Parents' attitude related to melanocytic nevus count in children

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Sun exposure, fair phototype, and a high common melanocytic nevus (MN) count have been identified as the most important risk factors for melanoma. MN are mainly acquired during childhood, and their relationship to sun exposure, sunburn, and light skin complexion is well documented. The purpose of this study was to investigate how the sun protection attitudes of parents and their offsprings affect MN development in children. We designed a cross-sectional study in 828 9-year-old school children. Trained nurses counted the MN on each child's back and arms, depending on their size. Questionnaires filled by children and parents provided information about sun exposure, attitude towards the sun, and sun-protection behaviors. Multivariate analysis showed that the childhood MN count was linked to fair phenotype – fair skin: rate ratio (RR) = 3.80, 95% confidence interval (CI) = 2.25–6.41; blue/green eyes: RR = 1.2, 95% CI = 1.11–1.34; blond hair: RR = 1.25, 95% CI = 1.10–1.41; history of sunburn: RR = 1.13, 95% CI = 1.03–1.23, seaside sun exposure – RR = 1.14, 95% CI = 1.01–1.28, and to their parents' behaviors during exposure to the sun – increase in the number of MN when parents used sunscreen: RR = 1.23, 95% CI = 1.08–1.40; decrease in MN count when parents wore a tee-shirt: RR = 0.86, 95% CI = 0.79–0.93. In conclusion, fair phenotype and sun exposure are known major risk factors for MN. Parents' behaviors influence their children and appeared in our analysis as another determinant predictor of MN count, being protective against (wearing a tee-shirt when exposed to sun) or increasing the risk (sunscreen use, reflecting higher sun exposure) for childhood MN development. ***European Journal of Cancer Prevention*** **00:000–000 © 2010 Wolters Kluwer Health | Lippincott Williams & Wilkins.**

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Introduction

Melanoma is a cancer commonly affecting young adults and its incidence is on the increase in the industrialized world. In the US, the probability of developing melanoma from birth to the age of 39 years is 0.13% for men, (second after hematological cancers, 0.16%) and 0.21% for women (after breast cancer, 0.48%) (Jemal *et al.*, 2007). Several risk factors have been identified: many of them are constitutional, such as pigmentation characteristics (blue eyes, fair hair, fair skin, freckles) and a family history of skin cancer (Gandini *et al.*, 2005c). Acute sun exposure (sunburn) during childhood and a high number of melanocytic nevi (MN) are statistically associated, and are the most important environmental risk factors for melanoma (Gandini *et al.*, 2005a, 2005b).

Fair phototype and freckles are also the risk factors for MN development, and acute sun exposure during childhood. Obviously, public awareness campaigns influence the latter only (Gallagher *et al.*, 1990; English and Armstrong, 1994; Wiecker *et al.*, 2003; Whiteman *et al.*, 2005, 2008; Mahé *et al.*, 2009; Quéreux *et al.*, 2009). This is one of the action points of the World Health Organization, which considers that 'prevention efforts should focus on this critical age group and work towards changing children's knowledge, attitudes and behavior in relation to sun protection' (Rehfüss and von Ehrenstein, 2002).

Some risk factors for MN development are still controversial, such as the role of intermittent and/or cumulative sun exposure (Wiecker *et al.*, 2003; Whiteman *et al.*, 2005; Dodd *et al.*, 2007), neonatal blue-light phototherapy (Mahé *et al.*, 2009), and the use of a sunscreen (Autier *et al.*, 1998; Gallagher *et al.*, 2000; Bauer *et al.*, 2005a). Parents also seem to play an important role in the development of MN in their children. Their sun exposure and sun-protective behaviors may influence their children's attitude (Johnson *et al.*, 2001; Wiecker *et al.*, 2003; Whiteman *et al.*, 2005), but few authors have studied in depth the impact of parental attitudes on MN development in children (Johnson *et al.*, 2001; Wiecker *et al.*, 2003; Whiteman *et al.*, 2005).

In 2007, we conducted a prospective study investigating the effectiveness of several educational measures on sun protection in primary schools, during which we identified several risk factors for MN. We confirmed the importance

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of pale phototype characteristics and the history of sunburn, but not of neonatal blue-light phototherapy on the early development of MN (Mahé *et al.*, 2009). Hereafter, we report the impact of parental sun protection behaviors and sun exposure (both parents and children) on MN count in their offspring.

Methods

In May–June 2007, we conducted a cluster-controlled study, investigating the effectiveness of several educational measures on sun protection in primary schools of the greater Paris area. Details of this study have been published earlier (Mahé *et al.*, 2009). Briefly, 52 schools were stratified according to mean socio-economic status and then randomly selected for the four different interventions. A MN count was performed by two trained nurses on the arms and backs of children present on the day of the evaluation, after their parents had given written informed consent. MN were recorded according to their size (≤ 2, 2–5, > 5 mm), using a circular template on rigid transparent plastic. Small MN were distinguished from freckles by their dark color and, if present, by their raised appearance. Halo nevi were counted, but nevus spilus, congenital nevi, and blue nevi were excluded. No attempt was made to distinguish junctional MN from lentigo simplex. In all cases of doubt, pigmented lesions were not counted.

One of each child's parents completed a standardized case report form validated earlier in nonrandomized preliminary studies, a few days before the intervention (Johnson *et al.*, 2001) Children completed another independent questionnaire at school, on the day of the intervention. They reported their holiday destinations during the past year, selecting from four different destinations: 'seaside', 'mountain', 'skiing', and 'countryside or elsewhere'. Frequency of their usual sun exposure during peak hours was measured on a 4-point scale: 'always', 'often', 'sometimes', and 'never'. They also reported their parents' sun habits by answering this question 'when you are on holiday, does your father/mother expose himself/herself to the sun?' Parents reported information on their own sun-protection practices and those used for their child. These concerned clothing habits (wearing a tee-shirt, ultraviolet protective clothing, hat and cap, and sunglasses), sun exposure (staying in the shade, sun exposure at peak hours), and sunscreen use during exposure to the sun. Frequency of these behaviors was assessed on the same 4-point scale as used for children.

Data were collected in case report forms created with Sphinx software V 5 (*http://www.lesphinx-developpement.fr*). Parents and children filled in the questionnaire, which was scanned with Sphinx software. Quantitative results were expressed as mean ± standard deviation. For mean comparisons between groups, we used the Student's *t*-test and analysis of variance. In the event of significant results, multiple comparison tests using the contrast method were performed. A P value less than 0.05 was considered as statistically significant. The qualitative data were compared with the χ^2 test.

Tests were performed to identify variables significantly associated with MN count. Univariate analysis was first conducted by treating the variables as categorical. All covariates with a P value less than 0.05 in the univariate analysis [including data from the first part of the study (Mahé *et al.*, 2009)] were included in the multivariate model, with the exception of interlinked covariates (for questions whose response rate was more than 70% associated. For variables with a P value less than 0.05, the Poisson regression was used and the rate ratio (RR) estimates for MN development – and their corresponding 95% confidence interval (CI) – were calculated. Statistical analyses were performed using SAS software V 9.1 (SAS Institute, Inc., Cary, North Carolina, USA).

Results

The study analysis included 828 children who participated in the physical examination and whose parents had completed the questionnaire. They were homogenous for age (mean age 9 years), and there were as many girls as boys. The children' baseline characteristics have already been published. The mean number of common MN was 16.7 per child on the arms and back, irrespective of MN size (Mahé *et al.*, 2009).

Sun exposure

Holidaying at the seaside ($P = 0.02$) or in the mountains ($P = 0.008$), and skiing ($P = 0.0009$) in the past year were significantly associated with a higher MN count (Table 2). No such association was observed for holidays taken in the countryside ($P = 0.19$), or for daily outdoor activities during peak sun hours ($P = 0.45$) (Table 1).

Impact of parents' behavior on the melanocytic nevus count of their children

Children who reported that their parents exposed themselves to the sun on holidays 'often' or 'every day' had more MN ($P = 0.04$ for father, $P = 0.03$ for mother, Table 1). MN counts were also higher for children whose parents had experienced sunburn ($P < 0.0001$).

Children whose parents declared that they wore a tee-shirt when exposed to the sun had significantly fewer MN than those whose parents did not wear sun-protective clothing ($P = 0.002$) (Table 2). In contrast, children whose parents reported using sunscreen for themselves presented with more MN ($P < 0.0001$). Similarly, children whose parents reported wearing sunglasses (81%) also presented with a higher MN count ($P = 0.0005$).

Sun-protective methods used by parents for their children and melanocytic nevus count

Sunscreen application on children was associated with a higher MN count ($P < 0.0001$). For those children who

Table 1 MN count in children (mean ± standard deviation) depending on their sun exposure[a]

	N (%)	Nevus count (mean ± standard deviation)	*P* value
Past year holiday destination			
Seaside			
No	143 (19)	14.9 ± 9.5	0.02
Yes	623 (81)	17.2 ± 10.6	
Mountains			
No	426 (61)	16.1 ± 10.9	0.008
Yes	278 (39)	18.1 ± 9.7	
Skiing			
No	406 (56)	15.8 ± 10.8	0.0009
Yes	314 (44)	18.4 ± 9.7	
Countryside			
No	237 (33)	16.1 ± 11.4	0.19
Yes	492 (67)	17.2 ± 10.0	
Frequency of sunny outdoors activities in peak hours			
Never – sometimes	427 (54)	16.6 ± 10.0	0.45
Often – everyday	360 (46)	17.1 ± 10.7	

MN, melanocytis nevus.
[a]Questions for children.

Table 2 MN count (mean ± standard deviation) in children, depending on parental behavior

	N (%)	Nevus count (mean ± SD)	*P* value
Parental history of sunburn episodes			
No	71 (9)	9.1 ± 9.1	0.0001
Yes	709 (91)	17.5 ± 10.1	
Parents behavior with regard to protecting themselves from the sun			
When exposed to sun do you…			
Wear a tee-shirt?			
Never-sometimes	340 (44)	18.1 ± 10.5	0.002
Often-always	439 (56)	15.8 ± 10.2	
Use ultraviolet protective clothes?			
Never-sometimes	766 (97)	16.9 ± 10.3	0.16
Often-always	395 (50)	13.6 ± 11.5	
Wear a hat or a cap?			
Never-sometimes	392 (50)	17.3 ± 10.6	0.15
Often-always	395 (50)	16.3 ± 10.1	
Wear sunglasses?			
Never-sometimes	154 (19)	14.1 ± 10.6	0.0005
Often-always	637 (81)	17.4 ± 10.2	
Avoid sun exposure at peak hours?			
Never-sometimes	194 (25)	17.0 ± 10.3	0.74
Often-always	590 (74)	16.7 ± 10.3	
Stay in the shade?			
Never-sometimes	200 (26)	17.0 ± 9.9	0.7
Often-always	579 (74)	16.7 ± 10.5	
Use sunscreen?			
Never-sometimes	129 (16)	13.3 ± 10.8	0.0001
Often-always	660 (84)	17.5 ± 10.1	
On holiday, how often does your…[a]			
Father expose himself to the sun?			
Never-sometimes	454 (60)	16.4 ± 10.3	0.04
Often-always	301 (40)	17.9 ± 10.5	
Mother expose herself to the sun?			
Never-sometimes	418 (54)	16.1 ± 10.7	0.03
Often-always	353 (46)	17.6 ± 9.9	

MN, melanocytis nevus.
[a]Questions for children.

received sunscreen, a 20–50 sun-protective factor product was used in more than 60% of cases. Sun-protective factor did not seem to have an impact on the MN count ($P = 0.18$) (data not shown).

Seeking the shade when exposed to the sun reduced the MN count ($P = 0.03$), but we found no statistical evidence indicating that the other sun-protection attitudes, such as wearing ultraviolet protective clothes ($P = 0.08$), a hat or a cap ($P = 0.54$), and sunglasses ($P = 0.25$), or avoiding exposing children to the sun during peak hours ($P = 0.16$) influenced the MN count of the children in the study (Table 3).

Multivariate analysis

With the exception of the interlinked variables (Table 4), we included all the covariates having a P value less than 0.05 in the univariate analysis in the multivariate model.

Table 3 MN count (mean ± standard deviation) in children as a function of parental attitudes towards protecting their children from the sun

	N (%)	Nevus count (mean ± SD)	*P* value
When exposed to the sun, as a sun-protective measure for your child, do you make him/her…			
Wear a tee-shirt?			
Never-sometimes	171 (22)	17.4 ± 10.1	0.34
Often-always	618 (78)	16.6 ± 10.4	
Use ultraviolet protective clothes?			
Never-sometimes	741 (95)	16.9 ± 10.4	0.08
Often-always	40 (5)	14.0 ± 10.1	
Wear a hat or a cap?			
Never-sometimes	61 (8)	15.9 ± 10.6	0.54
Often-always	730 (92)	16.8 ± 10.3	
Wear sunglasses?			
Never-sometimes	309 (39)	16.2 ± 10.8	0.25
Often-always	480 (61)	17.1 ± 10.0	
Avoid sun exposure at peak hours?			
Never-sometimes	124 (16)	17.9 ± 10.6	0.16
Often-always	663 (84)	16.5 ± 10.3	
Stay in the shade?			
Never-sometimes	114 (15)	18.6 ± 10.1	0.03
Often-always	671 (85)	16.4 ± 10.3	
Use sunscreen?			
Never-sometimes	47 (6)	9.8 ± 11.3	< 0.0001
Often-always	739 (94)	17.2 ± 10.1	

MN, melanocytis nevus.

Table 4 Univariate[a] and multivariate analyses

	Univariate analysis, *P* value	Multivariate analysis, *P* value
Child's phenotype[5]		
Eye color	< 0.0001	< 0.0001
Hair color	< 0.0001	0.0003
Skin color	< 0.0001	< 0.0001
Sunburn episodes	< 0.0001	0.008
Childrens' sun exposure		
Holidays at seaside in the past year[b]	0.01	0.02
Parent's sun exposure		
Father's sun exposure on holidays[b]	0.04	0.67
Mother's sun exposure on holidays[b]	0.03	0.22
Parent's sunburn episodes	< 0.0001	0.17
Parents' behaviors to protect themselves when exposed to sun		
Wearing a tee-shirt	0.002	0.0003
Wearing sunglasses	0.0005	0.06
Sunscreen use	< 0.0001	0.001
Parent's behaviors with regard to protecting their children from the sun		
Looking for shade	0.03	0.16
Sunscreen use	< 0.0001	0.11

[a]Covariates having a $P < 0.05$ and not interlinked.
[b]Questions for children.

Holidays by the seaside, in the mountains, and skiing were associated: of the children who had been to the mountains, 81.3% had also been to the seaside; 86.2% of the children who had been skiing had also been to the seaside. We kept the covariate 'holidays at the seaside' for the multivariate analysis, considering it to be the best reflection of sunny holidays, children's backs being more exposed than when skiing and holidaying in the mountains.

In these children, a history of sunburn and phototype were also associated. The definition of phototype included sunburn susceptibility. More than 70% of phototype I–IV children had experienced sunburn at least once (72.0, 76.9, 70.0, and 71.4%, respectively). Child phototype and skin color were also linked: 88.9% of children who had a black skin color were of phototype V. Child phototype was therefore linked both to skin color and to a history of previous sunburn. We excluded this and kept the covariate 'history of sunburn' in the multivariate model.

Fair phenotype, sun exposure, and parental behaviors remained statistically correlated to MN count in the multivariate model. The child pigmentation characteristics associated with a higher MN count were: fair skin: P value less than 0.0001, RR = 3.80, 95% CI = 2.25–6.41; blue/green eyes: P value less than 0.0001, RR = 1.2, 95% CI = 1.11–1.41; blond hair: $P = 0.0006$, RR = 1.25, 95% CI = 1.10–1.41; and a history of sunburn: P value less than 0.0008, RR = 1.13, 95% CI = 1.03–1.23 (Table 5). Seaside holidays ($P = 0.03$, RR = 1.14, 95% CI = 1.01–1.28), parental tee-shirt wearing as a sun-protective measure ($P = 0.003$, RR = 0.86, 95% CI = 0.79–0.93), and use of sunscreen ($P = 0.002$, RR = 1.23, 95% CI = 1.08–1.40) were also significant predictors of MN development in children (Table 5).

Table 5 **Nevus count in children and phenotypic characteristics[a], sun exposure and parental' behaviors: multivariate analysis[b]**

Risk factors (n)	Ratio (95% confidence interval)	P value
Child phenotype		
Eye color		
Brown/black (471)	1.00	
Blue/green (287)	1.2 (1.11–1.34)	<0.0001
Hair color		
Dark (175)	1.00	
Red (13)	1.21 (0.83–1.75)	0.31
Light brown (428)	1.1 (0.99–1.35)	0.06
Blond/fair (161)	1.25 (1.10–1.41)	0.0006
Skin color		
Black (25)	1.00	
Medium (268)	3.13 (1.85–5.27)	<0.0001
Fair/pale (479)	3.80 (2.25–6.41)	<0.0001
Sunburn episodes		
No (353)	1	
Yes (426)	1.13 (1.03–1.23)	0.0008
Sun exposure		
Holidays at seaside during the past year[a]		
No (143)	1.00	
Yes (623)	1.14 (1.01–1.28)	0.03
Parental behavior when exposed to sun		
Parent wears tee-shirt when exposed to sun		
Never-sometimes (340)	1.00	
Often-always (439)	0.86 (0.79–0.93)	0.003
Sunscreen use		
No (129)	1.00	
Yes (660)	1.23 (1.08–1.40)	0.002

[a]Poisson regression, having included noninterlinked covariates with a $P > 0.05$ in the univariate analysis.
[b]Questions for children.

Discussion

This large multicenter study on a cohort of French children homogenous for age highlights how the sun-protection behavior of parents affects MN development in their children. There was a positive correlation between sun exposure and the number of MN in children. A higher MN count was found in children whose parents actively sought the sun on their holidays and used sunscreen on their own bodies. A lower MN count was found in children whose parents wore a tee-shirt to protect themselves when exposed to sun.

Sunny holidays – that is, at the seaside –were significantly associated with a higher MN count in our study. Few studies have explored the hypothesis that MN development is linked to both acute and chronic sun exposure (Carli *et al.*, 1997; Wiecker *et al.*, 2003; Harrison *et al.*, 2008), and this risk factor is still the subject of debate. Some authors consider that intermittent sun exposure influences MN development (Gallagher *et al.*, 1990; English and Armstrong, 1994; Dwyer *et al.*, 1995; Carli *et al.*, 2002; Dulon *et al.*, 2002; Gefeller *et al.*, 2007; Harrison *et al.*, 2008), and is more important as sunny holidays last at least 3 weeks (Wiecker *et al.*, 2003). The impact of sunny holidays might be more substantial for children who live in higher latitudes, whereas it may be less so in the tropics, because of the permanent high-radiation levels. Radiations of the Sun is more intense in tropical countries, and higher MN counts have been found in children living at lower latitudes (Fritschi *et al.*, 1994; Dwyer *et al.*, 1995; Dulon *et al.*, 2002; MacLennan *et al.*, 2003). Some authors have therefore pointed out the role of chronic sun exposure, considering that sunny holidays play a minor role in MN development (Darlington *et al.*, 2002; Wiecker *et al.*, 2003; English *et al.*, 2005; Whiteman *et al.*, 2005; Dodd *et al.*, 2007; Harrison *et al.*, 2008). The differences analyzed in latitudes and in populations could explain the contrasting results reported in various studies. In all cases, effective sun protection seems to be warranted, whether during outdoor activities at home or at school, or during family holidays in the sun.

A child's MN count is strongly influenced by the attitude of his or her parents. This factor has not been fully explored, but it has been reported that more the parents liked outdoor tanning, higher the number of MN presented by their children (Rodvall *et al.*, 2007). Similarly, the MN count in children rose in proportion to the amount of time their parents spent in the sun on a holiday. Several studies have reported that the MN count in children is significantly correlated with that of their parents (Graham *et al.*, 1999; Wiecker *et al.*, 2003), which could reflect identical sun-exposure habits. Children's sun-exposure patterns by necessity depend on those of their parents (Robinson *et al.*, 2000), and parents' lifestyle preferences therefore determine the risk of MN development in their children. These findings are confirmed by our multivariate analysis, in which the MN counts were higher in children whose parents used sunscreen on their own exposed skin. Parental use of sunscreen use is linked to their sun exposure and also reflects how their children are also exposed (Robinson *et al.*, 2000; Johnson *et al.*, 2001). Parents should be encouraged to engage in sun-safe practices as their attitudes can influence their children's behavior. It has been reported that when one adult wears a hat or a shirt, the same item is also worn by at least one child in a family group (Kakourou *et al.*, 1995; Zinman *et al.*, 1995; Robinson and Rademaker, 1998; Johnson *et al.*, 2001). As an illustration, our multivariate model confirmed that the MN count was lower in children whose parents wore a tee-shirt for sun-protection purposes; wearing a tee-shirt is therefore an effective measure.

Income, level of education, and holiday patterns could also play a role in sun protection and sun-exposure habits. In our study, children who had been skiing in the past year had more MN than other children. These holidays may reflect a higher socio-economic class. As the role of sun exposure during these holidays on MN count is probably low, children are almost entirely covered when skiing. We did not study this social factor in our questionnaire. With regards to melanoma (Shack *et al.*, 2008), a high-parental educational level and income have been reported as a risk factor for MN development (Carli *et al.*, 1995; Wiecker *et al.*, 2003; Whiteman *et al.*, 2005). Development of MN may also depend on country and lifestyle, religion, and culture: in a Turkish study, children whose mothers wore traditional dress had fewer MN (Oztas *et al.*, 2007). In all cases, and whatever the income or education level, the more positive the parents are about sun protection, the more their children are protected against sun radiation and MN development. Like Johnson *et al.* (2001), we think that campaigns, which target both parents and children may have synergistic effects on MN development.

Use of sunscreen was the main sun-protective measure employed by parents to protect their children in our study. Its application was associated with a higher MN count in these children. Sunscreen is easy to use and is therefore widely used to protect children during sun exposure (Autier *et al.*, 1998; Hall *et al.*, 2001; Severi *et al.*, 2002; Bauer *et al.*, 2005b). Similarly, sunscreen use may have been overreported by parents, as 94% of the parents reported that they applied sunscreen to their child when exposed to the sun. Results of the univariate analysis were no more statistically significant in the multivariate analysis ($P > 0.05$), but there may have been a bias, because of the high number of sunscreen users analyzed. There are conflicting results concerning the harmful (Autier *et al.*, 1998; Darlington *et al.*, 2002; Bauer *et al.*, 2005a, 2005b) or protective effect of sunscreen on MN development (Gallagher *et al.*, 2000). Some authors report higher MN counts in children who use sunscreen. They suggest that sunscreen is used to the detriment of the other sun-protective practices, leading to extended sun exposure of children with a fair phototype (who are more vulnerable to sunburn) to the sun (Autier *et al.*, 1998; Darlington *et al.*, 2002; Bauer *et al.*, 2005a, 2005b). Others believe that sunscreen use has a protective effect against MN development (Gallagher *et al.*, 2000), especially among freckled children (MacLennan *et al.*, 2003). Inappropriate sunscreen use may be a limit and underestimate its protective effects.

Information was reported by parents and children themselves. Therefore, the answers may not be fully reliable and this can be considered to be a limitation of our study. This limitation also applies to all the earlier studies, because of the difficulty in assessing true personal sun exposure. As parents were informed of the aims of the study at baseline, we cannot exclude the possibility that they altered their responses to reflect the 'sociably desirable' practices (Whiteman *et al.*, 2005). This mainly concerns their sun exposure habits, which may have been underestimated and the sun protective practices they used for their child. Sun protection methods used for their children, such as wearing a tee-shirt, a hat, applying sunscreen, avoiding sun exposure at peak hours, and staying in the shade was reported by more than 70% of parents. These response rates do not tally with the results of direct observation studies, in which these practices are rarely used (Olson *et al.*, 1997). Response rates of parents with regard to how they protected themselves were much lower, and may be a more accurate reflection of their true habits.

Conclusion

Sun exposure and fair phenotype (including a history of earlier sunburn) are major risk factors for MN development. Parents' behavior can be considered as another important risk factor in our study. As parents represent a social model for their children, prevention campaigns must be aimed at both parents and their children, to obtain synergistic and long-lasting effects.

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