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Body Mass Index in Children and Their Parents: A Cross-Sectional Study in a Study Population of Children from Southern Italy

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Abstract

The prevalence of overweight and obesity has increased over the last decades. Parental obesity plays an important role in determining childhood obesity. We aimed to evaluate the relationship between parental and offspring' weight status in a population of children from South of Italy, as no data have ever been published from this area. We recruited 636 children (5.7 ± 1.5 years old) and their parents. Seventy-three (11.5%) and sixteen (2.5%) children were overweight and obese, respectively. Offspring weight status was significantly associated with parents' weight status. The linear regression analysis showed that offspring BMI was more affected by paternal than by maternal BMI. Our data confirmed that parents' weight status plays an important role on children's BMI. Interestingly, in our study, parents' height and weight were measured and not reported as in most of the previous papers, strengthening our conclusions. We suggest that intensive nutritional education and preventive programs should be performed in children with overweight / obese parents rather than in children with normal weight parent. Furthermore, nutritional education should be performed also for overweight parents to modify preventable risk factor for pediatric obesity.

Keywords: Obesity; Childhood; Parents; BMI

Introduction

The worldwide prevalence of overweight and obesity has dramatically increased among young people during the last decades. Furthermore, the relative raise over the last twenty years was higher in developing Countries (+65%) than in developed Countries (+48%) [1]. In Italy, the prevalence of overweight and obesity in children and adolescents aged from 6 to 17 years ranges from 13.7% to 23.6% and from 3.7% to 12.3% [2-5], respectively.

Obesity is associated with many health problems in childhood and represents a risk factor for obesity in adulthood [6]. It is associated with a proinflammatory and prothrombotic state [7], leading to cardiovascular dysfunction, type 2 diabetes mellitus, metabolic syndrome, snoring, asthma, early puberty, menstrual irregularities, steatohepatitis, pulmonary, renal, musculoskeletal, gastrointestinal, and psycho-social problems [6,8].

Once established, obesity is difficult to treat. Thus it is important to identify modifiable risk factors, contributing to the development of overweight and obesity, which have to be targeted by preventive programs [9]. Among the risk factors, parental obesity was identified as a predominant risk factor for childhood obesity, likely due to a combination of genetic, epigenetic, social, and environmental factors [10]. Consequently, the risk of childhood obesity is higher in obese parents' children [11-15]. Children with 2 obese parents are 10 to 12 times more likely to be obese [15-17]. The same-sex correlation between parents and child seems to be stronger than the opposite-sex correlations [18].

Cross-sectional studies have demonstrated that parental body mass index (BMI) is predictive of offspring BMI, in keeping with the evidence that parental lifestyle affects the children's behavior. Other studies reported that infant BMI is more strongly associated with maternal than paternal obesity in different age brackets [19,20]. Inverse association between socio-economic status and adiposity in children is well established [11,15], and the influence of the father seems to be stronger than that of the mother [14].

A limit of these studies is that parental height and weight were often reported and not measured, affecting the reliability of the results. Furthermore, no studies on population recruited in South of Italy have ever been performed. Prompted by this consideration, we focused our attention on the relationship between parental and offspring' weight status in a population of preschool and school children recruited in a single Centre from South of Italy.

Subjects and Methods

The study population included 636 children (5.7 ± 1.5 years old, age range 2.9 – 9.0 years, 348 males - 54,7%;) and their biological parents. Children were recruited at school during a routine medical examination. Anthropometric measurements were performed by a single trained physician using standard procedures. Standing height by a wall-mounted Harpenden Stadiometer and weight in underwear by an electronic scale with digital readings accurate to 0.1 kg were measured. BMI was calculated dividing the weight in kilograms by the square of height in meters and expressed as Standard Deviation Score (SDS) [21]. Overweight and obesity were defined in according to the IOTF growth charts [22]. Adulthood obesity was defined as BMI ≥ 30 kg/m^2, overweight as BMI between 25 and 30 kg/m^2. The study was submitted and approved by the local ethic committee. Statistical

analysis was run by SPSS Software v.17. Statistical difference was considered significant when $p < 0.05$.

Results

Males and females were not different in terms of age at recruitment, BMI SDS, and rate of normal / underweight, overweight, and obesity (Table 1). Seventy-three (11.5%) and sixteen (2.5%) patients were overweight and obese, respectively, and 547 (86.0%) were normal / underweight, without any difference between gender (Table 1). In the mothers, the rate of normal / underweight subjects was higher than in the fathers ($p < 0.001$, Table 1).

	Males	Females	Whole samples	Fathers	Mothers
Age (years)	5.7 ± 1.5	5.7 ± 1.6	5.7 ± 1.5	37.3 ± 6.2	33.8 ± 5.8
BMI (SDS)	0.15 ± 1.12	0.04 ± 1.06	0.1 ± 1.1	---	---
BMI (kg/m2)	17.0 ± 2.8	16.8 ± 2.6	16.9 ± 2.7	25.7 ± 2.9	23.9 ± 3.8
Under / normalweigth (n. patients, %)	293 (84.2%)	254 (88.2%)	547 (86%)	299 (47.0%)	437 (68.7%)
Overweight (n. patients, %)	43 (12.3%)	30 (10.4%)	73 (11.5%)	291 (45.8%)	145 (22.8%)
Obese (n. patients, %)	12 (3.7%)	4 (1.4%)	16 (2.5%)	46 (7.2%)	54 (8.5%)

Table 1: Features of offspring and their parents at recruitment. The values as expressed as mean ± standard deviation.

The chi-square analysis showed that offspring weight status was significantly associated with fathers ($p = 0.01$) and mothers ($p = 0.001$) weight status (Table 2). In males, there was no statistically significant association with paternal or maternal weight status, while in females the rate of obesity was significantly higher in obese mothers' daughters ($p = 0.003$).

Offspring classification	Father classification			Mother classification		
	Normal / Underweigth	Overweight	Obesity	Normal / Underweigth	Overweight	Obesity
Normal / underweight (n. patients, %)	269 (49.2%)	242 (44.2%)	36 (6.6%)	391 (71.5%)	114 (20.8%)	42 (7.7%)
Overweight (n. patients, %)	22 (30.1%)	44 (60.3%)	7 (9.6%)	41 (56.2%)	22 (30.1%)	10 (13.7%)
Obesity (n. patients, %)	8 (50.0%)	5 (31.3%)	3 (18.8%)	5 (31.3%)	9 (56.3%)	2 (12.5%)

Table 2: Distribution of normal / underweight, overweight, and obesity in the offspring on the basis of mother's and father's weight status.

Offspring BMI was significantly correlated with both mothers ($r^2 = 0.157$ and $p < 0.001$) and fathers BMI ($r^2 = 0.169$ and $p < 0.001$). In males, BMI was correlated with mothers BMI ($r^2 = 0.153$ and $p = 0.004$) and fathers BMI ($r^2 = 0.144$ and $p = 0.007$). In females, BMI was correlated with mothers BMI ($r^2 = 0.176$ and $p = 0.003$) and fathers BMI ($r^2 = 0.191$ and $p = 0.001$). Both mothers and fathers BMIs were significantly different among normal / underweight, overweight and obese children (Figures 1a and 1b).

The linear regression analysis showed that offspring BMI was affected by both paternal and maternal BMI (offspring BMI = -2.242 + 0.149 * fathers BMI + 0.135 * mothers BMI, $R = 0.215$, $p = 0.001$). The same result was obtained both in males (offs= 0.001) than and in females (offspring BMI = -2.726 + 0.171 * fathers BMI + 0.145 * mothers BMI, $R = 0.245$, $p < 0.001$).

Discussion

Our data obtained in a quite large population of children from South of Italy confirmed that the parents weight status strongly affected children BMI [13,14]. Maternal obesity plays a significant role mostly in determining daughters weight status. In the present study, the parents height and weight were measured and not reported as in the majority of the previous papers. This is an important point, because women typically under-report their weight while men typically over-report their height [18].

Even if a recent twin-study [23] concluded that genetic factors play the most important role in determining children weight status, available evidence suggests that obesity results from multiple interactions between genes, environmental and behavioral factors [24]. A lot of papers analyzed the relationship between parents and offspring weight status, showing that parents can indirectly influence unhealthy dietary (fatty foods, snacking, sweetened beverages), physical activity or sedentary behaviors (TV and computer addiction) of their children [10].

Besides these evidences, different data were reported about parents and offspring weight status at different age. Some data showed that early childhood growth was affected by both paternal and maternal BMI [25], with and independent and additive effect [26]. On the other hand, it was suggested that the maternal weight affected the severity of

childhood obesity at age 7, but both maternal and paternal weight affected offspring BMI at 15 years [27]. The mothers-offsprings correlations in BMI seemed to reach the maximum at 11 years, while the father-offsprings correlation at 16 years [28], Similarly, Safer et al. showed that both of parents BMI affect offspring BMI, but the effect of mothers BMI appeared sooner [29].

Perez-Pastor et al. reported a close association between fathers and sons BMI, as well as between mothers and daughters BMI, indicating a social or behavioral influence and not a genetic inheritance of obesity. By the age of 8, there was a significant gender interaction with a risk of obesity 10-fold greater in girls and six-fold greater in boys [18]. In contrast, Linabery et al. and Heude et al. reported that infant BMI was more strongly associated with maternal than paternal obesity overall, with significant differences at birth and from 2-3 years [19] and from birth to puberty [20].

Our study confirmed the association between parental and offspring BMI, showing that both of parents BMIs plays a role by itself on offspring BMI. The regression analysis suggested that paternal BMI plays a major role than maternal BMI in determining offspring BMI, in contrast with some papers showing a larger effects exerted by maternal BMI [19,20,29] and other ones reporting a similar effects exerted by both of the parents [25,26].

Our data largely confirm the correlation between parental and offspring BMI described in literature, however some findings are brand new. Firstly, we show that father BMI affects offspring BMI more than the maternal BMI. Interestingly, beside the effect of parental BMI on offspring BMI, the maternal obesity is significantly associated with daughter BMI in our study population, a finding never reported before, helping us to identify a group of patients prone to develop obesity. Finally, children of our study population are young as compared to other papers, suggesting that the effect of parental obesity is exerted in young children.

The differences in age at recruitment of children and parents, social environment, and population size among all the studies likely accounted for the differences in the results. In conclusion, our paper confirms that offspring BMI is largely affected by parents BMI. Fathers BMI seems to play a major role on BMI, even if overweight / obese daughters were more frequently among overweight / obese mothers offspring. Obesity is a difficult condition to treat, involving behavior and eating attitude and nutritional education plays a key role in the prevention of obesity.

Overweight is a worldwide increasing social and medical issue, requiring great consideration not only from physicians. The identification of modifiable risk factors plays a key role in the prevention of pediatric obesity and our study shows that parental obesity is a risk factor for offspring obesity. Nutritional education should be an actual activity, provided by general practitioners and hopefully also at school setting. All children should be educated, but education nutritional programs should involve also their parents as parental BMI plays an important role in offspring weight status. In those families with overweight / obese parents, the prevention programs are recommended to be intensive, aiming to avoid an early onset of excessive weight gain. We recommend that in such families, also the parental obesity has to be targeted to facilitate weight loss in the children.

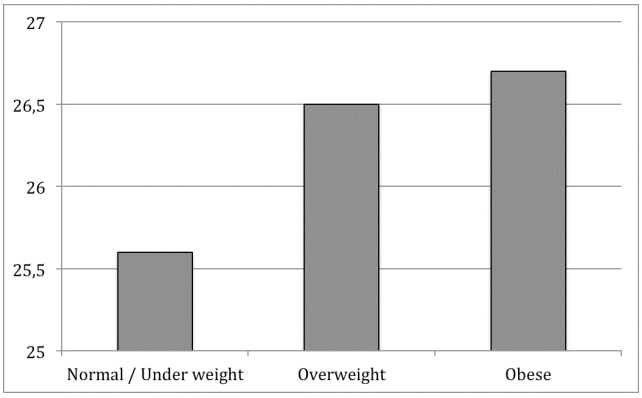

Figure 1a: Fathers BMI (kg/m2) on the basis of offspring weight status.

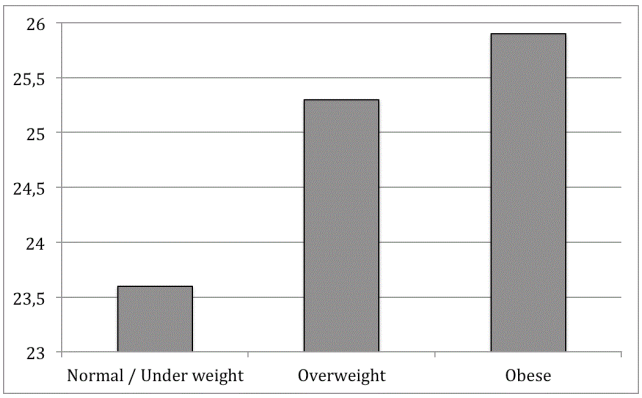

Figure 1b: Mothers BMI (kg/m2) on the basis of offspring weight status.

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