Prevalence and Tracking of Weight Disorders in Italian Primary School Students: A Three-Year Follow-Up

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A B S T R A C T

Obesity has been widely described as the latest epidemic, and in some areas obesity co-exists with undernutrition. The purpose of this study was to assess the variability of weight status of a cohort of 279 Italian primary school students followed longitudinally for three years. Overweight was the most common weight status disorder in both sexes and generally prevailed in females. Underweight was also more frequent in females than males, while males generally showed a higher incidence of obesity. Overweight showed the highest stability in females. In males, tracking of overweight was 62.5%, while that of normal weight was 89.36%. Overweight tracks through the three consecutive years in a high percentage of both sexes. In the whole sample (regardless of sex and weight category), overweight shows the highest increase over the three-year period. This study provides public health professionals with useful data for policy planning in regard to childhood obesity.

Key words: *weight status, tracking, children, Italy*

Introduction

Growth data are still an important public health tool to define the growth status of children and sub-optimal conditions of health. Indeed, the evaluation of growth in individual children is an efficient way of monitoring their health[1]. Well-designed growth studies can provide information to assess changes in growth and nutritional status in the community. In particular, they provide information about obesity and may help to clarify the causes of the recent epidemic and its health consequences.

Childhood obesity is rapidly emerging as a global epidemic with profound public health consequences. Indeed, excess adiposity is reaching epidemic proportions among children and adults in many industrialized countries and in the upper socio-economic strata of developing nations (in some areas, obesity and undernutrition co-exist). Health risks associated with obesity, e.g. metabolic syndrome, are increasingly being seen at younger ages. Moreover, it is generally believed that the greatest health risk of childhood obesity is the future probability of adult obesity and its associated consequences. The need to monitor overweight and obesity in children, to assess preventive measures and to identify high-risk groups has often been emphasized[2–8].

The number of overweight children in EU countries is expected to rise by 1.3 million per year, with more than 300,000 children becoming obese each year without urgent action to counteract the trend[9]. On the other hand, undernutrition in infants, children and adolescents poses a considerably larger public health problem internationally, and anorexia nervosa is the third most chronic condition of adolescence in the developed world[10].

In Italy, a strong geographic gradient in obesity has been observed in adult obesity. Despite growing concern about paediatric obesity, no regular national surveys had been conducted to assess its prevalence. Several surveys conducted at local or regional level had noted some geographic differences in paediatric obesity levels, although their magnitude has been difficult to assess because of differences in methods and definitions and limited geographic coverage. According to Binkin et al.[11], the prevalence of obesity is twice as high in the south as in the north. Not only in the south but also in the centre and

north, the median BMI was higher than the IOTF median. Italy appears so to have a major childhood obesity problem that is differentially affecting the three areas of the country. Furthermore, with the decentralization of the healthcare system, it is likely that the most affected regions are precisely those that have the least resources to provide adequate management for those who are currently obese and to prevent further increases.

Prevention appears to be the most promising way to deal with the current trends. Although cross-sectional surveys are useful to monitor growth status and the prevalence of underweight *vs.* obesity, longitudinal data are required to mark their stability or tracking over time. Previous studies have focused on specific samples or other age classes, and no data are available on the stability of weight status in Italian children. The purpose of this study was 1) to estimate the prevalence of underweight, overweight and obesity in children from Bologna (Emilia-Romagna, Italy) and 2) to track the weight status (underweight, overweight and obesity) of these school-children over three years.

Materials and Methods

Data were collected from students attending two primary school of Bologna (Italy) from the scholastic years 2004/05 to 2006/07; thus the children were followed longitudinally for three years. All subjects were informed about the purposes and contents of the research and written informed consent was obtained from the parents before participation. The surveys were carried out from November to April of each school year; for each children the measurement were carried out after one year of each other.

The sample consisted of 279 subjects (146 males and 133 females, numerically equilibrate among the considered age classes) from Bologna (Italy). The parameters considered in the present study are height (to 0.1 cm with a portable stadiometer, Raven Minimetre – Raven Equipment, Essex, UK) and weight in light indoor clothing (to 0.1 kg with Seca Scales – Seca Scales, Brooklyn,

USA). Body mass index (BMI) was calculated (weight (kg)/height(m)^2). Overweight and obesity were defined using cut-offs proposed by Cole et al.[12], underweight using the cut-off proposed by Cole et al.[10], since this cut-offs are usually consider in International comparison and they are utilized in the majority of studies about weight disorders in Italy[11,13–15].

Tracking was defined as maintaining underweight, overweight or obesity over the three-year period. Tracking coefficients were calculated by Spearman's correlation coefficients.

All statistical analyses were performed with Statistica 5.5 (StatSoft, Inc. 2000) and the significance level was set at p<0.05.

Results

In males, underweight is observed between 7 and 11 years, in females between 6 and 10 years (Table 1). The highest incidences are seen at 8 years (9.3% in males, 11.0% in females) and 10 years (10.3% in males, 10.7% in females). In males, overweight and obesity occur in all the age classes (Table 1). Overweight is particularly high at 8 (20.6%) and 9 years (22.2%). In females, overweight tends to increase with age, passing from 15.8% at 6 years to 31.8% at 11 years. Obesity shows a decreasing trend with age in males, passing from 15.8% at 6 years to 5.3% at 11 years. The trend is more irregular in females: the highest incidence of obesity is observed at 6 years (10.5%) and the lowest at 9 years (2%), while it is absent in 11-year-old girls.

Females generally present higher incidences of underweight and overweight than males, while males show a higher incidence of obesity. However, the sex differences are not statistically significant (χ^2). Sex differences in overweight and obesity do not show a definite pattern in the literature[16]. In some studies, males show a higher incidence than females[13,17–19], while the opposite is observed in others[20–22].

However, if we consider the incidence of overweight in Italy (Table 2), our values are lower only than those reported for Pescara and Campania. There seems to be a trend to increasing overweight from northern to southern Italy as already underlined. As regards obesity (Table 3), our values are lower than those from Pescara, Cagliari, Avellino and southern Italy.

Studies on tracking of weight status in the males of our sample indicate that underweight persists throughout the three-year period in 63.64% of the cases, while 36.36% of the underweight boys become normal weight. The normal weight subjects track in 89.36% of cases, while 5.32% become underweight and the same percentage overweight. Among the overweight subjects, 62.5% of males track overweight, but about 29.20% become normal weight, only a small percentage (8.30%) become obese. Obesity tracks in 47.10% of cases and the other boys become overweight (52.90%). In the females, 42.86% track underweight during the triennium and the others

TABLE 1
PREVALENCE OF WEIGHT DISORDERS

Age (years)	6 yrs.	7 yrs.	8 yrs.	9 yrs.	10 yrs.	11 yrs.
Males						
Underweight		1.5	9.3	6.8	10.3	5.3
Normalweight	68.4	73.1	59.8	64.1	70.5	73.7
Overweight	15.8	11.9	20.6	22.2	15.4	15.8
Obesity	15.8	13.4	10.3	6.8	3.8	5.3
Females						
Underweight	5.3	4.5	11.0	8.9	10.7	
Normalweight	68.4	71.6	62.6	63.4	60.7	68.2
Overweight	15.8	17.9	17.6	25.7	23.2	31.8
Obesity	10.5	6.0	8.8	2.0	5.4	

TABLE 2
COMPARISON BETWEEN OVERWEIGHT PREVALENCE OF OUR SAMPLE AND OTHERS ITALIAN SAMPLES

	City/Region	Boys	Girls	Boys+Girls	Age (years)
Present study	Bologna (Emilia-Romagna)	11.9–22.2	15.8–31.8	14.93–24.39	6–11
Maffeis et al. (1993)[13]	North-Est Italy	15.7	11		4–12
Maffeis et al. (1998)[20]	North Italy			22.3	8.6 ± 1
Gnavi et al. (2000)[30]	Torino (Piemonte)			16.27	10–11
Manzoli et al. (2005)[31]	Pescara (Abruzzo)			40.6	6–14
Manzoli et al. (2005)[31]	Pescara (Abruzzo)			33.3	6–14
Sanna et al. (2006)[32]	Cagliari (Sardegna)			11.5–15.4	6–10
Barba et al. (2006)[14]	Avellino (Campania)	27	25		6–11
Valerio et al. (2006)[33]	Salerno (Campania)			29.3	7
Bertoncello et al. (2007)[15]	Veneto	21.06	31.3		9–11
Binkin et al. (2009)[11]	North			20.2	8–9
Binkin et al. (2009)[11]	Centre			24.6	8–9
Binkin et al. (2009)[11]	South			23.6	8–9
Binkin et al. (2009)[11]	All			23.6	8–9

become normal weight. Normal weight subjects track in 79.57% of cases, while 11.83% pass to the under weight category and 8.60% become overweight. In overweight subjects, the tracking rate is 84.00% and the other girls become normal weight. The obese girls remain in this weight category in 50.00% of cases, while the others become overweight. In the Campania region of Italy, the tracking of overweight and obese subjects over three years was 73% and 80% respectively[32]. Spearman's tracking coefficients show significant positive correlations in normal weight subjects of both sexes (r=0.69, p<0.01), in overweight subjects (m: r=0.51, p<0.05; f: r=0.62, p<0.01) and in obese males (r=0.69, p<0.05).

Considering the males and females together, we can see that the normal weight status (–3.59%) and obesity (–3.94%) decrease over time, while underweight (+2.87%) and overweight (+4.66%) increase. Thus, overweight is the weight status with most variation over time.

Discussion and Conclusion

This study shows that the prevalence of weight disorders in children in Emilia-Romagna is among the highest in Italy. Moreover, these weight disorders persist over time. In the three-year period, overweight presents the highest stability in both sexes, underweight shows higher stability in males than in females, while obesity tracks in about 50% of cases in both sexes. When the entire sample is considered (independently of age and sex), overweight and underweight increase over time. Overweight presents the highest percentage variation over time. These results suggest that, in addition to overweight and obesity, particular attention must be paid to underweight, especially since this weight status is rarely investigated in Italy and the rest of Europe. The frequency with which underweight affects the children of our study and its increase over time underline the need for monitoring this category.

TABLE 3
COMPARISON BETWEEN OBESITY PREVALENCE OF OUR SAMPLE AND OTHERS ITALIAN SAMPLES

	City	Boys	Girls	Boys+Girls	Age (years)
Present study	Bologna (Emilia-Romagna)	6.8–15.8	2–15.8	2.44–13.16	6–11
Gnavi et al. (2000)[30]	Torino (Piemonte)			6.76	10–11
Manzoli et al.(2005)[31]	Pescara (Abruzzo)			19.5	6–14
Manzoli et al.(2005)[31]	Pescara (Abruzzo)			7.7	6–14
Sanna et al. (2006)[32]	Cagliari (Sardegna)			14–22.7	6–10
Barba et al. (2006)[14]	Avellino (Campania)	21	21		6–11
Valerio et al. (2006)[33]	Salerno (Campania)			10.3	7
Bertoncello et al. (2007)[15]	Veneto	5.92	5.15		9–11
Binkin et al. (2009)[11]	North			7.5	8–9
Binkin et al. (2009)[11]	Centre			10.6	8–9
Binkin et al. (2009)[11]	South			16.6	8–9
Binkin et al. (2009)[11]	All			12.3	8–9

Considering overweight and obesity, our results are in accordance with the literature, that suggests an increased risk for overweight or obese children of remaining overweight. This aspect and its complications suggest the importance of preventive efforts. Preventive actions can be carried out effectively in children by early identification and treatment of underweight, overweight and obese individuals[23]. In fact, the persistence of overweight and obesity into adulthood occurs mainly in subjects affected since childhood[23].

On the other hand, underweight also needs attention, since anorexia nervosa is one of the most common chronic conditions of adolescence in the developed world and female teens may adopt harmful strategies to lose weight even when they are normal weight[24].

According to Plachta-Danielzik et al.[25], data to support a particular strategy to prevent weight disorders are currently lacking.

The magnitude of the problem in children is also obscured by methodological problems[16]. In a review on the tracking of childhood overweight into adulthood, Singh et al.[26] underlined the difficulty of combining the results of various studies due to the heterogeneity of (i) the analytical methods used to examine the degree of persistence of overweight, (ii) the intervals over which persistence is studied and (iii) the criteria used to define overweight. Nevertheless, they concluded that the risk of overweight children becoming overweight adults is at least twice as high as for normal weight children.

Studies on tracking of weight status since childhood are important for the identification of children with a high probability of becoming overweight or obese adults.

Since obesity is related to the energy content of the diet and an increasingly sedentary lifestyle[27-29], interventions should focus on changing alimentary and exercise patterns. Physical activity can help to maintain a healthy body weight, normal body fat proportions and blood pressure levels. School health programs have the potential to influence the health of nearly all children within existing institutional structures. Schools have been a popular setting for the implementation of interventions, as they offer continuous intensive contact with children. Like the majority of EU countries, Italy has two periods of school--based physical education (PE) per week. Nevertheless, the European Heart Health Initiative (2001) suggests increasing PE to a minimum of three hours per week across the EU for all ages of young people.

This study is the preliminary phase of a larger longitudinal project dealing with modifications of body composition and functional characteristics associated with growth. The extension of our study to the later age classes of these children will allow us to follow their growth in time, to monitor their weight status, to better define the tracking of nutritional disorders and to plan adequate interventions.

Acknowledgements

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PREVALENCIJA I PRAČENJE POREMEĆAJA TJELESNE TEŽINE KOD TALIJANSKIH OSNOVNOŠKOLACA: TROGODIŠNJA STUDIJA

S A Ž E T A K

Pretilost je najčešće opisana kao posljednja velika epidemija, koja u pojedinim predijelima često ide ruku pod ruku s pothranjenošću. Cilj ove longitudinalne studije bio je uočiti varijabilnost u promjeni tjelesne težine na skupini od 279 talijanskih osnovnoškolaca kroz tri godine. Debljina je bila najčešći poremećaj tjelesne težine kod oba spola, a prevladavala je kod djevojčica. Pothranjenost je također bila češća kod djevojčica nego dječaka, dok su dječaci uglavnom češće pokazivali veći stupanj pretilosti. Debljina je pokazala najveću točku stabilnosti kod djevojčica. Kod dječaka, debljina je bila konstantna kod 62,5% pojedinaca, a normalna težina kod 89,36%. U cjelokupnom uzorku, bez obzira na spol i kategoriju težine, debljina pokazuje najveći rast unutar trogodišnjeg perioda. Ova studija daje korisne podatke stručnjacima za javno zdravstvo u svrhu budućih planiranja sprečavanja pretilosti u djece.