Evaluation of a health promotion intervention for skin cancer prevention in Spain: the *SolSano* program

YOLANDA GILABERTE1*, JUAN PABLO ALONSO2, M. PILAR TERUEL3, CRISTINA GRANIZO2 and JAVIER GÁLLEGO2

1Service of Dermatology, Hospital San Jorge, Huesca, Spain, 2Department of Public Health, Government of Aragón, Spain and 3Department of Psychology and Sociology, School of Education, University of Zaragoza, Spain

*Corresponding author. E-mail: ygilaberte@salud.aragon.es

**SUMMARY**

The incidence of skin cancer is increasing worldwide, and Spain is no exception. *SolSano* is the first Spanish health education program for sun safety directed at elementary school children. The objective was to evaluate *SolSano*’s effects on students’ knowledge, attitudes and practices about sun safety. A non-randomized, before/after, community intervention without control group, with schools as the unit of intervention, was used for the study. Five thousand eight hundred and forty-five children from 215 Aragonesian Primary Schools (Grades 1–2) participated in the program in their classes during the 2004–2005 academic year. The educational package contained an activity guide for teachers, a workbook for each pupil, a poster and an informative pamphlet for families. The pre-test and post-test surveys were similar and were composed of two parts: the first part uses the ‘Draw and Write research strategy’ and the second part was a questionnaire. One thousand five hundred and twenty-two students completed both questionnaires, 49.2% were boys, and the mean age was 6.6; 45.7% self-reported pale skin and easy sunburn and 48% dark skin and rarely sunburn; 72.3% of the children reported having dark hair and eyes, and 51.6% freckles or moles. The mean score for the complete survey significantly increased by 1.55 points (1.38–1.72) after the intervention (p < 0.001), and girls did better than boys. Sunscreens were the most-commonly employed sun protection strategy while strategies such as seeking shadow and wearing clothes exhibited the greatest increase after the *SolSano* program [percentage increase of 19.3% (16.4–22.3) and 26.8% (23.4–30.3), respectively]. At baseline, 35.8% of children reported sunburns during the previous summer compared with 23.5% after the program. *SolSano* also achieved a slight reduction in the percentage of students who desired to be tanned. Our study demonstrates that significant knowledge can be acquired, attitudes regarding the healthiness of a tan can be modified and intentions to change sun protection behaviour can be promoted by well-designed educational programs.

**Key words**: school health promotion; skin cancer prevention

**INTRODUCTION**

The incidence of skin cancer is increasing worldwide, and Spain is no exception. Of particular concern is the increase in the incidence of the most serious form of cancer, malignant melanoma (Ocaña-Riola et al., 2001; Nieto et al., 2003).

Reducing lifetime exposure and severe intermittent exposure to ultraviolet radiation appears to be the best preventive strategy for skin cancer. In this sense, sun safety during childhood and adolescence may be especially beneficial because a history of painful sunburns in early life increases the risk of developing all three types of skin cancer and actinic keratoses.
in adulthood (Weinstock, 1996; Steptoe and Wardle, 2001; Kennnedy et al., 2003). Additionally, recreational sun exposure during childhood and adolescence in Mediterranean populations has been shown to be a risk factor for the development of basal cell carcinoma (Corona et al., 2001). There is also a strong educational reason, as behaviours acquired early in childhood are more likely to persist in adulthood. Additionally, children are more receptive than adolescents to practise sun protective behaviours and are more amenable to the instructions of parents or other adults (Saraiya et al., 2004).

Public health advisors now recommend that the routine practice of sun protection behaviours, including limiting sun exposure, using sunscreens and protective clothing, minimizing sunburns, avoiding tanning beds, and wearing sunglasses to prevent eye damage, is best started in childhood (Emmons and Colditz, 1999; Jorgensen et al., 2000). To address these issues, many sun awareness programs and resources for school-aged children have been reported in Australia (Giles-Corti et al., 2004), Canada (Rivers and Gallagher, 1995; Goodeham and Guenther, 1999a), the USA (Buller et al., 1996; Glanz et al., 1998; Grant-Peterson et al., 1999; Geller et al., 2003) and Europe (Boldeman et al., 1991; Boldeman et al., 1993; Hughes et al., 1996; Murphy, 2002). Some Mediterranean countries have also implemented these kinds of programs in their schools (Estève et al., 2003; Oncology Cooperative Group, 2003; Bastuji-Garin et al., 1999). Nevertheless, to our knowledge, no programs such as these have been tried in Spain, one of the sunniest countries in Europe.

SolSano is the first Spanish health education program for sun safety directed specifically at elementary school children (Gilaberte et al., 2000). SolSano’s main message is that there are both benefits and dangers associated with sun exposure. Therefore, its overall goal is to provide sun protection education to schools in Aragón (Grades 1–2) in order to teach children to enjoy the sun while avoiding its harmful effects and ultimately reduce the incidence and effects of skin cancer and other UV-related health problems.

The aim of the study was to evaluate the effect of the Spanish school-based sun protection program SolSano on students’ knowledge, attitudes and practices about sun safety.

METHODS

Study design

The study was a non-randomized, before/after, community intervention without control group, with schools as the unit of intervention.

Population of the study

The SolSano program was offered to all the schools in Aragón (n = 395), a region of approximately 1269 000 inhabitants (year 2005) located in northern Spain, for the academic year 2004–2005. Five thousand eight hundred and forty-five children from 215 schools took part in the program in their classrooms, which meant that 54.43% of the Aragonese Primary Schools pupils (Grades 1–2) participated in the program.

Intervention

SolSano is a school-based health program whose aim is that children gain the knowledge, attitudes, and skills required to reduce harmful effects of sun exposure and, in consequence, to prevent skin cancer. SolSano has been carried out in the region of Aragón (Spain) since 2000 by children in primary school, grades 1 and 2 (ages 6–8 years). SolSano has been adopted as part of the official health promotion strategies of the Department of Public Health.

Briefly, the educational intervention consists of educational materials given to children and their parents. A panel of educators, teachers, pediatricians, and dermatologists performed the curricular materials taking the American program SunSafe as a model, with appropriate permission (Dietrich et al., 1998). Intervention was carried out by the provision of these materials by the student’s regular teachers in their classroom. The educational package contained: (i) activity guide for teachers, (ii) a workbook for each pupil and several activities to be photocopied, and (iii) a poster with recommendations about how to behave in the sun. All intervention components promoted the same message: avoid the sun between 12 AM and 4 PM, cover up using hats, protective clothes and sunglasses, and apply sunscreen with a sun protection factor (SPF) \( \geq 15 \). Additionally, each activity consisted of the development of a variety of appropriate activities meeting prescribed educational standards that
combined sun protection messages and other aspects of student’s regular learning in sciences, mathematics, social studies, foreign languages, arts, and other subjects. The family received an informative pamphlet about sun protection sent by the school when the children were participating in the SolSano activities in their classroom (Gilaberte et al., 2002). Our program included a guide for pediatricians at Primary Care Centres in order to encourage them to advise children and parents on how to reduce skin cancer risk (Gilaberte et al., 2002).

The intervention was performed during spring 2005, from April to June.

**Evaluation of the intervention**

The SolSano program was evaluated using a pre-test and post-test design to determine Grade 1 and 2 student’s baseline knowledge and behaviour related to sun exposure and the impact of the unit on these parameters. The pre-test survey was given to the children prior to start of the SolSano activities in the classroom in April 2005, and the post-test survey was given after the school summer holidays, in September 2005, at the beginning of the following course. The pre-test and post-test surveys were similar and were composed of two parts: (i) the ‘Draw and Write research strategy’ and (ii) a questionnaire based on one previously used by Rademaker et al. (1996), Newton Bishop et al. (1997), and Buller et al. (Buller et al., 1996) (Appendix 1). Additionally, we validated the survey in previous studies (Gilaberte Calzada et al., 2000; Gilaberte et al., 2002). The ‘Draw-and-Write technique’ provides information about what children and their caregivers do to protect them from the sun, without giving the children specific information about the topic of the survey, sun protection (Pion et al., 1997).

In the drawings, we analysed whether the children either drew, or wrote about, wearing clothes, hats, sunglasses or sunscreen, or playing under a shadow (Figure 1). The first drawing was intended to determine what the caregivers do to protect their children from the sun, and activities involving the swimming pool or the beach were chosen as they normally occur under close parental supervision; whereas, the second drawing tried to discover how children protect themselves from the sun, and this included school trips to the country, which often take place without parental supervision. Drawings deemed ‘non-understandable’ were not considered for evaluation. The accompanying survey consisted of 15 multiple-choice questions to assess demographic characteristics including sex, age, hair and eyes colour, tendency to sunburn, and the presence of moles. The behaviour test items examined the use of sunscreens, hats, sunglasses, shadows, and sleeved shirts, in which outdoor activities these are used, SPF and the frequency of putting sunscreen on, desire for a suntan and sunburn experiences. Knowledge about the period of the day when the sun exposure is the most dangerous was also recorded.

Each variable was separately analysed but also an overall score of the complete survey was calculated. The scoring system was as follow: each of the five sun protection methods represented in the drawings was given one point; items with only one correct answer (Questions 3, 9, 10, and 13) were one point; questions with an Always, Sometimes, and Never response.

![Fig. 1: Sample drawings and captions produced by two different children in response to scenario 1 (see Appendix 1) (A) and 2 (B). (A) Scored as positive for sunscreen and shadow; (B) scored as positive for hat, sunglasses and clothes.](image-url)
scale (Questions 5, 6, 7, 8, 11, and 12) were given 1, 0.5, and 0 points, respectively. In Question 4, each of the marked answers was given 0.25 points.

In summary, the marks for the survey were: (i) Drawings, from 0 to 10; (ii) Questions, from 0 to 12; and (iii) an overall mark of 0 to 22.

Data analysis

Analysis of the impact of SolSano intervention was restricted only to the pupils who performed both the pre-test and post-test. Frequencies and percentages for qualitative variables and mean with the standard deviation for the quantitative ones were determined. To measure the effect of the intervention, we calculated the difference between ratios for paired samples with 95% confidence intervals. Additionally, the paired samples Student \( t \)-test was used to compare means. We performed a one-way ANOVA test to compare the means (stratified mean by demographic factors). The results of the analysis were considered statistically significant when \( p < 0.01 \).

RESULTS

Overall, 5845 students received the SolSano information kit. A total of 2546 children (43.56%), from 102 educational centres completed the first questionnaire (before receiving the kit). Of these 2546, 1522 children from 74 schools participated in the follow-up stage. The responses given by these 1522 students who completed both the pre-test and post-test were analysed (final response rate was 26.04%).

Demographic characteristics of the sample

Demographic characteristics of the sample are summarized in Table 1. Respondents had a mean age of 6.6 and a median of 7; 49.2% were boys. Most of the children were in first grade of Primary school (82.3%) because the SolSano curriculum is directed at children in first grade who then continue it in second grade. In some country schools, older students who share classrooms with Grade 1 and 2 students also participated in the program.

One thousand and twenty-one children (67.1%) lived in towns of more than 50,000 inhabitants and 501 (32.9%) attended rural schools.

In regard to skin cancer risk factors, 45.73% self-reported pale skin and easy sunburns. Most of the children reported having dark hair and eyes (72.3 and 74.2%, respectively). More than half of the pupils reported having freckles and/or moles (51.2%). Using these four items together, we established a new variable called ‘risk for skin cancer’ with a score ranging from 0 (minimal risk) to 4 (maximum risk) (pale skin and easily sunburns, light hair and eyes, and presence of freckles and/or moles). Only 5.8% of our sample had four skin cancer risk factors, 12.2% three, 24.4% two, and 31.2% one.

Pre- and post-intervention scores comparison

Results are summarized in Table 2. There has been a statistically significant increase in mean

<table>
<thead>
<tr>
<th>Table 1: Demographic characteristics of student participants</th>
<th>Frequency</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>749</td>
<td>49.21</td>
</tr>
<tr>
<td>Female</td>
<td>773</td>
<td>50.79</td>
</tr>
<tr>
<td>Grade</td>
<td></td>
<td></td>
</tr>
<tr>
<td>First</td>
<td>1253</td>
<td>82.33</td>
</tr>
<tr>
<td>Second</td>
<td>251</td>
<td>16.49</td>
</tr>
<tr>
<td>Third</td>
<td>11</td>
<td>0.72</td>
</tr>
<tr>
<td>Fourth</td>
<td>7</td>
<td>0.46</td>
</tr>
<tr>
<td>Schools</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>1021</td>
<td>67.08</td>
</tr>
<tr>
<td>Rural</td>
<td>501</td>
<td>32.92</td>
</tr>
<tr>
<td>Phototypes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pale skin and easy sunburns</td>
<td>696</td>
<td>45.73</td>
</tr>
<tr>
<td>Dark skin and rare sunburn</td>
<td>731</td>
<td>48.03</td>
</tr>
<tr>
<td>No answer</td>
<td>95</td>
<td>6.24</td>
</tr>
<tr>
<td>Hair colour</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light</td>
<td>404</td>
<td>26.54</td>
</tr>
<tr>
<td>Dark</td>
<td>1101</td>
<td>72.34</td>
</tr>
<tr>
<td>No answer</td>
<td>17</td>
<td>1.12</td>
</tr>
<tr>
<td>Eye colour</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light</td>
<td>370</td>
<td>24.31</td>
</tr>
<tr>
<td>Dark</td>
<td>1129</td>
<td>74.18</td>
</tr>
<tr>
<td>No answer</td>
<td>23</td>
<td>1.51</td>
</tr>
<tr>
<td>Freckles or moles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>779</td>
<td>51.18</td>
</tr>
<tr>
<td>No</td>
<td>694</td>
<td>45.60</td>
</tr>
<tr>
<td>No answer</td>
<td>49</td>
<td>3.22</td>
</tr>
<tr>
<td>Risk for skin cancer index</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>257</td>
<td>16.89</td>
</tr>
<tr>
<td>1</td>
<td>475</td>
<td>31.21</td>
</tr>
<tr>
<td>2</td>
<td>372</td>
<td>24.44</td>
</tr>
<tr>
<td>3</td>
<td>186</td>
<td>12.22</td>
</tr>
<tr>
<td>4</td>
<td>89</td>
<td>5.84</td>
</tr>
<tr>
<td>No valid</td>
<td>143</td>
<td>9.40</td>
</tr>
</tbody>
</table>
scores of the drawings (1.032, CI = 0.93–1.13), tests items (0.52, CI = 0.40–0.64) and the complete survey (1.55, CI = 1.38–1.72) after the intervention (p < 0.001). Subgroups analyses revealed that girls showed an improvement significantly higher than boys. Grade 2 children did better than those in Grade 1. No significant differences between the pre- and post-test mean scores were detected between urban or country schools. With regard to the skin cancer risk index, before the intervention, children with more risk factors had scores significantly higher (9.14 ± 2.88) than those with less risk factors (8.15 ± 2.81) (p < 0.001). However, after the intervention, differences between these two groups were not detected [9.9 ± 3.51 versus 9.81 ± 3.02 respectively (p = 0.9)]. No clear differences were observed for the four risk factors separately.

Pre- and post-intervention drawings comparison

All the sun protection practices were more represented in both drawings made after the
SolSano program than before (Table 3). In the first drawing, sunscreen was the most frequently found sun protection method, either in the pre-test [638 children (41.90%)] or in the post-test [875 children (57.55%)]. However, in the second drawing, wearing hats was the predominant practice in the pre-test [522 children (34.30%)] and wearing clothes in the post-test [800 children (52.60%)]. Sunglasses seemed to be used by a small percentage of children. Seeking shadow and wearing clothes were those sun protection strategies which increased the most as a result of the SolSano program (percentage difference of 19.34 and 26.85% respectively).

### Pre- and post-intervention test items qualitative comparison
All the responses of the children’s surveys improved after the intervention (Table 3). The percentage of children who identified correctly the part of the day when the sun is more dangerous increased 22.6% (19.5–25.8%). At pre-test, 645 (42.4%) students were aware that SPF 15 was the minimal number needed for sun protection and at post-test, 954 (62.7%) pupils indicated 15 as the minimal SPF required.

At the beach, most of the children (82%) said that they protected themselves from the sun before and after the SolSano intervention. However, they did not appear to use sunscreens while practising sports, playing in the park, or walking on the mountains (Table 3). In the post-test, the percentage of students who reported to protect themselves from the sun in these situations increased.

At baseline, 544 (35.8%) children reported that they had received a sunburn during the previous summer compared with 357 (23.5%) at post-test. Additionally, there was a slight

<table>
<thead>
<tr>
<th>Drawing 1 (represented items)</th>
<th>Pre-test (n = 1522)</th>
<th>Post-test (n = 1522)</th>
<th>Percentage difference</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunscreen (%)</td>
<td>41.9</td>
<td>57.6</td>
<td>15.6</td>
<td>12.4 to 18.9</td>
</tr>
<tr>
<td>Shadow (%)</td>
<td>16.8</td>
<td>36.1</td>
<td>19.3</td>
<td>16.4 to 22.3</td>
</tr>
<tr>
<td>Hats (%)</td>
<td>6.2</td>
<td>10.5</td>
<td>4.4</td>
<td>2.45 to 6.3</td>
</tr>
<tr>
<td>Clothes (%)</td>
<td>2.2</td>
<td>9.7</td>
<td>7.5</td>
<td>5.9 to 9.1</td>
</tr>
<tr>
<td>Sunglasses (%)</td>
<td>1.4</td>
<td>2.6</td>
<td>1.5</td>
<td>0.5 to 2.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drawing 2 (represented items)</th>
<th>Pre-test (n = 1522)</th>
<th>Post-test (n = 1522)</th>
<th>Percentage difference</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunscreen (%)</td>
<td>28.8</td>
<td>38.9</td>
<td>10.1</td>
<td>6.8 to 13.4</td>
</tr>
<tr>
<td>Shadow (%)</td>
<td>10.1</td>
<td>15.3</td>
<td>5.1</td>
<td>2.7 to 7.5</td>
</tr>
<tr>
<td>Hats (%)</td>
<td>34.3</td>
<td>47.4</td>
<td>13.1</td>
<td>9.8 to 16.4</td>
</tr>
<tr>
<td>Clothes (%)^a</td>
<td>25.8</td>
<td>52.6</td>
<td>26.8</td>
<td>23.4 to 30.3</td>
</tr>
<tr>
<td>Sunglasses (%)</td>
<td>6.9</td>
<td>14.8</td>
<td>8.0</td>
<td>5.8 to 10.2</td>
</tr>
<tr>
<td>Got Sunburn (%)</td>
<td>35.8</td>
<td>23.5</td>
<td>−12.4</td>
<td>−15.3 to −9.4</td>
</tr>
<tr>
<td>Use SPF &gt;15 (%)</td>
<td>42.4</td>
<td>62.7</td>
<td>20.3</td>
<td>17 to 23.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sunscreen re-application</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Always (%)</td>
<td>52.4</td>
<td>55.6</td>
<td>3.2</td>
<td>0.3 to 6.3</td>
</tr>
<tr>
<td>Sometimes (%)</td>
<td>26.1</td>
<td>28.0</td>
<td>1.9</td>
<td>1.1 to 4.9</td>
</tr>
<tr>
<td>Never (%)</td>
<td>19.6</td>
<td>15.0</td>
<td>−4.6</td>
<td>−7.2 to −2.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sunscreen continuous application</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Always (%)</td>
<td>60.3</td>
<td>62.8</td>
<td>9.0</td>
<td>6.1 to 11.9</td>
</tr>
<tr>
<td>Sometimes (%)</td>
<td>20.3</td>
<td>20.8</td>
<td>0.5</td>
<td>−2.3 to 3.2</td>
</tr>
<tr>
<td>Never (%)</td>
<td>17.1</td>
<td>14.9</td>
<td>−2.2</td>
<td>−4.7 to −0.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sun safe timetable (12–4 PM) knowledge (%)</th>
<th>Pre-test (n = 1522)</th>
<th>Post-test (n = 1522)</th>
<th>Percentage difference</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Park (%)</td>
<td>23.6</td>
<td>31.3</td>
<td>7.7</td>
<td>4.6 to 10.7</td>
</tr>
<tr>
<td>Beach (%)</td>
<td>82.1</td>
<td>82.4</td>
<td>0.3</td>
<td>−2.4 to 3.0</td>
</tr>
<tr>
<td>Sports (%)</td>
<td>31.5</td>
<td>37.0</td>
<td>5.5</td>
<td>2.2 to 8.8</td>
</tr>
<tr>
<td>Mountains (%)</td>
<td>52.5</td>
<td>57.4</td>
<td>4.9</td>
<td>1.5 to 8.3</td>
</tr>
<tr>
<td>Desire to be tan (%)</td>
<td>48.3</td>
<td>43.8</td>
<td>−4.5</td>
<td>−7.3 to −1.7</td>
</tr>
</tbody>
</table>

^aOnly long-sleeved shirts were valid.
reduction (4.5% less) in the percentage of students who desired to be tan.

DISCUSSION

General
This report focuses on the intervention program SolSano designed to educate and influence the sun-protective behaviour of school-aged children. Our results support that such programs can improve their knowledge and habits concerning sun damage and sun protection. Additionally, the SolSano curricular materials were easily implemented by the teachers and were considered entertaining and fun by the Grade 1 and 2 students.

Several of the measures used in this study were self-reports by children, which can be influenced by social desirability and demand effects (Buller et al., 2006). Nevertheless, being asked to draw does not determine the children’s responses (Hughes et al., 1996) and the drawings also showed improvement in the children’s use of sun protective methods after the intervention.

A systematic literature review (Saraiya et al., 2004) identified a total of 33 reports on the effectiveness of educational and policy interventions about sun safety in primary schools, none of them in Spanish. The overwhelming majority of interventions showed a significant change in knowledge scores (22 out of 25) and a significant change in attitude scores (13 out of 17). We can tell that our study also improved knowledge and behaviour, based on the increase in the overall student’s score. In both the drawings and in the questionnaire, the use of sunscreen was the sun protection method most frequently employed by the children. A study carried out in Great Britain (Murphy, 2002) showed that sunscreens are the most common form of sun protection, whereas T-shirts and sunglasses, important means of protection, are rarely considered useful. This misconception is mainly due to the effect of mass media advertisement of sunscreen. In our study, after the SolSano intervention, all protective practices increase, but more importantly and different from other studies (Geller et al., 2003) is that wearing sunglasses and clothes or seeking the shade increased more significantly than sunscreen use. These are the most natural and safe way to protect children from the sun and sunscreen should be used to complement them (Etzel et al., 1999) (WHO, INTERSUN, Geneva, Switzerland. http://www.who.org/).

In the second drawing, wearing a hat was the predominant represented practice in the pre-test and wearing clothes in the post-test. The reason for this could be that the setting for the first drawing happens at the swimming-pool or the beach where most of the children drew themselves on swimsuit, whereas the second one could happen either in the beach or in the mountain, where children usually wear clothes and caps.

In relation to SPF, SolSano increased the number of children who knew that 15 was the minimal number needed for sun protection. This knowledge is important because SPF 30 broad-spectrum sunscreens have demonstrated to attenuate the number of nevi in white children, especially if they have freckles (Gallagher et al., 2000).

Demographic differences in sun safety knowledge level were detected with regards to known risk factors. Students who are at a higher risk of the short- and long-term effects of UV radiation scored higher on the test compared to the students at lower risk. In contrast to other programs (Gooderham and Guenther, 1999b), SolSano not only succeeded in improving the test score in these children, but also in those at lower skin cancer risk, who erroneously believe, often along with their parents, that they do not need so much sun protection because their skin does not easily burn (Gilaberte et al., 2001; Horsley et al., 2002; Stinco et al., 2005).

Related to gender, girls showed an improvement significantly higher than boys. This is important, firstly because in general women are more prone to sunbathe and get tanned than men, and secondly because it may reduce the incidence of melanoma in the future, the occurrence of which is higher among females not only in Spain but also in most other European countries (Ocaña-Riola et al., 2001; Nieto et al., 2003). This may help to confirm another theory (Stinco et al., 2005), that girls are more conscious of their body image, hence more likely to respond to such information, and may therefore use more sun protection practices.

According to our results, SolSano not only improved the self reported sun-protection practices but also reduced the number of children who experienced a sunburn during the summer.
It is said that sunburn avoidance in childhood must be the most important goal in the primary prevention of melanoma (Kaskel et al., 2001). Therefore, we can affirm that SolSano has been successful, at least, in its first and immediate goal: to reduce the number of children who sunburn during the summer.

One of the most important aims of SolSano is that children do not consider a tan attractive and they do not seek to be tanned. Almost 50% of our students considered tanning as something desirable/attractive. It is surprising that even at the age of 6, pupils appear to be conscious of their image, as has been previously observed (Horsley et al., 2002). After the intervention, this percentage diminished but it is still higher than in other countries like Canada where this percentage was around 30% (Barankin et al., 2001).

The improvement in the overall student’s score (knowledge and behaviour) after the intervention was significant. Nevertheless, considering that the maximum mark was 22 and the final mean of our children was 9.83 ± 2.88, more interventions are needed to strengthen and improve the children’s knowledge and behaviour about sun safety, as it has been previously demonstrated (Buller et al., 2006).

**Possible improvements to the study**

A limitation of the study could be that the participation shrinks at each survey, which is not unexpected because it involves consecutive school years. 40.29% of children who completed the pre-test did not complete the post-test. Nevertheless, this percentage of fail response is similar to that obtained in other studies (Barankin et al., 2001; Geller et al., 2005). Additionally, our sample still has a reasonable size.

In our study, we did not recover any information from parents, who play an important role in the sun-protection practices of their children, especially in young ones (Buller et al., 1995; Gilaberte et al., 2001). However, as involving parents would significantly increase both the cost and complexity of the study, and given that the SolSano program is school-based, their inclusion was considered neither necessary nor cost-effective.

The pre-test and post-test were not undertaken at the same distance in time from summer. The pre-test was performed in April, requiring students to give answers to questions based on their memory of last summer (some 8 months previous), whereas the post-test was performed just after the summer vacations. Nevertheless, one of the strengths of our evaluation method is that we performed the post-test more than 3 months after the children received the cross-curricular classroom SolSano in their schools. Most of the studies in which these kind of programs are evaluated, the post-test is distributed 1 to 6 weeks after teaching the program (Morris and Elwood 1996; Gooderham and Guenther 1999b; Geller et al., 2003), and only a few programs have been evaluated after the summer holidays (Barankin et al., 2001). On the other hand, it is possible that knowledge gained during the 5-month period between pre-test and post-test may be attributed to other community experiences about sun safety; although, to the best of our knowledge, no promotional sun protection activities were developed in the region during that summer.

**Conclusion**

In summary, SolSano has demonstrably achieved its main short-term goal, to improve children’s knowledge and habits about sun damage and sun protection. This kind of program must have a follow-up component in order to strengthen the achieved habits and to carry on teaching those children who did not reach an appropriate level of knowledge and habits about sun safety. For that reason, an intervention with new educational materials has been introduced for pre-adolescent students (10–12 years old) with new units about the ozone layer and ultraviolet radiation and how to use the UVI index as a guide when sun protective behaviour should be encouraged as well as when it may not be required (Sinclair, 2006). Additionally, sun protection campaigns should consider skin cancer prevention recommendations in recreation, sports, and community settings which complement and reinforce schools efforts (Marks, 1987; Dietrich et al., 2000; Weinstock et al., 2002).

Finally, public health education strategies that encourage sun protection and primary prevention of skin cancer must be promoted and developed by national or regional governments, as is being undertaken in Aragon (Eide and Weinstock, 2006). Only in this way will such campaigns have impact on the incidence of skin
cancer in the future, which is the main and final goal of the SolSano program.

FUNDING

Supported by the Department of Public Health, Government of Aragón, Spain.

ACKNOWLEDGEMENTS

We would like to thank Nick Thompson for his assistance in translating this manuscript into English.

REFERENCES


### APPENDIX 1. SCHOOL SUN SAFETY SURVEY

**Drawings**

(1) You are at the beach or pool with your family during a very hot and sunny day. Draw and write what your caregivers/parents are doing to take care after your brothers, sisters and you.

(2) Draw your-self in a very sunny and hot summer day, in the mountain, the swimming-pool or the beach. Write what you wear or do for the sun.

**Questions**

(3) The sun is more dangerous:

(a) Between 8 and 10 a.m.

(b) Between noon and 4 p.m.

(c) Between 5 and 8 p.m.

(d) During all day.

(e) They are not dangerous at all.

(4) In which of these activities do you protect yourself from the sun?

(a) Playing in the park.

(b) In the beach or the swimming pool.

(c) Practicing sports outside.

(d) In the mountains.

(e) None.

(5) Do you wear hat almost always/sometimes/never.

(6) Do you cover up almost always/sometimes/never.

(7) Do you seek the shade almost always/sometimes/never.

(8) Do you use sunscreen almost always/sometimes/never.

(9) Did you sunburn last summer?

(a) Yes.

(b) No.
(c) No reply.
(10) Which is the SPF of your sunscreen?
   (a) I don’t apply sunscreen.
   (b) Less than 15.
   (c) Equal or more than 15.
   (d) I don’t know.
(11) Do you reapply your sunscreen?
   (a) Almost always.
   (b) Sometimes.
   (c) Almost never.
(12) When you get a tan, do you keep applying sunscreen?
   (a) Almost always.
   (b) Sometimes.
   (c) Almost never.
(13) Do you like to be tanned?
   (a) Yes.
   (b) No.
   (c) I don’t care.
(14) Your skin is:
   (a) Pale and it burns easily with the sun.
   (b) Dark and it rarely burns with the sun.
(15) My hair is (color).
(16) My eyes are (color).
(17) I have freckles and/or moles:
   (a) Yes.
   (b) No.

(This survey can be obtained in its original language (Spanish) from ygilaberte@salud.aragon.es.)