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ORIGINAL ARTICLE

Assessing population-wide behaviour change: concordance of 10-year trends in self-reported and observed sun protection

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Abstract
Objectives Increases in socially desirable responses in self-reports might occur in the context of ongoing public education. We examine concordance of trends in two long-term studies monitoring population impact for SunSmart.
Methods One study employed telephone interviews of Melbourne residents; the other entailed observations at public recreation venues across Melbourne. The studies assessed people's sun protection on identical weekend dates (Nw = 33 dates). Data from five summers between 1992 and 2001 ($n \sim 23{,}000$ individuals) were analysed. A body cover index score was calculated for participants on each date. Outcomes were aggregated separately for Saturdays and Sundays by date and year. Regression analyses tested whether these trends differed by survey method.
Results The pattern of change in body cover over time was similar for both surveys. Self-reported body cover was consistently higher than observed body cover, suggesting that social desirability bias may be present. Regression analyses showed no divergence between self-reported and observed trends in mean body cover, suggesting no evidence of significant increased social desirability bias in self-reporting over time.
Conclusion Findings suggest that self-report offers a valid means of assessing change in a population's sun protection compliance over time, at least when self-reports are precisely focussed for time and activity context.

Keywords Validity · Observational measures · Self-report · Sun protection · Behaviours

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Introduction

Accurate monitoring of the behavioural outcomes of public education to prevent skin cancer is a crucial step in ensuring effectiveness. A number of studies verify the validity and reliability of self-reports for measuring adults' and children's sun protection behaviours. Nonetheless, discrepancies between self-report and more objective measures often exist, with either inflated reports or unsystematic differences when comparisons are made (Glanz et al. 2009, 2010; O'Riordan et al. 2008, 2009).

Skin cancer is readily prevented by reducing exposure to ultraviolet radiation (UVR) among susceptible populations (Glanz and Saraiya 2005). Since the 1980s in the Australian state of Victoria, public education campaigns have promoted the population's use of covering clothing, hats and sunscreen when outdoors (Anti-Cancer Council of Victoria 1981). The 'SunSmart' program implemented public education and advocacy strategies to promote policy development and environmental change to community groups and organisations for over two decades (Hill et al. 2009). 'SunSmart' awareness across the state population has steadily increased from 46 % in 1989, 65 % in 1992 (Anti-Cancer Council of Victoria 1994), 81 % in 1995, 87 % in 1998 (Anti-Cancer Council of Victoria 1999), to 94 % in 2006–2007 (Dobbinson et al. 2007).

Except for people with rare genetic diseases, skin cancers develop years after the UVR exposure (Situm et al.

2008). Ultimately, the effectiveness of these programs in promoting behaviour change is measured by monitoring skin cancer incidence over time. Encouragingly, malignant melanoma rates among younger cohorts have declined in recent years in Victoria, although incidence increased overall (Thursfield and Giles 2007). This pattern of incidence change supports the likelihood that public education contributed to the reductions in skin cancer rates (Staples et al. 2006). Still without evidence of behaviour change a link between the program and the decline in skin cancer is weak. Assessment of the population's behaviours alongside measures of program delivery and reach is needed to determine the value of these investments.

Self-report surveys are widely used for assessing sun protection behaviours at the population level (Dobbinson and Hill 2004; Dobbinson et al. 2008a; Glanz and Mayer 2005; Shoveller and Lovato 2001). Their advantages include the potential generalisability of the findings, the ability to ask questions about non-observable influences on behaviours (knowledge, attitudes or beliefs, and intentions), as well as past experiences (sunburn) and sun protection habits. Clothing and hat use may be readily observed. However, observing sunburn is difficult given a change in skin colour may be slow to develop after exposure; while sunscreen may be applied prior to the outdoor activity and therefore also not readily observed. Sunburn is an important short-term marker of excessive exposure and skin cancer risk (Dennis et al. 2008) and therefore self-reports of recent sunburn provide a useful exposure outcome measure for public education programs. For these reasons, telephone-based self-report surveys of the population have provided an important evaluation tool for the SunSmart program across the decades providing rapid feedback to inform and improve program delivery (Hill et al. 2009).

Nonetheless, reliance on self-reports for monitoring behaviour change across the years raises specific potential threats to internal validity. For example, socially desirable responses may inconveniently increase as an artefact of higher exposure to campaign messages. Independent evidence (e.g. objective measures) that is consistent with self-report would enhance confidence in conclusions drawn from self-reports of sun-related behaviours about program outcomes.

Several studies have utilised objective measures of sun exposure and sun protection behaviours. Methods include the use of colorimeters to measure depth of tan and sunburnt skin (Creech and Mayer 1997), skin swabbing to measure sunscreen use (O'Riordan et al. 2006), video observations of sun protection behaviours (Dobbinson et al. 2009; Milne et al. 1999; Stanton et al. 2003), and polysulphone badges to measure UVR exposure levels (Andersen et al. 2010; O'Riordan et al. 2008; Stanton et al. 2003; Yaroch et al. 2006). However, these technical approaches are problematic for generating population estimates, for reasons including their intrusiveness (which may itself influence the behaviour) and the fact that behaviour is typically inferred from measures of the exposure after the behaviour occurred rather than observed directly. For larger population studies, direct observations of people's use of sun protection in outdoor recreational settings are likely to provide most comparability with self-report methods (Dixon et al. 2008; Lagerlund et al. 2006; Maddock et al. 2007; O'Riordan et al. 2006).

Previous research comparing objective and self-reported sun protection behaviours suggests that self-reports are relatively valid (Glanz and Mayer 2005; O'Riordan et al. 2009) with one study in particular showing relatively good internal consistency of self-reports (Glanz and Mayer 2005). An important question to be answered is whether the social desirability bias increases over time as awareness of skin cancer campaigns increases. The current study examines the 10-year trends (long-term patterns of concordance) in self-reported compared with observed use of sun protection in two large population-based studies in Melbourne, the capital of Victoria.

Methods

Design

Our data sources were from the Sun Survey and Sun Observation studies in Melbourne. The data used from these studies met the criteria of having measurements of participants' sun protection behaviours relating to the same dates, times and city. Specifically, dates from 1992 to 2002 on Saturdays and Sundays in February between the hours of 11 a.m. and 3 p.m. were considered. A brief summary of the methods for each study is outlined below and the details have been previously published (Dixon et al. 2008; Dobbinson et al. 2008b; Hill et al. 1992, 1993; Lagerlund et al. 2006). These studies provide concurrent assessment of people's sun protection behaviours in Melbourne from which we examined correspondence between self-reported and observed trends over time between 1992 and 2001 for a single outcome measure of the proportion of protected skin covered by clothing and hats. Sunglasses use was not considered in the outcome measure given observation of sunglasses began in 1993. Data for 2002 were excluded, as inclement weather restricted the observation data collection to too few February dates.

Self-reported telephone surveys

Population-based surveys of the weekend sun protection behaviours and sunburn of Melbourne residents' age

14–69 years have been conducted since the summer of 1987–1988. These surveys provide the main measure to assess the impact of the SunSmart program on the population of Victoria. Weekly cross-sectional telephone interviews were conducted on Monday and Tuesday evenings during the Southern hemisphere summer. Respondents were interviewed via self-report about the sun protection they used during the Saturday and Sunday prior to interview. The study minimises recall bias for self-reports by asking about the behaviours of respondents on specific recent dates during the peak UVR hours. To avoid cuing socially desirable responses, questions on health knowledge were sequenced after those on activities, clothing cover and hats. In the interests of response validity, priority was given to asking questions within 72 h of the behaviours taking place, which prevented extended call backs to maximise response rates. Response rates decreased over time (53 % in 1988, 45 % in 1992 and 23 % in 2001) in line with the experience of telephone survey organizations during this period. Despite falling response rates, previous analyses indicated that little variation in age, sex, or skin-type of participants across years, and changes in educational attainment and employment categories of participants reflected the population changes (Dobbinson et al. 2008b).

Observational surveys

The Sun Observation study was established in February 1992. The study observed teenagers' and adults' sun protection compliance during leisure outdoor activities in public recreational venues across the city of Melbourne on weekends in February (and occasionally early March). People excluded from the observations were those wearing uniforms (including sports uniforms) or religious clothing (religious headwear) or working. The recreational settings included parks and gardens, pools and beaches, golf courses and tennis courts. Observations of participants' use of shade, clothing, hats and sunglasses were made by trained research assistants following written study protocols and demonstrate high inter-rater agreement on most measures. Those measures used in current analyses (headwear, shirt sleeve-length and leg cover) all had intra-class correlations above 0.90 (Lagerlund et al. 2006).

Comparability of samples

The observation sample related to the population's outdoor leisure recreation in public settings excluding people in sporting or other uniforms, while the telephone surveys considered sun protection during all activities including in private settings and other public venue types (e.g. outdoor cafes in retail shopping precincts, or boating off-shore were not included in the observational study). To improve comparability, respondents who reported that they were out of the Melbourne metropolitan area during their outdoor activity were excluded from the analyses.

Comparability of measures

The observations and self-reports provided comparable measurement of the sun protection behaviours of participants during their outdoor activities. For example, the recording of the extent of protection to the arms and upper body by clothing was equivalent (none, sleeveless/singlet, short-sleeved, elbow length, ¾ length or long-sleeved) for both self-reports and observations.

Previous studies (Dixon et al. 2008; Lagerlund et al. 2006) have noted that cloud varies by location. To adjust for cloud during people's outdoor activities we utilised the respondents' reports for the telephone-based data and observer ratings of cloud at the venues for the observational data. The observer ratings were collapsed into the categories sunny, in-between, cloudy, or cannot say, which were identical to the self-report responses.

The ambient 3 p.m. temperatures recorded at the central Melbourne meteorology station were also added to link the prevalence data with temperature conditions for the relevant weekend dates. Age is observed based on physical appearance for observations (intra-class correlations $p = 0.81$) (35) and is self-reported for the telephone survey.

Statistical analysis

The data considered in our analysis of self-reported and observed sun protection use were collected during five summers from 1992 to 2001 on which people's sun protection was assessed on concurrent dates in February. Selecting the measures of sun protection for the same dates in both studies meant that the local weather conditions were equivalent.

Both studies were cross-sectional but variations in study design resulted in self-reports for Saturday and Sunday by the same individual, and the independent observations were highly likely to have been of different individuals at the venues each day. For this reason the sun protection outcomes for Saturdays and Sundays were examined separately. In addition, the respondents' self-reports for the given day were only included in the analyses if the respondent was outdoors in Melbourne during the peak UVR period on that date. The final analyses were based on two separate weekend day and year datasets. There were $n = 12{,}241$ people observed and $n = 1{,}017$ self-reports on 18 Saturdays in one dataset, and $n = 9{,}578$ people observed and $n = 810$ self-reports on 15 Sundays in the other dataset (see Table 1 for selection).

Table 1 Selection of participants with sun protection measures assessed on comparable dates in Melbourne 1992–2001 (unweighted *N*)

	Self-report	Observation	Total
Total study participants 1992–2001 equivalent years	6,392[a]	23,130	N/A
Participants in February	2,063[b]	21,819[c]	N/A
N outdoors on 18 equivalent Saturday dates 1992–2001	1,017	12,241[c]	13,258
N complete BCI data for Saturday dates[d]	662	12,151	12,813
N outdoors on 15 equivalent Sunday dates 1992–2001	810	9,578[c]	10,388
N complete BCI data for Sunday dates[d]	547	9,508	10,055

BCI body cover index

[a] Of Sun Survey respondents interviewed during December–February (and occasionally March) in 1992–2001, 69.7 % were outdoors on at least 1 day of the weekend for consideration in this study

[b] Excluded participants with missing age, sex or skin type. $N = 106$ interviews on one March date related to February weekend activities. Of the remaining $N = 2{,}063$ respondents, $n = 1{,}438$ reported were outdoors on at least 1 day of the weekend

[c] Excluded observation participants with missing/unknown age or sex

[d] Excluded cases with missing data needed to calculate the body cover index score, and respondents out of Melbourne for their outdoor activity

Outcome variables

Equivalent outcome measures were constructed for both survey methods. A body cover index score was calculated for the study participants on each date according to the details of either their self-reported or observed sun protection behaviours. The score describes the proportion of the body covered by considering nine regions of the body separately. The final score reflected the extent of protected skin cover to the entire body (0 totally exposed, to 1 fully covered), as indicated by participants' use of clothing and hats while outdoors on either Saturday or Sunday. This index was largely based on the body cover score used previously for the Sun Observation study (Dixon et al. 2008), which was developed to allow comparison with self-reports. The exposure indices used in previous Sun Survey publications also considered sunscreen use and foot covering (Dobbinson et al. 2008b; Hill et al. 1992, 1993), which were not assessed in the observational study.

This outcome score was used to describe graphically the unadjusted change in the mean skin protection among the population over time by survey method. The mean body cover score and 95 % confidence intervals (CI) were plotted separately for data from Saturdays and Sundays by aggregating the outcomes for each method by weekend date, then by year. These plots were repeated to describe the trends in mean body cover overall and by sex as assessed by observations and self-reports related to Saturday and Sunday. The ratio of potential over-reporting for self-reports was also calculated by considering the aggregated mean self-reported body cover divided by mean observed body cover for each survey year.

Multiple linear regression was used to statistically test the difference in trends in mean body cover over time by survey method. The analysis was repeated adjusting for age, sex, temperature and cloud cover. 'Day' was the unit of analysis and the mean body cover index was calculated for each year by aggregating by date and year. Survey year was treated as a continuous variable in the analyses to account for survey gaps and the number of years since the reference year. The model coefficients from the adjusted analysis were used to graph a best-fit trend line in mean body cover and 95 % confidence intervals (CI) for each survey method. In plotting these results, the model parameters were held constant to consider the covariate conditions: male, 20–49 years, on days of 25 °C, with these model coefficients used to fit the predicted regression lines and the 95 % CI. Quadratic trends were also examined.

PASW statistics 18.0 was used for data management; Stata 11.2 was used for the statistical analysis.

Results

Sample demographics

On the concurrent dates from 1992 to 2001, a total of $n = 23{,}130$ people were observed outdoors at recreation venues and $n = 2{,}063$ respondents were interviewed about their activities on the equivalent dates. In total only 1,438 Sun Survey respondents (69.7 %) reported that they were outdoors on at least 1 day of the weekend on the dates considered in the study. Table 1 details the number of participants from each study available for analysis of concurrent dates.

Comparison of the observed and self-report sample demographics in Table 2 suggests that these samples were similar by age, while the observations consistently included 7–10 % fewer women than in the self-report sample.

Table 2 Age and gender of participants in the Melbourne 1992–2001 trend analyses overall and for survey year by day and method (%)

	Self-reports					Observations				
	Age			Sex		Age[a]			Sex	
	14–19	20–49	50^+	Males	Females	14–19	20–49	50^+	Males	Females
Saturdays										
1992	19	68	13	55	45	22	59	19	67	33
1995	18	68	14	55	45	24	61	15	62	38
1998	20	63	17	54	46	26	62	13	61	39
2000	26	59	15	55	45	24	59	17	63	37
2001	27	62	11	50	50	24	60	17	64	36
Total	21	65	14	54	46	24	60	16	63	37
Sundays										
1992	20	66	14	56	44	26	62	12	58	42
1995	20	63	17	59	41	19	63	18	66	34
1998	19	72	10	54	46	14	68	18	61	39
2000	27	57	16	54	46	18	62	20	62	38
2001	27	63	11	45	55	22	60	18	58	42
Total	22	65	14	54	46	19	63	18	61	39

A number of observed participants ($n = 90$ Saturday and $n = 119$ Sunday) had missing data due to unknown observed age or gender and were excluded

Some figures do not add to 100 % due to rounding

[a] Age categories are based on the self-report age grouping. The observed age categories were: 14–20, 20–50, 50^+

N Saturdays: self-reports $n = 1{,}017$, observations $n = 12{,}241$

N Sundays: self-reports $n = 810$, observations $n = 9{,}578$

Overall, there were more men than women both observed and reported to be outdoors on the selected dates each survey year. Adults in the broad age group of 20–49 years were also more commonly observed and reported to be outdoors, when compared with adolescents and older adults. The age and gender of participants outdoors on the selected Saturday dates varied slightly over time. A similar age and gender pattern was observed for the sample on Sundays, which also varied slightly over time.

Descriptive trends in mean body cover used

The mean self-reported body cover was 0.76 (SD = 0.14) on Saturdays and 0.75 (SD = 0.14) on Sundays. The mean observed body cover was 0.68 on both days (SD = 0.18 on Saturdays and SD = 0.19 on Sundays). Figure 1 and Table 3 describe the change in mean body cover of study participants as measured by self-report and observation during the study period. The mean body cover scores as determined by self-reports were consistently higher than for observations both overall and for males and females separately. In any given year the ratio of potential over-reporting of self-reported mean body cover compared with observed mean body cover ranged from a factor of 1.1–1.2. In addition, there was relatively good concordance between the self-reports and observations in the pattern of unadjusted trends in body cover over time. Mean body cover among participants outdoors appeared more variable over time on Saturdays, with a peak in body cover in 1998 when compared with a more linear trend in mean body cover up until 2000 on Sundays. This apparent linear increase in body cover among participants was more discernible for females.

Regression results comparing trends in mean body cover by method

The results for the unadjusted linear regression and the regression adjusting for sex, age, cloud cover and temperature (Table 4) were relatively similar for most parameters. For self-reports these models showed no evidence of a linear increase or decrease in mean body cover between 1992 and 2001 for Saturdays or Sundays. In contrast, both regression models showed evidence of a small linear increase in observed mean body cover over time for Sundays. For Saturdays the increase in observed mean body cover over time was less marked with the adjusted model providing weak evidence of this increase.

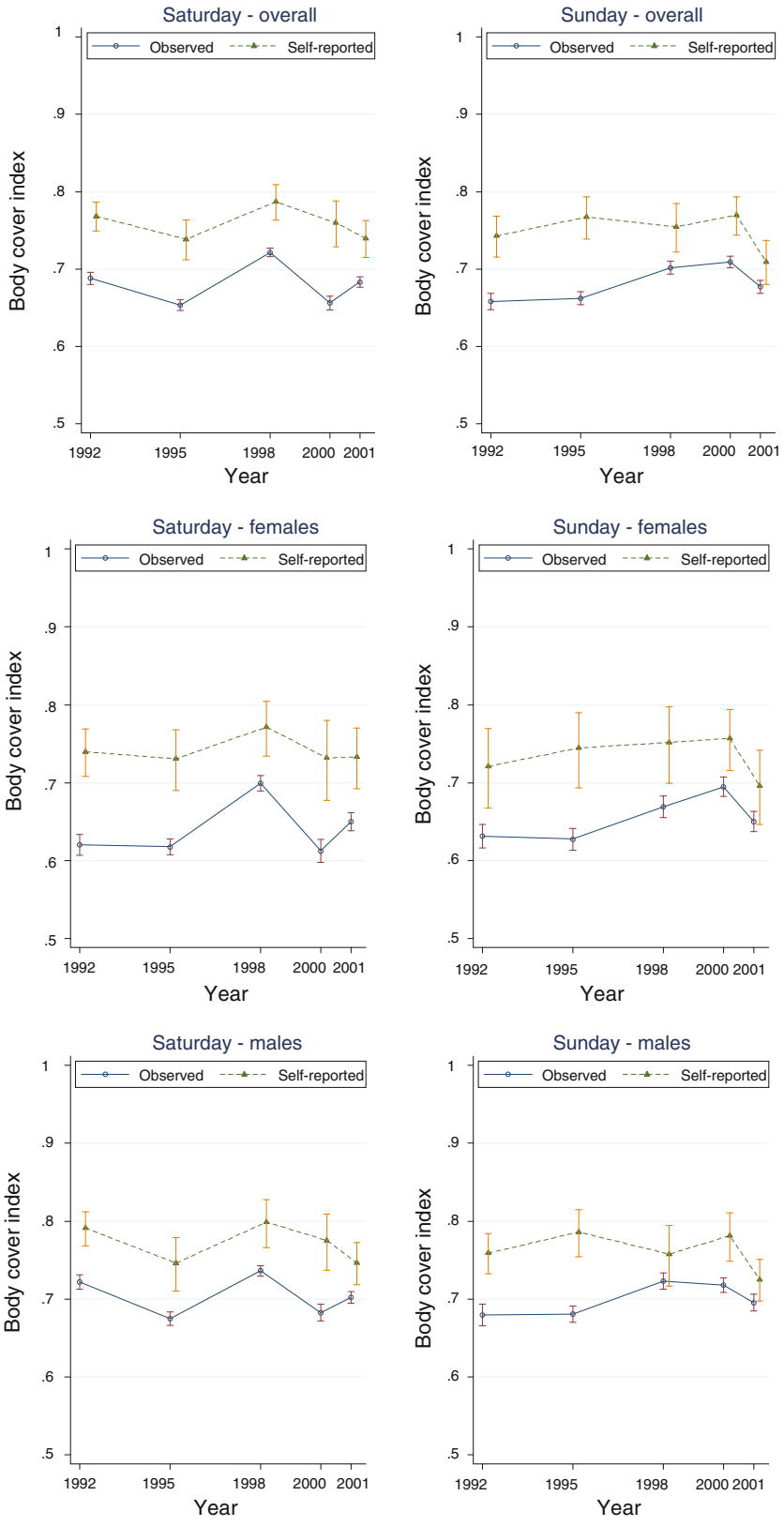

Fig. 1 Unadjusted trends in mean body cover index (Melbourne 1992–2001) by study method

Table 3 Participants' mean body cover index (unadjusted for covariates) (95 % CI) aggregated for Saturdays and Sundays by year and survey method, with potential over-reporting of self-reports calculated (Melbourne 1992–2001)

Survey year	*N*	Saturday self-report	Saturday observed	Ratio[a] of maximum potential over-reporting
1992	2,607	0.77 (0.75–0.79)	0.69 (0.68–0.70)	1.1
1995	2,692	0.74 (0.71–0.76)	0.65 (0.65–0.66)	1.1
1998	3,083	0.79 (0.76–0.81)	0.72 (0.72–0.73)	1.1
2000	1,704	0.76 (0.73–0.79)	0.66 (0.65–0.67)	1.2
2001	2,727	0.74 (0.72–0.76)	0.68 (0.68–0.69)	1.1
		Sunday self–report	Sunday observed	
1992	1,591	0.74 (0.72–0.77)	0.66 (0.65–0.67)	1.1
1995	2,119	0.77 (0.74–0.79)	0.66 (0.65–0.67)	1.2
1998	2,046	0.75 (0.72–0.79)	0.70 (0.69–0.71)	1.1
2000	2,471	0.77 (0.74–0.79)	0.71 (0.70–0.72)	1.1
2001	1,828	0.71 (0.68–0.74)	0.68 (0.67–0.69)	1.0

[a] Ratio calculated by self-report/observed mean body cover

Table 4 Model slope parameters for the unadjusted and adjusted trends in mean body cover index of participants (overall) by year and survey method (Melbourne 1992–2001)

	Unadjusted regression results				Adjusted regression results[a]			
	Coefficient	95 % CI	Std error	*P* value	Coefficient	95 % CI	Std error	*P* value
Saturday								
Sun observation	0.001	−0.0004 to 0.002	0.0005	0.214	0.001	0.000 to 0.002	0.001	0.025
Sun Survey	−0.001	−0.005 to 0.003	0.002	0.563	−0.001	−0.004 to 0.003	0.002	0.800
Interaction	−0.002	−0.006 to 0.002	0.002	0.389	−0.002	−0.005 to 0.002	0.002	0.425
Sunday								
Sun observation	0.005	0.004 to 0.006	0.001	0.000	0.003	0.002 to 0.004	0.001	0.000
Sun Survey	−0.001	−0.006 to 0.004	0.002	0.640	−0.002	−0.007 to 0.003	0.002	0.374
Interaction	−0.006	−0.010 to −0.001	0.002	0.019	−0.005	−0.010 to −0.001	0.002	0.031

In these models, survey year was treated as a continuous independent variable

[a] Adjusted for the independent variables: survey, year, sex, age group, cloud, 3 pm temperature

Similarly, there was no evidence for an interaction between trends in self-reported and observed body cover for Saturdays' data. However, in both the unadjusted and adjusted models there was weak evidence of an interaction in trends by survey method for Sundays. The small negative coefficient in these models describing a small convergence in mean body cover estimates by these methods over time.

Figure 2 shows the overall fitted trends and model slope parameters for the relationship between body cover and time by survey method. The figure indicates that there was little change in mean body cover index over time for self-reports and a small positive slope for observations. There was no evidence of divergence between self-reported and observed trends in mean body cover, while the trend lines slightly converged as survey year increased.

In addition, there was no evidence of a quadratic relationship between body cover over time by method, and the details of these results are not reported.

Discussion

Both survey methods show relatively concordant trends in the mean proportion of the body covered by clothing and headwear among the Melbourne population outdoors during Saturdays and Sundays in late summer. However, the adjusted regression analyses showed evidence for very small linear increases in mean observed body cover across the years, with no evidence of change over time for self-reported body cover. This difference was mainly due to the

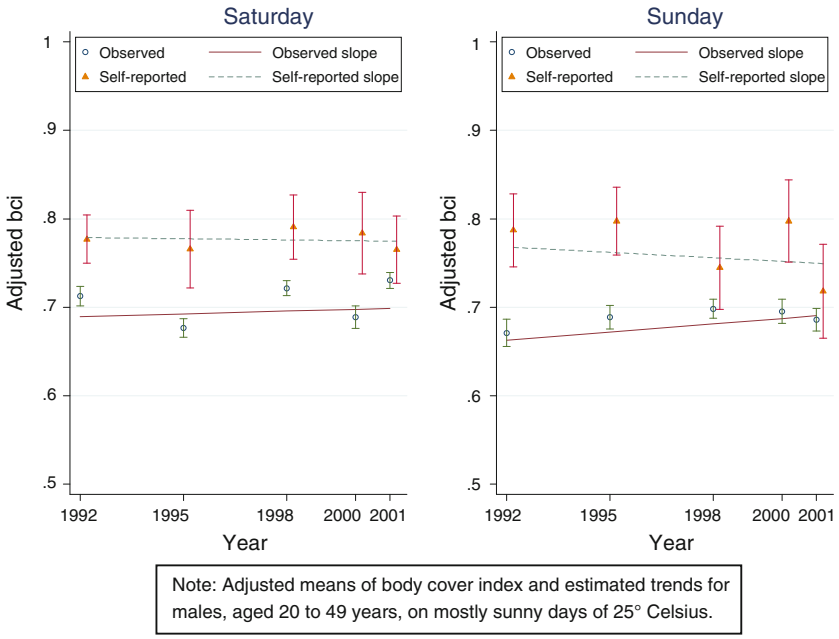

Fig. 2 Adjusted trends in mean body cover index over time (Melbourne 1992–2001) by survey method: statistical comparison of fitted regression slopes and 95 % confidence intervals

disparity in sample sizes, since for both Saturday and Sunday the magnitude of the estimated slopes was similar between the two groups (though in opposite directions), but the very large numbers in the Sun Observation group resulted in highly precise estimates. The strong concordances of the estimates overall and by gender provide evidence of the concurrent validity of the two methods, observation and self-report. Despite sustained SunSmart delivery across the decade analysed, there was no evidence of divergence of body cover estimates by survey method over time.

Both studies have large samples and used consistent recruitment methods over time. This suggests that both samples should be able to detect a population-wide shift in sun protection compliance occurring at any particular time, whether this is an increase or decrease. The trends in mean body cover will likely reflect a number of temporal influences: for example, sun protection policy improvements in schools (Dobbinson et al. 2005), local government (Dobbinson et al. 2004) and workplaces (Dobbinson and Knight 2001); variable exposure to SunSmart media campaign advertising across the years with generally a decrease in advertising exposure as measured by cumulated Target Audience Ratings Point recorded across the month before and during the surveys (979 in 1992, 535 in 1995, 685 in 1998, 435 in 2000, 205 in 2001); and other variable media influences (Dixon et al. 2007; Scully et al. 2008) including increased portrayal of images of models with darker tans in youth-targeted magazines after 1998 (Dixon et al. 2007). The pattern of trends in unadjusted mean body cover overall is consistent with expected increases in compliance following sustained program implementation but with decreasing supportive media messages and images since 1998.

The findings for higher self-reported compared with observed body cover are of interest. It is reasonable to expect that our measures would detect moderate to large increases in socially desirable responses if they were to occur, which would result from the majority of respondents' small inflations of their sun protection behaviours or even a smaller group with substantial over-reporting. The congruence in trends in mean body cover, for samples measuring sun protection on the same dates and each considering their settings consistently over time, suggest that the methods are detecting temporal effects. Moreover, this synergy between body cover estimates suggests that only two possibilities remain, either small and variable socially desirable responding in self-reports, or moderate to large and steady levels of social desirability bias over time. This stable or small element of bias is encouraging in the context of decreasing response rates to these self-report surveys, with no evidence of increasing response bias which might have occurred if people with more compliant health attitudes and behaviours were more likely to respond to surveys (Zambon et al. 2008).

Caveats apply to these interpretations which limit measurement of the actual level of social desirability bias in the reported body cover estimates by comparison with observed estimates. Different individuals likely participated in both surveys. Moreover, while the surveys had many settings in common, private settings were only able to be assessed in self-reports, and a few other public settings (e.g. other sports centres, outdoor shopping centres and street footpaths, work-related activities) were not

observed. It is difficult to predict in which direction these different settings might affect sun protection compliance and the disparity in mean body cover index observed. However, we anticipate that the proportions of people undertaking activities in the self-report settings would be relatively stable, and recruitment procedures ensured the stability of the observation settings over the 10-year period of the study. The disparity in mean body cover estimates may partly or fully be explained by a wider range of settings considered for self-reports. Similarly, there were consistently more males observed compared with interviewed which may also partly explain disparities. The findings however do not shed light on whether social desirability bias in self-reports was increasing during the early years of the SunSmart program before 1992.

A few further limitations of note need to be considered. There was a considerable difference in sample size between the two surveys, and although based on aggregated weekend data from five summers there were only five data points for the trend lines. This implies that review of the pattern of concordance is particularly valuable in our analyses. Also the findings are not directly comparable to the separately analysed self-report and observational trends (Dixon et al. 2008; Dobbinson et al. 2008b; Hill et al. 1992, 1993; Lagerlund et al. 2006), given the current analyses were based on a subset of the data with overlapping dates.

Most importantly, our observations were compared with self-reports where behaviours assessed were recent, and focussed on a specific day, time period and situation (the respondent's particular outdoor activity), and in which potential bias from revealing the study purpose during recruitment was avoided. However, other studies commonly use a different focus on measuring sun protection habits. It cannot be assumed that our study provides evidence for the validity of this type of self-report. Clothing worn is highly context dependent. Therefore, questions about typical sun-related behaviour may be more indicative of predispositions towards sun protection and tendency to usually perform sun protection in the right context, rather than a scale of actual sun exposures.

The period analysed for the study is some years ago, but avoided minor questionnaire changes for the self-report surveys introduced in 2003–2004. To our knowledge no other study has examined population trends in sun protection for self-reports and observations over such an extended period so, despite the age of the data, the findings are of relevance to the field.

Implications

Both methods provide unique and important contributions to monitoring the SunSmart program outcomes, but have strengths and weaknesses. The study observing people in outdoor recreational venues in Melbourne provides an estimate of change in compliance with sun protection without potential social desirability bias, but has some population coverage issues. The telephone-based self-report surveys provide good population coverage and relatively accurate adjustment for age and skin type to measure program impact. However, in future years to achieve population coverage for telephone surveys it will be necessary to incorporate changes to landlines and mobile-only household usage to samples.

Together with the previous validity studies on specific interventions (Glanz et al. 2009, 2010; Lower et al. 1998; O'Riordan et al. 2006, 2008, 2009), our findings should provide researchers confidence to use self-reports precisely focused on time and activity context to measure changes in the population's sun protection behaviours over time. Albeit this is with an element of social desirability bias, therefore program evaluations should place emphasis on the relative change in sun protection behaviours. Self-report is not only a method that lends itself to population sampling for purposes of estimating population parameters, it is one that throws light on unobservable yet potentially modifiable variables such as knowledge, beliefs and attitudes that may be the underlying causes of behaviour. This is important because self-reports from telephone surveys are widely used to inform and evaluate skin cancer prevention programs.

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