

THE ASSOCIATION BETWEEN OBESE CHILDREN'S BODY MASS INDEX AND  
PARENTAL BODY MASS INDEX IN SCHOOL-AGED CHILDREN<sup>1</sup>\*Maria Moualla, MD, <sup>2</sup>Ahmad Chreitah, PhD and <sup>3</sup>Souad Sakkour, PhD<sup>1,2,3</sup>Department of Pediatrics, Tishreen University, Faculty of Medicine, Lattakia, Syria.

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## ABSTRACT

**Background:** Obesity in childhood is a public health problem, whose importance has progressively increased in the last few years. Environmental factors are implicated in the rapid increases in prevalence of childhood overweight that have occurred in the past 2 decades. Parental obesity is a predominant risk factor for childhood obesity, and family factors including socio-economic status (SES) play a role in determining both parents and children weight. It is essential to unpick how shared family factors impact on child weight. **Objectives:** This study aims to determine the association between parental weight status measured by body mass index, familial socio-economic factors and the risk of childhood obesity at school age. **Materials and Methods:** An observational analytic cross-sectional study was conducted in 400 obese children (161 males 40.3% and 239 females 59.7%) who were followed up at the pediatric endocrine clinic at Tishreen University Hospital in Latakia-Syria between July 2023 - August 2024 and who met the eligibility criteria and had complete data. **Results:** Out of 400 obese children, 351 children (87.7%) had obese or overweight mothers, and 182 children (54.5%) had obese or overweight fathers. A significant relationship was found between parental obesity or overweight, and the obesity in their children. Additionally, a significant positive correlation was observed between high parental education level and low financial income, and their children's obesity. **Conclusion:** The study revealed a significant association between parental obesity and overweight and children's obesity. We therefore recommend involving parents in weight loss programs applied to their children.

**KEYWORDS:** childhood obesity, body mass index, parental BMI, Syria.

## INTRODUCTION

The World Health Organization WHO has considered overweight and obesity a global epidemic among children since 1998.<sup>[1]</sup> The overweight/obesity prevalence has doubled and tripled in pre-school and primary school-aged children, respectively.<sup>[2]</sup> Among developing societies, Eastern Europe and the Middle East have the highest prevalence of childhood overweight.<sup>[3]</sup> The prevalence of obesity varies by racial, ethnic, and socioeconomic factors. Childhood obesity is more common in African Americans, American Indians, and Mexican Americans than in non-Hispanic whites and obesity is also more prevalent in low-income populations.<sup>[4]</sup>

Childhood obesity is associated with comorbidities affecting almost every system in the body including, but not limited to, the endocrine, gastrointestinal, pulmonary, cardiovascular, and musculoskeletal systems. Many of the comorbidities encountered in youth with obesity, including type 2 diabetes mellitus (T2DM), dyslipidemia, obstructive sleep apnea (OSA), and steato-

hepatitis, used to be previously considered "adult" diseases.<sup>[5]</sup>

Obesity results from the interaction between environmental factors (overconsumption of foods high in carbohydrates and fats, increasing promotion of fast foods, lack of nutritional awareness, as well as lack of physical activity due to urban lifestyle and frequent use of transportation instead of walking); and genetic factors which are difficult to determine.<sup>[6]</sup>

Parents provide children with both genes and environments, so it is not surprising that there are strong family resemblances in adiposity.<sup>[7]</sup> For children, the family environment plays a central role in shaping their eating and activity patterns.<sup>[8][9]</sup> Parents' eating and activity patterns are essential components of family environments; parents serve as role models for children's eating and physical activity and influence children's access to food and opportunities for physical activity.<sup>[10]</sup> From the gene-environment interaction perspective, the parental generation's chronic exposure to obesogenic environments commonly found in modern societies may

lead to metabolic adaptations that produce epigenetic phenotypes more susceptible to obesity, such as insulin resistance and leptin resistance. These adaptive phenotypes are inheritable by subsequent generations and, therefore, could put these generations at risk of overweight or obesity.<sup>[11]</sup> Parental obesity more than doubles the risk of adult obesity among both obese and non-obese children under 10 years of age.<sup>[12]</sup> Therefore, it is necessary to study this relationship due to the lack of research correlated to children.

## MATERIALS AND METHODS

### Study population

After approval by the local research ethics committee, and with the parents' written consent and children's assent, an analytic cross-sectional study was conducted in 400 obese and severe obese children (161 males 40.3% and 239 females 59.7%) aged 6-14 years old seen at the General Pediatric Clinic of Tishreen University Hospital in Lattakia-Syria between July 2023 and August 2024 and met the eligibility criteria and had complete data.

**Eligibility criteria:** A. Inclusion criteria: obese and severely obese children at school age observed at the General Pediatric Clinic of Tishreen University Hospital in Lattakia-Syria

B. Exclusion criteria:

- 1- Endocrine obesity: diabetes mellitus type 2, hypothyroidism
- 2- Being on medications or having a condition known to influence insulin action or insulin secretion (e.g. glucocorticoid therapy) as indicated by parents.
- 3- Syndromic obesity (Prader-willi, Laurence-moon-Biedl, Turner)

### Procedures

Children who met inclusion criteria were classified according to their \*BMI percentile (p) according to \*CDC as follows: obese with BMI  $\geq 95$ p and  $< 99$  p, and severe obese with BMI  $\geq 99$ p. Weight was measured with the child in the center of a scale in light clothing and without shoes. Height was measured with the child standing with back leaning against the stadiometer of the same scale. We did the same previous procedures with

parents of those obese children who met the inclusion criteria, the parents' BMI was measured and classified according to CDC as follows: underweight with BMI  $< 18.5$ , normal weight with BMI 18.5-24.9, overweight with BMI 25-29.9, obesity with BMI 30-34.9 and severe obesity with BMI  $\geq 35$ . Data were collected on family history of obesity, family financial income, and father's/mother's education degree (we considered those who had a high secondary and post-secondary education as high educated, and who had lower than secondary education considered low educated).

\*BMI; body mass index \*CDC; Centers for Disease Control and Prevention.

### Statistical Analysis

The statistical analysis included both descriptive and inferential statistics based on the tests of statistics. Descriptive statistics were used for quantitative variables calculating the mean and standard deviation, and for qualitative variables, frequencies and percentages were calculated. Inferential statistics were conducted using the Chi-square test to study the relationship between qualitative variables. We used Z-test to examine the difference between the percentages of two groups. The results were considered statistically significant with a p-value  $\leq 5\%$ . The IBM SPSS statistics (version 25) program was used to calculate statistical coefficients and analyze results.

## RESULTS

A total of 400 obese and severe obese children, 239 females (59.7%) and 161 males (40.3%) were included in our study. The children's ages ranged from 6 to 14 years, with an average age of  $11.13 \pm 1.68$  SD. Among the age groups, the 10-14 age range represented the largest percentage of the research sample at 66.7%. Out of the 400 children, 368 children (92%) were obese and 32 children (8%) were severely obese. The number of children with both normal weight parents was 34 children (8.5%), number of children of both obese/overweight parents was 136 (34%) and number of children with one obese/overweight parent was 264 (66%).

**Table (1) showing the distribution of study sample according to their mothers and fathers weight status calculated by BMI.**

Father/mother weight status	N	%
Normal weight fathers	Total children 182 ;	45.5%
	103 girls	56.5%
	79 boys	43.5%
Overweight or obese fathers	Total children 218 ;	54.5%
	136 girls	62.4%
	82 boys	37.6%
Normal weight mothers	Total children 49 ;	12.3%
	21 girls	42.8%
	28 boys	57.2%
Overweight or obese mothers	Total children 351 ;	87.8%
	218 girls	62.1%
	133 boys	37.9%

As shown in table (1), 54.5% of children had obese or overweight fathers compared with 45.5% of children with normal weight fathers. Additionally, 87.7% of children had obese or overweight mothers compared with 12.3% of children with normal weight mothers.

We noticed that obese girls with obese or overweight fathers or mothers consisted a higher percentage in comparison with obese boys.

**Table (2) showing the relationship between child's obesity and parental weight status calculated by BMI.**

Parental weight status	Total number of obese children	p-value
Overweight or obese mother	351(87.7%)	0.000>
Overweight or obese father	218(54.5%)	0.000>

Based on the results presented in Table (2), the overweight and obesity of fathers and mothers is

statistically significantly associated with children's obesity with a p-value <0.05.

**Table (3) the difference between percentage of children with obese or overweight mothers and percentage of children with obese or overweight fathers by applying Z-test.**

Children with obese/overweight mother	Children with obese/overweight father	p-value
87.7%	54.5%	0.0008

According to table (3), There was a statically significant difference between the percentage of children with obese/overweight mothers at 87.8%, and the percentage

of children with obese/overweight fathers at 54.5% with a p-value of 0.008.

**Table (4) showing the relationship between children's obesity and socio-demographic factors.**

Socio- demographic variables	Total number of obese children	p-value
Family history of obesity (FHO)	121 children (30.2%) negative 279 children (69.8%) positive	0.003
household income	212 children (53%) low 135 children (33.7%) medium 53 children(13.3%) high	0.000>
Mother's education level	155(38.7%) low educated 245(61.3%) high educated	0.000>
Father's education level	157(39.2%) low educated 243(60.8%) high educated	0.000>

As shown in table (4), we found that the positive family history of obesity, the higher education level of fathers/mothers, and the lower household income consistent with a statistically significant relationship with a p-value of <0.05. Factors such as gender did not reveal any statistically significant associations.

## DISCUSSION

This present study aimed to assess the association between measured parents weight status and familial socio-economic status with children's obesity. Our data suggest that parents weight status appears to be the most significant factor leading to childhood obesity, this means that children from families with overweight/obese parents are at a significantly high risk of obesity.

This present study included 400 obese and severe obese children who met the inclusion criteria. The percentage of children with overweight/obese mothers was 87.7%, and at a lower rate, the percentage of children with overweight/obese fathers was 54.5%.

Female children with overweight/obese parents constituted a higher percentage compared to male children. A significant positive association was found

between children's obesity and the high father/mother BMI, as maternal obesity/overweight had a greater effect on both male and female children than paternal obesity/overweight.

Data from parents in the present study confirmed the reported association between lower household income and obesity in both children and parents. A positive association was found between positive history of family obesity and childhood obesity. Additionally, we found a significant relationship between high parental education level and their children's obesity.

No statistically significant relationship was found between gender of children and their obesity.

The potential mechanism explaining the relationship between childhood obesity and parental obesity/overweight may include the obesogenic lifestyles and behavioral traits which can be easily passed down from parents to children through the family socialization process.<sup>[11]</sup>

The mother's influence on childhood obesity could be of epigenetic origin. The Y chromosome carries few genes,

and Y-linked traits are uncommon. They also tend to be associated with male infertility. X-linked traits from the mother are commoner, but the chances of a daughter being affected are the square root of those of the son (for example, 1:10 000 against 1:100).<sup>[13]</sup>

Emiear et al reported in a study of school children in Ireland that children of obese parents were three times more likely to be overweight than children of normal-weight parents, he explained that by the interaction between genetic and environmental factors.<sup>[14]</sup>

In a study involving children in the UK, Perez-Pastor et al. have reported a close association between paternal and son's BMI, as well as between maternal and daughter's BMI, indicating a social and not genetic inheritance of obesity. He attributed this to similar behavior and habits between the child and his same-sex parent.<sup>[15]</sup>

In Spain, Julian et al have found that 453 out of 800 children had at least one obese parent compared to 132 obese children with parents of normal weight. Obesity in any parent determines a higher severity of their offspring obesity and metabolic comorbidities, more importantly when obesity is present in the mother or in both parents, which is similar to our study.<sup>[16]</sup> According to Svensson et al, the severity of obesity at age 7 related significantly with the mother's BMI, but not with paternal BMI. The adjusted severity of obesity at age 15 correlated significantly with both parents' BMI. The mother's influence in early childhood could be of epigenetic origin.<sup>[17]</sup>

In an international study across 12 countries, Muthuri et al have reported a negative influence of maternal higher education on child overweight in lower economic status countries. He found negative relationships between parental education and child physical activity in Colombia, Kenya, Portugal, and South Africa. He speculated that these between country differences might be a consequence of social norms and perceptions that a healthy child should be rounder. He found that more educated parents moving up in social status and preferring motorized transport and richer foods, coupled with a lower understanding of the importance of maintaining healthy body weights and participating in adequate levels of physical activity among parents from lower rather than higher economic status countries.<sup>[18]</sup>

The study had several limitations, including a small sample size and a cross-sectional design that made it difficult to establish causal relationships with accuracy. Additionally, we had declarative variable, which is the household income, because we do not have accurate national programs for determining household income in Syria. Our study was conducted at a local level only because it was self-funded.

## CONCLUSION

Body mass index and health behaviors and life styles are associated within families. According to our findings, parental overweight/obesity appears to be the most influential factor leading to children's obesity. In addition, low household income and parental high education level may increase the risk of children's obesity. Our findings suggest that parental BMI should be recognized as a marker of families at risk of obesity, and to better controlling obesity, physical activity and eating patterns within families should be targeted. The early intervention to improve health behaviors and prevent obesity may have the potential for long-term benefits, preferably before children's habits become established. Due to the high prevalence of obesity in parents and children, population based interventions are required.

## DECLARATIONS

Ethical approval and consent to participate: Ethical approval for this study was obtained from the Scientific Research Ethics Committee at Tishreen University in April 2023 following the Declaration of Helsinki.

## Consent for publication

Not applicable.

## Availability of Data and Materials

All the data generated or analyzed during this study are included in this published article. The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

**Competing interests:** None.

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## Author Contributions

Maria Moualla collected the data collection, checked the quality of the data collection, analyzed and interpreted the data, designed and coordinated the study, undertook and checked the quality assessment, produced the first draft of the manuscript, wrote and edited the manuscript and approved the final manuscript before submission.

The project was supervised by Ahmad Chreitah and Souad Sakkour. The authors conducted the quality assessment, evaluated the collected data, analyzed and interpreted the data, checked the quality assessment, edited the manuscript and approved the final manuscript.

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