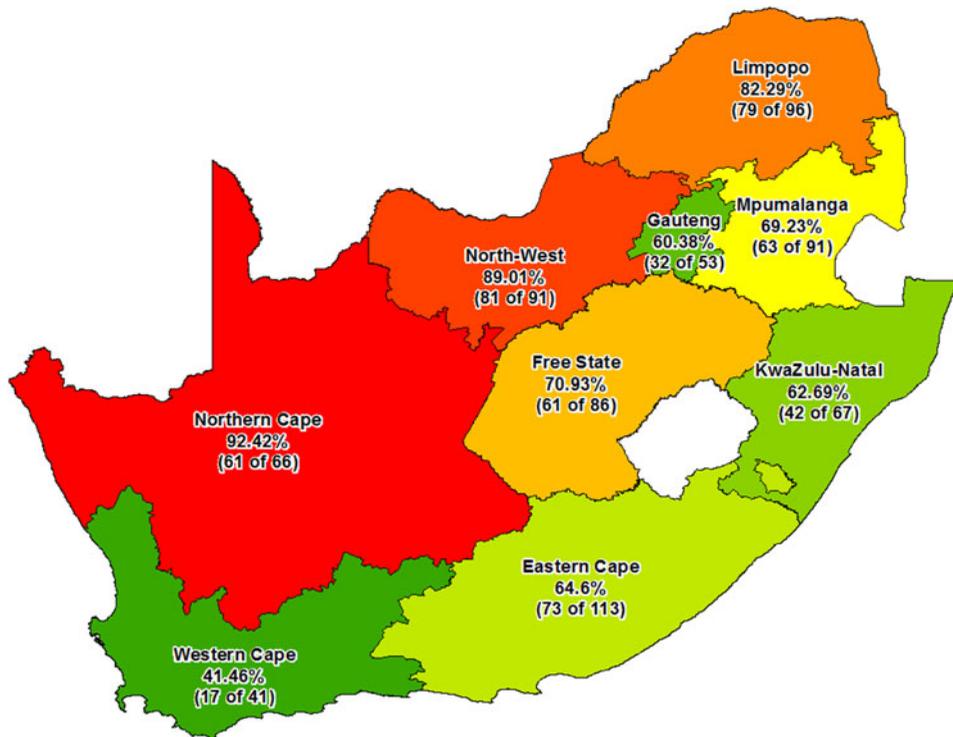


Figure 7. By province, unweighted percentage of children replying ‘sometimes/most of the time/always’ to the question, ‘How often when you were outside last summer did you wear a hat or a cap to protect yourself from getting sunburnt’ as a percentage of all replies for this question.

no school had a ‘no hat, no play’ or ‘no hat, play in the shade’ rule and very few schools had a sun-protective hat as part of the school uniform (Wright, Davids, et al., 2013), it may be that children were reporting on their hat use outside of school, i.e. on weekends and after school hours when wearing a hat may be more of a fashion statement than purposeful sun protection. Further work is needed to unravel these findings.

The question on use of clothing produced different results from a geographical perspective compared to hat use. From the unweighted results, the most number of children in KwaZulu-Natal, Limpopo and the Eastern Cape reportedly covered up with clothing to protect them from the sun. At least in KwaZulu-Natal, high humidity and temperatures may affect clothing and sunscreen use due to discomfort levels. It may also be that cultural differences in traditional dress play a role in these findings, as well as financial constraints that hinder purchasing of other sun protection alternatives. One such alternative is sunscreen and a spatial analysis of sunscreen use was quite different from clothing use. Similar percentages of children in the Eastern Cape and Free State (self-reported to be mostly White in this sample) reported to use sunscreen as those in Gauteng and Mpumalanga. Sunscreen is relatively expensive, hence one would expect that the more affluent provinces (in terms of annual household income) would have more children reporting sunscreen use. According to the Census 2011 Provinces at a Glance report (Statistics South Africa, 2012), the ranking of province by average annual household income saw the provinces in the following order: Gauteng, Western Cape, Northern Cape, KwaZulu-Natal, Mpumalanga, Free State, North West, Eastern Cape and Limpopo. Since

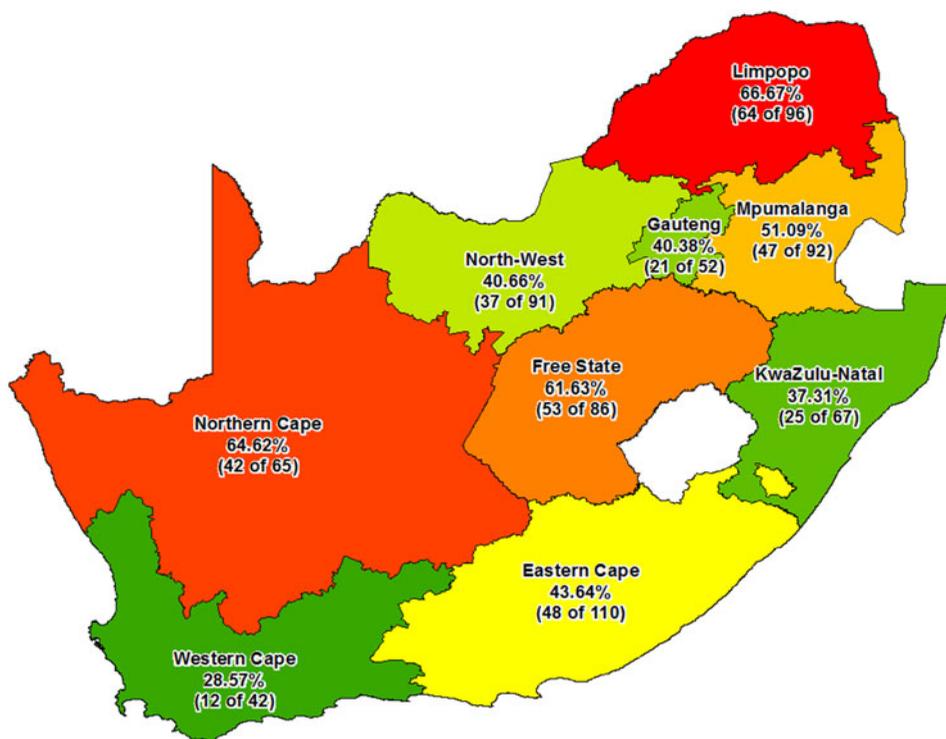


Figure 8. By province, unweighted percentage of children replying ‘sometimes/most of the time/always’ to the question, ‘How often when you were outside last summer did you wear a broad-brimmed hat, a bucket hat or a cap with flaps to protect yourself from getting sunburnt’ as a percentage of all replies for this question.

the sample of children in the Eastern Cape was mostly White children, they are unlikely to represent the majority of children in this province in terms of their annual household income and they probably come from homes that can afford to buy sunscreen for daily use. One must also consider that in South Africa, store-bought sunscreen is not the only topical agent used for sun protection. Some ethnic groups make use of clays and homemade pastes to act as skin whitening agents, but also offer, inadvertently, some sun protection (other benefits and risks are unknown). No information on the rate of use of such agents is reported in the literature, but this is considered important for future research since indigenous ‘sunscreens’ may need to be an essential part of sun awareness and sun protection campaigns in South Africa as an alternative, cost-effective choice.

Successful sun-awareness campaigns that bring reductions in the burden of disease associated with sun exposure need to be multi-pronged, customised for local conditions and run consistently for a long time. According to Statistics South Africa, the percentages of households that have a mobile phone in working order increased from 32.3% in 2001 to 88.9% in 2011, nationally. No province had less than 80% of households with at least one working mobile phone. This presents a unique opportunity for public health to provide messages regarding sun protection and awareness to families.

A limitation of our study is that we were constrained by budget for the number of schools per province that we could include in the study sample. The cross-sectional nature of the study design meant that results are a snapshot from 2012 and may differ from results

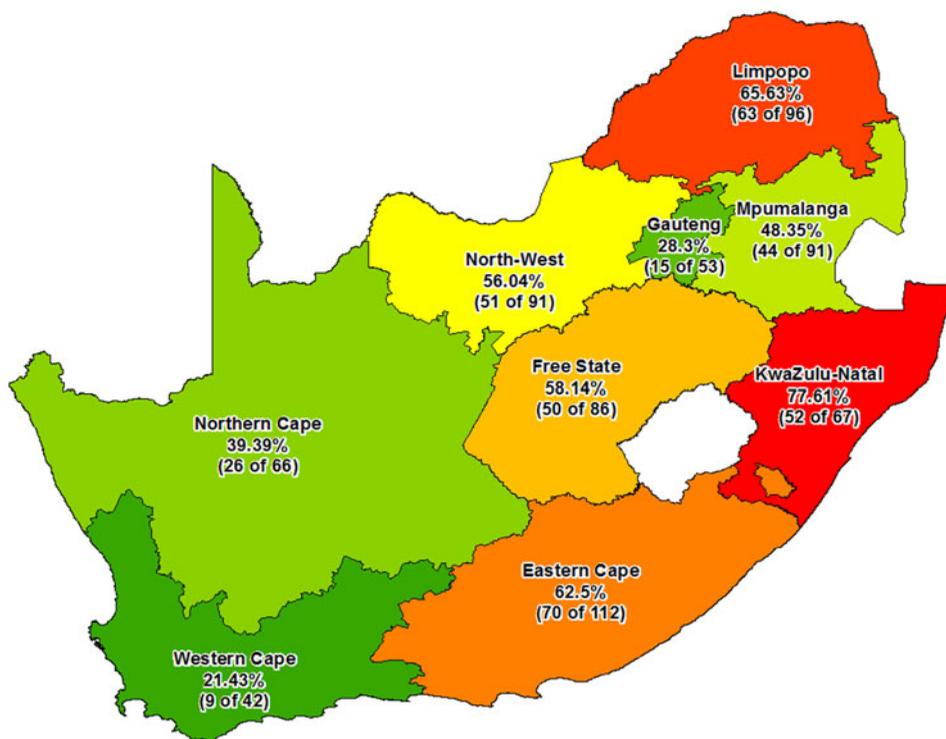


Figure 9. By province, unweighted percentage of children replying ‘sometimes/most of the time/always’ to the question, ‘How often when you were outside last summer did you cover up with clothing other than a hat to protect yourself from getting sunburnt’ as a percentage of all replies for this question.

collected in another year or from different schools. Given that ocular exposure and health impacts are of concern in South African, it would be prudent for future studies to ask questions on eye health risks and protective methods. Other study limitations include the reliance on self-reporting of usual behaviour that is strongly contextually linked; however, previous studies have shown that children are reasonably good at reporting (Riley, 2004). Children’s understanding of certain questionnaire items is also of some concern, for example, it is questionable how many children knew what a sunbed is. Focus group discussions among children aged 11–13 years would help better understand children’s knowledge of sun-related terms such as sunbed and sunscreen. The study was carried out during the third school term (late winter, early spring) by requirement of government and this may have an influence on the children’s responses compared to had the questionnaire been carried out during summer months. Questionnaires were sent via a postal survey and class lists were not provided to the researchers at the time of the survey, therefore schools were contacted at a later point to determine number of non-responders to apply in the weighting model. Exclusion criteria applied meant that the survey results were not representative of the entire South African primary school population but instead a sample of government, urban schoolchildren in the nine provinces. The study sample was not representative of the South African population aged 11–13 years in terms of skin type; there were only 40% Black children compared to approximately 80% Black children in the entire South African population of this age. Although schools were randomly selected

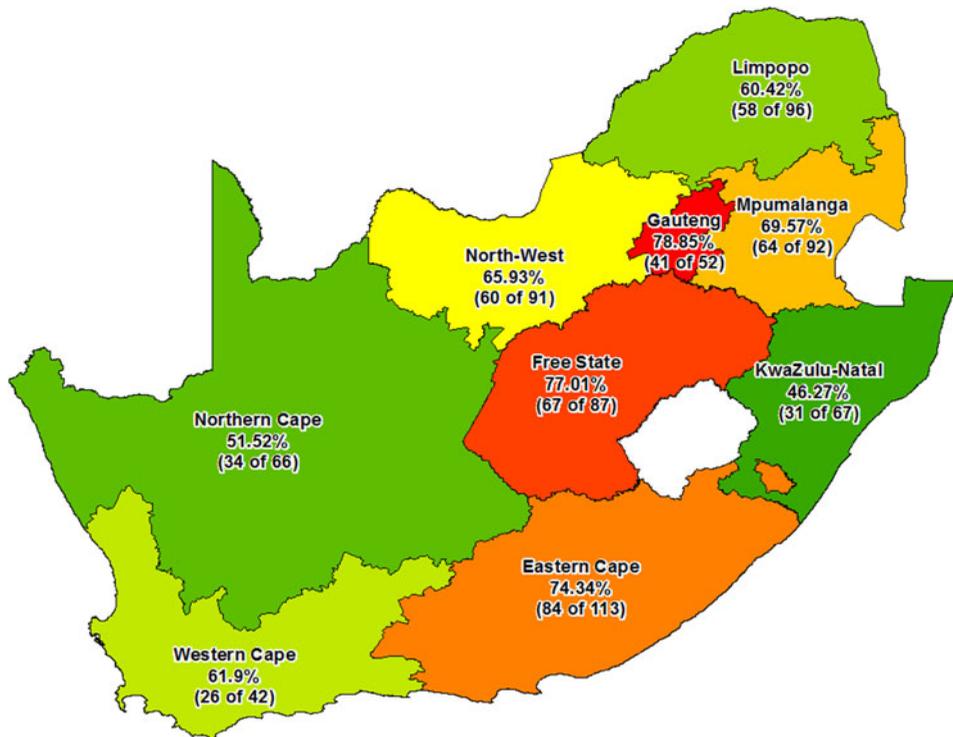


Figure 10. By province, unweighted percentage of children replying ‘sometimes/most of the time/always’ to the question, ‘How often when you were outside last summer did you use a sunscreen when you were out in the sun’ as a percentage of all replies for this question.

from the government urban primary school population in all provinces, exclusion of rural schools may have contributed towards this skewed representivity. We attempted to improve the validity of our results by applying a weighting that accounted for the number of schools in each province and the number of children at each school. Applying a weighting gives some degree of confidence for generalisation of results to a whole provincial population when the SE is low and the CI is tight. These results raise interesting questions that will trigger further research and support the need for more students in each province to be surveyed.

These study results have shown that some South African schoolchildren do practice some safe sun behaviours; however, the incidence of sunburn was relatively high. Sunburn during childhood and adolescence has been associated with skin cancer development (Oliveria et al., 2006; Saraiya et al., 2004), and is also a proxy for high sun exposure that is linked to ocular effects such as cataracts (Neale, Purdie, Hirst, & Green, 2003), and suppression of some immune responses (Norval & Wood, 2011). Evidence of differences by province in sunburn incidence as well as positive sun-related behaviours confirms that a nationwide, uniform approach to sun-awareness campaigns is not appropriate in South Africa. Children in the Western Cape reportedly had, among others, a high incidence of sunburn and one of the lowest self-reported use of sun protection such as hats and sunscreen. This is also the province known to have skin cancer incidence rates reportedly as high as those in Australia. The South African Melanoma Advisory Board (2013) has indicated that there has been a very large increase in the number of cutaneous melanoma

Table 4. Weighted proportions (% , SE, 95% CI) of children's responses to four of the nine behaviour questions by province.

Province	Last summer, got sunburnt after being in the sun			Got a suntan last summer			Suntanned regularly last summer to try to get a suntan			Ever used a suntan		
	%	SE	95% CI	%	SE	95% CI	%	SE	95% CI	%	SE	95% CI
Mpumalanga	78.71	4.69	69.5–87.93	78.09	4.83	68.6–87.58	34.62	6.4	22.05–47.2	5.2	2.01	1.26–9.14
Limpopo	54.42	5.6	43.42–65.41	61.8	5.44	51.1–72.49	8.3	3.03	23.52–14.26	4.76	2.51	–0.16–9.69
Gauteng	78.57	11.38	56.23–100.91	85.71	9.71	66.66–104.7	14.29	9.7	–4.77–33.34	14.29	9.71	–4.77–33.34
North-West	43.09	5.66	31.98–54.2	54.8	5.58	43.84–65.76	57.02	5.66	45.9–68.14	6.69	3.07	0.66–12.71
Free State	43.21	6.22	30.99–55.43	63.48	6.01	51.69–75.27	8.31	3.57	1.3–15.32	3.31	2.32	–1.24–7.89
KwaZulu-Natal	65.71	4.47	56.4–75.02	59.66	5.19	49.46–69.85	17.62	3.67	10.4–24.84	7.28	2.21	2.95–11.61
Northern Cape	36.76	6.38	24.22–49.29	26.69	5.78	15.35–38.05	7.94	3.61	0.86–15.03	4.98	2.94	–0.8–10.76
Eastern Cape	75.94	6.09	63.99–87.89	76.63	6.25	64.37–88.9	32.47	6.94	18.85–46.1	8.12	4.26	–0.24–16.48
Western Cape	68.03	5.07	58.07–77.99	55.29	5.74	44.01–66.56	11.08	3.33	4.54–17.62	2.63	1.32	0.03–5.21

Table 5. Weighted proportions (% , SE, 95% CI) of children's responses to five of the nine behaviour questions on 'last summer sometimes/most of the time/always, did you' by province.

Province	Chose to stay in the shade to protect oneself from getting sunburnt			Wore a hat or a cap to protect oneself from getting sunburnt			Wore a broad-brimmed hat, a bucket hat or a cap with flaps to protect yourself from getting sunburnt			Covered up with clothing other than a hat to protect oneself from getting sunburnt			Used a sunscreen when out in the sun		
	%	SE	95% CI	%	SE	95% CI	%	SE	95% CI	%	SE	95% CI	%	SE	95% CI
Mpumalanga	69.87	6.66	56.8–82.95	66.68	6.34	54.23–79.14	46.17	6.55	33.31–59.04	48.67	6.72	35.48–61.86	78.7	4.63	69.62–87.78
Limpopo	95.38	2.1	91.25–99.5	78.5	4.76	69.16–87.84	61.61	5.55	50.71–72.5	62.79	5.48	52.03–73.56	66.51	5.21	56.28–76.73
Gauteng	92.86	7.14	78.83–106.88	69.23	13.32	43.07–95.39	57.14	13.73	30.19–84.09	57.14	13.73	30.19–84.09	35.71	13.29	9.62–61.81
North-West	78.57	4.5	69.72–87.41	67.62	5.49	56.84–78.4	63.1	5.48	52.34–73.87	58.85	5.61	47.83–69.86	77.97	4.49	69.15–86.78
Free State	97.52	1.75	94.08–100.96	61.81	6.06	49.91–73.72	37.76	6.04	25.91–49.62	78.43	5.06	68.53–88.34	49.84	6.21	37.63–62.04
KwaZulu-Natal	88.17	2.91	82.56–93.89	66.72	5.04	56.81–76.62	45.23	5.29	34.85–55.61	63.56	5.05	53.64–73.48	78	3.95	70.25–85.75
Northern Cape	83.96	4.91	74.31–93.61	92.06	3.61	84.97–99.14	63.96	6.37	51.45–76.46	30.1	5.62	19.07–41.13	52.54	6.55	39.67–65.41
Eastern Cape	80.84	6.07	68.91–92.76	61.58	7.06	47.73–75.44	37.82	7.05	23.97–51.67	26.24	6.62	13.25–39.23	77.88	6.43	65.24–90.52
Western Cape	94.62	2.05	90.6–98.64	92.94	2.26	88.51–97.38	30.61	4.96	20.87–40.34	60.35	5.53	49.49–71.21	68.14	5.37	57.59–78.68

cases in the Western Cape, estimated as 69 per 100,000 Whites in 2009. This is about a three-fold increase over the incidence in 2000–2004 and equals or exceeds the figure of 65 per 100,000 in Australia. Health promotion officers in the Western Cape may achieve large gains in public health through the implementation of comprehensive, multi-component skin cancer prevention programmes, including in schools. The Cancer Association of South Africa may consider piloting a programme of this nature in the Western Cape and monitoring behavioural change and subsequent impact on health outcomes. An attempt to change perceptions might also help. It is possible that people self-reporting as part of the Coloured ethnic group do not see themselves as vulnerable towards excess sun exposure and thus do not attempt to protect themselves adequately.

## Conclusion

Based on our findings from the first study of sun exposure and sun protection behaviours among South African schoolchildren, provincial differences are evident and support the notion that a uniform nationwide sun-awareness campaign is not appropriate for South Africa. Further research is needed at a provincial scale to understand the reasons for the occurrence of sunburn and the uptake of sun protection behaviours. A study is also planned to assess South Africans' skin photosensitivity, including comparing self-reported skin colour to measured skin colour, in an attempt to better understand how South Africans classify their own skin type and decide on personalised sun protection choices. Hence, the results of this study and future work will work towards informing the design of sun awareness and protection intervention programmes to prepare appropriate health promotion messages for South African schoolchildren.

## Notes

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