Factors associated with body coverage and personal UV radiation dose: preliminary findings.

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Abstract. Personal received solar ultraviolet radiation (UVR) is the primary influence on serum 25-hydroxyvitamin D (25(OH)D) levels. Demographic, personal and behavioural factors have the potential to affect received UVR. Body clothing coverage and personal dosimeter UVR data from 247 participants (18-80 years) in Year 1 of the Vitamin D and Sun Exposure study were analysed and associations with demographic, personal and behavioural factors investigated.

Introduction

Levels of 25(OH)D among many in the New Zealand population have been reported as insufficient. Received solar ultraviolet radiation (UVR) is the primary influence on serum 25(OH)D levels. However, little is known about the relations between UVR exposure and vitamin D levels. Accordingly, one aim of the overall project of which this particular study is part, was 'to quantify relations between sun exposure and changes in controlling for demographic, personal and geophysical factors.' These factors include sex, age, self-defined ethnicity, skin type, Body Mass Index (BMI)), outdoor occupation, geographical region, season and weekend versus weekday exposure. The present study focuses on the associations between UVR and body coverage and these possible influences. Information about potentially modifiable factors is important for the design of health promotion interventions for reducing the risk of vitamin D deficiency or insufficiency as well as skin cancer. Similarly, information about non-modifiable factors is potentially useful for targeting health promotion interventions. The specific aims for the study reported here were to report differences in percentage body coverage and personal UVR dose, in SEDs, by key demographic and personal factors.

Methods

Study sample

The sample for these preliminary analyses included all those recruited during Year 1 (2008) of the overall study for whom full data were available *(see Table 1)*.

Table 1: Participants included in statistical models

	Auckland	Dunedin	Total
Females	117	51	168
Males	44	35	79
	161	86	247

Instruments

UVR exposure was measured by personal dosimeter fixed onto an elastic arm band with a velcro closure worn outside of clothing. These dosimeters have a spectral response that closely matches the erythemal action spectrum and provide time-stamped measures of UVR thereby, for example, allowing comparison between weekday and weekend exposure. Their full technical specifications are described elsewhere (Allen et al. 2005), and their use has been reported in two population studies, one among school children, (Wright et al., 2007) the other among outdoor workers (Hammond et al., 2009). The daily diary used to obtain data on body coverage was based a clothing diary previously developed and used among school children (Wright et al., 2007), then adapted for use in the study of outdoor workers (Hammond et al., 2009) and finally extended for the current study to include a wider range of adult clothing, allowing for cultural differences. The diary time periods were the three time bands used for Southern Hemisphere sun protection advice, September to March, i.e. before 11am, 11am to 4pm, and after 4pm. This report focuses on the middle period, during which approximately 64% of total UVR dose was received. The clothing data were then converted to percentage body coverage using the Lund and Browder chart (Hettiartchy & Papini, 2004). Height and weight were measured using, respectively, a SECA stadiometer and Tanita HD-316 scales by Wedderburn. From these two measures, a body mass index (BMI) value (kg/m^2) was calculated. Skin colour at the upper inner arm, an area minimally exposed to the sun, was measured using a Datacolor CHECK™ spectrophotometer and converted to individual typology angle (ITA) values, following Del Bino et al. (2006). Outdoor occupation was based on self reports of the past four weeks obtained during baseline interview.

Results

The distribution of arithmetic mean percentage body coverage by calendar month for the Auckland and Dunedin participants is presented, with 95% confidence intervals in **Figure 1**. There were consistently higher levels of body coverage for the more southerly, Dunedin participants. There was a divergence in mean body coverage between the two centres in spring (after August), with Dunedin coverage remaining relatively steady, but Auckland coverage gradually reducing. The highest levels of mean body coverage, mostly above 80%, occurred approximately from April to September, usually the coldest months in both centres.

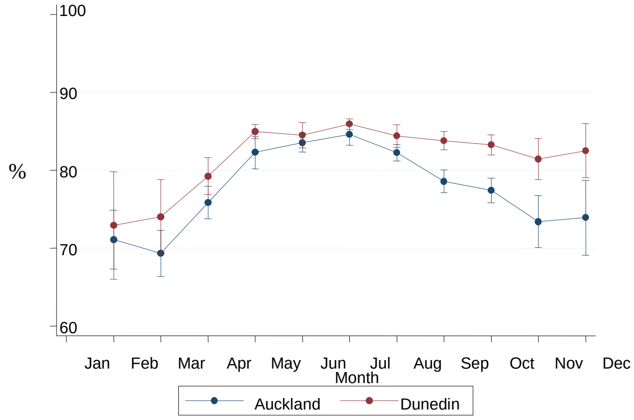

Figure 1: Arithmetic mean percentage body overage

The associations of a range of plausible influences with reported body coverage and dosimeter measured SEDs are presented in Tables 2 and 3, respectively. Each partially adjusted model controls for centre, season and the interaction between these two factors, whereas the fully adjusted models control for all reported factors. Fractional polynomials were used to assess the linearity of the continuous predictors (age, BMI, and ITA), but no significant departures from linearity were noted. With respect to body coverage (Table 1), an age effect in the partially adjusted model remains statistically significant when fully adjusted for all factors, with increased coverage for increasing age. A weekend effect is the only other effect that is statistically significant in both models, with lower coverage at weekends. The outdoor worker effect goes from being marginally statistically significant in the partially adjusted model (lower coverage for outdoor workers) to a non-statistically significant result in the fully adjusted model. When log-transformed SEDs and cloud adjusted maximum UVR were individually added to the model, higher SEDs and higher maximum UVR were each statistically significantly associated with lower body coverage (p<0.001 for both).

Table 2: Body coverage models

	Partially adjusted model		Fully adjusted model	
	Difference in arithmetic means (95% CI)	p-value	Difference in arithmetic means (95% CI)	p-value
ITA, per 10 units)	-0.1 (-0.5-0.3)	0.575	-0.2 (-0.5-0.2)	0.404
Female	1.1 (-0.5-2.8)	0.177	0.9 (-0.6-2.4)	0.233
BMI (per 5 units)	-0.3 (-0.9-0.2)	0.261	-0.3 (-0.8-0.2)	0.279
Age (per 10 yrs)	0.7 (0.3-1.1)	0.001	0.7 (0.3-1.1)	0.002
Weekend	-2.7 (-3.3--2.1)	<0.001	-2.7 (-3.3—2.1)	<0.001
Outdoor worker	-2.6 (-5.1-0.0)	0.046	-1.9 (-4.4-0.6)	0.131

With respect to dosimeter measured SEDs, there was a non-statistically significant tendency for females to have a lower SEDs dose in the partially adjusted, but not the fully adjusted model. For each decade of age, the dose increased by roughly a quarter in both models. There was a significantly lower dose at weekends in both models. An outdoor worker effect was statistically significant in both models, with an approximate doubling of dose in the fully adjusted model. When cloud adjusted maximum UVR was added to the model, it was statistically significantly associated with higher SEDs (p<0.001), while the other associations remained unchanged.

Table 3: UVR dose models

	Partially adjusted model		Fully adjusted model	
	Difference in arithmetic means (95% CI)	p-value	Difference in arithmetic means (95% CI)	p-value
ITA, per 10 units)	1.04 (0.95-1.12)	0.431	1.06 (0.97-1.15)	0.186
Female	0.74 (0.53-1.02)	0.068	0.82 (0.59-1.13)	0.215
BMI (per 5 units)	1.04 (0.91-1.19)	0.537	1.00 (0.88-1.14)	0.988
Age (per 10 years)	1.23 (1.11-1.37)	<0.001	1.26 (1.13-1.39)	<0.001
Weekend	0.80 (0.69-0.93)	0.004	0.8 (0.69-0.93)	0.004
Outdoor worker	1.79 (1.17-2.73)	0.008	1.95 (1.24-3.07)	0.004

Discussion

A number of plausible, statistically significant results were obtained and these potentially have considerable practical significance. Those who reported occupational outdoor work were found to have almost double the UVR dose. Body coverage increased significantly with increasing age, whereas UVR dose increased by approximately 25% for each decade of age. There was lower body coverage at weekends, but also a lower UVR dose. The latter may be due to spending time indoors, but could also indicate lower compliance with study protocols on wearing dosimeters at weekends. Some next steps will be to confirm these preliminary findings in the full dataset and to identify and investigate plausible interactions.

References

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