

Ana Filipa DUARTE^{1,2}
 António PICOTO²
 Altamiro da Costa PEREIRA^{3,4}
 Osvaldo CORREIA^{1,2,3,4}

¹ Centro Dermatologia Epidermis, Instituto CUF, Porto, Portugal

² Portuguese Skin Cancer Association, Portugal

³ Center for Health Technology and Services Research (CINTESIS) and Department of Health Information and Decision Sciences, Faculty of Medicine, University of Porto, Portugal

⁴ Faculty of Medicine, University of Porto, Portugal

Reprints: Ana Filipa Duarte
 <duarte.af.t30@gmail.com>

Sun protection in children: a behavioural study

Background: Incidence of skin cancer is increasing worldwide and UV exposure at a young age is an important risk factor. **Objectives:** To compare sun exposure-related knowledge and behaviour among children during school and holiday periods. **Material & Methods:** A cross-sectional study was undertaken at 12 Oporto public primary schools. Educational sessions for educators were held by dermatologists every spring from 2004 to 2012. An educational activity book, *Play and Learn with Jo Spots*, was distributed to all primary school children and was explained by the educators every year. A questionnaire about sun exposure and behaviour was given to students in 2004 and 2012. **Results:** In total, 2,114 students answered the questionnaire (1,233 in 2004 and 881 in 2012). Children practiced more outdoor sports in 2012 than in 2004 (86% vs 56%; $p < 0.001$), but spent less time outside when the sun's rays were most dangerous. The use of hats (64% vs 59%; $p = 0.028$) and sunscreen (35% vs 15%; $p < 0.001$) at school and the application of sunscreen before going to the beach improved over time (51% vs 26% in 2004; $p < 0.001$). However, there was an increase in sunburn rate (43% vs 37%; $p = 0.005$). **Conclusion:** Sun exposure-related behaviour among primary school students in Oporto is improving but is still far from optimal. School would appear to be an adequate setting for effective and long-lasting sun protection interventions, and the introduction of educational books at schools, such as *Play and Learn with Jo Spots*, might be effective in bringing about positive behavioural changes.

Key words: sun protection, behaviour, knowledge, children, educational activity book

Article accepted on 25/09/2017

The incidence of skin cancer has increased steadily in recent decades, and a direct correlation with sun exposure, especially at a young age, has long been recognized [1, 2].

UV protection measures should start in early childhood [3], since avoidance of intense sun exposure and adoption of behaviours that limit sun exposure are likely to decrease the risk of skin cancer (including melanoma) in adulthood [4].

Children spend a large part of their time at school, and schools can thus play an important role in helping to protect them from UV exposure [5]. Because knowledge, beliefs, and behaviours acquired during childhood are difficult to change later in life [6], regular primary prevention activities targeting children are important for bringing about long-lasting changes in sun-protective behaviour [7-9].

The aim of this study was to analyse sun exposure-related behaviour and knowledge among children during school and holiday periods, and to assess the possible impact of an educational activity book on appropriate sun protection behaviour; the book in question, *Play and Learn with Jo Spots*, was introduced to primary schools in Oporto, Portugal in 2003.

A greater understanding of children's practices will help to identify strategies for improving sun-related knowledge and behaviour and minimise UV exposure for this high-risk age group.

Materials and methods

An observational cross-sectional survey study was performed. Schools and students were selected according to their availability. Parents were informed and consented to the study.

The survey was conducted at 12 public primary schools in Oporto in June 2004, prior to the introduction of the activity book, *Play and Learn with Jo Spots*. The survey was then repeated eight years later (in June 2012) at the same schools. The survey was conducted in schools that were not included in the pilot study of 2003.

The survey was based on a questionnaire (*supplementary material 1*) that contained demographic questions related to the children and their schools; questions on sun-exposure behaviour during school and holiday periods, and seven true or false questions to test their knowledge. The questionnaire was designed specifically for children following a review of the relevant literature [2, 6, 10, 11], and was validated using 1,472 students in a pilot study in 2003 [12].

Since 2003, every spring, the children's teachers have attended educational sessions on skin cancer risk factors and preventative measures, including open discussions led by dermatologists. The activity book, *Play and Learn with Jo Spots* (*supplementary material 2*), has been distributed

doi: 10.1684/ejd.2018.3290

Table 1. Comparison of demographics and sun exposure-related behaviour between 2004 and 2012.

	2004 (n = 1233)		2012 (n = 881)		p*
	n	%	n	%	
Age (years)					
7	283	23	141	16	<0.001
8	358	29	229	26	
9-10	518	42	485	55	
11/+	74	6	26	3	
Do you have trees in your school playground?					
No	12	1	9	1	0.477
Yes	1221	99	872	99	
Is there shade in your school playground?					
No	25	2	25	3	0.125
Yes	1 208	98	856	97	
When it is sunny, do you practice outdoor sports at school?					
No	543	44	123	14	<0.001
Yes	690	56	758	86	
If you practice outdoor sports when it is sunny, what time do you usually do this?					
Before 12 AM and / or after 4 PM	604	49	643	73	<0.001
Between 12 AM and 4 PM	629	51	238	27	
When it is sunny, do you usually wear a hat at school?					
No	506	41	317	36	0.028
Yes	727	59	564	64	
When it is sunny, do you usually apply sunscreen at school?					
No	1 048	85	573	65	<0.001
Yes	185	15	308	35	

*Chi square test

every year to all primary school students and discussed in class by the teachers since 2004.

The book contains important information on UV exposure and sun protection, and focuses on a healthy relationship with the sun (*supplementary material 3*).

Statistical analysis

Data analysis was performed using contingency tables and the χ^2 test for independence. Statistical significance was established at a *p* value of less than 0.05.

Results

A total of 2,114 questionnaires were completed; 1,233 in 2004 and 881 in 2012.

The data for 2004 and 2012 are presented in *table 1*. The practice of outdoor sports in the sun was more common in 2012 than 2004 (86% vs 56%; $p < 0.001$), however, less time was spent during hours of more intense sunshine (73% before 12 noon and/or after 4 p.m. in 2012 vs 49% in 2004; $p < 0.001$). A larger proportion of children in 2012 reported wearing a hat (64% vs 59%; $p < 0.028$) and using sunscreen (35% vs 15%; $p < 0.001$) at school when it was sunny.

Data comparing sun-related behaviours during school holidays for 2004 and 2012 are presented in *table 2*. In 2012, 51% of children stated that they applied sunscreen at home before going to the beach (vs 26% in 2004; $p < 0.001$). However, the proportion of children who said that they did

not apply sunscreen while at the beach or after swimming increased from 19% to 28% ($p < 0.001$) and 72% to 81% ($p < 0.001$), respectively. An increase was also observed for rates of sunburn in the previous year (43% vs 37%; $p = 0.005$) and reports of more than two sunburn episodes (35% in 2012 vs 28% in 2004; $p = 0.045$).

The results for the section on sun-related knowledge in 2004 and 2012 are summarised in *table 3*. The proportion of correct answers increased for five questions (from 59% to 86%, depending on the question), remained unchanged for one question, and decreased for another (sunscreen provides better protection than a shirt); this question was answered correctly by 42% of children in 2004 but by only 36% in 2012 ($p < 0.003$).

Discussion

Despite the limitations of our study (reliance on a self-assessment method and a long period between the first and second cohort survey), the results highlight several relevant points.

Our comparison of data for 2004 and 2012 shows that, overall, sun exposure-related behaviours among primary school students in Oporto are improving. More children are using hats and sunscreens, and while the practice of outdoor sports has increased, exposure has decreased during the time of day when the sun's rays are most dangerous.

The behavioural changes detected during holiday periods are somewhat contradictory. We observed an increase in sunburn rates, even though over 50% of the students stated

Table 2. Comparison of sun exposure-related behaviour and sunburn history during school holidays in 2004 and 2012.

	2004 (n = 1233)		2012 (n = 881)		p*
	n	%	n	%	
In the summer, do you usually go to the beach?					
No	13	1	35	4	<0.001
Yes	1 220	99	846	96	
Do you usually wear a hat at the beach?					
No	100	8	97	11	0.018
Yes	1135	92	784	89	
Do you usually apply sunscreen at home before going to the beach?					
No	912	74	432	49	<0.001
Yes	321	26	449	51	
Do you apply sunscreen at the beach?					
No	234	19	247	28	<0.001
Yes	999	81	634	72	
Do you reapply sunscreen after going for a swim?					
No	888	72	714	81	<0.001
Yes	345	28	167	19	
Did you get sunburnt last year?					
No	777	63	502	57	0.005
Yes	456	37	379	43	
If so, how often did you get sunburnt?					
Once	251	55	174	46	0.045
Twice	77	17	72	19	
More than twice	128	28	133	35	

*Chi square test

Table 3. True or false questions relating to knowledge (2004 and 2012).

	2004 (n = 1233)		2012 (n = 881)		p*
	n	%	n	%	
The intensity of the sun in your school garden is different to the intensity of the sun at the beach					
False	678	55	528	60	0.059
When it's sunny, you only have to wear a hat if you go to the beach					
False	949	77	731	83	<0.001
The shade of a tree often provides good protection from the sun					
True	1036	84	696	79	0.005
The best time for practicing sports or being at the beach is from 12 AM to 16 PM					
False	863	70	670	76	0.005
Sunscreen provides better protection than a shirt					
False	518	42	317	36	0.003
All sunscreens have the same protection factor					
False	937	76	678	77	0.645
The best protection from the sun is a hat and a shirt and sunscreen on exposed skin					
True	1011	82	749	85	0.047

*Chi square test

that they regularly used sunscreen (compared with 26% in 2004). Although high, the sunburn rate is similar to other studies for schoolchildren in Switzerland [13] and Italy [14]. In 2012, 43% of the students had been sunburnt

the previous year and over a third had been sunburnt on more than two occasions. Previous findings suggest that sunscreen application is frequently suboptimal, leading to prolonged sun exposure and consequently to sunburn [15].

Typical factors associated with unexpected sunburn are the application of thin layers, use of excessively liquid formulations, poor distribution of spray, and failure to reapply after swimming (less than 20% in this study) [15, 16]. Sunscreen use gives a false sense of security, prolonging the exposure time and enhancing the risk of sunburn [17]. The use of sunscreens should continue to be recommended, but always in combination with other protective measures, such as shade, hats, sunglasses, and clothes (covering the neckline and forearms, with appropriate material) [18-20].

A high proportion of children provided correct answers to the questions addressing their knowledge. The questions are all covered in the *Play and Learn with Jo Spots* book. Despite the disparities in behaviour in different settings (even with improvement over eight years), the majority of the students were aware that the intensity of the sun's rays is the same at the beach and in the school playground, and that protection is necessary whenever it is sunny. A large proportion of children were also familiar with the importance of using adequate protection (hats, shirts, shade, and sunscreen). More children incorrectly stated that sunscreen provided greater protection than wearing a shirt in 2012 (64% vs 58%; $p = 0.003$) and about 25% of children believed that all sunscreens protect equally. This misconception could be the result of mass marketing campaigns by the sunscreen industry, which should be duly monitored by the authorities responsible.

More than 50% of children wear a hat when exposed to the sun at school, as reported in the literature [21]. As in other studies [22], hats and sunscreens are still used more at the beach than at school (90% vs 60% and 50% vs 35%, respectively) or other outdoor settings [23]. Sunburn mostly occurs during beach holidays [14]. UV exposure time is usually much longer during holiday periods because parents are less strict with regards to the length of time children are outside. Parents should therefore also be a target of primary prevention campaigns. Regarding the school setting, protective measures employed during playtime and lunch breaks (when the UV index is at its peak) should be the same as those used at the beach. There is room for improvement in this area.

An ideal time to promote good sun-protective behaviour would appear to be during childhood [8, 10]. Our findings confirm that schools are an adequate setting for educational interventions targeting sun-protective attitudes and behaviours, supporting previous reports [3]. Overall, we observed an improvement in behaviour between 2004 and 2012, confirming that it is worth continuing efforts targeting young children. However, patience and persistence are needed as, while knowledge may be acquired rapidly, changes in attitudes and behaviour take longer [24-27].

Although the value of written educational material at schools has been debated in the literature [28-30], the use of the *Play and Learn with Jo Spots* book over the eight-year period may have contributed to the positive results observed. The educational sessions held with the teachers each spring are also important as they equip teachers with the knowledge they need to convey the relevant information to their students and help bring about changes in school practices and infrastructure (e.g. timing of outdoor activities, use of shade).

We emphasize the importance of supporting the development of healthy sun-related habits early in life, as this may be much more effective and long-lasting than efforts to

reverse poor habits at a later stage [31]. Primary prevention of skin cancer should be integrated into the school curriculum for children, starting from at least the age of six years. Parents and educators, however, should also ensure the protection of preschool children and take the opportunity to teach simple measures [14, 32, 33].

Further studies are needed to better understand how changes in sun exposure-related knowledge and behaviour in primary schools should be managed.

Acknowledgements. We are indebted to all the dermatologists (in particular, José Carlos Fernandes, Natividade Rocha, and Ana Margarida Barros), educators, and secretarial staff who have made the implementation of the Jo Spots school campaign possible since 2004, Alexandre Caires for the illustrations in *Play and learn with Jo Spots* and Orquídea Ribeiro for assistance with statistical analyses. ■

Disclosure. *Financial support: none. Conflict of interest: none.*

Supplementary Material

Supplementary material (Supplementary material 1 and Supplementary material 2) accompanied by the online version of this article is available on <http://www.sciencedirect.com> and doi:10.1684/ejd.2018.3290.

References

1. Gritz ER, Tripp MK, de Moor CA, Eicher SA, Mueller NH, Spedale JH. Skin cancer prevention counseling and clinical practices of pediatricians. *Pediatr Dermatol* 2003; 20: 16-24.
2. McKinlay A, Breitbart EW, Ringborg U, Greinert R. 'Children under the Sun'-UV radiation and children's skin. WHO Workshop - Children's sun protection education. *Eur J Cancer Prev* 2002; 11: 397-405.
3. Cercato MC, Nagore E, Ramazzotti V, Sperduti I, Guillen C. Improving sun-safe knowledge, attitude and behaviour in parents of primary school children: a pilot study. *J Cancer Educ* 2013; 28: 151-7.
4. Berneburg M, Surber C. Children and sun protection. *Br J Dermatol* 2009; 3: 33-9.
5. Guy GP Jr., Holman DM, Watson M. The important role of schools in the prevention of skin cancer. *JAMA Dermatol* 2016; 152: 1083-4.
6. Geller AC, Colditz G, Oliveria S, et al. Use of sunscreen, sunburning rates, and tanning bed use among more than 10 000 US children and adolescents. *Pediatrics* 2002; 109: 1009-14.
7. Saraiya M, Glanz K, Briss P, Nichols P, White C, Das D. Preventing skin cancer: findings of the Task Force on Community Preventive Services On reducing Exposure to Ultraviolet Light. *MMWR Recomm Rep* 2003; 52: 1-12.
8. Lin JS, Eder M, Weinmann S. Behavioral counseling to prevent skin cancer: a systematic review for the U.S. Preventive Services Task Force. *Ann Int Med* 2011; 154: 190-201.
9. Saraiya M, Glanz K, Briss PA, et al. Interventions to prevent skin cancer by reducing exposure to ultraviolet radiation: a systematic review. *Am J Prev Med* 2004; 27: 422-66.
10. Hewitt M, Denman S, Hayes L, Pearson J, Wallbanks C. Evaluation of 'Sun-safe': a health education resource for primary schools. *Health Educ Res* 2001; 16: 623-33.
11. Dixon H, Borland R, Hill D. Sun protection and sunburn in primary school children: the influence of age, gender, and coloring. *Prev Med* 1999; 28: 119-30.

- 12.** Correia O, Barros AM, Rocha N, *et al.* Skin cancer primary prevention programme for school children. Analysis of behavioral practices. *Skin Cancer* 2006; 21: 67-76.
- 13.** Reinau D, Meier C, Gerber N, Hofbauer GF, Surber C. Sun protective behaviour of primary and secondary school students in North-Western Switzerland. *Swiss Med Wkly* 2012; 24: 13520.
- 14.** Balato N, Gaudiello F, Balato A, Monfrecola G. Sun habits in the children of Southern Italy. *J Am Acad Dermatol* 2007; 57: 883-7.
- 15.** Autier P, Boniol M, Dore JF. Sunscreen use and increased duration of intentional sun exposure: still a burning issue. *Int J Cancer* 2007; 121: 1-5.
- 16.** Thieden E, Philipsen PA, Sandby-Moller J, Wulf HC. Sunscreen use related to UV exposure, age, sex, and occupation based on personal dosimeter readings and sun-exposure behavior diaries. *Arch Dermatol* 2005; 141: 967-73.
- 17.** Jansen R, Osterwalder U, Wang SQ, Burnett M, Lim HW. Photoprotection: part II. Sunscreen: development, efficacy, and controversies. *J Am Acad Dermatol* 2013; 69: 881-2.
- 18.** Gefeller O, Pfahlberg A. Sunscreen use and melanoma: a case of evidence-based prevention? *Photodermatol Photoimmunol Photomed* 2002; 18: 153-6.
- 19.** Garbe C. Patterns of sun protection for young children: do we deliver the right sun-protection messages? *Br J Dermatol* 2012; 166: 1365-2133.
- 20.** Skotarczak K, Osmola-Man Kowska A, Lodyga M, Polanska A, Mazur M, Adamski Z. Photoprotection: facts and controversies. *Eur Rev Med Pharmacol Sci* 2015; 19: 98-112.
- 21.** Dudley DA, Cotton WG, Winslade MJ, *et al.* An objective and cross-sectional examination of sun-safe behaviours in New South Wales primary schools. *BMC Public Health* 2017; 17: 21.
- 22.** Li J, Uter W, Pfahlberg A, Gefeller O. A comparison of patterns of sun protection during beach holidays and everyday outdoor activities in a population sample of young German children. *Br J Dermatol* 2012; 166: 803-10.
- 23.** Gilaberte Y, Alonso JP, Teruel MP, Granizo C, Gallego J. Evaluation of a health promotion intervention for skin cancer prevention in Spain: the SolSano program. *Health Promot Int* 2008; 23: 209-19.
- 24.** Vuadens A, Ackermann S, Levi F, Bulliard JL. Sun-related knowledge and attitudes of primary and secondary schoolchildren in western Switzerland. *Eur J Cancer Prev* 2016; 5: 5.
- 25.** Dadlani C, Orlow SJ. Planning for a brighter future: a review of sun protection and barriers to behavioral change in children and adolescents. *Dermatol Online J* 2008; 14: 1.
- 26.** Everett Jones S, Guy GP Jr.. Sun safety practices among schools in the United States. *JAMA Dermatol* 2017; 153: 391-7.
- 27.** Ackermann S, Vuadens A, Levi F, Bulliard JL. Sun protective behaviour and sunburn prevalence in primary and secondary schoolchildren in western Switzerland. *Swiss Med Wkly* 2016; 12.
- 28.** Naldi L, Chatenoud L, Bertuccio P, *et al.* Improving sun-protection behavior among children: results of a cluster-randomized trial in Italian elementary schools. The "SoleSi SoleNo-GISED" Project. *J Invest Dermatol* 2007; 127: 1871-7.
- 29.** Crane LA, Asdigian NL, Baron AE, *et al.* Mailed intervention to promote sun protection of children: a randomized controlled trial. *Am J Prev Med* 2012; 43: 399-410.
- 30.** Ho BK, Reidy K, Huerta I, *et al.* Effectiveness of a multicomponent sun protection program for young children: a randomized clinical trial. *JAMA Pediatr* 2016; 170: 334-42.
- 31.** Fernandez-Morano T, De Troya-Martin M, Rivas-Ruiz F, *et al.* Behaviour, attitudes and awareness concerning sun exposure in adolescents on the Costa del Sol. *Eur J Dermatol* 2014; 24: 85-93.
- 32.** Aulbert W, Parpart C, Schulz-Hornbostel R, Hinrichs B, Kruger-Corcoran D, Stockfleth E. Certification of sun protection practices in a German child day-care centre improves children's sun protection- the 'SunPass' pilot study. *Br J Dermatol* 2009; 3: 5-12.
- 33.** Munoz Negro JE, Buendia-Eisman A, Cabrera Leon A, Serrano Ortega S. Variables associated with sun protection behaviour of preschoolers. *Eur J Dermatol* 2011; 21: 985-90.