TITLE

SunSmart schools: a New Zealand skin cancer primary prevention intervention blueprint for primary school settings

RUNNING HEAD

A skin cancer prevention intervention for primary school children

Manuscript word count: 741 excluding abstract and references

Table count: 1

Figure count: 1

Authors

BM McNoe[i]

AI Reeder[i]

MP de Lange[ii]

Names of institutions:

I. Cancer Society Social and Behavioural Research Unit, Department of Preventive and Social Medicine, Dunedin School of Medicine, University of Otago, Dunedin, New Zealand

II. Department of Preventive and Social Medicine, Dunedin School of Medicine, University of Otago, Dunedin, New Zealand

Corresponding author:

Bronwen McNoe

PO Box 56, Dunedin 9054, New Zealand

DEAR EDITOR, Skin cancer is an important public health issue. Internationally, 2 to 3 million keratinocyte cancers and 132,000 melanoma skin cancers are diagnosed annually.[1] Yet the risk of developing skin cancer can be mitigated by reducing exposure to ultraviolet radiation (UVR).[2] Although exposure to excessive UVR throughout life is important for increasing melanoma risk, it may be particularly crucial during childhood.[3] Children spend a considerable time at school and the school day encompasses the main period of high UVR. Students can spend at least part of that time outdoors and receive a substantial proportion of their total UVR exposure while at school.[4] In addition, students take part in outdoor school events, such as sports days that can result in extended periods of exposure to high UVR levels.

The World Health Organisation (WHO) recommends that schools implement a comprehensive sun protection programme that addresses policy, practice, curriculum content and environment, but also provides recognition and acknowledgement of school efforts.[5] The SunSmart Schools Accreditation Programme (SSAP), first implemented in Australia, follows these guidelines but in Australia also forms part of a broader multicomponent community wide 'SunSmart' programme which includes widespread media campaigns, interventions in workplaces, local government and other community groups. In comparison with Australia, NZ has tended to lag behind in skin cancer control. Despite NZ having the highest age standardised rate of melanoma in the world,[6] the SSAP is the only comprehensive sun protection intervention delivered nationally to any cohort. Although of concern, this does provide a unique opportunity to assess how effective the SSAP is at improving school sun protection policies and practices in a context of relative isolation and independence from other SunSmart activities. The NZ SSAP awards accreditation to schools that enrol in the programme and meet the 12 minimum accreditation criteria.

Every primary school principal in New Zealand was invited to participate in an online electronic survey of their school's sun protection policies and practices. An additive 'accreditation score' was calculated based on responses to survey questions related to each of the SSAP criteria. In total, 1243 schools participated, representing 62% of the total primary school population (age approximately 5-11 years). Responding schools represented 'all schools' well in terms of school socioeconomic decile rating, type, size and geographic area. Schools that were SunSmart accredited and/or had a higher decile rating were slightly over-represented in the final cohort. With the exception of shade provision and planning outdoor events, SunSmart accredited schools performed statistically better than non-accredited schools for all of the minimum SSAP criteria (Table 1). These differences may be attributable, at least in part, to these factors being perhaps the most difficult for most schools to attain, irrespective of accreditation status. Although the provision of shade can be very effective at protecting students from excessive UVR,[7] it can be challenging for schools to achieve as it is expensive to install and maintain, requiring fund-raising or community grants. The planning of outdoor events can be practically difficult for schools as the entire school day (9am to 3pm) falls within the period of highest clear-sky UVR (10am to 4pm).

When considering the mean score (range 0-12) for the minimum criteria, accredited schools scored significantly higher than non-accredited schools: 9.35 compared with 8.51 (95% confidence interval 0.63 to 1.04).

The main limitation of this study is that, although it does reflect behaviour rather than knowledge, it is based on self-report measures and may be subject to social desirability bias. However, onsite visits conducted with a prior sample found broad agreement between on-site observation and self-reported

sun protective practices.[8] We cannot conclude that the difference in sun protection behaviours observed between the accredited and non-accredited schools is solely due to the programme, it could potentially be that school communities more interested in sun safety join the programme, whereas those that are not do not.

The strength of the study is that it was a nationwide survey of all primary school principals and the characteristics of responding schools broadly reflected the overall demographic profile of all primary schools. It provides evidence that the delivery of a comprehensive sun protection programme in a primary school setting is positively associated with school sun protection policies and practices, which can reduce students' exposure to excessive UVR and, ultimately, their risk of skin cancer.

Funding: Cancer Society of New Zealand and University of Otago

Conflict of interest:

Both BMM and AIR report grants from Cancer Society of New Zealand Inc during the study period.

Table 1: Minimal criteria for accreditation in SSAP

Criteria		Accredited schools		Non accredited schools		Difference
		n	%[1]	n	%[1]	p-value
1	Compulsory sun protective hat worn	480	86.6	374	58.6	<0.001
2	Sun protection policy	571	100.0	571	96.8	<0.001
3	All school community informed of sun protection policy	533	94.2	492	80.9	<0.001
4	Students not wearing hat must play in allocated shade areas	528	95.3	551	85.8	<0.001
5	Broad spectrum sunscreen of at least SPF30 encouraged	448	79.2	448	71.1	0.001
6	Sun protective clothing encouraged	457	80.6	465	72.5	0.001
7	Staff role model sun protective hats	512	95.9	504	83.9	<0.001
8	SunSmart programmes formally included in the curriculum	247	47.5	227	40.0	0.014
9	Sun protection considered in formal planning documents for outdoor events	353	66.6	389	65.3	0.66
10	Outdoor activities are rescheduled whenever possible to minimise time outdoors	180	33.7	133	22.2	<0.001
11	School has sufficient shade or is working towards sufficient shade for most passive activities (e.g. eating lunch, outdoor classroom activities)	279	50.4	347	54.6	0.146
12	Board of Trustees review shade policy at least tri-annually	526	98.3	478	85.1	<0.001

[1]Of respondents to the question.

REFERENCES

1 World Health Organisation. Skin cancers. (http://www.who.int/uv/faq/skincancer/en/index1.html). In. Accessed February 2018.

2 Armstrong B, Autier P, Bajdik CD *et al. Prevention of Skin Cancer*. Dordrecht: Kluwer Academic Publishers. 2004.

3 Whiteman D, Whiteman CA, Green A. Childhood sun exposure as a risk factor for melanoma: A systematic review of epidemiologic studies. *Cancer Causes Control* 2001; **12**: 69-82.

4 Wright C, Reeder A, Bodeker G *et al.* Solar UVR exposure, concurrent activities and sun-protective practices among primary schoolchildren. *Photochem. Photobiol.* 2007; **83**: 749-58.

5 World Health Organization. Sun Protection and Schools. How to Make a Difference. Geneva. 2003.

6 Whiteman DC, Green AC, Olsen CM. The growing burden of invasive melanoma: projections of incidence rates and numbers of new cases in six susceptible populations to 2031. *J. Invest. Dermatol.* 2016; **136**: 1161-71.

7 Parisi AV, Turnbull DJ. Shade provision for UV minimization: A review. *Photochem. Photobiol.* 2014; **90**: 479-90.

8 Jopson JA, Reeder AI. SunSmart voices: Results from site visits to 22 primary schools throughout New Zealand. In: *Technical Report*. Dunedin, New Zealand: Cancer Society Social & Behavioural Research Unit, Department of Preventive & Social Medicine, Dunedin School of Medicine, University of Otago. 2011; 1-50.