The use of observational methods for monitoring sun-protection activities in schools

E. Milne, B. Corti, D. R. English, D. Cross¹, C. Costa and R. Johnston¹

Abstract

Evaluation of health promotion interventions aimed at behavioural or environmental change involves assessing change that occurs as a result of the program. Direct observational methods can be used for this purpose and this paper describes three such methods that we pilot tested for use in a 5-year intervention study aimed at reducing sun exposure in primary school children. (1) Monitoring ‘No hat, no play’ policies. This method involved video taping children in selected school play areas during lunch time and analysing the content of the videos to assess the proportion of children wearing various types of hats. (2) Assessing shade provision in the playground. This method involved taking aerial photographs of each school and using them to estimate the proportion of shade in play areas available to children at lunchtime. (3) Shade use. This involved children wearing polysulphone film badges to measure the amount of UV-B exposure they received during one lunch period, relative to the total possible dose registered on index badges. Each method was implemented successfully, and we demonstrated that the video and aerial photography methods produced highly reproducible results and that all three methods were feasible. These three methods will be used in our intervention study to assess longitudinal change in schools’ sun-protection policy and practice.

Introduction

The Kidskin project is a school-based intervention study which aims to reduce sun exposure and increase sun-protection habits in participating children. The 5-year project involves a cohort of almost 1800 Year 1 children who commenced school in February 1995 at 33 primary schools in Perth, Western Australia. There are three study groups: a control, a moderate intervention group and an intensive intervention group. One component of the intensive intervention is to encourage and assist schools to introduce specific sun-protection policies and practices.

The major focus of our efforts to influence sun-protective policy and practice include:

- A ‘No hat, no play’ policy, whereby children are required to wear a broad brimmed or legionnaire style (with a peak at the front and a flap covering the back of the neck) hat when they are outdoors at school. (These are referred to as ‘Gold Standard’ hats.)
- An increase in shade in the playground.
- Teachers actively encouraging children to use available shade.

Policy interventions will be evaluated by determining changes in the proportions of children wearing Gold Standard hats at schools during lunch, the amount of shade provided at each school and the extent of shade use. Two approaches will be used in Kidskin—a survey of school principals and direct observational methods. Two methods
are used because self-reported data, such as those obtained from questionnaires, are not always consistent with what is observed directly (Sackett, 1978). For example, an Australian study of sun-protection practices in schools found a significant discrepancy between the proportion of children wearing hats as estimated by primary school principals and that observed by researchers visiting the schools (Schofield et al., 1991). We will use the observational methods to validate the information from the principals’ survey.

This paper reports the development and pilot testing of observational methods for measuring the three parameters of interest. We believe the methods have the potential for wider application in health promotion evaluation.

### Development and pilot testing of methods

#### Extent of hat wearing during lunch time

Schofield et al. (Schofield et al., 1991) estimated the proportion of children wearing hats at lunchtime at schools. Observers mapped the playgrounds into defined areas and then visually scanned each area to count the children wearing particular types of hats. In a later study of child care centres (Schofield et al., 1993) six randomly selected children at each centre were observed during outdoor activities at specified intervals during the day. The observer recorded the number of observation intervals during which the children were wearing their hats and other protective clothing.

Grin et al. (Grin et al., 1994) examined the sun-protection policy and practices of child day care centres in Connecticut. The investigators examined each classroom for the presence of hats and observed children playing. They reported the percentage of centres in which hats for children of all ages were identified as ‘present’, although it was not a requirement that the hats were worn at the time.

Lombard et al. (Lombard et al., 1991) assessed sun-protective behaviours, including the wearing of hats, at two private swimming clubs in Virginia.

Observers walked a predetermined route covering the entire pool area at specific times during the day and recorded information about each patron. Several other studies have described the observation of children’s sun-protection behaviour on the beach, including the wearing of hats, protective clothing and sunscreen (Bennetts et al., 1991; Olson et al., 1997).

Our preliminary observations demonstrated that assessment of the proportion of children wearing particular types of hats at school was not feasible, in terms of personnel and time, using direct observational methods, particularly in large schools; therefore, an alternative method was needed. Although not specific to sun-protection practices, several observational studies have reported the successful use of video cameras in recording children’s behaviours (Cooper and Ingleby, 1974; Hold-Cavell et al., 1986).

#### Pilot testing—methods and results

Three pilot schools were selected and each principal’s permission to film the playground was obtained. A typical spring day was selected for the pilot study—maximum temperature 20–25°C with little or no rain, variable winds and high scattered cloud. Atypical temperatures and weather might have influenced the number of children playing outside and/or wearing hats at lunchtime.

Parents and children were not formally told about the study or its purpose. A number of factors influenced this decision: the potential for bias due to children’s reactivity, the absence of potential harm caused by the study in contrast to the likely benefits, and the fact that only public behaviour was to be observed and recorded.

Each observer consulted the principal and asked him/her to identify the main play areas used by the children. At each school, separate play areas were provided for children of different ages and the observers selected one area for each age group. Both shaded and unshaded outdoor play areas were eligible for inclusion. Observers then selected suitable unobtrusive vantage points in each of the selected areas from which to film the children.

Filming took place during the lunch break fol-
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Following the time allocated for eating lunch. Using a hand-held video camera, the observer panned slowly from left to right across each of the nominated play areas in turn. The zoom facility was used to film children in more distant parts of the area and panning was slowed in busier areas.

To assess the stability over time of the observed hat-wearing behaviour within play areas at each school, filming was repeated in each area 15 min later. In one of the three schools, two observers independently filmed the same play areas over the same lunchtime in order to assess the effect of the observer on the results.

The video tapes were analysed independently by two trained observers using high-quality editing equipment, and following a specific protocol and standardized recording schedule. This involved pausing the video using the ‘freeze frame’ facility (thereby holding the image still), and slowing it using ‘slow advance’ and ‘slow rewind’ functions, so that analysts could count and record the total number of children in the area, and the type of hat worn by each child. The proportion of children wearing Gold Standard hats was calculated. The assessment and rating of the video from a single school took about an hour.

For the purposes of assessing the reproducibility of the results, we calculated the intra-class correlation coefficients (ICCs) from one way analysis of variance as described by Armstrong et al., p. 100 (Armstrong et al., 1992), with each play area representing an experimental unit. (An ICC of one is produced when the analysis of two sets of measurements taken using a particular method produces results which are in perfect agreement, i.e. the results of the measure are perfectly reproducible.)

- The first shoot of each play area was viewed and assessed by the same observer on two occasions, a week or more apart, and the results compared. The ICC was 0.98 (lower bound of 95% confidence interval 0.93). From the two viewings, the observer estimated the percentage of Gold Standard hats to be 21 and 20%, respectively.
- The first and second shoots of each play area were examined by a single observer, and the results compared. The ICC was 0.95 (lower bound of confidence interval 0.84). The observer estimated the percentage of Gold Standard hats in the two shoots to be 21 and 18%, respectively.
- Where two observers had independently filmed three play areas at one of the three schools, the videos of each play area were analysed and compared. There were insufficient data to estimate an ICC, but the results can be summarized as follows: from the two videos, the observer identified 29 and 20%, respectively, of children wearing Gold Standard hats. Thus, the amount of variation when two different observers filmed an area appeared higher than that when the same observer filmed an area twice.

Shade provision in schools

One Australian study has examined the amount of shade available in schools. Schofield et al. (Schofield et al., 1991) took aerial photographs of New South Wales schools and calculated the proportion of shade provided. Using 20×30 cm photographs, the grounds (excluding buildings and out-of-bounds areas) “were divided into logical areas of approximately rectangular or triangular shape” (p. 136). The shaded area was then calculated as a proportion of the total area available for children’s use. Grin et al. (Grin et al., 1994) estimated the percentage of shade from trees, buildings and canopies in each of 25 day care centres in Connecticut, USA. This was achieved through observations of the centres and playgrounds, but no methodological details were given.

The two alternative approaches involve either measuring the exact dimensions of the shaded and
non-shaded areas ‘on-the-ground’ or using aerial photographs to measure the proportion of shade. The amount of resources, in terms of personnel and time, that would be involved in physically measuring each of the shaded and non-shaded areas of the playground renders this method impractical. Therefore, we used aerial photography.

Pilot testing—methods and results
The pilot study involved aerial photography of three randomly selected primary schools. School principals were not informed that the aerial photography measurements took place. Again, a number of factors influenced this decision: the potential for reactivity by the school administration in the area of shade provision over the course of the study (including in the control schools), the absence of potential for harm from this part of the study and the fact that the information is in the public domain.

A qualified pilot and an experienced amateur photographer were engaged to fly over and photograph the selected schools on a fine day. The study was conducted between 12 noon and 1 p.m. as this is the time of most relevance to shade provision at schools. The plane was flown at an altitude of 1000 feet, the lowest level permitted over inhabited areas. The photographer took three or four overhead shots of each school while approaching from several different directions. He used a 35 mm Nikon F1 still camera, equipped with a 45 mm wide-angle lens. The sortie took about 45 min.

The best photograph of each school was selected on the basis of aerial angle (directly overhead is ideal), clarity of image and whether or not the picture included the entire school grounds. These photographs were enlarged to 25×17 cm prints in order to optimize the accuracy of shade measurement. The buildings, playgrounds and out-of-bounds areas in each school were identified from school maps provided by the Building Management Authority of Western Australia.

A sheet of transparent plastic was laid over each photograph and the areas of the playground available to children during lunch breaks outlined on it using a felt pen. This information had been provided by the school principals. These areas were generally circular, triangular, rectangular or square and simple geometric formulae were used to calculate their total area, which formed the denominator for the calculation of the shade proportion. All shaded areas, including trees, verandas, covered walkways and purpose-built undercover play areas, were marked on the plastic transparencies in a different coloured felt pen, superimposed on the markings for the available play areas. The total shaded area was calculated for each school and expressed as a proportion of the total area available to children at lunchtime. Three people independently performed these calculations and a high level of inter-observer agreement was achieved: School A: mean 24% (23, 28 and 21%); School B: mean 23% (21, 25 and 24%); and School C: mean 33% (34, 34 and 31%). Data from this pilot study involving only three schools did not permit calculation of more sophisticated measures of reproducibility.

Shade use
Several approaches have been applied to the observation of the sun-protective behaviour of children in relation to shade use. In the study by Schofield et al. (Schofield et al., 1991), observers visually scanned school playgrounds, counting and recording on a tabulated schedule the number of children in the shade and in the sun. This information was then used to calculate the proportion of children using the shaded areas. In another study involving children at child care centres (Schofield et al., 1993), investigators counted the number of intervals during which six randomly selected children were in the sun, in the shade or in partial shade. More precise details of the methods of observation were not given.

In their study of swimming pool patrons, Lombard et al. (Lombard et al., 1991) measured patrons’ shade use by marking each patron’s position on a map. The number and proportion of patrons using the shade were recorded.

In a study of beachgoers, Foot et al. (Foot et al., 1993) examined the use of beach umbrellas. Each of three body regions (head/face, torso and legs) was classified as being protected if they were
more than 50% shaded at the time. A similar study was undertaken by Pratt and Borland (Pratt and Borland, 1994) in Victoria in 1990–91, in which observational data regarding shade use were collected from 92 adolescents on a surf beach.

During initial visits to schools, it soon became apparent that direct behavioural observation of shade use was not feasible. We therefore explored ‘behavioural measurement’ as an alternative approach; this involves the use of a mechanical or sensory device to measure the biological consequences of the behaviour of interest. This approach differs from direct behavioural observation in that it derives data from an instrument rather than from a human observer and because the biological consequences associated with the behaviour, and not the behaviour itself, are recorded (Tryon, 1985).

An inexpensive method of behavioural measurement related to sun exposure is the dosimetry of personal solar ultraviolet radiation (UVR) exposure, using polysulphone film badges (Davis et al., 1981). When used in a badge as a personal dosimeter, the polysulphone film is usually mounted in a holder (30 mm square), with a central aperture of 12×16 mm, or in a mount with four circular apertures (6 mm diameter) (Diffey, 1984). Since the mid-1970s, polysulphone film badges have been used successfully to estimate UVR received by subjects wearing single lapel badges (Challoner et al., 1976; Corbett et al., 1978; Leach et al., 1978). Several studies have examined sun exposure at different body sites relative to the vertex, and demonstrated that a horizontal badge on the ‘epaullette’ region of the shoulder receives a dose of between 75 and 80% of that at the vertex (Diffey et al., 1977; Holman et al., 1983). Measurements from badges worn by individuals can be compared with those from badges placed in full sun to calculate the proportion of the potential dose that was actually received.

Pilot testing—methods and results

A primary school that had been previously used in pilot testing for the Kidskin project took part in this pilot study, as consent had already been obtained from the children’s parents. The study was conducted on a typical spring day so that the number of children playing outside in the sun and shade would be representative of the time of year.

Four badges were used as ambient badges in the school grounds over the same exposure period as the badges worn by the children. They were mounted horizontally on a specially designed padded tile, comprising a sheet of cardboard with four slots in which the badges were placed, attached to a ceramic tile wrapped in bubble wrap. We used four badges to record ambient exposure in order to reduce the effects of variability of individual badges (Gibbs et al., 1984).

Consent was obtained from the parents, principal and teachers involved in the study, but the children themselves were not informed of the study objectives. This was justified because of the potential for bias due to the children’s reactivity and the potential for harm resulting from any deliberate attempt to increase sun exposure. Furthermore, only public behaviour was being observed and recorded. However, the children’s verbal assent was obtained before the polysulphone badges were pinned to their clothing.

Although the measurements were made over the lunch break, the two observers pinned the badges on the children just after morning recess to minimize reactivity. One film badge was attached with safety pins to the clothing at the left shoulder. With the children’s consent, long hair which was likely to cover the badges was tied up. Those who inquired about the purpose of the study were given an explanation which did not include the assessment of sun exposure, e.g. ‘that the badges would help us to find out how children spend their lunch break’. After the badges were attached, the children returned to their classes to continue their usual activities and the two observers assessed their behaviour for reactivity over the following hour. When the lunch bell rang and the children went outside to eat lunch and play, the four ambient badges were uncovered and placed horizontally in full sun in an area out-of-bounds to children.

The observers watched the children in the playground over the lunch period to assess their reactiv-
ity to the badges. Classroom and playground observations indicated that there was minimal reactivity on the part of both participating and non-participating children. The wearing of hats did not prevent badges from being fully exposed to the sun and would therefore not have affected the UVR dose registered.

At the end of the lunch period, the badges were removed from the children’s clothing and the ambient badges were covered. The time of exposure of all badges was recorded. They were then packaged, identified only by a coded number and sent to the Australian Radiation Laboratory for analysis.

The badge readings were expressed as ‘effective erythemal dose’ (EED) in joules per square metre (J/m²). The mean EED from the four ambient badges was 571.4 J/m². Two of the ambient badges registered close to 600 J/m² while the results of the other two were closer to 540 J/m². The results of the badges worn by the children varied from a minimum of 27 J/m² to a maximum of 241.7 J/m², with a mean EED of 100.4 J/m². The mean percentage of the total ambient exposure received by the children was 17.6%, while the median was 13.6%.

**Discussion**

The potential for environmental factors to have a significant impact on the outcome of intervention studies and health promotion programs is now widely acknowledged. It is therefore essential to monitor these variables over the course of studies and programs involving such intervention. The resulting data can then be used to evaluate the intervention components, and to contribute to the interpretation and understanding of the overall study findings.

Several factors affect the validity of each method. (We would describe these three quantitative measures as being valid if they demonstrated high precision and a lack of bias.) With regard to measuring children’s observed behaviour, it must be representative of usual behaviour, i.e. subject reactivity should be avoided. For this reason, the principals, teachers, parents and children were not fully informed of the purpose of some of the studies. Parents giving consent for the badge study were asked not to reveal the exact function of the badges to their children. A time delay between obtaining parental consent and conducting the study reduced the potential for reactivity. Similarly, school staff who were aware of the video study and the function of the dosimeters were asked not to attempt to influence the children’s usual behaviour in any way.

It is also important that the behaviour of the children observed is representative of all those at the school. Thus, the areas for video recording were chosen on the basis of designated age group and without reference to hat-wearing behaviour.

Another important issue is raised here by the somewhat less favourable results in the part of the video study where two observers filmed the same play areas. These results are unlikely to have been caused by inconsistencies in the video content analysis, because of the high level of intra-rater agreement evident in this study. Therefore, the importance of thoroughly training the observers who undertake the filming is demonstrated, with particular attention being paid to specific instructions about how to identify boundaries for the areas being filmed and about whether or not children on the periphery of these areas should be included.

The random selection of participating children from all those whose parents consented to the badge study made it likely that these children were representative of those at the school. We believe that no ‘volunteer’ effect (where children whose parents consented to the badge study might be different in behaviour from other children) was observed, because over 90% of parents gave their consent.

Several technical issues should be considered in relation to the validity of the measurement of shade use using polysulphone film badges. Firstly, it is important to ensure that the wearing of a hat does not affect the badge reading. Otherwise, the combined effects of two behaviours of interest (wearing hats and staying in the shade) are being
assessed; this would not provide a ‘clean’ measure of each behaviour. Secondly, it is important that the UVR measured is related to sun exposure and not to exposure to fluorescent light in the classroom. Information from the Australian Radiation Laboratory suggests that the minimal UVR which may be emitted from various types of fluorescent lighting in the classroom in the time between recess and lunch would not contribute significantly to the overall dose registered by the dosimeters (P. Gies, pers. commun.). Neither would the badges have been exposed to direct solar UVR during this period because glass windows in the classroom block approximately 99% of UV-B (Gies, 1994). Furthermore, the sun would have been close to overhead during this period and therefore not shining directly in the windows.

Although previous work indicates that the precision of an individual’s measure of exposure increases when four or five badges are used per body site (Gibbs et al., 1994), this was not considered necessary in this study. We averaged the readings from badges worn by all children at each school and were not interested in individual readings. We used the results of this study to calculate the number of badges required in the Kidskin study, which involves 33 schools. We calculated that, if we attached single badges to 30 children at each school, we could detect a 25% difference in the mean proportion of potential exposure between intervention and control schools for an ICC of 0.1 and power of 80%, and a 37% reduction for an ICC of 0.3.

With respect to the measurement of shade, it is important to measure it at lunchtime during spring and summer, as this is when children are outside at school. Measurements made at other times may not reflect accurately the provision of shade at crucial times. Furthermore, all buildings and structures seen on the aerial photographs must be clearly identified on maps, so that their availability for children’s use at lunchtime may be accurately determined. Only accessible areas and those truly suitable for children’s play should be included in the calculation of the shade proportion.

### Advantages of the methods adopted

Each of the methods tested in this study proved less labour-intensive and therefore more efficient than others used previously. Compared with direct observation, there are a number of advantages of using videos to record behaviour: it enables information to be accurately recorded; it is quicker than manually recording all the information about children in each play area; it allows several recordings to be made in each area to check the stability of the measures; it provides a permanent record of the data collected; and it allows inter- and/or intra-rater reliability testing to be conducted throughout the study.

Similarly, aerial photography proved low in personnel, time and staff travel costs, and not unreasonable in terms of flying costs. Photographs of a large number of facilities can be taken in a relatively short time and the method is less unobtrusive than taking shade measurements in the school grounds. In addition, shadows are likely to change during time-consuming manual measurement, whereas aerial photographs provide a ‘snapshot’ of the shadows cast as well as showing the physical layout of the school and the shade structures provided. Furthermore, inter- and/or intra-rater reliability tests of the shade measurement process can be readily performed. The disadvantages of the aerial photography method are that it precludes assessment of the aesthetic qualities of each area and quantitative assessment of complete versus partial shade (which may be impractical in terms of equipment costs in any event).

Likewise, the use of polysulphone badges for the measurement of shade use is low in personnel, travel and material costs. This method provides quantitative information about the proportion of time that children at each school spend in the sun versus in the shade over a given period. A permanent record of these data can be kept and the method is easy to replicate.

Results of the pilot studies for each method reinforced and emphasized the importance of thoroughly training observers, both initially and
throughout the period of observation. It also confirmed the need for comprehensive research protocols for all personnel involved in data collection. Thorough documentation of the methods used and challenges encountered is also important in allowing the methods to be replicated during post-testing. Copies of the protocols are available on request.

Although the observational methods developed and tested in this study apply fairly specifically to sun-protection policy implementation and children’s behaviour in schools, it is hoped that they will also find future application in the broader context of sun protection. For example, aerial photography may be used to measure shade provision at beaches, public swimming pools and public parks or beach umbrella use during the summer. Polysulphone badges have been used to validate self-reported behaviour in a study of sun exposure conducted in Tasmania (Dwyer et al., 1996). The video technique could be used, for example, to record the sun-related behaviour of people at beaches, as a tool in the evaluation of community-wide sun-protection campaigns. The use of videos to record behaviour also has potential application in health promotion evaluation in other areas, e.g. in monitoring adherence to non-smoking policies or safe alcohol serving practices at health-sponsored gatherings such as music festivals. The video technique is receiving widespread acknowledgement as a method for Behavioural Research in Cancer, Anti-Cancer Council of Victoria; Ms Tommy Cordin and Mr Michael Winter, research assistants in UWA Department of Public Health; and Dr Peter Gies, Australian Radiation Laboratory.

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