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Nevus Count on Specific Anatomic Sites as a Predictor of Total Body Count: A Survey of 3,406 Children from Italy

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Scanty information is available on the relation between nevus count on specific anatomic areas and the total body surface, particularly in children. The authors analyzed this issue by using data from a uniquely large study conducted in 1997 on 3,406 schoolchildren (1,746 boys and 1,660 girls) aged 13–14 years in 13 cities from northern, central, and southern Italy. Children were examined by trained dermatologists who counted melanocytic nevi ($\geq$2 mm in diameter) on 19 different anatomic sites. Overall, the mean number of nevi was 17.3 (18.6 in boys and 15.8 in girls). The adjusted correlation coefficients (r) with number of nevi on the whole body were 0.74 for head and neck, 0.83 for anterior and 0.84 for posterior trunk, and 0.88 for upper and 0.80 for lower limbs. With reference to single anatomic sites, the best predictor of total nevus count was the lateral arms ($r = 0.80$), overall and in strata of sex and pigmentary characteristics. This large study provides definite evidence that examining the upper limbs only, particularly the lateral arms, is a practical and suitable tool for predicting total nevus count in children.

body regions; child; dermatology; Italy; nevus

Abbreviation: CMM, cutaneous malignant melanoma.

The total number of common melanocytic nevi is a recognized marker for the risk of cutaneous malignant melanoma (CMM) (1). Thus, in a case-control study from Italy based on 542 cases with CMM, subjects with more than 45 nevi had 10-fold the relative risk of CMM compared with those with five or fewer nevi and approximately fourfold the risk compared with those having 16–30 nevi (2). A meta-analysis of the literature before September 2002 found 26 case-control or cohort studies that analyzed the association between CMM risk and total number of nevi. The pooled relative risk for the presence of 101–120 nevi compared with fewer than 15 was 6.89 (95 percent confidence interval: 4.63, 10.33) (3). In the same meta-analysis, 17 additional observational studies provided data on the association between presence of nevi on the arms and CMM risk. The pooled relative risk was 4.82 (95 percent confidence interval: 3.05, 7.62) for 11–15 compared with 0 nevi on the arms (3). In fact, given the impracticability of counting nevi on the whole body, many studies collected information on number of nevi on only selected anatomic areas (mainly arms, limbs, or trunk) as a proxy for total body nevus count (1, 3, 4).

However, scanty information is available on the relation between number of nevi on different anatomic areas and whole body nevus count. To our knowledge, only three

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studies analyzed this issue in adults. A study from Scotland of 197 subjects found that nevus counts on the upper limbs, lower limbs, and trunk were strongly correlated with whole body counts (5). In another survey based on 310 Swedish adults, counts on the anterior surface of the thighs and the lateral arms were the best predictors of total body nevus count (6). Moreover, a study conducted in Spain of 146 adults found that nevi on the arms of men (adjusted $r = 0.88$) and on the thighs of women (adjusted $r = 0.82$) well correlated to total body count (7). In that study, nevus count on the arms enabled study of the risk factors for total nevi and CMM that was as effective as when whole body count was used (7).

Number of nevi in children is correlated to total number of nevi in adults and hence to risk of CMM in adult life (8–10). Therefore, nevus numbers are a tool in early age to select individuals at risk of CMM (11, 12). To our knowledge, only one study has provided information on the relation between total body count and numbers of nevi on selected anatomic sites in children. That study, based on 524 children aged 8–9 years from Sweden, found a strong correlation between total count and counts on the back or on the lateral arms ($r = 0.77$) (12).

We analyzed the issue by taking advantage of a uniquely large data set of children in southern Europe.

MATERIALS AND METHODS

During the spring of 1997, we conducted a multicenter study among schoolchildren attending the third class of a number of secondary schools in Italy. The methods of the present study have already been described (13). Briefly, we selected 13 provinces according to the presence of a dermatologic center participating in the clinical network of the Italian Group for Epidemiological Research in Dermatology (GISED). The provinces were located in northern (latitude 45.7–44.7°: Bergamo, Cremona, Ferrara, Verona, Reggio Emilia), central (latitude 44.4–43.6°: Florence, Ravenna, Cesena, Ancona, San Marino Republic), and southern (latitude 41.1–40.8°: Naples, Benevento, Bari) Italy.

The study was coordinated locally by a dermatologist, who obtained a list of the schools in each district. Two or three schools per district, according to a preliminary agreement by the local study coordinator, were randomly selected from the list. In each school, all children attending the third class were eligible.

The schools gave permission to conduct the study by contacting the parents and their children. A standard questionnaire was distributed to parents, and written permission to examine children was asked for. Overall, 99 percent of the parents consented to participate in the study. Of these, 2 percent were non-Caucasian. For the present analyses, we considered a total of 3,406 European Caucasian children (1,746 boys and 1,660 girls) for whom we had written permission, who were examined by dermatologists, and whose parents filled in the questionnaire. The age of children ranged from 12 to 17 years, but most of them were aged 13 (73 percent) and 14 (23 percent) years. The questionnaire included information about parents' education, family residence, children's anthropometric characteristics, personal history of selected diseases, family history of melanoma, dietary habits, use of sunscreen, lifetime sun exposure, pattern of reaction to sun exposure, and lifetime history of sunburns.

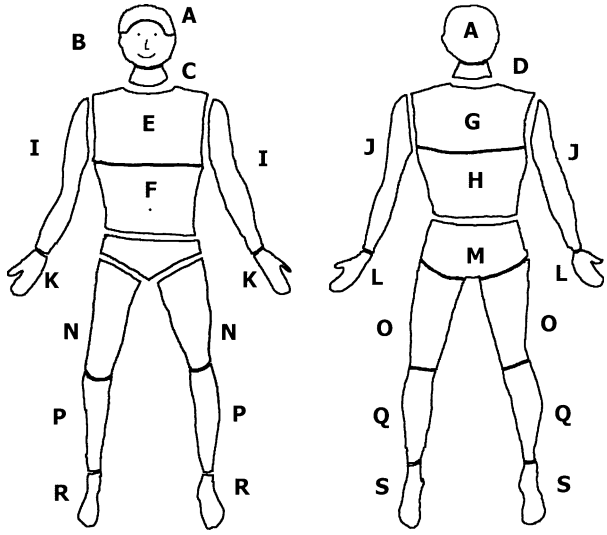

FIGURE 1. Scheme of the anatomic sites considered in the present study of nevus counts, Italy, 1997.

Children were examined individually by trained dermatologists in the school infirmary. Besides skin examination with an assessment of pigmentary traits, dermatologists counted the melanocytic nevi, equal to or greater than 2 mm in diameter, at 19 predefined anatomic sites. Genitalia (accounting for 1 percent of total body surface (14)) and, limited to girls, breast areas were not examined. Figure 1 shows the different anatomic sites considered in the present study. The proportion of body surface for each anatomic site was derived by the Lund & Brouder chart (14), as modified for children aged 13 years. Whole body nevus counts were calculated by adding the site-specific counts. An atlas was developed for the recognition of pigmentary lesions, and a nevometer was used to determine the sizes of the lesions. Congenital nevus-like nevi and blue nevi were counted separately and were not included in total nevus count.

Skin color was evaluated according to a three-grade scale (dark, medium, fair) and was based on the examiner's judgment and on comparison to representative sample photographs. Eye color was evaluated according to a five-category scale (black/brown, hazel, brown/green, green/gray, blue) and hair color according to a five-category scale (black, dark/medium brown, light brown, blond, red). Inter- and intrarater reliability for the judgment about pigmentary traits and nevus counts were assessed in preliminary duplicate exercises and were judged to be excellent, with intra- and interobserver intraclass correlation coefficients ranging between 0.70 and 0.97.

For the present analyses, mean numbers of nevi equal to or greater than 2 mm in diameter were calculated. To compare number of nevi between sexes, we used the

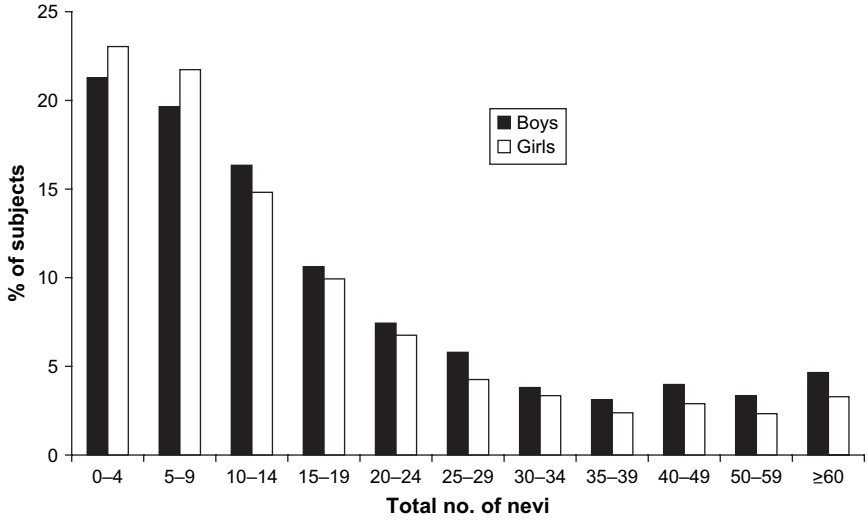

FIGURE 2. Distribution of total nevus counts for 3,406 schoolchildren (1,746 boys and 1,660 girls) aged 13–14 years, Italy, 1997.

Wilcoxon rank-sum test (Mann-Whitney). Correlation coefficients (r) between number of nevi at specific anatomic sites and total number of nevi were derived by multiple linear regression models after allowance for sex, body mass index, and hair, eye, and skin color (7).

RESULTS

Figure 2 shows the distribution of total nevus count in our population according to sex. For 3,406 schoolchildren (1,746 boys and 1,660 girls), we found a median total body nevus count of 11. Overall, 3.2 percent of children had no nevi and 44.3 percent had fewer than 10 nevi (41.3 percent of boys and 47.3 percent of girls). Boys had a higher total nevus count than girls (median of 12 and 10, respectively; $p < 0.001$).

Figure 3 shows the nevus distribution according to different body areas and sex. Boys had more nevi than girls on the head and neck ($p < 0.001$), on the anterior trunk ($p < 0.001$), and on the posterior trunk ($p < 0.001$). Compared

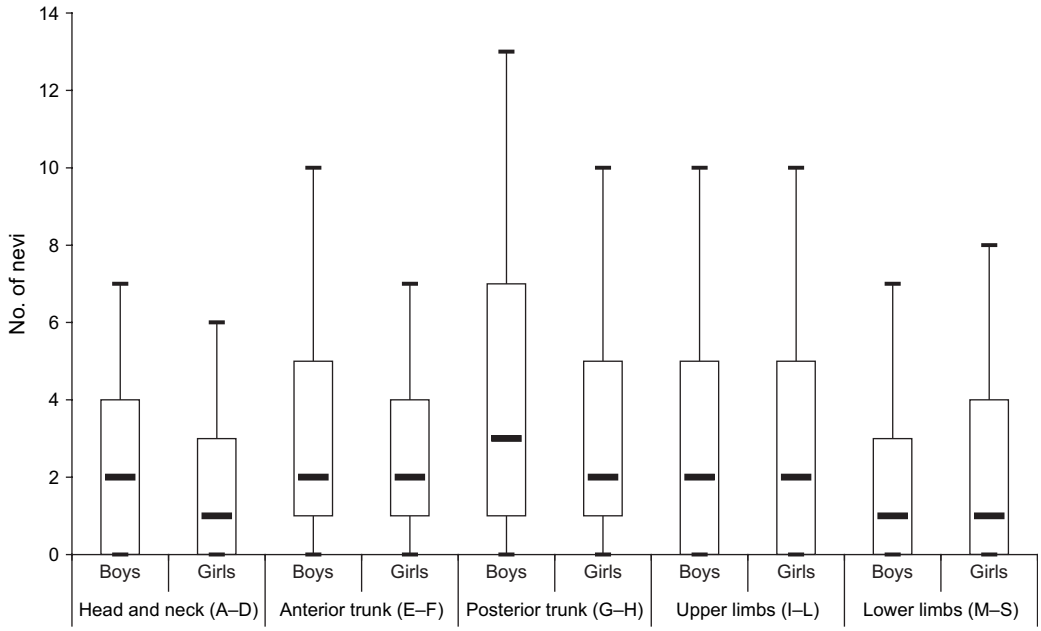

FIGURE 3. Number of nevi on selected anatomic areas (refer to figure 1) of 1,746 boys and 1,660 girls, Italy, 1997. Thick horizontal lines indicate median values. Boxes indicate the 25th–75th percentiles and bars the 90th percentiles.

TABLE 1. Distribution among 3,406 Italian schoolchildren (1,746 boys and 1,660 girls) of number of common melanocytic nevi according to anatomic sites,*,† 1997

Anatomic site	% of body surface	Total		Boys		Girls	
		Mean (SD‡)	Adjusted *r*	Mean (SD)	Adjusted *r*	Mean (SD)	Adjusted *r*
Whole body	99.00	17.3 (20.0)		18.6 (21.7)		15.8 (18.1)	
Head and neck	12.00	2.5 (3.2)	0.74	2.9 (3.6)	0.78	2.1 (2.5)	0.68
A: Scalp	5.00	0.1 (0.3)	0.05	0.1 (0.4)	0.06	0.0 (0.2)	0.06
B: Face	5.00	1.3 (2.0)	0.65	1.5 (2.2)	0.68	1.1 (1.6)	0.59
C: Anterior neck	1.00	0.7 (1.2)	0.52	0.8 (1.3)	0.55	0.6 (1.1)	0.48
D: Posterior neck	1.00	0.4 (0.9)	0.45	0.5 (1.1)	0.52	0.3 (0.7)	0.31
Anterior trunk	13.00	3.3 (4.2)	0.83	3.9 (4.9)	0.87	2.7 (3.1)	0.76
E: Chest	9.00	2.3 (3.0)	0.78	2.8 (3.5)	0.81	1.9 (2.4)	0.72
F: Abdomen	4.00	1.0 (1.7)	0.63	1.1 (2.0)	0.71	0.9 (1.4)	0.49
Posterior trunk	13.00	4.7 (5.8)	0.84	5.5 (6.6)	0.88	3.8 (4.8)	0.79
G: Shoulders	4.00	1.6 (2.8)	0.67	2.0 (3.4)	0.75	1.2 (1.9)	0.53
H: Back	9.00	3.1 (4.2)	0.73	3.5 (4.3)	0.75	2.6 (3.9)	0.71
Upper limbs	19.00	3.8 (5.5)	0.88	3.8 (5.8)	0.89	3.7 (5.3)	0.88
I: Arms, medial	7.00	1.3 (2.5)	0.77	1.4 (2.7)	0.78	1.3 (2.4)	0.75
J: Arms, lateral	7.00	2.3 (3.5)	0.80	2.3 (3.5)	0.81	2.3 (3.4)	0.78
K: Palms	2.50	0.1 (0.3)	0.16	0.1 (0.3)	0.18	0.1 (0.3)	0.14
L: Dorsum of hands	2.50	0.1 (0.4)	0.33	0.1 (0.4)	0.36	0.1 (0.4)	0.30
Lower limbs	42.00	3.0 (5.6)	0.80	2.6 (4.5)	0.81	3.4 (6.5)	0.85
M: Buttocks	5.00	0.5 (1.1)	0.54	0.4 (0.9)	0.46	0.6 (1.3)	0.65
N: Anterior thighs	8.75	1.0 (2.3)	0.72	0.9 (1.9)	0.72	1.2 (2.7)	0.76
O: Posterior thighs	8.75	0.5 (1.2)	0.64	0.5 (1.1)	0.63	0.5 (1.3)	0.67
P: Anterior lower legs	6.25	0.4 (1.0)	0.56	0.3 (0.8)	0.49	0.4 (1.2)	0.66
Q: Posterior lower legs	6.25	0.4 (1.1)	0.59	0.4 (1.0)	0.59	0.4 (1.2)	0.62
R: Dorsum of feet	3.50	0.1 (0.4)	0.32	0.1 (0.4)	0.31	0.1 (0.4)	0.34
S: Soles	3.50	0.1 (0.4)	0.07	0.1 (0.4)	0.06	0.1 (0.3)	0.10

* Refer to figure 1 for a scheme of these anatomic sites.
† Correlation coefficient (*r*) with total number of nevi.
‡ SD, standard deviation.

with girls, boys had a similar nevus count on the upper limbs ($p = 0.431$) but a lower count on the lower limbs ($p < 0.001$).

Table 1 shows the mean number of nevi by sex on the whole body and according to 19 different anatomic sites (A–S) schematized in figure 1. Mean number of nevi, on the basis of approximately 99 percent of the total body surface area, was 17.3 (18.6 in boys and 15.8 in girls). Table 1 also shows the relation between number of nevi on each anatomic area and total number of nevi. The adjusted correlation coefficients were 0.74 for nevi on the head and neck, 0.83 for the anterior trunk, 0.84 for the posterior trunk, 0.88 for the upper limbs, and 0.80 for the lower limbs. The best single anatomic site predicting whole body nevus count was the lateral arms (accounting for 7 percent of the body surface area), the adjusted *r* being 0.80.

When we considered the correlation between number of nevi on a specific area and on the total body excluding that specific area, the correlation coefficients were 0.65 for the head and neck, 0.74 for the anterior trunk, 0.72 for the posterior trunk, 0.79 for the upper limbs, and 0.65 for the posterior limbs.

Table 2 shows the relation between nevus count on body areas grouped according to their propensity to sun exposure and nevus count on the upper limbs. The correlation coefficients were 0.58 for chronically, 0.84 for intermittently, and 0.85 for infrequently exposed areas. Corresponding estimates for the lateral arms were 0.54, 0.80, and 0.67.

Table 3 shows the correlation between total body count and number of nevi on the upper limbs, and the lateral arms, in strata of selected pigmentary characteristics. The strong correlation was consistent in strata of skin, eye, and hair color.

Figure 4 shows receiver operating characteristic curves that plot the accuracy of classifying children with more than 22, 39, and 54 nevi (corresponding in this population to the 75th, 90th, and 95th percentiles of total nevus count, respectively), according to numbers of nevi on both the upper limbs and lateral arms. In our population, the most accurate thresholds in terms of nevi on the upper limbs were 4

TABLE 2. Correlation among 3,406 Italian schoolchildren between nevus count on body areas grouped according to their propensity to sun exposure and nevus count on the upper limbs and on the lateral arms, 1997

Body areas according to their propensity to sun exposure	Mean (SD*)	Correlation with nevus count on the upper limbs	Correlation with nevus count on the lateral arms
Chronically exposed (face, neck, and dorsal aspects of hands)	2.6 (3.3)	0.58	0.54
Intermittently exposed (trunk, lateral surfaces of upper limbs, and anterior surface of lower limbs)	11.8 (13.8)	0.84	0.80
Infrequently exposed (buttocks, medial surface of upper limbs, posterior surface of lower limbs, palms, and soles)	2.8 (4.7)	0.85	0.67

* SD, standard deviation.

(sensitivity = 85.2 percent, specificity = 82.6 percent) to classify children having more than 22 nevi, 7 (sensitivity = 89.9 percent, specificity = 89.3 percent) for those having more than 39, and 10 (sensitivity = 92.2 percent, specificity > 93.5 percent) for those having more than 54 nevi. Corresponding estimates in terms of number of nevi on the lateral arms were 3 (sensitivity = 75.6 percent, specificity = 85.1 percent), 4 (sensitivity = 85.7 percent, specificity = 84.4 percent), and 5 (sensitivity = 88.0 percent, specificity = 86.9 percent), respectively.

DISCUSSION

This study confirms findings from other investigations conducted among children (12) and adults (5–7) and therefore provides conclusive evidence that nevus counts on selected anatomic sites, including anterior and posterior trunk and upper and lower limbs, are suitable for estimating total nevus count. In particular, there was a high correlation for upper limbs, which has relevant public health implications. In fact, nevus count on upper limbs, especially lateral arms, represents a practical and appropriate tool to identify children with many nevi and therefore at increased risk of developing CMM (8, 12, 15) and possibly other skin diseases (16).

As an example, we considered the relation between number of nevi on the whole body and on the arms by using data from an Italian case-control study of 542 cases with CMM and 538 controls (2). The multivariate odds ratios for an increment of three nevi on the whole body was 1.08

TABLE 3. Correlation among 3,406 Italian schoolchildren between nevus count on the whole body and number of nevi on upper limbs and lateral arms in strata of selected pigmentary characteristics, 1997

Strata	No. of children	%	Mean no. of total nevi (SD*)	Correlation with nevus count on the upper limbs	Correlation with nevus count on the lateral arms
Skin complexion†					
Dark	467	13.8	13.2 (18.8)	0.88	0.78
Medium	1,941	57.1	16.9 (19.7)	0.88	0.80
Fair	989	29.1	19.7 (20.8)	0.90	0.83
Eye color					
Black/brown	1,463	43.0	14.2 (16.8)	0.88	0.79
Hazel	699	20.5	19.1 (22.6)	0.88	0.80
Brown/green	390	11.5	20.3 (21.2)	0.88	0.79
Green/grey	451	13.2	17.3 (17.2)	0.86	0.78
Blue	403	11.8	21.8 (25.4)	0.90	0.80
Hair color					
Black	322	9.5	13.5 (16.1)	0.88	0.76
Dark/medium brown	1,615	47.4	15.5 (18.6)	0.88	0.79
Light brown	1,077	31.6	19.2 (22.1)	0.89	0.82
Blond	360	10.6	22.3 (20.5)	0.84	0.76
Red	32	0.9	18.0 (27.4)	0.94	0.87

* SD, standard deviation.
† The sum does not add to the total because of nine missing values.

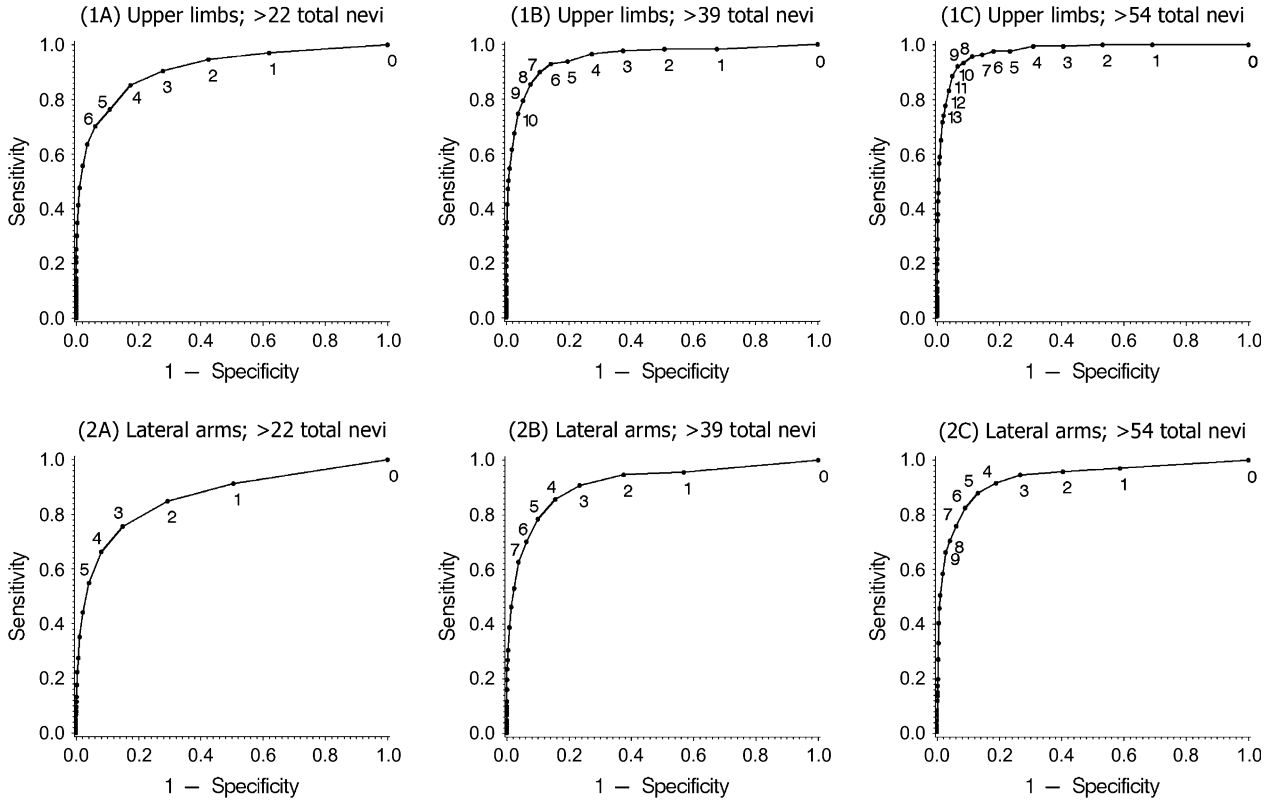

FIGURE 4. Receiver operating characteristic curves plotting the accuracy of numbers of nevi on the upper limbs (top, 1A–1C) and the lateral arms (bottom, 2A–2C) in classifying children with more than 22 (A), 39 (B), and 54 (C) nevi (corresponding in this population to the 75th, 90th, and 95th percentiles of body nevus count, respectively), Italy, 1997.

(95 percent confidence interval: 1.06, 1.11) and that for an increment of one nevus on the arms was 1.07 (95 percent confidence interval; 1.04, 1.10).

Our findings are in agreement with a previous study of 524 Swedish children, which reported a high correlation between nevus counts on the back and lateral arms and the whole body (12). That study suggested that the lateral arms could be a good indicator for the count of nevi on areas frequently exposed to the sun (12). However, we also found a high correlation coefficient with infrequently exposed areas.

Other studies of adults on smaller samples (6, 7) found that the arms of men but the thighs of women were the best areas to predict whole body nevus count. The apparent difference may well be due to random variation or to selective inspection of different body sites of the two sexes, although in this study the correlation coefficients between total body nevus count and number of nevi on upper limbs were systematically the highest ones across strata of sex and pigmentary traits. Moreover, nevus count on upper limbs appeared to be the best marker also of nevus count on all the other areas.

To our knowledge, this is the largest study providing data on this issue in children. Moreover, participants were examined by dermatologists who counted the nevi and assessed pigmentary traits. Among other strengths are the multicentric design of the study, the large number of body sites considered, and the possibility of allowing for several covariates, including sex and pigmentary traits.

The issue is of particular relevance now, given the interest in conducting population-based CMM screening programs (17, 18). In fact, whereas most authorities do not recommend routine screening for skin cancer in the primary care setting using a total-body skin examination of asymptomatic individuals (17–20), there is a consensus on performing routine screenings on subjects at high CMM risk (18, 21–24). Nevus counts on the arms are likely to be an important adjunct to defining high-risk individuals (17). Weatherhead and Lawrence (22) retrospectively analyzed data from all patients attending the melanoma screening clinics in the United Kingdom for the period 1997–2004. Public awareness increased over time, and the general practitioner threshold for referral fell. Thus, the number of new patients increased by over 230 percent in 8 years, despite a decline in the proportion of patients with a diagnosis of melanoma (22).

The present results also have important implications for the design of epidemiologic investigations studying nevus distribution on large samples of children, where whole body counts are impractical. In the same studies, counts of

melanocytic nevi obtained from standardized photographs have the potential to replace counts made by physicians and dermatologists (25).

In conclusion, the present results confirm the appropriateness of nevus count on the arms as a proxy of body nevus count, already used in previous epidemiologic studies of children and adults (3, 4, 26).

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Conflict of interest: none declared.

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