Assessing Children's Ultraviolet Radiation Exposure: The Use of Parental Recall via Telephone Interviews

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ABSTRACT

Objectives. This study evaluated the validity of a parental report measure of children's solar protection behaviors.

Methods. Fifty-eight children had skin color assessed twice with a colorimeter. Between measurement sessions, parents were interviewed by telephone to assess children's indoor–outdoor status and solar protection across 40 hourly intervals.

Results. Parental report of child's indoor–outdoor status was significantly correlated with the colorimeter values, whereas the use of sunscreen and protective clothing was not.

Conclusions. This measure was feasible for assessing ultraviolet exposure in young children. The component that assessed the number of intervals spent outdoors evidenced predictive validity. (*Am J Public Health.* 1997;87:1146–1049)

Introduction

Exposure to ultraviolet (UV) radiation is a primary risk factor for both nonmelanoma skin cancers and melanoma.[1-7] Sunscreen use in the first 18 years of life could reduce lifetime incidence of nonmelanoma skin cancers by an estimated 78%.[8–12] As the number of interventions targeting children for reducing UV radiation exposure increases, accurate measurement strategies will be needed; measuring young children presents unique challenges. The objectives of this study were to (1) modify the Solar Protection Behavior Diary[13,14] to serve as a telephone-administered interview of parents regarding their child's solar exposure and protection behaviors, (2) field test the new instrument, and (3) validate the new instrument using a colorimeter that is sensitive to UV-induced skin color changes.[15–17]

Methods

Subjects

Subjects, who lived in San Diego, Calif, were 58 volunteer child–parent pairs. To be eligible for the study, children had to (1) be between 6 and 9 years of age, (2) be able to tan at least moderately, and (3) have at least several body sites free of freckles. The second criterion attempted to reduce the number of subjects having skin type I (see Table 1).[18]

Measures

The parental-recall telephone interview was adapted from the Solar Protection Behavior Diary, developed by Girgis and colleagues as a self-report, paper-and-pencil measure and validated against direct observations of clothing.[13,14] Each interview was conducted between 3 PM and 9 PM and covered the child's activity in hourly intervals from 10 AM to 3 PM for that day; the latter typically are considered peak UV hours.[12] Items included indoor–outdoor status and, for outdoor activities only, what clothing the child wore and whether the child wore sunscreen on each body part. The body parts measured included the face, neck, shoulders, upper arms, lower arms, torso, legs, and feet. Parents also were asked to rate their confidence in the accuracy of the information they provided.

Each parent (usually the mother) was phoned once weekly, over an 8-week interval, on randomly determined, nonrainy days; he or she was interviewed while the child was available. When the interview could not be conducted on the scheduled evening, it was attempted on the following evening; the child's solar protection behaviors were assessed for the day the parent actually was reached.

Three parent-report indices were derived from the 40 intervals. First, simple counts were computed for number of intervals spent outdoors (intervals outside). Second, a solar protection score was computed via the original formula of Girgis et al. (A. Girgis, written communication, May 1994). For each interval spent outdoors, each of eight body sites received a subscore; sites protected by adequate clothing or sunscreen of sun protection factor (SPF) 15+ received a higher score. The combined score can range from 0 to 16; we averaged this score across all outdoor intervals. Girgis et al. have used a cutoff of 12 or higher to indicate an adequate level of protection, since at least 75% of the body is protected (A. Girgis, written communication, May 1994).[13] Finally, we combined the intervals outside variable and the solar protection score to create an exposure score (for

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each of the 40 intervals, 0 = indoors, 1 = outdoors and a solar protection score of 12 or higher, and 2 = outdoors and a solar protection score of less than 12). The values for each interval then were summed; this score could range from 0 to 80.

The objective measure of skin color was the Chroma Meter (CR-300; Minolta), an instrument that measures the color of objects on three dimensions. Previous dermatological studies suggested that two dimensions, L* and b*, are sensitive to tanning.[15–17] L* indicates the color's lightness from black to white, with the value increasing as the color lightens; b* assesses blue to yellow, with the value increasing as the color becomes more yellow (i.e., more tan).[19]

Immediately prior to and following the series of interviews, six body sites per child were measured: five "exposed" sites (i.e., forehead, upper arm, lower arm, upper leg, lower leg) and one "unexposed" site (i.e., underarm). Session 1 occurred during the first week of July 1994, and session 2 occurred during the last week of August 1994. Intrarater and interrater reliabilities were high, as described elsewhere.[20]

For analyses, a composite mean combining the individual site scores for the five exposed sites was computed for each session for both L* and b*. Then, for L* and b* separately, the means from sessions 1 and 2 of the composite scores and the individual site scores were used as cross-sectional indicators of skin color.[20]

Results

Subject Characteristics and Parental Recall Data

There were no attrition and no missing data. Table 1 presents selected child demographic and skin cancer risk factors.

The mean duration of each parent interview was 4.2 minutes (SD = 0.65). Table 2 presents rates of selected behaviors.

The mean solar protection score was 9.9 (SD = 2.66). According to the criterion of Girgis et al. (i.e., a solar protection score of 12 or higher), 22% of the subjects were considered to be protected.[13,14] Neither age (6 to 7 years vs 8 to 9 years) nor gender differences were found for solar protection score, ($t = 0.10$, $df = 56$, $P = .92$ and $t = 0.28$, $df = 52.35$, $P = .78$, respectively). The mean intervals outside score was 15.3 (SD = 4.52). Older children were outdoors significantly more often than younger children (17.0 vs 13.9; $t = 2.73$, $df = 56$, $P < .01$). No gender difference was found ($t = 0.58$, $df = 56$, $P = .56$). Mean parental confidence ratings, on a five-point Likert-type scale (1 = not at all, 5 = absolutely), were 4.85 (SD = 0.20) for clothes and 4.81 (SD = 0.29) for sunscreen.

TABLE 1—Characteristics of Sample Children: San Diego, Calif, Summer 1994

	Sample, No. (%)
Age, y[a]	
6	20 (34.5)
7	12 (20.7)
8	11 (19.0)
9	15 (25.9)
Sex	
Girls	31 (53.4)
Boys	27 (46.6)
Race/ethnicity	
White, non-Hispanic	52 (89.7)
Hispanic	2 (3.4)
Asian or Pacific Islander	2 (3.4)
American Indian	1 (1.7)
Other[b]	1 (1.7)
Participating parent	
Mother	50 (86.2)
Father	8 (13.8)
Eye color	
Blue	24 (41.4)
Brown	16 (27.6)
Hazel/green	16 (27.6)
Gray	2 (3.4)
Hair color	
Blonde	28 (48.3)
Light brown	14 (24.1)
Medium brown	10 (17.2)
Dark brown	3 (5.2)
Red	2 (3.4)
Black	1 (1.7)
Skin type[c]	
I	2 (3.4)
II	5 (8.6)
III	30 (51.7)
IV	21 (36.2)

[a]Mean = 7.36, SD = 1.21.
[b]Multiethnic (of Hispanic, Asian, and White descent).
[c]Listed in descending order of risk using typing of Fitzpatrick.[18] Responses were made to the following item: "Which of the following best describes your child's reaction to his/her first exposure to summer sun for 1/2 hour at midday?" (I = painful burn next day and no tan 1 week later, II = painful burn next day and light tan 1 week later, III = slightly tender burn next day and moderate tan 1 week later, IV = no burn next day and good tan 1 week later).

TABLE 2—UV Exposure/ Protection Variables

	Intervals Spent Outside,[a] %
Sunscreen use	
None	69.2
On at least 1 body site	30.8
Sunscreen SPF[b]	
Less than 15	7.0
15 or higher	93.0
Hat use	
None	84.1
Cap (e.g., baseball)	12.7
Bicycle helmet	3.0
Visor	0.2
Wide-brimmed hat	0
Hat with flaps	0
Upper body clothing	
Short sleeves, no collar	62.0
Tank top	22.3
Bathing suit top or nothing	15.0
Long sleeves, no collar	0.4
Short sleeves, collar	0.2
Long sleeves, collar	0.1
Lower body clothing	
Shorts, skirts (above the knees)	72.5
Bathing suit bottom	19.7
Shorts, skirts, jeans (below the knees)	7.8

[a]Based on 887 total outside intervals (summed across subjects).
[b]Of the 273 intervals in which sunscreen was used. SPF = sun protection factor.

Validity Data

Table 3 shows the correlation coefficients from Pearson tests of the association between the Chroma Meter variables and the parent report indices. Neither the solar protection score nor the exposure score was significantly correlated with the Chroma Meter L* or b* scores. Tests of correlation also were performed between Chroma Meter scores for individual sites and the corresponding solar protection score for an individual site; no statistically significant relationships were found. In contrast, the intervals outside score was significantly correlated, in the predicted direction, with the L* scores of two body sites plus the composite site score and with the b* scores of all body sites, as well as the composite. In two series of partial correlation analyses, one controlling for underarm skin color and one controlling

TABLE 3—Correlation Coefficients for Chroma Meter Score with Intervals Outside Score, Solar Protection Score, and Exposure Score

Chroma Meter Score (by Body Site)	Intervals Outside Score	Solar Protection Score	Exposure Score
L*			
Composite	−.30*	−.20	−.13
Face	−.23	−.19	−.12
Upper arm	−.33*	−.09	−.20
Lower arm	−.21	−.20	−.09
Upper leg	−.23	−.22	−.04
Lower leg	−.31*	−.22	−.16
b*			
Composite	.37**	.09	.23
Face	.31*	.13	.18
Upper arm	.40**	−.04	.26*
Lower arm	.30*	.01	.25
Upper leg	.35**	.19	.17
Lower leg	.28*	.10	.18

Note. For L*, higher scores indicate whiter skin. Consequently, L* would be predicted to have a positive correlation with solar protection score and a negative correlation with intervals outside score and exposure score. For b*, higher scores indicate yellower (tanner) skin. Consequently, b* would be predicted to have a positive correlation with intervals outside score and exposure score and a negative correlation with solar protection score.
*$P < .05$; **$P < .01$.

for skin type, results similar to those shown in Table 3 were found.

Discussion

The results that addressed the feasibility of a parental recall measure of child's UV exposure were promising. The advantages of this format included the ability of the interviewer to (1) probe and/or clarify a question when necessary and (2) collect data in the evening, when both parent and child were available. The duration of the phone interview was acceptable to parents, even with repeated assessments.

We used the individual items of the original Solar Protection Behavior Diary with little modification. However, our measure was based on parent (vs self) report and was administered by phone (vs paper and pencil). In addition, we supplemented the solar protection score with the intervals outside score and the exposure score in an attempt to assess cumulative exposure. Cumulative indices of solar exposure and protection are desirable because they potentially correspond to actual risk. The solar protection score does not address cumulative UV exposure; it involves only outdoor intervals, and the mean is used.

Regarding the validity of parental reports, the intervals outside score showed a statistically significant correlation with both L* and b* Chroma Meter scores. No correlation was found between the Chroma Meter data and the solar protection or exposure score. When the colorimeter measure is used as the "gold standard," these data indicate that parents were accurate in reporting whether the child was outdoors but not in reporting how much protection the child used. Two alternate explanations for the lack of association between colorimeter values and parent reports of protection behaviors are that (1) protection strategies may not have "dose–response" relationships with UV exposure and (2) the relationship between UV exposure and tanness may not be linear.[20]

The Chroma Meter is potentially valuable as a validation strategy if "tanness" is an acceptable marker of cumulative UV exposure. In other analyses, the Chroma Meter has been shown to be sensitive to changes in skin color from summer to winter on both color scales.[20] Potential limitations of the Chroma Meter include measurement errors caused by (1) inadequate or excessive pressure to skin by measuring the head; (2) subject movement; (3) freckles, moles, and so forth on measurement site; and (4) inaccurate site location. Other strategies to test the validity of our measure that may deserve attention in future research include direct observations (on a subset of intervals) and dosimeters that use UV-sensitive film.[21]

In conclusion, the parental report measure evaluated in this study appears to be a feasible method for assessing UV exposure and protection behaviors in young children and a valid measure for assessing the number of intervals spent outdoors. More research is needed to determine the relative accuracies with which parents report their child's indoor–outdoor status and use of sunscreen and protective clothing. □

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Injuries to Bicyclists in Wuhan, People's Republic of China

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ABSTRACT

Objectives. This study examined the morbidity and mortality from bicycling injuries in Wuhan, China.

Methods. Police department data for the year 1993 complemented by data from emergency room interviews were analyzed.

Results. The death rate from bicycling injuries was estimated as 2.2 per 100 000 population, more than seven times the rate for the United States. At least 79% of the fatalities and 17% of the emergency room cases sustained head injuries, the majority (71%) of which resulted from contact of the head with the concrete or asphalt road. None of the patients was wearing a helmet at the time of injury, and helmet use among the general bicyclist population was nonexistent.

Conclusions. Bicycle-related head injury is an important public health issue in China. The effectiveness of safety helmets in developing countries needs to be evaluated. (*Am J Public Health.* 1997;87:1049–1052)

Introduction

The epidemiological characteristics of bicycling injuries and the effectiveness of helmets in preventing head injuries in bicyclists have been well documented in the United States and other developed countries. In a recent study, Baker and colleagues[1] reported that head injuries are noted in about 40% of bicyclists admitted to hospitals and more than 70% of fatally injured bicyclists. In developing countries, bicycles are widely used as the means of transportation, but research on injuries to bicyclists is rarely seen in the literature.

Unlike the United States and other industrial nations, where motor vehicle occupants are the predominant traffic fatalities and bicyclists account for only about 2% of all traffic deaths,[2] bicyclists are the most common victims in China's increasing problem of traffic-related injuries. In Wuhan, People's Republic of China, bicyclists account for about 45% of all traffic fatalities.[3] In a survey conducted in six cities in China, Wang et al.[4] reported that the incidence of brain injury due to head trauma is 56 per 100 000 population per year, and that bicycle-involved crashes are believed to be the leading cause of brain injury. This study examines injuries to bicyclists in a metropolitan area of China. Of special interest are the incidence and mechanism of head injuries to bicyclists and the potential value of quality helmets for preventing head injuries to bicyclists in China.

Methods

Data for this study were from two sources: the Police Department of Wuhan City traffic crash database and personal interviews of bicycle-related trauma patients treated in emergency rooms. With a population of about 3.5 million in 1993, Wuhan is the capital city of Hubei Province, located in the middle section of the Yangtze River area.

The police department records all traffic crashes resulting in "serious" personal injuries or direct economic loss of more than 200 Chinese yuan (about $24), using uniform questionnaires. The police department database for 1993 was scanned to obtain all crashes involving bicyclists. To provide detailed information on injury characteristics and outcomes, a specially designed questionnaire was used for personal interviews in emergency rooms. The interviews were conducted in the emergency rooms of

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