

ORIGINAL ARTICLE

# Aspects of motor development and quality of life in the context of child obesity

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## Abstract

**Introduction:** Child development is a period of progressive and complex transformations related to growth, maturation, learning, motor skills, and psychosocial issues.

**Objective:** Analyze the influence of obesity on the aspects of motor development and quality of life of children aged three to eight years, and their mothers' levels of anxiety and depression.

**Methods:** Cross-sectional descriptive and quantitative approach study with children enrolled and attended at a pediatric endocrinology in Fortaleza, CE, in the period between June and November 2017. The study sample consisted of 24 children from three to eight years of age. We used the anthropometric quantification, the Motor Development Scale, and the Pediatric Quality of Life Inventory (PedsQL™) for children. We applied the Beck anxiety and depression questionnaires for mothers.

**Results:** 16 were female, and 17 were severely obese. Most of the sample showed motor development changes 42,85% classified as "inferior" in the obesity category, and 41.17% in the severely obese category. Both groups revealed "complete right-handed" and "undefined" laterality in around 40% of the individuals. The quality of life had a low mean score. The majority of mothers from both groups presented minimal anxiety and depression.

**Conclusions:** Obesity interferes negatively with the overall motor development, determination of laterality, and quality of life of children, perceiving more severe levels of anxiety and depression in mothers of children severely obesity.

**Keywords:** pediatric obesity, motor disorders, child health, quality of life, family relations.

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## Authors summary

### Why was this study done?

It's known of the consequences of obesity in terms of metabolic changes and cardiovascular risks, however, this study was carried out in order to understand how obesity can interfere in the motor and psychosocial skills of children and also how this health situation can act on maternal psychic levels, inferring a consequence in the family environment. It's hoped that the results will direct treatment interventions and a more comprehensive understanding to the consequences of obesity in childhood period, both related to the child's health and its repercussion in the social and family spheres.

### What did the researchers do and find?

In addition to measuring the anthropometric data of the 24 children to determine their obesity levels, their motor development levels were assessed using the Rosa Neto Motor Development Scale (MDS). Additionally, a questionnaire was administered to determine the quality of life of the children, and anxiety and depression levels among their mothers to understand the relationships between these factors and pediatric obesity. This study found a high prevalence of severe obesity among the 24 children, diminished motor development in all psychomotor factors, especially global motricity and balance, and impairments in aspects of quality of life, especially in the emotional aspect. The presence of maternal anxiety and severe depression was found only in the severely obese group of children.

### What do these findings mean?

These findings indicate a need for greater vigilance and control of factors that favor the emergence of pediatric obesity, as well as follow up of emotional aspects within the scope of children's quality of life—reflecting the need for early intervention for adequate child development. Besides, the study showed that childhood obesity generates maternal anxiety and depression, perpetuating the vicious cycle of obesity, which suggests that the mothers of these children are also in need of care. We also question whether these mothers' mental health could be linked to obesity levels in their children.

## INTRODUCTION

Child development is a series of progressive, continuous, dynamic, and complex transformations related to growth, maturation, learning, motor skills, and psychosocial issues. A child's development depends on environmental, genetic, psychological, and social factors, as well as the amount of affection demonstrated by the mother and family<sup>1</sup>.

In recent years, the prevalence of obesity has escalated in all age groups due to increasingly sedentary lifestyles and easier access to high-calorie foods. Its incidence in childhood and adolescence is a public health problem that represents the possible persistence of this condition into adulthood and an increased risk of the appearance of metabolic diseases<sup>2</sup>.

According to data from the World Health Organization, childhood obesity affects one out of every three children between five and nine years in Brazil, with overweight at a rate of 15% and obesity of 5%. It is worth mentioning that four out of five obese children will present this condition until the end of their lives<sup>3,4</sup>.

In addition to the short- and long-term metabolic changes, psychosocial issues, and cardiovascular problems known to result from obesity, this condition can also negatively influence physical development and motor learning in the early childhood period. It may also have an impact on adulthood<sup>5</sup>.

In this context, it is essential to understand how obesity acts to the detriment of child development regarding the motor, social, and communication aspects. Hence, this study's objective is to analyze the influence of obesity on the aspects of motor development and the quality of life of children aged three to eight years and their mothers' levels of anxiety and depression.

## METHODS

### Study Design

This is a cross-sectional, descriptive study with a quantitative approach.

### Study Location and Period

This is a survey conducted with patients registered and attended at a pediatric endocrinology clinic of a University Hospital Unit linked to the Unified Health System (SUS) located in Fortaleza, CE, Brazil, carried out from June to November 2017.

### Study Population and Eligibility Criteria

Because of the difficulty of physical space to perform tests and the time required to complete and collect the questionnaires, the study accounts for the non-probabilistic sampling of the consecutive and convenience type. The sample consisted of 24 obese children, considering the nutritional diagnosis of the Food and Nutrition Surveillance System<sup>6</sup>, and their respective mothers.

The study included children three to eight years old within the weight for age percentile, according to the recommendations of the Ministry of Health (MOH), for childhood obesity<sup>7</sup>. Those excluded possessed diagnoses of neurological, motor, or cognitive disorders, and children who failed to complete the Motor Development Scale (MDS) tests.

### Data Collection

#### Data collection occurred in three phases:

1 Anthropometric quantification (weight and height) of children measured by the Body Mass Index (BMI) and stratified by age according to the recommendations of MOH<sup>7</sup>.

2 Application of MDS with the children<sup>8</sup>.

3 A form filled out by mothers with data related to the child and application of the children's QoL questionnaires, anxiety, and depression levels of the mothers.

The tests were administered individually and in a secluded place by a single researcher previously trained

and familiar with the scales used. The children underwent the test clothed, removing only the pieces that could interfere with the tests' performance, such as overall motor skills and balance. The tests had pre-stipulated difficulties and were graduated by the child's CA according to the following sequence: fine motor skills, global motor skills, balance, body schema, spatial organization, temporal organization and laterality (manual, pedal, and eyepiece); with specific characteristics (maximum duration, number of attempts, command and execution errors) according to the guidelines contained in the Motor Assessment Manual by Rosa Neto<sup>8</sup>.

Each test was explained and demonstrated by the researcher. The test was then initiated and applied according to the patients' CA. Patients advanced through tests until an error was detected; if an individual was unable to perform the initial tests, tests consistent with the previous CA were applied until the individual succeeded.

The MDS, which evaluates the motor skills of children aged two to eleven years, was applied to assess the development of the sampled children. A diversified test with a graded difficulty through applying a test that addresses various motor dimensions concerning the biological age or chronological age (CA) in months. Through MDS, the General Motor Age (GMA: the sum of the positive results of each test, in months) and the General Motor Quotient (GMQ: GMA divided by the CA multiplied by 100) are determined, from this value it is obtained the classification of the motor profile from the very lowest to the highest; and Specific Motor Quotient (SMQ) of each psychomotor factor and its subsequent classification<sup>9</sup>.

To assess children's Quality of Life(QoL), the Pediatric Quality of Life Inventory (PedsQL<sup>TM</sup>) version 4.0 was applied. This tool has 23 items covering four domains (physical, social, emotional and school) and also includes a questionnaire for the parents of children and adolescents between 02 and 18 years of age, allowing measurement of this condition through the parents' opinion<sup>10</sup>.

Each construct questions how much each item represented a problem in the last month, with five possible answers. It scores from 0 to 4 (0 - never, 1 - rarely, 2 - sometimes, 3 - often and 4 - almost always a problem), each negative answer will be scored inversely on a scale of 0 - 100 (0-100; 1-75; 2-50; 3-25; 4-0), thus, the higher the score (obtained by adding the items divided by the number of questions answered), the higher the QoL<sup>11</sup>.

The mothers performed the Beck Anxiety Inventory<sup>12</sup> consisting of a scale produced from various instruments self-report to measure the anxiety elements and the Beck Depression Inventory for measuring manifestations with patients and the intensity of depressive symptoms<sup>13</sup>.

The questionnaires were first explained to the children's guardians, detailing each of the aspects addressed and how to respond to them. They were delivered to literate mothers individually, though they were permitted to consult the researcher in any doubt. For those who presented some difficulties in understanding, the questionnaires were filled out by the researcher herself.

## Data Analysis

The data were analyzed with the aid of the software Statistical Package for the Social Sciences (SPSS) version 22.0 and Microsoft Office Excel 2013. To observe the associations between obesity, psychomotor variables, QoL, and motor development, we performed tests and non-parametric correlations – the Kruskal-Wallis test and Spearman's correlation coefficient, respectively. Values of  $p < 0.05$  were considered significant.

## Ethical and Legal Aspects of the Research

The ethics committee of the institution approved the research (CAAE No. 80919017.0.0000.5054), and all participants willingly signed an informed consent and assent form.

## RESULTS

Of the 24 children studied, 16 were female, with a mean CA of  $84.58 \pm 16.43$  months. Table 1 presents the population studied's general data, observing a prevalence of severe obesity, mean education of 4.21 years, and BMI of  $25 \text{ kg/m}^2$ . In GMA, a difference of around 22 months was observed. The average overall motor development was rated as inferior through the GMQ, revealing that the group reported a negative motor age or a motor age lower than its biological age.

**Table 1:** General characteristics of sampled children. Fortaleza, CE, 2017 (n=24)

VARIABLES	n (%)
Sex	
Female	16 (66.66)
Male	8 (33.33)
Obesity	
Obesity	7 (29.16)
Severe Obesity	17 (70.84)
	Mean $\pm$ SD
Education (years of study)	4.21 $\pm$ 1.10
BMI (Kg/m <sup>2</sup> )	25.13 $\pm$ 3.90
CA (months)	84.58 $\pm$ 16.43
GMA (months)	62.17 $\pm$ 14.51
GMQ (months)	73.83 $\pm$ 12.05

n: number of participants; BMI: body mass index; CA: chronological age; GMA: general motor age; GMQ: general motor quotient.

### Motor Development and the Emotional State of Mothers

Figure 1 shows the SMQ of each psychomotor factor, revealing a distance between the observed quotients and healthy motor development in all factors, the SMQ consistently falling short of the normal. This disparity

was very severe in the aspects of balance and language/temporal organization, which were distinctly lower. When correlating the obesity classifications with the values found in the study, it was noticed that as obesity increases (from obesity to severe obesity), the distance from the ideal for global motricity and balance factors increases.

Psychomotor Factor	Specific Motor Quotient (Mean ± SD and classification)	Obesity Classification	Mean	Standard deviation	Median
Fine motricity	75.42±13.47 Lower	Obesity	-22.86	10.29	-20
Global motricity	69.89±23.50 Lower	Severe Obesity	-17.53	12.70	-16
Balance	65.97±18.42 Very low	Obesity	-16.00	16.93	-17
Body scheme/speed	75.99±16.34 Lower	Severe Obesity	-26.71	19.22	-27
Space organization	75.90±14.57 Lower	Obesity	-22.86	10.29	-20
Language/temporal organization	66.70±12.74 Very low	Severe Obesity	-28.12	17.66	-28

**Figure 1:** Classification of motor quotient for each psychomotor factor related to the degree of obesity. Fortaleza, CE, 2017.

On analyzing the classification of general motor development and laterality within the group of obese patients in the studied sample, a predominance of classification “inferior” had a prevalence of 42.85% in the obese group and 41.17% of the severely obese group.

Additionally, a similar result was observed in children with a predominance of right-handedness and undefined laterality, with 42.86% in the two classifications for the obese group and 41.18% for the severely obese group (table 2).

When correlating CA with psychomotor factors, a moderate to strong correlation was observed in all factors ( $r = 0.742$ ,  $p = 0.000$ ,  $p = 0.001$ ,  $p = 0.001$ ,  $p = 0.002$ ,  $p = 0.002$  and  $p = 0.005$ , respectively, with regards to the factors fine motor skills, global motor skills, balance, body scheme, spatial organization, language/temporal organization).

Minimal anxiety and depression levels were found to be prevalent among the mothers in both obesity groups. However, only the mothers of children with severe obesity showed severe anxiety and depression (table 2).

**Table 2:** Classification of general motor development and laterality of children, and anxiety and depression of mothers according to obese and severe obesity groups. Fortaleza, CE, 2017.

General Motor Development Classification	Obesity		Severe Obesity	
	Score	%	Score	%
Normal medium	-	-	2	11.76
Normal low	2	28.53	2	11.76
Lower	3	42.85	7	41.17
Very low	2	28.53	6	35.29
Laterality Classification				
Completely right-handed	3	42.86	7	41.18
Crossed laterality	1	14.29	3	17.65
Undefined laterality	3	42.86	7	41.18
Anxiety and Depression Classification				
Minimal anxiety	4	57.14	7	41.18
Mild anxiety	1	14.29	3	17.65
Moderate anxiety	2	28.57	4	23.53
Severe anxiety	0	-	3	17.65
Minimal depression	3	42.86	6	35.29
Mild depression	2	28.57	6	35.29
Moderate depression	2	28.57	3	17.65
Severe depression	0	-	2	11.76

### Children’s Quality of Life

It was found a decrease in the general QoL of children in all aspects evaluated with values lower than 70, the emotional and social aspects receiving the lowest mean score (58.54 points), and the highest mean score (67.71 points), respectively (table 3).

This decrease in scores in the emotional aspect dimension was statistically significant, with  $p=0.047$  when correlated with the classification of motor development.

When these children were asked about their preferred places and styles of play, most preferences

were associated with less active games such as playing with toys (stroller and doll), drawing and painting, and playing “school,” among others, even though the places mentioned such as the street, the square, the park, their house or their room may offer other possibilities of activities. Additionally, mothers reported that their children do not have peaceful nights of sleep, displaying plenty of movement during sleep, or even interruptions of the cycle; such reports were especially recurrent in children with Severe Obesity.

**Table 3:** Description and statistics of the Quality of Life of sampled children. Fortaleza, CE, 2017.

Dimensions	n	Mean	Standard Deviation	Minimum	Maximum
Physical capacity	24	62.50	19.70	6.00	100.00
Emotional aspect	24	58.54	20.35	20.00	100.00
Social aspect	24	67.71	19.05	20.00	95.00
School activity	24	63.08	19.82	30.00	95.00
Total	24	63.08	12.96	37.00	88.00

## DISCUSSION

### Aspects of Motor Development

A relationship between physical skill and obesity was found, in which the higher the degree of obesity, the worse the motor skills of the children became. Their motor performance consistently underperformed the CA.

This fact evidenced the disparity of more than 20 months of CA concerning GMA which concurs with the results of another study<sup>1</sup> which reported that overweight children compared to eutrophic children tend to be less active, in addition to spending more extended time in front of screens (i.e., television, video games), which relates to the motor difficulties they present.

The results of the assessment for each psychomotor factor showed a considerable difference in CA compared to GMA in 95.83% of the sample, and that all these factors were under normal with “lower” development classifications, except for balance and language/temporal organization, which obtained classifications of “very low.”

As a result, the increase in BMI was associated with an under global psychomotor development and negative motor age in almost 100% of the sample and a higher incidence of lower motor levels. Such data are similar to those obtained in another study<sup>14</sup> carried out with obese school children aged six to 10 years who also demonstrated low motor development levels on the MDS.

The performance of motor skills in childhood, in the presence of overweight and obesity, tend to be shorter with low overall motor precision, manual dexterity and coordination of gross motor skills<sup>15</sup>.

It is worth mentioning that global motor skills and balance tended to be more impaired as obesity worsened, due to the greater distance from CA with motor age.

A previous research<sup>16</sup>, have highlighted significant differences in the general motor development of obese children, especially in the performance of global motor skills, balance, and body scheme. These conditions may be associated with greater difficulty in jumping, running and

orthopedic changes, increased risk of falls and fractures, and difficulty with self-awareness/ body coordination, manual dexterity, agility, and speed, interfering in their dynamic and static balance.

As for laterality, a predominance of complete and undefined dexterity was observed with the same classifications as both obese and severely obese groups. A study<sup>17</sup> with obese students reported a prevalence of right-handedness.

While there is no evidence for the predominance or visible preference of the use of one side versus the other, we have the installation of undefined laterality. This condition could be related to motor coordination difficulties, especially when present in ages older than seven years<sup>18</sup>, which may justify its presence in our study.

### Aspects of Quality of Life

Obesity correlates not only to delays in the development of motor skills but a diminished QoL as well<sup>16</sup>. In the present study, we verified a decrease in the children’s QoL, observing lower values in the categories of emotional aspects and physical capacity.

Corroborating the results found in this study, in a literature review<sup>19</sup>, the majority of the studies analyzed displayed a significant decrease in physical activity and emotional aspects in obese children when compared to eutrophic children.

Low physical development indices can cause reduced performance in daily activities and difficulties when learning new skills (academic performance), further damaging the motor performance and obstructing psychic and social relationships. When children cannot perform the tasks that most other children can do, they may feel removed from their peer groups, resulting in withdrawal and isolation<sup>20</sup>.

The biopsychosocial conditions of obesity do not necessarily cause death but can induce great psychological distresses, such as depression, social isolation, low self-

esteem, difficulties forming relationships and bodily dissatisfaction, which may impact the health of sufferers<sup>1,20</sup>.

Global and gross motor skills are related to the overall physical capacity of the quantity and quality of motor experiences and practices experienced during childhood. Changes in these abilities impact children's affective-social behavior, generating adverse effects on self-esteem and decreased interest in physical activity practices, which is associated with the maintenance of obesity and causes long-term decreases in QoL (in physical and psychosocial aspects), as well as emotional distress in parents<sup>21,22</sup>.

### Maternal Anxiety and Depression Level

Obesity has a relationship with psychological conditions such as anxiety and depression. According to psychoanalytic theory, children try to master their anxiety through excessive food intake to compensate for feelings of sadness and emotional deprivation or the presence of an unstable relationship with their parents<sup>23</sup>.

With this in mind, we evaluated the anxiety and depression levels of the mothers of obese children in this study to identify the emotional impacts that this condition can have on parents. Our findings demonstrate a minimal prevalence of depression and anxiety among mothers, regardless of the level of their children's obesity. However, it is essential to note that cases of mothers with anxiety and severe depression were only found among children in the severe obesity group.

There is evidence to suggest a correlation between psychological aspects and childhood obesity, as well as a correlation between BMI and physical inactivity. What is not yet known is the causal relationship between them<sup>24</sup>. Due to the multiplicity of possibilities, further investigations are required in this area.

Anxiety is related to family context, genetics, and environmental conditions. Some studies point to the hypothesis of the heritability of anxiety disorder (AD), which is more frequent among children who are more inhibited. Children with parents with AD are more prone to adopting an inhibited pattern (possibly due to overprotection exerted by parents, preventing them from exploiting all their capabilities) and developing a psychiatric disorder. Anxiety is present in about 5.2% to 6% of Brazilian children and adolescents<sup>25</sup>.

The higher the presentation of maternal depressive aspects, the less prevalent are the children's social and relational skills, in which the internalization of psychosocial problems (i.e., anxiety, depression, isolation, feelings of inferiority) may worsen during the child development period and culminate in psychological distress in adolescence and adulthood<sup>26</sup>.

Maternal symptoms of psychological distress are correlated with a higher probability of overweight and obesity in children, especially at an early age and in low-income socioeconomic environments<sup>27</sup>. Chronic depression affects child development more directly than episodic states, reflecting in the physical (fat and muscle

weakness) and psychosocial dimensions of the child. Poor parental practices (feeding, screen time, physical activity), early introduction of solid foods before the cessation of breastfeeding and insensitivity of mothers (i.e., negativity, use of physical punishment), may also interfere with children's psychological wellbeing, especially in the relationship between mother and son<sup>27,28</sup>.

The current research presented limitations, such as (a) sample size, with a view to a better representation of the studied population, exposing the need for more research into this topic with a more significant number of participants; (b) assessment of the children's anxiety and depression symptoms; and (c) methodological restriction because it doesn't allow determining causality.

While the relationship between childhood obesity, higher incidences of cardiovascular diseases and metabolic disorders in childhood and the maintenance of obesity in adulthood has been discussed widely, in our study, we were able to observe other interfaces of childhood obesity, revealing its interference with motor development as well as the socio-affective and psychosocial status of children.

Such results suggest that overweight children have a delay in global motor development, which represents a deficit to assess early, monitored, guided and, if possible, acted on through psychomotor interventions and interdisciplinary teams to stimulate the development of each child, using motor experiences that provide social and emotional activities for the child, family, and community.

Changes in all domains of QoL, particularly in the emotional aspect. There is an emphasized influence of obesity in this aspect as well as the physical, social, and school activity aspects.

A direct relationship was found between the degree of obesity in children and mothers' emotional status, which displayed higher levels of anxiety and depression in mothers of children with severe obesity—implying a vicious circle of obesity and signals that these mothers also need attention and care. Note, that relationship with this age group children is not well established in the literature. Thus, the direction of the causal relationship is unknown, assuming there is a cause-effect association that is uni- or bidirectional. Further research along these lines is encouraged, considering the complexity of the topic and the relationship between risk behaviors for childhood obesity and maternal mental health.

From the perspective of public health, these outcomes reveal the need for more surveillance and control of the factors that favor pediatric obesity, considering its direct influence on children's motor development, quality of life, and emotional aspects. Early intervention is essential to promote complete and adequate child development.

This study's findings converge upon the need for interdisciplinary and multi-professional intervention strategies aimed at the promotion, prevention, and treatment of childhood obesity in all its dimensions – clinical, psychological, and social – with a focus on the health of children and their families, especially their mothers.

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## Resumo

**Introdução:** O desenvolvimento infantil é um período de progressivas e complexas transformações relacionadas ao crescimento, maturação, aprendizagem, habilidades motoras e questões psicossociais.

**Objetivo:** Analisar o desempenho das habilidades motoras em crianças obesas, analisar a qualidade de vida das mesmas e os níveis de ansiedade e depressão de suas mães.

**Método:** Pesquisa transversal, descritiva, comparativa e de abordagem quantitativa com crianças atendidas em um ambulatório de endocrinologia pediátrica localizada no município de Fortaleza – CE, entre junho e novembro de 2017. A amostra foi composta por 24 crianças, de 3 a 8 anos de idade. Foi realizada a quantificação antropométrica, aplicação da Escala de Desenvolvimento Motor, do Questionário Pediátrico sobre Qualidade de Vida das crianças (Pediatric Quality of Life Inventory – PedsQL™) e dos questionários de ansiedade e depressão de Beck com as mães.

**Resultados:** 16 eram do sexo feminino e 17 obesos graves. Obteve-se alteração no desenvolvimento motor em quase 100% da amostra, com uma classificação quanto ao nível motor como “inferior” em 42,85% no grupo de obesos e 41,17% no grupo de obesos graves. Houve um predomínio da lateralidade “destro completo” e “indefinida” em ambos os grupos com pouco mais de 40% da amostra. Quanto a qualidade de vida foi observada uma baixa média de escores; estando as mães classificadas, em sua maioria, nos dois grupos, com presença de ansiedade e depressão mínimas.

**Conclusão:** A obesidade interfere negativamente no desenvolvimento motor global, determinação da lateralidade e qualidade de vida das crianças, percebendo-se níveis mais graves de ansiedade e depressão nas mães de crianças com obesidade grave.

**Palavras-chave:** obesidade pediátrica, transtornos motores, saúde da criança, qualidade de vida, relações familiares.

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