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ORIGINAL ARTICLE

Socio-economic inequalities in physical activity practice among Italian children and adolescents: a cross-sectional study

Bruno Federico · Lavinia Falese · Giovanni Capelli

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Abstract
Aim The aim of the study was to evaluate whether socio-economic inequalities in the practice of physical activity existed among children and adolescents, using different indicators of socio-economic status (SES).
Subjects and methods Data were derived from the Italian National Health Interview Survey carried out in 2004–2005, which examined a large random sample of the Italian population using both an interviewer-administered and a self-compiled questionnaire. This study was based on a sample of 15,216 individuals aged 6–17 years. The practice of physical activity was measured on the basis of questions regarding frequency and intensity of activity during leisure time over the past 12 months. Parents' educational and occupational level, as well as family's availability of material resource, were used as indicators of SES. Multivariable logistic regression analyses were performed to estimate the contribution of each SES indicator to the practice of physical activity, adjusting for potential confounding factors. The results of the regression models are expressed as odds ratio (OR) with 95% confidence intervals (95% CI).
Results About 64% of children and adolescents in the sample declared that they participated in moderate or vigorous physical activity at least once a week. After adjustment for gender, age, parental attitudes towards physical activity and geographical area, the practice of physical activity increased with higher parental educational and occupational level and greater availability of material resources. Children and adolescents whose parents held a middle or high educational title were 80% more likely to practice moderate or vigorous physical activity than subjects whose parents had a lower level of education (OR = 1.80, 95% CI: 1.40–2.33), while subjects with unemployed parents had an odds of practicing moderate or vigorous physical activity 0.43 times that of those children whose parents belonged to the top job occupation category (administrative/professionals). Socio-economic differences were about the same when the practice of vigorous physical activity only was considered instead of that of moderate or vigorous physical activity.
Conclusion Interventions that promote the practice of physical activity, and especially those aimed at the wider physical and social environment, are strongly needed to contrast socio-economic differences in physical activity among children and adolescents.

Keywords Children and adolescents · Physical activity · Socio-economic factors

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Introduction

Physical activity is a positive determinant of health and predictor of short- and long-term individual health status. Regular practice of physical activity may contribute to the prevention of the main chronic degenerative diseases (diabetes, overweight, obesity, hypertension, osteoporosis) as well as favour psychological balance, development and the improvement of social skills among children and adolescents (Hardman and Stensel 2003; Warburton et al. 2006; Washington et al. 2001). Although the positive effects on health of physical activity have largely been demonstrated, the regular practice of physical activity is

less and less frequent in developed countries. Indeed, inactivity is one of the main causes of the current epidemics of childhood obesity (World Health Organization 2004). In children and adolescents, participation in physical activity and sports is particularly important because it is associated with lower levels of antisocial behaviour (Harrison and Narayan 2003), higher levels of positive emotional well-being (Steptoe et al. 1997) and greater participation in sports in adulthood (Tammelin et al. 2003).

Levels of physical activity among children and adolescents are highly variable, and few consistent correlates have been identified (Lindquist et al. 1999). These include individual, parental and environmental influences. Boys are generally more active than girls, and children are more active than adolescents (Kohl and Hobbs 1998; Seabra et al. 2007), although the latter finding was not confirmed in another study (Brodersen et al. 2007). Economic resources and familial set-up exert decisive influences on children's and adolescents' physical activity practice, with those from more advantaged familial background often having higher levels of physical activity than those in poorer families (Gordon-Larsen et al. 2000; Van der Horst et al. 2007). Both cultural and material familial resources are important predictors of physical activity: when parents provide support, their offspring are more likely to engage in physical activity (Sallis et al. 2000; Hoefer et al. 2001). However, some authors reported that once parental attitudes are taken into account, familial resources do not influence children's physical activity any longer (Kirk et al. 1997). It is therefore unclear whether the association of socio-economic status (SES) with children's and adolescents practice of physical activity persists, when other factors, including parents' physical activity practice, are taken into account. In addition, previous studies took into account only few dimensions of SES, mainly focusing on either parental occupation or parental educational level. We therefore aimed to evaluate whether socio-economic inequalities in the practice of physical activity existed among children and adolescents, using different indicators of SES (parental education and occupation level, and family's available material resources).

Methods

We used data collected in the most recent Italian Health Interview Survey, which was performed by the Italian National Statistical Institute (Istat) in 2004–2005. This survey examined a random sample, representative of the Italian resident population, of 128,040 non-institutionalized individuals within strata of geographical area, municipality and household size (Istat-Istituto Nazionale di Statistica 2006). The non-response rate of the survey was 14.3%. Our study included all subjects aged 6–17 years (n=15,216) examined in the survey. From the interviewer-administered and the self-compiled questionnaire, we abstracted data on gender, age, geographical area, physical activity practice, parents' educational and occupational level, availability of material resources, perceived health status and parents' physical activity practice.

We used three different indicators of SES: parental educational level, parental occupational level and family's availability of material resources. Parental educational level was grouped into three categories according to the highest level successfully completed by one of the parents: low (primary school), middle (secondary school) and high education (university degree). Parental occupational level was grouped into five categories: administrative/professionals, self-employed, manual workers, unemployed and housewives, and those who had retired from work. Familial material resources were categorized into three classes on the basis of information about house type (country house/cottage, apartment, council house) and the availability of the following two utilities: heating and drinkable water. Material resources were classified as less than good if at least one utility was not available or the house was poorly maintained. They were classified as good if both utilities were present and the subject lived in a properly maintained apartment, and as very good if both utilities were present and subjects lived in a properly maintained country house/cottage.

The practice of physical activity was measured on the basis of questions regarding frequency and intensity of activity during leisure time over the past 12 months. Each subject was asked whether he/she was engaged in moderate or vigorous physical activity at least once a week. The practice of moderate physical activity was defined as the practice at least once a week of activities such as walking, doing gymnastics or cycling at moderate speed. The practice of vigorous physical activity was defined as the practice at least once a week of intense physical activity such as running, cycling or other sweat-producing activities.

Bivariate analyses were carried out using the chi-square test. Multivariable logistic regression models were used to examine the contribution of the three socio-economic indicators to children's and adolescents' participation in physical activity adjusting for potential confounding factors. Two separate logistic regression models were performed using as outcome variables the practice of moderate/vigorous activity and that of vigorous activity only. In order to increase the power of the analyses, the upper two categories of educational level (middle and high education) were collapsed into one. A further grouping was performed for geographical area (northern/central regions vs southern/insular regions). The results of the regression models are expressed as odds ratio (OR) with 95%

confidence intervals (95% CI). The overall likelihood ratio test was used to evaluate the significance of the model, while the partial likelihood ratio test was used to determine whether adding a covariate significantly improved the model. Interaction terms were added to the model and retained if the corresponding p value was lower than 0.05. All statistical analyses were carried out using the software package Stata 10.1.

Results

Table 1 shows the characteristics of the study sample, which included 15,216 subjects aged 6–17 years, as well as their parents' characteristics. About 64% of children and adolescents in the sample reported that they participated in moderate or vigorous physical activity at least once a week. Among these, about half practised vigorous physical activity at least once a week. The percentage practising moderate or vigorous physical activity was 27.8% among children's and adolescents' fathers and 19.0% among subjects' mothers.

The practice of moderate or vigorous physical activity varied according to individual, parental and environmental characteristics: it was higher in boys (69.7%) than in girls (58.1%) and in subjects aged 12–14 years compared to both younger and older subjects (Table 2). Statistically significant differences emerged for all of the three indicators of SES considered: most striking were differences according to family's material resources and parental employment.

Table 3 shows the results of the regression analyses: crude and adjusted ORs of the practice of moderate or vigorous physical activity, and those of vigorous activity only, along with 95% CI are reported. Socio-economic differences in the practice of physical activity were found at both the univariate and the multivariable analysis, although differences were somewhat attenuated in the latter. Both multivariable models were highly statistically significant, with p values lower than 0.001 at the overall likelihood ratio test. The degrees of freedom were 15 for the former model (moderate or vigorous physical activity) and 14 for the latter (vigorous physical activity), the only difference between the two models being the interaction term which was not significant in the latter model.

Adjusting for all of the variables reported in the table, children and adolescents with unemployed parents had an odds of practicing moderate or vigorous physical activity 0.43 times that of those children whose parents belonged to the top job occupation category (administrative/professionals). On the other hand, subjects whose parents held a middle or high educational title were 80% more likely to practice moderate or vigorous physical activity than subjects whose parents had a lower level of education, with adjusted OR=1.80 (95% CI: 1.40–2.33). The

Table 1 Characteristics of the sample (n=15,216)

	n	%
Gender		
Boys	7,822	51.4
Girls	7,394	48.6
Age		
6–8	3,612	23.7
9–11	3,683	24.2
12–14	3,970	26.1
15–17	3,951	26.0
Geographical area		
North-western regions	2,788	18.3
North-eastern regions	2,781	18.3
Central regions	2,366	15.6
Southern regions	5,328	35.0
Insular regions	1,953	12.8
Perceived health status		
Less than good	767	5.0
Good or very good	14,449	95.0
Parental educational level[a]		
Low	5,396	35.5
Middle	7,339	48.2
High	2,481	16.3
Parental employment[a]		
Administrative/professional	6,599	44.3
Self-employed	3,511	23.6
Manual	4,186	28.1
Unemployed/housewife	480	3.2
Retired	110	0.7
Material resources		
Less than good	2,938	19.7
Good	10,699	71.8
Very good	1,271	8.5
Practice of moderate or vigorous physical activity		
No	9,748	35.9
Yes	5,468	64.1
Father's practice of moderate physical activity		
No	9,911	72.2
Yes	3,815	27.8
Mother's practice of moderate physical activity		
No	11,964	81.0
Yes	2,811	19.0

[a] The highest level in one of the parents

Table 2 Percentage of subjects practising moderate or vigorous physical activity according to individual, parental and environmental characteristics

	% practising moderate or vigorous physical activity	*p* value
Gender		
Boys	69.7	
Girls	58.1	< 0.001
Age		
6–8	55.9	
9–11	67.6	
12–14	69.4	
15–17	62.8	< 0.001
Geographical area		
North-western regions	74.6	
North-eastern regions	74.7	
Central regions	72.4	
Southern regions	52.4	
Insular regions	55.7	< 0.001
Perceived health status		
Less than good	57.8	
Good or very good	64.4	< 0.001
Parental educational level[a]		
Low	53.6	
Middle	68.2	
High	74.6	< 0.001
Parental employment[a]		
Administrative/professional	72.5	
Self-employed	63.3	
Manual	55.4	
Unemployed/housewife	40.2	
Retired	63.6	< 0.001
Material resources		
Less than good	52.3	
Good	66.3	
Very good	74.4	< 0.001
Father's practice of moderate physical activity		
No	77.6	
Yes	58.8	< 0.001
Mother's practice of moderate physical activity		
No	82.5	
Yes	59.8	< 0.001

[a] The highest level in one of the parents

adjusted OR of practising moderate or vigorous physical activity was 1.47 (95% CI: 1.33–1.62) for children and adolescents with "good or very good" material resources compared to those with "less than good" ones. When parents practiced physical activity, their offspring were more likely to participate in moderate or vigorous physical activity. Living in southern Italy or in insular regions was associated with a lower participation com-

Table 3 Crude and adjusted odds ratios (95% CI) of practising moderate or vigorous physical activity and vigorous physical activity only

	Moderate or vigorous physical activity				Vigorous physical activity only			
	OR[a]	95% CI	ORadj[b]	95% CI	OR[a]	95% CI	ORadj[b]	95% CI
Gender								
Boys	1		1		1		1	
Girls	0.60	0.57–0.65	0.63	0.56–0.71	0.44	0.42–0.48	0.41	0.37–0.44
Age								
6–8	1		1		1		1	
9–11	1.64	1.50–1.81	1.85	1.66–2.07	1.87	1.68–2.09	2.06	1.82–2.33
12–14	1.79	1.62–1.97	2.04	1.83–2.28	2.29	2.07–2.55	2.67	2.37–3.01
15–17	1.33	1.21–1.46	1.52	1.36–1.69	2.02	1.82–2.25	2.41	2.14–2.72
Geographical area								
Northern and central regions	1		1		1		1	
Southern and insular regions	0.40	0.37–0.43	0.48	0.45–0.52	0.42	0.39–0.45	0.46	0.42–0.50
Perceived health status								
Less than good	1		1		1		1	
Good or very good	1.32	1.14–1.53	1.39	1.17–1.66	1.27	1.07–1.50	1.45	1.19–1.77
Parental educational level[c]								
Low	1		1		1		1	
Middle and high	2.00	1.87–2.15	1.80	1.40–2.33	1.79	1.66–1.93	1.37	1.24–1.52
Parental employment[c]								
Administrative/professional	1		1		1		1	
Self-employed	0.66	0.60–0.72	0.84	0.76–0.93	0.77	0.70–0.84	0.91	0.82–1.01
Manual	0.47	0.43–0.51	0.71	0.64–0.78	0.57	0.53–0.63	0.77	0.70–0.87
Unemployed/housewife	0.26	0.21–0.31	0.43	0.34–0.56	0.30	0.23–0.40	0.46	0.32–0.66
Retired	0.66	0.45–0.98	0.80	0.49–1.29	0.66	0.43–1.01	0.94	0.56–1.56
Material resources								
Less than good	1		1		1		1	
Good or very good	1.87	1.72–2.03	1.47	1.33–1.62	1.77	1.61–1.95	1.44	1.28–1.61
Father's practice of physical activity								
No	1		1		1		1	
Yes	2.43	2.23–2.64	1.63	1.48–1.79	1.77	1.61–1.95	1.44	1.28–1.61
Mother's practice of physical activity								
No	1		1		1		1	
Yes	3.17	2.86–3.51	2.15	1.91–2.43	2.07	1.90–2.26	1.56	1.41–1.72
Girl*middle/high education			0.83	0.71–0.97				

[a] Crude odds ratio

[b] Adjusted odds ratio: the model includes all variables reported in the table

[c] The highest level in one of the parents

pared to other regions, with adjusted OR=0.48 (95% CI: 0.45–0.52).

When the practice of vigorous physical activity was considered instead of that of moderate or vigorous physical activity, results of the logistic regression analysis were largely overlapping. All three socio-economic indicators considered were significantly associated with the practice of vigorous physical activity: the higher the status, the more frequent the practice of vigorous physical activity, although inequalities were generally smaller compared to the model with moderate or vigorous physical activity as the outcome variable.

Since we hypothesized that parental characteristics could have a different effect depending on their offspring age and gender, we tested for interaction between parent's education and occupation and their offspring demographics. In the multivariable model with moderate or vigorous physical activity as the outcome variable, the only significant interaction was found between parental education and gender, showing the different influence parent's educational level has on their daughters and sons. No significant interaction was found for the model with vigorous physical activity as the outcome variable.

Discussion

Summary of the main findings

In our study, adjusting for individual and area-level variables, all three indicators of SES (parental education and occupational level, and availability of material resources) were significantly associated with children's and adolescents' physical activity practice. The practice of physical activity increased with higher parental educational and occupational level and greater availability of material resources.

Limitations of the study

Firstly, physical activity measurement relied on self-reported data. Physical activity has traditionally been measured with surveys and recall instruments, which are often preferred to objectively measured physical activity because of greater convenience (Heitzler et al. 2006; Scully et al. 2007). A widely used tool is the International Physical Activity Questionnaire, which is usually applied for monitoring population levels of physical activity among adults (Craig et al. 2003). Among children, the validity of similar questionnaires is limited (Lachat et al. 2008). Some studies reported a moderate to good agreement between self-reported and objectively measured physical activity (Epstein et al. 1996; Sallis et al. 1996). Our measurement of physical activity may have suffered from some misclassification. However, if the misclassification was not differential, that is, the misclassification did not significantly vary by socio-economic indicator, the result would be a dilution of the effect. In other words, the socio-economic differences in physical activity practice found in this study are probably smaller than they actually are.

A second limitation of the study is the cross-sectional design, which is of limited value in the search for causal explanation because exposure and outcome are measured at the same time. However, it is likely that all three socio-economic determinants under investigation preceded in time, and were not followed by, children's and adolescents' practice of physical activity. A third limitation is the lack of information in the available data set on those psychological factors which may influence the participation in physical activity, such as anxiety and self-esteem. Accounting for these factors would probably have attenuated the effect of parental socio-economic characteristics and attitudes towards physical activity, but it is unlikely that the effect of all three measures of SES would have been cancelled out.

Comparison with other studies

Several studies found a positive association between SES and children and adolescents' physical activity practice. According to a recent review, mother's educational level and family income were consistently associated with physical activity practice among adolescents (Ferreira et al. 2007). In Finland, parental income and education were directly related to adolescents' physical activity or engagement in sport activities (Kantomaa et al. 2007). Among adolescents of central and southern Italy, a positive association between extracurricular physical activity and parental SES was found (La Torre et al. 2006). Contrary to the finding of Wagner et al. (2004), our results indicate an effect of familial available material resources on offspring physical activity also after controlling for parental sport habits. Our finding that available material resources limit the possibility to practice physical activity is justified, among others, by the study performed by Kirk et al. on 220 families in the Queensland and Victoria areas in Australia (Kirk et al. 1997). In this study, parents made a substantial contribution in terms of financial support to their children's participation in junior sport activities, given the yearly cycle of training and competition, distance from facilities and coaching, and costs associated with coaching, equipment and uniforms.

A more difficult access to sport facilities may probably explain the large heterogeneity in physical activity practice we found within the same country, namely the existence of a north-south gradient in physical activity practice. A study conducted by the Italian National Olympic Committee (CONI) found a huge gradient in the number of infra-

structures within Italy, with more structures being present in northern regions (CONI 2004). Focus group discussions revealed that safe, convenient, inexpensive facilities were considered essential for participation in physical activity especially by adolescents of lower SES, while different factors, such as fun, perceived competence and friends' support, were more relevant among youth of higher SES (Humbert et al. 2006). Other possible explanations of the north-south gradient are the higher level of social deprivation in southern regions and cultural factors that value physical activity differently.

Implications for policy

Since children and adolescents spend a large part of their time at school, school environment may strongly influence their engagement in physical activity. The implementation of school policies related to physical activity, like physical education classes, leisure time free use of playing fields, size and state of conservation of school facilities, and existence of parental supervision or organized activities, was associated with higher levels of children's and adolescents' physical activity (Ferreira et al. 2007), although there is considerable debate on the effect of compulsory school physical activity (Seabra et al. 2007; Cleland et al. 2008). A recent study from the Netherlands emphasizes the contribution of physical environment features, such as housing type, green spaces and traffic levels (de Vries et al. 2007). Since it is increasingly recognized that the wider physical and social environment is an important determinant of health and health behaviour, the availability of material infrastructure, such as children's playgrounds and sport facilities that are easily accessible as well as the social context of the community in which children and adolescents live, may increase their participation in physical activity (McKay et al. 2007).

Conclusions

Socio-economic differences in the practice of physical activity are present during childhood and adolescence and are of considerable extent. Interventions that promote the practice of physical activity, and especially those aimed at creating supportive neighborhood environments in more disadvantaged areas as well as at increasing accessibility to playgrounds and sport facilities, are strongly needed in order to contrast socio-economic differences in physical activity among children and adolescents.

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Conflict of interest The authors confirm that there are no relevant associations that might pose a conflict of interest.

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