SunSmart UV dosimetry programmes: From Southern Californian to New Zealand schools

'Tell me, and I will forget. Show me, and I may remember. Involve me, and I will understand' – Confucius ~450 BC

Martin W. Allen[1], Kimberley Miller[2], and Myles Cockburn[2]

1. MacDiarmid Institute for Advanced Materials and Nanotechnology, Department of Electrical and Computer Engineering, University of Canterbury, Christchurch, New Zealand **(email: martin.allen@canterbury.ac.nz)**
2. Keck School of Medicine, University of Southern California, Los Angeles, CA, USA **(email: mylesc@usc.edu)**

Abstract. We review the issues surrounding the potential introduction into New Zealand Schools of SunSmart UV Dosimetry interventions, similar to those pioneered in elementary schools in Los Angeles, California by the University of Southern California, using personal electronic UV dosimeters initially developed at the University of Canterbury, New Zealand.

Introduction

Excessive exposure to ultraviolet (UV) radiation and a history of sunburns in childhood and adolescence can significantly increase melanoma risk in adulthood. Lifetime patterns of sun exposure and protection are strongly influenced by knowledge, attitudes, and behaviour acquired while at school. A large percentage of lifetime UV exposure (up to 80%) occurs before 18 and at ages when the skin is more vulnerable to carcinogenic effects. Children in New Zealand attend school for at least 190 days a year and as such a significant proportion of childhood UV exposure may occur on school days, making school-based sun-exposure education programmes a significant primary skin cancer prevention opportunity.

Most schools in New Zealand have a 50-minute lunch break close to the solar noon, and a 25-minute morning interval, during which children are nearly always outside. During term 1 (Feb-Apr) and term 4 (Oct-Dec) the UV irradiance and the available erythemal dose during these periods can reach extreme levels and represents a high-risk period for excessive UV exposure. Table 1 shows that the mean weekly available dose may often exceed 40 SED (where 1 SED = 100 Jm^{-2} of erythemal UV radiation).

AUCKLAND, NZ.	Term 1			Term 4		
Max (Mean) Values	Feb	Mar	Apr	Oct	Nov	Dec
Noon Erythemal Irradiance (UVI)	11 (8)	7 (7)	4 (4)	8 (6)	11 (8)	13 (9)
Lunch-time (50 min) dose (SED)	8 (6)	5 (5)	3 (3)	6 (5)	8 (6)	10 (7)
11:00 am Erythemal Irradiance (UVI	7 (6)	4 (5)	4 (4)	8 (4)	9 (7)	10 (7)
Morning-break (25 min) dose (SED)	3 (2)	2 (2)	2 (2)	3 (2)	3 (3)	4 (3)
School (5-day) weekly dose (SED)	**54 (41)**	**34 (36)**	**23 (23)**	**45 (30)**	**58 (43)**	**68 (47)**

Table 1. Monthly values of the maximum (clear-sky) and mean (including clouds) UVI irradiance and available erythemal dose in Auckland, during a 50 minute school lunch-break centred at the solar noon and during a 25-minute morning break centred at 11:00 am. Data calculated from at least 5 years of UV measurements taken at Leigh, Auckland by NIWA (McKenzie 2008). (Note: 50 minute lunch-time dose = 0.75 * solar noon UVI)

What is USC SunSmart

SunSmart is a health education intervention, developed in 2006 by Assoc. Prof. Myles Cockburn and co-workers at the University of Southern California (USC) to teach elementary school students in the Los Angeles Unified School District about sun safety, through interactive lessons and group activities. Students learn to avoid excessive sun exposure by wearing protective clothing, applying sunscreen, and seeking shade during peak hours. The intervention involves three 1-hour workshops covering the harmful effects of sun exposure, use of sunscreen, use of protective clothing and hats, sun avoidance during peak hours, and shade seeking. Overall aims are to help reduce melanoma incidence in Southern California and to heighten the perceived risk for skin cancer leading to secondary prevention in adulthood.

Statistical evaluation of the programme in 2012 reported an increase in knowledge, intentions, and attitudes towards sun protective methods, but little demonstrated improvement in (self-reported) behaviour. Significantly, these findings mirror those of nearly all sun safety interventions targeted at children.

In 2013, the intervention was extended to include a 1-hour 'UV Dosimetry Laboratory', designed to provide an experiential element to reinforce the classroom-based learning. Students carry out their own investigations, with guidance from trained volunteer facilitators, collecting UV exposure data, using electronic dosimeters, from their school environment (including direct sun and shaded locations) and comparing the results against their own predictions. Extension activities include investigating the protection provided by hats, sunglasses, and sunscreen. By participating in the UV Dosimetry Laboratory, students experience a direct encounter with the nature of UV exposure rather than just thinking about it.

At the same time, a four-year $3.3 million randomized control trial, funded by the National Institutes of Health (NIH), was initiated to test the efficacy of the new intervention, in comparison to "regular" SunSmart alone and a no-intervention control. This trial involves at least 1,575 fourth and fifth grade children (9-11 years) from at least 18 Los Angeles elementary schools. In an innovative approach, baseline and follow-up UV exposure data, in a subset of at least 315 students, will be measured using the same electronic dosimeters, worn over 3 week periods. This will directly measure the students' post-intervention behaviors, allowing the effectiveness of the intervention to be directly verified with real-time UV exposure data.

The impact of the intervention is potentially far-reaching, since it is being conducted amongst a potential target population of almost 700,000 school children exposed to some of the highest levels of UV in the USA.

Forecast UV Index levels in Los Angeles (340 N) exceed UVI 8 (very high) from March to the end of September.

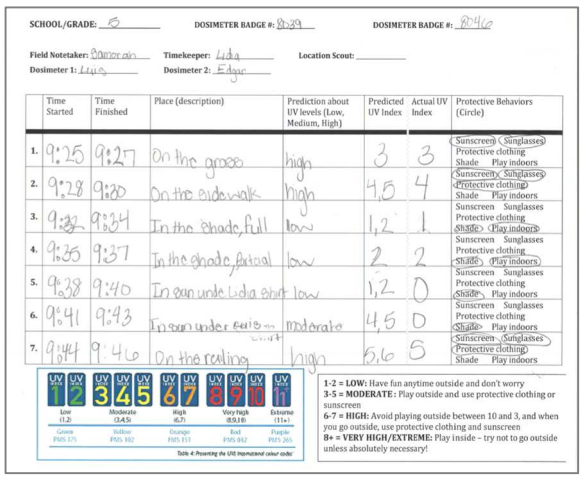
Key elements of the UV Dosimetry Laboratory:

Using personal electronic UV dosimeters, students work in teams of 4-5 to measure the UV exposure levels around their school environment, and then compare a visual graph of their results against expectations, based on their current sun protection knowledge and attitudes.

Step 1: Group discussion on locations and activities for the investigation.
Step 2: Make predictions based on their current sun protection knowledge.
Step 3: Field work - collecting UV exposure data from their school environment.
Step 4: Analysing a graph of their results, labelling locations and activities, comparing the results with their own predictions.
Step 5: Students make their own conclusions and behavioural recommendations.

Student roles include Field Notetaker, Time Keeper, Location Scout, Dosimeter Keeper #1, and Dosimeter Keeper #2. Each group is accompanied by a trained volunteer USC graduate student. Targeted locations include areas where the students commonly play, eat lunch, direct-sun, shade, under sunglasses, clothing etc. A Facebook page (https://www.facebook.com/usc.sunsmart) shows examples of students engaged in the laboratory.

Figure 1. left to right: Time Keeper, Field Notetaker, and Dosimeter Keeper.



SCHOOL/GRADE: 6 DOSIMETER BADGE #: 20039 DOSIMETER BADGE #: 20462

Field Notetaker: Damoran Timekeeper: Lidia Location Scout:

Dosimeter 1: Lucia Dosimeter 2: Edgar

	Time Started	Time Finished	Place (description)	Prediction about UV levels (Low, Medium, High)	Predicted UV Index	Actual UV Index	Protective Behaviors (Circle)
1.	9:25	9:27	On the grass	high	3	3	Sunscreen Sunglasses Protective clothing Shade Play indoors
2.	9:28	9:30	On the sidewalk	high	4,5	4	Sunscreen Sunglasses Protective clothing Shade Play indoors
3.	9:32	9:34	In the shade, full	low	1,2	1	Sunscreen Sunglasses Protective clothing Shade Play indoors
4.	9:35	9:37	In the shade, facial	low	2	2	Sunscreen Sunglasses Protective clothing Shade Play indoors
5.	9:38	9:40	In sun under Lidia shirt	low	1,2	0	Sunscreen Sunglasses Protective clothing Shade Play indoors
6.	9:41	9:43	In sun under tents	moderate	4,5	0	Sunscreen Sunglasses Protective clothing Shade Play indoors
7.	9:44	9:46	On the railing	high	5,6	5	Sunscreen Sunglasses Protective clothing Shade Play indoors

UV 1 2 Low (1,2) Green; UV 3 4 5 Moderate (3,4,5) Yellow; UV 6 7 High (6,7) Orange; UV 8 9 10 Very high (8,9,10) Red; UV 11+ Extreme (11+) Purple

Table 4: Presenting the UVI International colour code

1-2 = LOW: Have fun anytime outside and don't worry
3-5 = MODERATE: Play outside and use protective clothing or sunscreen
6-7 = HIGH: Avoid playing outside between 10 and 3, and when you go outside, use protective clothing and sunscreen
8+ = VERY HIGH/EXTREME: Play inside – try not to go outside unless absolutely necessary!

Figure 2. Example Field Note-sheet for the UV Dosimetry Laboratory.

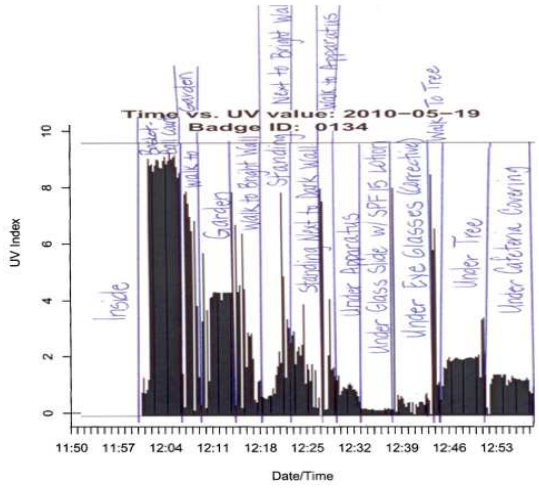


Figure 3. UV Index Graph downloaded from the UV dosimeter and labelled against the locations recorded by the Notetaker.

New Zealand Transferability Issues

Similar personal UV dosimeters have previously been used in New Zealand schools to measure the UV exposures of 345 children at 23 primary schools through-out the country. UV exposures were found to be generally higher on weekdays compared to weekends, confirming the importance of school sun protection initiatives (Wright 2007). Public access to UV climatology data is unrivalled in New Zealand, thanks to the efforts of NIWA. (http://www.niwa.co.nz/our-services/online-services/uv-ozone). However, a number of issues need to be addressed:

- Teacher buy in – must be carefully linked to the appropriate NZ health and sciences curricula.
- Primary or Secondary Schools? – Primary school programmes already successfully introduced into LA.
- Secondary school programmes offer an opportunity to re-establish sun safe attitudes and behavior acquired at primary school but lost/unlearnt during adolescence.
- Secondary school interventions need a stronger focus on experiential self-discovery rather than instruction and a more sophisticated set of experiments.
- A powerful approach might be to use senior secondary students to help out in primary school programmes.
- Issues with limited UV Index reporting in the New Zealand news media – use of on-line web delivery (e.g. NIWA) and smartphone apps can fill the gap.
- What about vitamin D? Avoiding mixed messages!
- Can it be 'shrink-wrapped for wide dissemination.

References

McKenzie, R.L., 2008. A Climatology of UVI for New Zealand. NIWA Client Report: LAU2007- 02RLM January 2008.

Wright C., Reeder A., Bodeker, Gray A., and Cox B., 2007. Solar UVR Exposure, Concurrent Activities and Sun-Protective Practices among Primary School Children. Photochem. Photobiol. 83, 749-758 (2007).

Acknowledgments

The National Cancer Institute and The National Institute of Child Health and Human Development [Grant R01-CA158407] (Cockburn, PI).