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Original article

Correlational study between body mass index conditions in children and their parents in pediatric, adolescence, adulthood ages

Elsa Vitale[1], Roberto Lupo[2], Alessia Lezzi[3], Cosimo Caldararo[4], Alessandra Rizzo[5], Simone Zacchino[6], Pierluigi Lezzi[7], Scupola Giovanni Maria[7], Antonino Calabrò[8], Giorgia Chetta[9], Pietro Corvace[1], Maurizio Ercolani[10], Salvatore Latina[11], Angelo Benedetto[11], Federico Cucci[12], Noemi Cimarelli[13], Erika d'Amanzo[14], Rocco Mea[15], Annarita Mignone[7]

[1]Local Healthcare Authority Bari, Bari (Italy); [2]San Giuseppe da Copertino Hospital, Lecce (Italy); [3]National Cancer Association (Ant) Italia Onlus Foundation, Lecce (Italy); [4]University of Bari, Lecce (Italy); [5]Local Health Authority Taranto, Taranto (Italy); [6]Prof. Petrucciani Hospital, Lecce, Lecce (Italy); [7]Vito Fazzi Hospital, Local Health Authority Lecce, Lecce (Italy); [8]Nuovo Ospedale degli Infermi, Local Health Authority Biella, Biella (Italy); [9]Strategic Regional Agency for Health and Social, A.Re.S.S. Puglia, Bari (Italy); [10]Regional Health Authority, Mental Health Department, Ancona, (Italy); [11]Umberto I Hospital, Siracusa (Italy); [12]Citta di Lecce Hospital, Gruppo Villa Maria, Lecce (Italy); [13]Freelance nurse, Lecce (Italy); [14]"Quadrifoglio" A.S.S.E.S.T cooperativa, Assistenza socio sanitaria e servizi territoriali Copertino, Lecce (Italy); [15]San Carlo Hospital, Potenza (Italy)

Abstract. *Background and aim:* The influence of individual parents depends on the age and sex of the child. Teenage boys, who have both overweight or obese parents, are more likely to be overweight themselves, but just having an obese mother is enough to increase the likelihood of a preschool boy are obese. To assess any correlations existed between BMI conditions in children related to their BMI parents' conditions, by considering their pediatric, adolescence and adulthood age. *Methods:* During 2020 and 2021 data were collected both from children, aged between 3 to 14 years old and their respective parents in the ambulatory setting. Additionally, it was assessed parent's weight conditions, both for mothers and fathers during their pediatric, adolescent and adult ages, by only considered if there were: underweight, normal weight, overweight or obese, respectively. *Results:* 135 children were enrolled with their respective parents, too. Significant correlations were performed between BMI in children and their mothers' conditions in pediatric age (ρ=0.196; p=0.025); between BMI in children and fathers, both during the adolescence (ρ=0.176; p=0.046) and the adulthood (ρ=0.184; p=0.037). Additionally, significant correlations were performed between BMI in children and their mothers' conditions in pediatric age (ρ=0.196; p=0.025); between BMI in children and fathers, both during the adolescence (ρ=0.176; p=0.046) and the adulthood (ρ=0.184; p=0.037). *Conclusions:* Significant correlations emerged between the BMI of parents and that of children. The timely intervention on cases of obesity and severe overweight within family contexts could prevent the possibility not only of diseases related to these realities, but also an increased risk of becoming obese in the adulthood.

Key words: adolescence, adulthood, body mass index, children, father, mother, pediatric

Introduction

In recent years, the average of Body Mass Index (BMI) and the proportion of overweight and obese people have increased around the world. The fight against obesity has become an important public health challenge worldwide due to the importance which it plays in many chronic diseases. Worldwide, an estimated 800 million people live with this condition recognized as a disease and millions more are at risk of developing it. In the United States, obesity is estimated to be present in 35% of adults and 17% of young people, defined as individuals between the ages of 2 and 19 (1). Obesity is a very common condition among children and adolescents around the world (2). It is now known that the roots of obesity are deep and well rooted in the current socio-cultural fabric, so much so that the only way to achieve progress is that given by the joint commitment and collaboration of all sectors and social forces. From 2017-2020 data of the "PASSI and PASSI d'Argento surveillance systems", it emerges that obesity affects 11% of 18-69 years old and 14% of over-65s. In Italy, 20.4% of children between the ages of 8 and 9 are overweight and 9.4% are obese (3) and suffer from this condition, too (4). In 2014, 1900 million adults were overweight or obese. The number of overweight or obese children under 5 has increased from 32 million in 1990 to 42 million in 2013 (5). Despite the efforts, no country, to date, has reversed its obesity epidemic, even if there are some signs of positive change that derive, mainly, from a flattening of the prevalence of childhood obesity, despite the many projects worldwide, probably because the latter have less access to education and correct information on lifestyles and health and usually live in areas that do not facilitate an active lifestyle. Obesity is the result of the interaction between behavioral, social and metabolic components, some genetically determined, others attributable to environmental factors. Without any intervention, an obese child will probably continue to be obese in adolescence and adulthood (6.7). Excess weight, in addition to being considered an aesthetic problem, favors an increase in risk factors for developing diseases such as: cardiovascular problems, orthopedic, diabetes mellitus, various types of cancer and in addition to having physical repercussions there are also harmful effects on a psychological level, such as reduced self-esteem and criticism of the physical aspect. Thus, a scenario of diseases deriving from overweight is outlined and the awareness that obese children will also become adults with the same problem (8,9). From a British study, where data from the Health Survey for England were examined, where the body mass index of the members of 14,401 families between 1995 and 2009 were taken into consideration, it emerges that the influence of parental obesity on the child's future obesity appears to be greater when it is on the maternal side. The International Association for the Study of Obesity has estimated that the UK has some of the highest rates in Europe of overweight or obese children between the ages of 5 and 17 (10). The results seem to be consistent with the idea that if parents are overweight or obese, the likelihood for their children of being overweight or obese is also greater. However, according to the study, the influence of individual parents depends on the age and sex of the child. Teenage boys, who have both overweight or obese parents, are more likely to be overweight themselves, but just having an obese mother is enough to increase the likelihood of a preschool boy are obese. To date, to our knowledge, few studies have addressed this condition. The aim of the present study was to assess any correlations existed between BMI conditions in children related to their BMI parents' conditions, by considering their pediatric, adolescence and adulthood age, too.

Materials and methods

Participants

During 2020 and 2021 data were collected both from children, aged between 3 to 14 years old and their respective parents in the ambulatory setting.

Only those who agreed to participate in the study by signing the informed consent, after being informed about the purpose of the study and after obtaining the relevant permissions were included.

Data collection

To achieve the purpose of the present study, some important information was collected from parents and

their children respectively. Specifically, as regards children data regarded:

- Sex, if the child was female or male,
- Age, expressed in years;
- Weight (w), expressed in kilograms (kg) and height (h), expressed in meters, in order to successively assessed the Body Mass Index values (BMI) for each participant. Specifically, the BMI value was determined as w in kilograms (Kg) divided by the square of the h in meters (Kg/m^2). According to the World Health Organization (WHO) growth charts, for children aged between 5-19 years, BMI conditions were assessed thanks to percentiles of growth, differentiating by sex available at the WHO web site at the tools and toolkits for growth (11);
- if the child practiced physical activity or not;
- if the weight condition was also associated with other comorbidities, and if the answer was positive, it was necessary to specify what kind of comorbidities was present, too;
- if the child assumed a regularly diet.

Additionally, it was assessed parent's weight conditions, both for mothers and fathers during their pediatric, adolescent and adult ages, by only considered if there were: underweight, normal weight, overweight or obese, respectively.

Data assessment

All data collected were included in an Excel data sheet and then, processed thank to the SPSS, IBM, version 20. All variables were all considered as categorical variables and therefore, presents as frequencies and percentages, with the exception of the child's age which was expressed in years and the, presented as mean ± standard deviation. Spearman correlations were performed between BMI conditions in children and their parents' BMI conditions, both in pediatric, adolescent and adult ages, too. All p-value<0.05 were considered as statistical significant and then, for only the significant correlations percentages were assessed to better understand the trend of the association between children BMI conditions and their respective mothers or fathers' conditions, too.

Ethical considerations

All participants and their parents signed a written consent for participation and future publication of their data. All data were collected and presented as anonymous data. Data were in agreement to the Helsinki declaration and participation was clearly stated as voluntary.

Results

135 children were assessed during the study period. All the children sampling characteristics collected were included in the Table 1.

By considering Spearman correlations between BMI conditions in children and their parents in pediatric, adolescent and adult ages (Table 2), significant correlations were performed between BMI in children and their mothers' conditions in pediatric age (ρ=0.196; p=0.025); between BMI in children and fathers, both during the adolescence (ρ=0.176; p=0.046) and the adulthood (ρ=0.184; p=0.037), respectively.

As regards significant correlations between BMI conditions in children and their mothers' conditions during their pediatric ages, most of overweight and obese children were associated to normal weight mothers, as shown in the Table 3. Additionally, most of the obese children were associated to normal weight fathers during their adolescent ages and now, at their adulthood ages, fathers reported higher BMI conditions, too (Table 3).

Discussion

The aim of the present study was to assess any correlations existed between BMI conditions in children related to their BMI parents' conditions, by considering their pediatric, adolescence and adulthood age, too. 135 children participated in the study, with

a prevalence of female gender (n = 74; 54.8%). 69.6% (n = 94) are normal weight, 7.4% (n = 10) underweight and 22.2% (n = 30) are obese, only 41.5% (n = 56) are physically active. Globesity, a term created to identify the spread of obesity, today represents a real health emergency throughout the world that affects people of all continents, races and cultures and has recently reached epidemic proportions. According to the World Health Organization (WHO), millions of people with obesity can develop complications (12); a high body mass index in childhood is associated with an increased risk of becoming obese as an adult and with an increased incidence of diabetes in adults (OR 1.70; 95% CI 1.30-2.22), coronary heart disease (CHD) (OR 1.20; 95% CI 1.10-1.31), diabetes mellitus present in 31% of cases and hypertension present in the measure of 22%, in 31% of children aged 12 or older years classified as overweight or obese. Only 20% of all adult cancers occurred in children classified as overweight or obese (13). Increasing body weight negatively affects well-being and increases stigma and discrimination. Numerous studies have shown how the stigma towards people with obesity and the episodes of discrimination based on weight are frequent and widespread on a global level (14,15). The stigma towards weight has been documented in all social settings, including the workplace, school, family and health care organizations (16-18). Overweight children are frequently mocked and bullied at school. Adolescents with overweight or obesity are more frequently subject to isolation and are more exposed to verbal, physical or cybernetic episodes of discrimination (19) Unfortunately, "globality" knows no borders and affects both developing and industrialized countries, young and old, children, men and women. The results of the awareness, care, and treatment in obesity management international observation show that obesity remains underdiagnosed and undertreated (16), due to the lack of knowledge even of health personnel and the low propensity to discuss it in different institutional settings such as school and family (18). In light of these harmful effects, attention must be focused on the treatment and prevention of obesity. By considering Spearman correlations between BMI

Table 1. Sampling characteristics (n=135).

Sampling characteristics	n(%)
Sex	
Female	74(54.8)
Male	61(45.2)
Age	11±2
Body Mass Index	
Under weight	10(7.4)
Normal weight	94(69.6)
Over weight	1(0.7)
Obese	30(22.2)
Physical Activity	
Yes	77(57)
No	56(41.5)
Not answered	2(1.5)
Comorbidities	
Acne	4(3)
Anemia	1(0.7)
Cardiomyopathy	1(0.7)
Celiac disease	1(0.7)
Irritable colon	2(1.5)
Diabetes mellitus	2(1.5)
Muscular dystrophy	1(0.7)
Eating disorder	1(0.7)
Insulin resistance	2(1.5)
Hyperinsulinemia	11(8.1)
Hypogonadism	8(5.9)
Hirsutism	1(0.7)
Crhon's disease	1(0.7)
PCOS	11(8.1)
Flat feet	10(7.4)
Gastroesophageal reflux	6(4.4)
Fatty liver	12(8.9)
Tachycardia	3(2.2)
Knee valgus	8(5.9)
Not answered	49(36.3)

Table 2. Spearman correlations between BMI in sons and their parents during their pediatric, adolescent and adult age.

BMI in sons	Mother in pediatric age	Father in pediatric age	Mother in adolescence	Father in adolescence	Mother in adulthood	Father in adulthood
RhO	0.196*	0.129	0.059	0.176*	0.108	0.184*
p-value	0.025*	0.142	0.508	0.046*	0.222	0.037*

*p<0.05 is statistical significant.

Table 3. How BMI conditions correlated among them?

Parents BMI conditions	BMI levels in children			
	Underweight n(%)	**Normal weight n(%)**	**Overweight n(%)**	**Obese n(%)**
Mother in pediatric age				
Under weight	1(0.8)	1(0.8)	1(0.8)	2(1.5)
Normal weight	0(0)	7(5.4)	28(21.5)	80(61.5)
Overweight	0(0)	0(0)	1(0.8)	9(6.9)
Father in adolescent age				
Under weight	0(0)	0(0)	5(3.9)	6(4.7)
Normal weight	1(0.8)	7(5.5)	22(17.2)	63(49.2)
Overweight	0(0)	0(0)	2(1.2)	17(13.3)
Obese	0(0)	1(0.8)	0(0)	4(3.1)
Father in adulthood				
Underweight	0(0)	0(0)	2(1.5)	1(0.8)
Normal weight	1(0.8)	4(3.1)	14(10.8)	35(26.9)
Overweight	0(0)	3(2.3)	8(6.2)	22(16.9)
Obese	0(0)	1(0.8)	6(4.6)	33(25.4)

*$p<0.05$ is statistical significant.

conditions in children and their parents in pediatric, adolescent and adult ages (Table 2), significant correlations were performed between BMI in children and their mothers' conditions in pediatric age ($\rho = 0.196$; $p = 0.025$); between BMI in children and fathers, both during the adolescence ($\rho = 0.176$; $p = 0.046$) and the adulthood ($\rho = 0.184$; $p = 0.037$), respectively. Obesity has a significant genetic component and its pathogenesis is multifactorial: in addition to genetic factors it is attributable to lifestyle changes such as a sedentary lifestyle which leads to an imbalance between energy intake and expenditure and to profound changes in societies and behavioral models of communities (obesogenic environment). Genetic factors play a crucial role in determining an individual's predisposition to weight gain and obesity. In recent years, several genetic variants have been identified as monogenic forms of human obesity; it has also been noted that alterations in environmental and epigenetic factors are one of the main causes of obesity, as evidenced by a review of studies (20). A recent study revealed hereditary traits regarding muscle parameters and adipose tissue between parent and child in childhood, compared to adolescence in which environmental influence seems to have a greater effect (21). The environment, through school, inactivity, immobility from TV and screens, addiction to smartphones Journal Title 12 / 21 and video games (22). They represent important causes of obesity. Childhood obesity can be present throughout life (23). Compared to healthy peers, overweight children have a probably 4 times greater ability to become obese adolescents (23), and overweight / obese adolescents are 5 to 7 times more likely to become overweight / obese adults (24,25). The identification of innovative strategies to improve the health outcomes of children and adolescents remains a priority of international research. Parents have a profound influence on their children's obesity and lifestyle behaviors through their own behaviors, parenting practices and their role in shaping the food and physical activity environment at home (26-28). A recent review has shown how home interventions affect the improvement of childhood obesity through the involvement of parents, who are in control of dietary intake, especially in pre-adolescent children (29). A longitudinal study of 3,285 families identified that children with an obese father but a healthy mother were 15 times more likely to be obese than children with healthy parents (30). Conversely, having an obese mother but a healthy father does not increase the risk of childhood obesity (31). A further study found an association between the mother's BMI and the risk of having an obese child, with an increase of 1.11 for each point of increase in the mother's BMI, as well as a correlation between the mother's higher BMI

and a less amount of physical activity in children (32). Obesity is therefore a complex condition that derives from the interaction of genetic, psychological and environmental factors. There is still too little talk of obesity and this represents a barrier to possible prevention and treatment interventions. By 2030, a real "epidemic" of obesity will break out across Europe and in Italy, according to estimates, overweight men will be 70%, a percentage not very different from those forecast for the countries most at risk. This is what emerges from the Eupean Congress On Obesity in Prague, which lead to the inclusion of Greece, Spain, Austria and the Czech Republic in the list of countries most at risk of overweight, but the worst prospect is that faced by the 'Ireland, where 89% of men will weigh more than their ideal weight by 2030 (33).

Conclusion

Obesity is a disease of our time that profoundly affects the state of health as it is accompanied by important diseases that worsen the quality of life (34,35). From our data, significant correlations emerged between the BMI of parents and that of children. The timely intervention on cases of obesity and severe overweight within family contexts could prevent the possibility not only of diseases related to these realities, but to prevent the increased incidence of obesity in the near future, as an elevated value in BMI during the childhood is associated with an increased risk of becoming obese in the adulthood.

Conflict of Interest: Each author declares that he or she has no commercial associations that might pose a conflict of interest in connection with the submitted article.

Informed Consent: All participants and their parents signed a written consent for participation and future publication of their data.

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Correspondence:
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Elsa Vitale
Centre of Mental Health Modugno, Local Healthcare Authority Bari,
via X marzo, 43, 70026 Modugno, Bari, Italy,
E-mail: vitaleelsa@libero.it