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Trends in adolescent overweight prevalence in Italy according to socioeconomic position

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Abstract

Background. The aim of this research is to update the trend in overweight (including obesity) prevalence among Italian adolescents, evaluating possible differences by age and gender, and analyzing their relationships with socioeconomic status, between 2002 and 2014.

Methods. The present study is based on data from the Italian HBSC study at four time points (2002, 2006, 2010 and 2014), which involved 15 035 adolescents, aged 11-13-15 (7540 boys and 7495 girls).

Results. Gender and age were associated with the occurrence of overweight. In all surveys, boys had a higher prevalence of excess weight compared to girls ($p < 0.001$), but only among girls there was a significant increasing trend (from 11.2% in 2002 to 13.3% in 2014). From 2002 to 2014, the risk of being overweight was inversely associated with the economic level of the family, for both genders and all age groups.

Conclusions. Data collected between 2002 and 2014 in Italy showed a low overall increase in prevalence of obesity and overweight and an inverse association between SES and obesity in all age groups and in both genders. These findings suggest that concerted, multi-sectorial, efforts are needed in Italy, in combination with a sound political will, focused on reducing social inequality associate.

Key words

- trend
- adolescent
- socioeconomic status
- BMI
- inequalities

BACKGROUND

In the last decades childhood and adolescent obesity rates have increased in both developed and developing countries [1-5]. In Western countries the time pattern of the upward trend was different: the obesity prevalence began to rise in the mid-1970s in US [6] whereas in United Kingdom [7], Spain [8], and Portugal [9] it started around ten years later. In some European countries, in the early 2000s, an annual increase in overweight and obesity by up to 1% [2] was observed, with prevalence rates ranging from 6% to 36% [10].

Emerging evidence indicates a plateau in the childhood obesity epidemic in economically advanced countries [11-13]. Two recent reviews observed that the childhood obesity had leveled off in several countries, such as Australia, United Kingdom, Denmark, Switzerland, New Zealand, France, Netherlands, Sweden and the United States [12, 13]. A cross-national study of trends in adolescents in Europe and US [14] reported a stabilization of prevalence during the 2002-2010 period in over half of the 25 countries examined, but an increasing trend in some Eastern European countries.

Despite the finding that suggests a stabilization of the phenomenon, the prevalence is still high and childhood-adolescent obesity remains a major public health issue because of its short and long-term adverse physical and psychological effects [15-19].

Among the factors that could be related to the occurrence of childhood obesity, the familial socioeconomic status (SES) has been widely examined [20-29], due to public health and policy implications, firstly for the prevention and management of overweight, but also because such disparities are likely to contribute to socioeconomic inequalities in health more broadly [30, 31].

Two recent systematic reviews have analyzed studies published since 1990 on the relationship between

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socioeconomic position (SEP) and childhood-adolescent weight status in rich countries [32, 33]. Both of them confirmed that in developed countries there was an inverse relationship between obesity and SEP. Specifically, Barriuso *et al*. [32] showed that the majority of the 158 papers from 1990 through 2013 observed the highest proportions of obesity in subjects from the lowest SEP. Chung *et al.* [33] analyzed socioeconomic differences in overweight and obesity trends over time in 30 studies from 1988 to 2011 across 15 countries, reporting that over half of the papers indicated increasing prevalence of overweight and obesity among low SEP children and adolescents.

None of the cited reviews included Italy. The paucity of Italian data limit our knowledge on how this health problem has evolved in different socioeconomic groups in Italy. To our knowledge there were only two studies analyzing adolescents overweight at the national level in Italy. Ahluwalia *et al.* [14] reported high but stable age-adjusted overweight prevalence during the 2002-2010 period, but did not assess possible differences across SES levels. Lazzeri *et al.* [34] observed an inverse association between being overweight/obese and parent's educational level in 2010: students having both parents with lower educational levels more likely to be overweight than their counterparts with at least one parent with a high educational level."

In this research, we updated the trend in overweight (including obesity) prevalence among Italian adolescents, evaluating possible differences by age and gender, and analyzing its relationship with socioeconomic status.

METHODS

Study design and participants

Our study was based upon the Italian "Health Behaviour in School-aged Children" study, carried out according to the international HBSC protocol. The HBSC is a WHO collaborative cross-national survey that collects data on health behavior every 4 years among nationally representative samples of youth aged 11-13-15 years, using school class as the primary sampling unit. Samples were drawn by systematic cluster sampling using probability proportional to population size (PPS), thus yielding a nationally representative sample. The recommended national sample size was 1500 and the mean age should be 11.5-13.5-15.5, where 90% of the sample should fall between ± 6 months of the mean age.

A standardized, anonymous and self-completed questionnaire was administrated in classroom by trained personnel or teachers. Italy joined the international network in 2001 and has carried out so far four waves (2002, 2006, 2010 and 2014), gathering data from more than 15 000 students. Participation was voluntary, and a parental opt-out consent was obtained.

Response rates for classes were 77.4%, 66.5%, 95.8% and 90.1% respectively for the four waves. In particular, there were never any major differences between males and females both in participation and in the completeness and coherence of the information provided in the questionnaires. All information on the participation and the quality data are available at http://www.hbsc.unito.it. The Ethics Committee of the University of Torino approved the national research protocol. A detailed description of the aims, theoretical framework and protocol of the international and Italian study can be found elsewhere [35-37].

Measures

Body Mass Index (BMI) (kg/m^2) was calculated using self-reported weight without clothes and height without shoes. Overweight status (including obesity) was assessed using the internationally standardized age- and gender-specific cut-offs recommended by the International Obesity Task Force [38] corresponding to adult BMI ≥ 25 kg/m^2.

Socioeconomic status (SES) was evaluated using the Family Affluence Scale (FAS) [39]. The FAS is a validated measure of material affluence, a composite score of four items: number of family-owned computers (none, one, two or more); having own bedroom (yes/no); number of cars in family (no, one, two or more); holidays with family in the last year (none, once, twice and more). The sum of responses produces an ordinal scale ranging from 0 to 7, which was recoded into three categories: lowest (0-3), intermediate (4-5) and highest affluence (6-7) levels.

Statistical analysis

Overweight, including obesity (OwO), prevalence rates from 2002 to 2014 were estimated by age group, gender and SES. Multivariate logistic regressions were performed to evaluate OwO trends over time and to assess the relationship between OwO and SES. Models were stratified by age and sex. Odds Ratios, with their 95% Confidence Intervals, were calculated for each survey wave and overall, considering OwO (dichotomized into yes vs. no) as the dependent variable, survey year, FAS, age and gender (female as reference) as independent variables. The lowest category of each categorical variable was taken as the reference group, except for FAS (highest level as reference). Survey year and FAS were used as continuous variables and the significance of their trend was tested from the p-value of the slope coefficient β computed from the logistic fitting process. All analyses were performed considering the effect of the survey design (including stratification, clustering and weighting). Computation were carried out using STATA v14.1 (StataCorp, College Station, TX, USA: StataCorp LP); a statistical significance level of 5% was used.

RESULTS

A description of the socio-demographic characteristics of the sample analyzed in this study by sex is presented in *Table 1*. Overall, participants in the 2002-2014 surveys were 15045, with almost the same distribution by age and sex in the four waves. On the contrary, we can notice differences in the SES index: in both genders, the lowest level of FAS decreased significantly from 2002 to 2010 while almost doubling from 2010 to 2014; an opposite trend is shown by the highest level in the same periods.

As shown in *Table 2* and *3*, the age and sex-adjusted

Table 1
Number of study subjects by age, nutritional status, Family Affluence Scale (FAS) and gender (2002-2014)

Survey year	2002				2006				2010				2014			
	Boys	Boys	Girls	Girls	Boys	Boys	Girls	Girls	Boys	Boys	Girls	Girls	Boys	Boys	Girls	Girls
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Both genders	1939		2095		1765		1722		2103		2020		1742		1658	
Age group																
11 yrs	700	36.1	659	31.5	542	30.7	524	30.4	647	30.8	579	28.6	543	31.2	517	31.2
13 yrs	728	37.6	792	37.8	594	33.7	595	34.6	761	36.2	737	36.5	621	35.6	593	35.8
15 yrs	511	26.3	644	30.7	629	35.6	603	35.0	695	33.0	704	34.9	578	33.2	548	33.0
Nutritional status																
Overweight (Ow)	364	18.8	208	9.9	389	22.0	177	10.3	376	17.9	218	10.8	326	18.7	185	11.2
Obese (O)	70	3.6	28	1.3	47	2.7	27	1.6	76	3.6	44	2.2	54	3.1	35	2.1
OwO	434	22.4	236	11.2	436	24.7	204	11.9	452	21.5	262	13.0	380	21.8	220	13.3
FAS																
High	558	28.8	526	25.1	649	36.8	545	31.7	1024	48.7	851	42.1	460	26.4	384	23.2
Medium	943	48.6	981	46.8	784	44.4	811	47.1	849	40.4	913	45.2	909	52.2	856	51.6
Low	438	22.6	588	28.1	332	18.8	366	21.2	230	10.9	256	12.7	373	21.4	418	25.2

Table 2
Prevalence of overweight (obesity included) from 2002 to 2014 by gender and survey year

	Total*		p**	Boys*		p**	Girls*		p**
	(%)	OR (95% CI)		(%)	OR (95% CI)		(%)	OR (95% CI)	
2002	16.6	1.00	0.60	22.4	1.00	0.35	11.2	1.00	0.04
2006	18.4	1.13 (0.98-1.29)		24.7	1.15 (0.97-1.35)		11.9	1.08 (0.87-1.33)	
2010	17.3	1.04 (0.92-1.19)		21.5	0.96 (0.82-1.12)		13.0	1.20 (0.99-1.45)	
2014	17.7	1.06 (0.92-1.23)		21.8	0.97 (0.82-1.16)		13.3	1.22 (0.98-1.51)	

*Logistic regression model adjusted for gender ($p < 0.001$) and age $p < 0.001$) in the column "All age" and only for age in the columns by gender.
**p for trend.

Table 3
Overweight (obesity included) from 2002 to 2014 by age group and survey year

	Total*		p**	11years*		p**	13 years*		p**	15 years*		p**
	(%)	OR (95% CI)		(%)	OR (95% CI)		(%)	OR (95% CI)		(%)	OR (95% CI)	
2002	16.6	1.00	0.60	19.8	1.00	0.44	16.4	1.00	0.37	13.2	1.00	0.40
2006	18.4	1.13 (0.98-1.29)		20.8	1.07 (0.86-1.33)		18.0	1.11 (0.87-1.41)		16.6	1.24 (0.98-1.56)	
2010	17.3	1.04 (0.92-1.19)		18.3	0.90 (0.73-1.11)		17.2	1.04 (0.83-1.30)		16.7	1.26 (1.00-1.59)	
2014	17.7	1.06 (0.92-1.23)		19.1	0.95 (0.74-1.24)		18.6	1.15 (0.90-1.45)		15.3	1.12 (0.86-1.44)	

*Logistic regression model adjusted for gender ($p < 0.001$) and age ($p < 0.001$) in the column "Total" and only for gender in the columns by age group.
**p for trend.

OwO prevalence rates didn't show a significant overall change in the period analyzed: 16.6% in 2002 survey, 18.4% in 2006, 17.3% in 2010 and 17.7% in 2014 (p for trend = 0.60). Gender and age were associated with the occurrence of OwO. In all surveys, boys had a higher prevalence of excess weight compared to girls ($p < 0.001$), but only among girls there is a significant increasing trend (from 11.2% in 2002 to 13.3% in 2014, p for trend = 0.04). In each age group the OwO occurrence had no significant variation, but adolescents tended to be less overweight with increasing age ($p < 0.001$).

The relationship between SES and OwO can be seen in *Table 4* and *5*. From 2002 to 2014, the risk of being overweight (including obesity) was inversely associated with the economic level of the family, for both genders and all age groups. Boys and girls in the lowest SES level had, respectively, 60% and 98% higher risk to be OwO than their counterparts in the highest SES group ($p < 0.001$). This pattern was confirmed also analyzing the overall association in each age group: 11, 13 and 15 years old from most deprived families were significantly more likely to be OwO than adolescents in the least

Table 4
Overweight (included obesity) from 2002 to 2014 by gender, FAS and survey year

Survey year	All years*			2002*			2006*			2010*			2014*		
	%	OR (95% CI)	p	%	OR (95% CI)	p	%	OR (95% CI)	p	%	OR (95% CI)	p	%	OR (95% CI)	p
FAS															
Boys			< 0.001			0.02			0.003			< 0.001			0.07
High	19.3	1.00		20.4	1.00		21.0	1.00		18.2	1.00		18.0	1.00	
Medium	23.0	**1.26 (1.10-1.44)**		20.9	1.03 (0.78-1.35)		26.0	**1.33 (1.04-1.70)**		22.5	**1.32 (1.02-1.70)**		23.2	**1.38 (1.01-1.88)**	
Low	27.7	**1.60 (1.36-1.88)**		28.1	**1.47 (1.07-2.02)**		28.9	**1.53 (1.14-2.07)**		32.6	**2.20 (1.59-3.04)**		23.1	1.37 (0.96-1.95)	
Girls			< 0.001			< 0.001			0.001			0.009			0.004
High	9.4	1.00		7.6	1.00		8.1	1.00		10.7	1.00		10.9	1.00	
Medium	12.1	**1.34 (1.12-1.59)**		10.2	1.35 (0.91-2.00)		12.7	**1.66 (1.10-2.48)**		14.0	**1.35 (1.03-1.78)**		11.8	1.08 (0.74-1.56)	
Low	16.8	**1.98 (1.64-2.41)**		16.3	**2.29 (1.60-3.27)**		15.6	**2.09 (1.35-3.24)**		16.8	**1.67 (1.09-2.56)**		18.4	**1.76 (1.19-2.61)**	

*Logistic regression model adjusted for survey year and age in the column "All years" and only for age in the others columns.

Table 5
Prevalence of overweight (obesity included) from 2002 to 2014 by age group, FAS and survey year

Survey year	All years*			2002*			2006*			2010*			2014*		
	%	OR (95% CI)	p	%	OR (95% CI)	p	%	OR (95% CI)	p	%	OR (95% CI)	p	%	OR (95% CI)	p
FAS															
11 years			< 0.001			0.008			0.06			0.10			0.19
High	17.7	1.00		17.9	1.00		18.5	1.00		16.9	1.00		17.7	1.00	
Medium	18.4	1.09 (0.91-1.31)		17.2	0.98 (0.68-1.42)		20.8	1.21 (0.84-1.74)		18.2	1.15 (0.81-1.64)		18.1	1.03 (0.74-1.43)	
Low	24.0	**1.54 (1.25-1.90)**		25.5	**1.66 (1.13-2.44)**		24.5	1.53 (1.00-2.35)		22.2	1.47 (0.96-2.26)		22.4	1.36 (0.86-2.16)	
13 years			< 0.001			0.006			0.01			0.01			0.08
High	14.2	1.00		13.6	1.00		14.4	1.00		14.6	1.00		14.0	1.00	
Medium	18.3	**1.41 (1.17-1.69)**		16.1	1.27 (0.92-1.77)		19.8	**1.62 (1.15-2.28)**		17.9	1.28 (0.90-1.82)		20.0	**1.58 (1.01-2.47)**	
Low	21.2	**1.76 (1.42-2.19)**		19.9	**1.73 (1.17-2.54)**		20.8	**1.66 (1.03-2.67)**		25.3	**2.02 (1.21-3.37)**		20.8	**1.76 (1.14-2.71)**	
15 years			< 0.001			0.02			0.003			< 0.001			0.12
High	12.9	1.00		11.3	1.00		12.8	1.00		13.4	1.00		13.5	1.00	
Medium	15.8	**1.39 (1.15-1.69)**		12.8	1.11 (0.68-1.81)		17.5	**1.48 (1.01-2.18)**		18.3	**1.60 (1.15-2.21)**		15.0	1.18 (0.83-1.68)	
Low	19.8	**1.99 (1.58-2.50)**		16.8	**1.87 (1.17-2.99)**		20.6	**1.94 (1.25-3.00)**		25.7	**2.58 (1.68-3.97)**		18.4	1.50 (0.91-2.49)	

*Logistic regression model adjusted for survey year and gender in the column "All years" and only for gender in the others columns.

deprived group. Examining the relationship within each survey wave, the lowest SES level showed a non significant excess of risk in 2014 among boys, as for 11 and 15 years-old.

An overall significant association was also observed between intermediate parental SES and OwO. Except among 11 years old, children from families having a medium SES show an higher risk of OwO than their richest peers. However, although an upward trend was found in almost all the 4 waves, it didn't result always statistically significant for both genders and all age groups.

DISCUSSION

Our study did not show a significant overall change in the prevalence of overweight, including obesity, between 2002 and 2014 in Italian adolescents. This finding is in agreement with recent surveys from several Western countries that reported a global stabilization

in the prevalence of overweight and obesity [11-14]. Ebbeling and Ludwig [40] suggested that public health campaigns of recent years aiming at raising awareness on childhood obesity and improving the quality of food in schools could explain the levelling off of the increasing trends in the US. Stamatakis and colleagues [26] suggested that the extensive media attention on obesity and the associated increase in body weight awareness at the individual and family level, as well as anti-obesity policies at the policy level, could possibly contribute to this decreasing prevalence of obesity.

The result of this study shows that the prevalence of overweight and obesity in the adolescent population in Italy is higher in males than females. These findings are consistent with other reports. A clear pattern of boys being more likely to be overweight than girls was noted across HBSC international survey countries [41]. Boys tend to have significantly higher prevalence in almost all countries and regions at all ages. Even if the prevalence is higher among boys, our data showed a significant increasing trend among girls. These findings do not agree with the results of the majority of the studies, where sex-specific trends were not found [4-10]. However, an increasing trend in overweight prevalence was observed, only among girls, in Germany and US over an 8-year period [14].

The variation in the proportion of participants in each category of Family Affluence Scale probably could be reflect the economical pattern observed in Italy during the economic crisis which was described by the Italian National Statistical Institute (Istat) and that set the beginning of the economic crisis in 2008-2009 with a peak of recession in 2012-14 [42].

Among the socio-demographic factors, a consistent negative association between SES and overweight and obesity was noted. This is congruent with several previous reports in developed countries (including USA, Canada, and North and Western European countries) particularly among Caucasian populations [24-34]. Increased prevalence was significantly associated with low family affluence, for girls and boys, in around half of countries and regions, but with higher family affluence (among boys only) in Armenia, Slovakia and Turkey. Prevalence of overweight was higher among children from less affluent families in 21 of 24 Western and 5 of 10 Central European countries.

However, children from more affluent families were at higher risk of overweight in Croatia, Estonia and Latvia. In Poland, Lithuania, Macedonia and Finland, girls from less affluent families were more overweight, whereas the opposite was found for boys [43].

Although previous studies noted a positive correlation between overweight and SES in developing countries, an inverse correlation was reported in the majority of the developed countries. With nutritional transition and economic growth, the relationship between SES and overweight changes, and the burden of overweight is borne by those with low SES.

In a recent publication Eldgar *et al.* [44] described an increasing socioeconomic inequality in many domains of adolescents health, and Moor *et al.* [45] have highlighted that in almost all European countries, social inequalities in health complaints remained constant over a period of up to 16 years (1994 to 2010).

Limitations of this study

When interpreting these results, some considerations should be taken into account. Self-reported weight and height measures, like other self-reported variables, are not as precise as actual measurements taken by trained people, are subject to random error, and, more importantly, can be subject to systematic reporting bias. Several validation studies have compared self-reported vs. measured heights and weights [46-48]. In general, the results from these validation studies suggest that mean self-reported heights in adolescents are greater than actual heights, and mean self-reported weights in children are lower than measured weights.

In Estonia self-reported and directly measured height and weight were collected from 3379 students (1071 aged 11, 1133 aged 13 and 1175 aged 15 years). A distinct age-related pattern in underestimation of weight, height and prevalence of overweight was found; the bias decreased with increasing age. The mean underestimation of overweight prevalence based on self-reports was small, 3.6% [49]. This self-report bias leads to an underestimation of mean BMI and BMI-based classification of weight status (overweight/obese); this bias being generally greater in girls than boys, with increasing age in youth, and with increasing BMI value [46,47,50]. Generally lower estimates of the prevalence of overweight (pre-obesity and obesity) are therefore obtained with self-reported measures [48, 51]. Some researchers have nonetheless concluded that self-reported height and weight are valid and acceptable for population-based studies [52, 53]. Strauss reported that 94% of youth aged 12-16 years are correctly classified as normal-weight or obese based on self-reported heights and weights, although others have found less convincing results [47, 48, 53]. Thus, there is sufficient evidence to support the use of prevalence rates for overweight (pre-obesity and obesity) derived from self-reported measures as fairly accurate proxies, particularly when such data cannot be obtained by actual measurements, and that self-reported heights and weights are suitable for identifying valid relationships in epidemiological studies [51-55]. A possibility would be to pool data from several such validation studies in the future to examine systemic bias in relation to age, height, weight, gender and overweight status and in terms of attenuation of associations.

Associations between weight status and lifestyle factors (e.g. physical activity, television viewing, breakfast habits) did not differ when based on self-reported versus measured height and weight data. Although there have been several reports on the prevalence of childhood obesity, our study is important mostly because of its strengths in terms of methodology, data collection and original results. We used several rounds of national representative data, taking into account primary sampling units and stratification, and examined the recent trends in adolescents' overweight and obesity.

This study is not only the first report from Italy showing the time pattern in adolescents' obesity and over-

weight in the last 12 years, but also the first evaluating its relationship with SES at a national level. Our results are even more important considering that research has shown that OwO in adolescence goes on towards obesity in later life [56, 57] and also increases the correlated morbidity in adulthood [58]. Over 30% of the Italian adult population is overweight and about 8% are obese, corresponding to approximately 15 million overweight and 4 million obese adults [59]. Excess of weight (including the conditions of overweight and obesity) is the sixth most important risk factor for the global burden of diseases, as for its association with several non-communicable diseases (NCDs), including cardiovascular diseases, such as hypertension and stroke, diabetes, cirrhosis, osteoarthritis and sleep apnea [60]. In Italy NCDs are estimated to account for 92% of all deaths [61]. For this reason it is important to acknowledge the fact that prevalence of childhood overweight and obesity have reached a plateau in Italy in recent years; it is possible that public health initiatives have contributed to the leveling off of obesity trends. During these years, many national activities (in particular nutritional education projects) have started in childhood, in pre-school and schools settings. Italian Ministry of Health has a long tradition of public health activities, official nutrition recommendations and food-based dietary guidelines and collaboration with schools, which probably formed a solid ground for these activities. However, the actual impact of these initiatives needs to be examined in future evidence-based studies.

CONCLUSIONS

In conclusion, the data collected between 2002 and 2014 over 15 000 adolescents in Italy showed an overall low increase in prevalence of obesity and overweight, but an increasing trend among girls and an inverse association between SES and obesity in all age groups and in both genders. These findings suggest that concerted, multi-sectorial efforts are needed in Italy, in combination with a sound political determination, focused on reducing social inequality associated with obesity.

Authors' contributions

GL and PD conceptualized the study, interpreted the results, wrote the manuscript and approved the final manuscript as submitted. FC conceptualized and designed the study, interpreted the study results, drafted the initial manuscript, and approved the final manuscript as submitted. PD, PB and LC carried out the statistical analyses. FC, PL, MG and AV coordinated and supervised data collection, reviewed and revised the manuscript, and approved the final manuscript as submitted. AB, ML and RS critically reviewed the paper and approved the final manuscript as submitted. All authors have read and approved the final manuscript.

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Conflict of interest statement

There are no potential conflicts of interest or any financial or personal relationships with other people or organizations that could inappropriately bias conduct and findings of this study.

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