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OBESITY AND PHYSIOLOGICAL BEHAVIOUR IN SECOND CYCLE CHILDREN DURING PHYSICAL ACTIVITY

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Abstract: *With a distinctive feature of a quasi-experiment, the influence of body weight on physiological behaviour during physical activity was determined. The data were recorded for processing and analysis in spreadsheets of the Microsoft Excel program and STATGRAPHICS PLUS 5.1. The behaviour of the dependent variables during the quasi-experiment makes us conclude that the thermoregulatory possibilities, the values of oxygen consumption and the organic adaptation index have unfavourable behaviour for children outside the body weight considered normal weight.*

Key words: *Body weight, physiological behaviuor, Organic Adaptation and Physical Activity.*

1. Introduction

Obesity is a chronic, multifactorial and complex disease characterized by excessive fat deposits that are harmful to health and increase the risk of developing chronic diseases such as type 2 diabetes, high blood pressure and dyslipidemia [10- 19].

Obesity is defined as excess body weight for a given height, the most used way to define overweight (BMI 25 to 29.9 kg/m2) and obesity (BMI ≥30 kg/m2) is the body mass index (BMI), although it is not a real measure of adiposity, it is easy to use in epidemiological studies and surveys [17]. However, BMI as a measure of adiposity is often questioned because the percentage of fat can be variable due to the patient's sex, age, race/ethnicity, cardiovascular fitness levels, and other factors, therefore, BMI should be interpreted with knowledge of the history, physical examination, and additional laboratory studies to arrive at an accurate risk assessment and treatment plan. The pathogenesis of obesity is complex, although caloric intake and lifestyles are evident in its development, sociocultural, behavioural, genetic and demanding factors must be considered that contribute to both its causality and persistence, configuring it as a multifactorial entity [1].

In addition, the Economic and Development Organization (2019) exposes its high impact on health and well-being, it

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is estimated that it generates an economic burden on the country of approximately 6% of the gross domestic product [13].

In Cuba, various studies have been carried out on children and adolescents, providing data that allow assessing the evolution of overweight and obesity in stages of life, among which the following stand out: The Study on Growth and Development of the Cuban population, carried out in 1972 with a representative sample that allowed obtaining national weight-for-height norms that evaluate the nutritional status based on the location of children in different channels. Percentiles [15].

In a study on changes in nutritional status in overweight and obese schoolchildren in Havana over two years, the result was that 87.6% of children were obese or overweight; after two years of follow-up, they remained in these categories. A high percentage of overall overweight is evident, which is why it is important to monitor the nutritional status of children and adolescents longitudinally [4].

Suggest that the current increase in the prevalence of obesity in our environment in children and adolescents is explained by the change in physical activity and eating habits in our population. Some of the dietary factors that have been shown contributed to an increase in adiposity at school age, in combination with sedentary habits, are increased energy and fat consumption, increased consumption of free sugars, low intake of vegetables and fruit and poor supervision by adults. In our environment, the risk increases when the sociocultural level is lower and several of the factors related to the "unhealthy" habits mentioned above come together. Regarding energy expenditure, the factor that determines the appearance of obesity to a greater extent is a sedentary lifestyle, related to habits such as watching television, using the computer or playing video games. The practice of at least 60 minutes a day of moderate or intense physical exercise prevents the appearance of obesity in children and adolescents. [11-12].

Identification of children with multiple risk factors is important. The risk associated with an identified factor is markedly affected by the intensity of other coexisting risk factors. Clinical and epidemiological studies have shown that individuals with multiple risk factors have a substantially increased risk of cardiovascular diseases, compared to those who have a single risk factor, as well as when they are grouped into the so-called metabolic syndrome.

Of obesity characterized by the existence of a body mass index between 25 and 29.9 [19].

Agree that childhood obesity has a multifactorial etiology, where the free demand for food, changes in eating habits, sedentary lifestyle and psychological and social factors have great fundamental importance [9-15].

WHO (2024) states that

• In 2022, one in eight people in the world was obese.

• In 2022, 37 million children under 5 years old were overweight.

• In 2022, more than 390 million children and adolescents aged 5 to 19 were overweight, of which 160 million were obese.

Complications in childhood obesity are associated with psychological problems, among these are school marginalization, low self-esteem, clinical depression and altered perception of the body schema.

Within orthopedics, septic necrosis of the hip due to excessive weight, stiff limbs, and osteoarthritis of the knees appear. In the respiratory area Lung failure, Sleep apnea.

Conducted a study focused on poor eating habits during COVID-19 and its negative influences on children and young people [2-4].

Conducted a study of schoolchildren in the Habana del Este municipality. Respondents showed excessive energy intake and preferences for energy-dense and hedonistic foods, nighttime meals, and screen games. Thus, schoolchildren find themselves immersed in an obesogenic environment [7-14].

Growth Disorder with an increase in muscle mass, advanced bone age and increased height. The skin can be affected by stretch marks and cellulite. Other frequent complications are cardiovascular diseases such as high blood pressure, increased cardiac volume, dyslipidemia, Increased cholesterol, Increased triglycerides, Increased bad LDL cholesterol, Decreased good HDL cholesterol, Atherosclerosis, Fatty liver, Insulin resistance, Diabetes, Increased frequency of gallstones and Breast cancer [8-19].

In most cases, obese children are passive, repressed, shy, their great appetite is due to an ability to escape, they eat compulsively, they have poor school and sports performance, in addition to showing little tolerance for the attitudes of their peers and families in relation to their appearance and acceptance, they very soon feel marginalized and rejected, insults from their peers can be destructive.

Surveys carried out on overweight children show the possibility of inadequate physiological functioning of these organisms in the face of the activities provided by the traditional school program.

This condition, which increasingly occupies a more relevant place, is added to chronic malnutrition and micronutrient deficiency. These three situations can coexist in the same country, community, family or individual. If this trend continues, the region will not meet the goal set by the World Health Assembly, which states that overweight children under 5 years of age does not increase between 2012 and 2025. [18].

Overweight and obesity in the Cuban population are increasing along with chronic non-communicable diseases, according to data from the National Health Survey carried out in 2022. [5].

This nutritional panorama of being overweight has worsened in recent years. In the case of girls, boys and adolescents who are affected by overweight, there is a greater chance of developing diabetes, obesity, chronic non-communicable diseases and some types of cancer throughout their lives. Additionally, the risks for the development of cognitive, behavioural and emotional difficulties, low self-esteem, stigmatization, poor socialization and/or depression increase.

How to determine childhood obesity

Anthropometric methods are universally used. The weight that is considered the weight-for-height ratio is a good indicator of adiposity in childhood up to 9 or 10 years of age. In Cuba, the national norms for growth and development are used in percentiles and the cut-off points for overweight and obesity, which are: Overweight is greater than 90 or 97 and obesity is greater than 97. [6].

States that the diagnosis of overweight and obesity is made by measuring the weight and height of people and calculating the body mass index (BMI): weight (kg)/height2 (m2). This index is an indirect marker of fat, and there are additional measurements, such as waist circumference, that can help diagnose obesity. [19].

Child physiology

In many areas of study, it is stated that the child should not be considered a small adult, and exercise physiology is no exception. Physiology applied to children still has a long way to go, awaiting results from numerous longitudinal studies in progress, which will give us valuable information for the future development of physical education and children's sports. When we face the literature that refers to the human organism and its response to physical effort, we almost always find that their mention refers to the adult individual and generally to athletes. Whether adapting to simple or occasional exercise or regular exercise, the child - like the adult - experiences particular physiological changes. The ability of children to work Anaerobically is significantly less than that of adolescents and adults. For example, the Anaerobic power generated by an 8-year-old child is 70% of what an 11-year-old can generate. A series of biochemical characteristics underline this condition, which highlights a lower level of Glycogen reserves and fundamentally a lower glycolytic enzymatic capacity (PPK, PDH, LDH). If we compare the Anaerobic alactacid power with the lactacid - both components of the Anaerobic power - we appreciate a difference in behaviour between [14].

These authors propose that from a metabolic point of view, the child can make efforts of short duration and high intensity, being nothing more than the natural way of playing, expressed by a high alactacid power like that of adults and with high trainability.

2. Methods and Procedures

2.1. Materials

- Hg thermometer. for clinical use
- Water suitable for consumption
- Cotton
- Alcohol to disinfect thermometers
- Clock
- Chronometer
- Data record cards
- Tables for the settlement of data
- 400-meter track

The physical activity to be carried out consists of traveling one-mile (1609) meters on the 400-meter track.

2.2. Methods

To determine oxygen consumption, the one-mile test will be applied to children, which consists of walking one mile as fast as possible.

Oxygen consumption will be calculated by the formula that corresponds to the mile test

Mile Test (Rockport Test)
Objective: Determine the maximum VO2 in subjects with low physical condition. Methodology: Walk the distance of one mile (1609.3 meters) according to the performer's personal pace.

Take heart rate at the end of the Take your heart rate at the end of the ride.

Control the time spent [20].

Apply the following formula to determine VO2 max:

VO2 máx.: 132. 6 – (0.17 x PC) – (0.39 x Edad) + (6.31 x S) – (3.27 x T) – (0.156 x FC)

where:

PC – Body weight;
S – Sex (0: women, 1: men);
T – Time in minutes; HR: Heart rate.

2.3. Methodological indications of the Test:

- The test should be suspended or not started if the patient feels discomfort.
- Precordial, nausea, dizziness, shortness of breath, incoordination, or other discomfort.
- With blood pressure equal to or greater than 160/100 mm Hg, the test should not be performed.
- Verbally stimulate the patient during the execution of the test.
- You cannot perform a sports walk during the test.
- The schedule should be done in the morning or afternoon when the sun does not affect it.
- To carry it out, comfortable clothing and footwear should be used.
- In ischemic patients, the first test should be performed after a
- Ergometric test (Therapeutic physical culture program for obese patients).

2.4. Temperature

The temperature will be taken in the shade and at rest for 5 minutes, the temperature will be determined in the sun, after the children are exposed to the sun for 20 minutes and the temperature will be taken for 5 minutes.

At the end of the physical activity, slow movements will be made for 5 minutes during which the body temperature will be taken.

The region for taking the temperature will be the oral region.

2.5. Heart rate

The recording of the heart rate will be done at the level of the radial artery, for 60 seconds and will be taken at the same moment that the body temperature is being taken. These moments will correspond to the same moment in which the effort ends and three minutes after the end of the effort, these values will allow the organic adaptation index to be determined.

Formula to calculate the adaptation index, this is expressed in percent.

$$\textit{Organic Adaptaction index (IA)} = \frac{\textit{Pulse of the end of the effort}}{\textit{Pulse 3 minutes after finishing the effort}} \times 100\text{- }100$$

Statistical techniques and procedures for analysing the results. The data will be collected in Excel spreadsheets where they will be organized and prepared for statistical analysis.

We worked with the STATGRAPHICS PLUS 5.1 statistical package to determine the simple statistics:

- Average

• Fashion
• Median

And with these to be able to carry out the descriptive statistics of the sample that will be analysed.

Percentage and sample purification analysis were carried out using the Microsoft Excel package

3. Analysis and Interpretation of the Results

Figure 1. To classify children as obese, overweight or normal weight, the latest Cuban weight-for-height norms according to age and sex were used.

The study results in more than a third of children, 38% exactly, being overweight or obese.

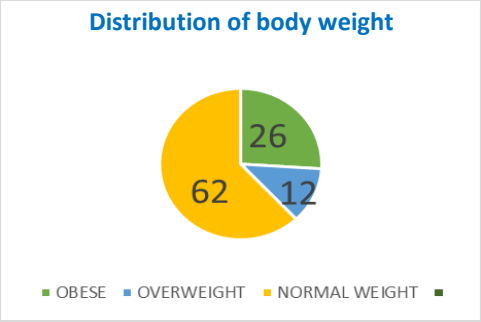

Fig.1. *Distribution of body weight in children in the second cycle of Cuba-Angola primary school*

Figure 2 shows the Values of the Arithmetic Means corresponding to the body temperature records in the shade in the area where the physical activity will take place, and it can be observed that the highest temperature value is recorded by obese children with 37.41 degrees Celsius.

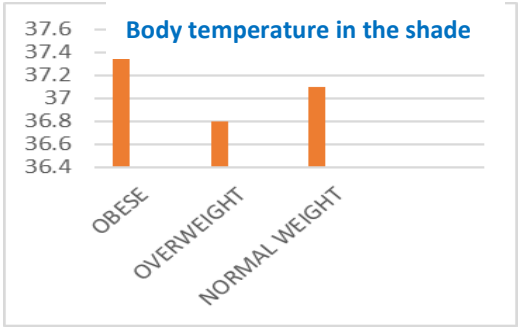

Fig. 2. *Values of the arithmetic means corresponding to the body temperature records in the shade in the area where the physical activity will take place*

Figure 3 shows the Values of the Arithmetic Means corresponding to the records of body temperature in the sun in the area where the physical activity will take place after exposing the children for 20 minutes. The highest records corresponded to overweight and normal weight children with 37.4 and 37.34 degrees Celsius respectively.

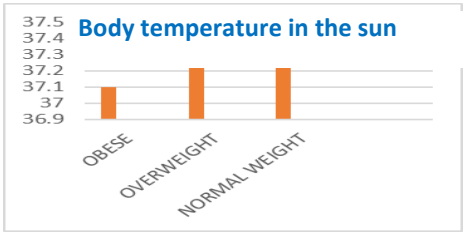

Fig. 3. *Values of the arithmetic means corresponding to the body temperature records in the sun in the area where the physical activity will take place*.

Figure 4. These records have a direct relationship with the thermoregulatory capacity in the face of physical activity, resulting in the lowest temperature records for the normal weight with 37.09 Degrees Celsius, which places them as those who thermoregulated most

efficiently, in the case of the overweight and obese they were the ones with the least efficient thermoregulation with final values of 37.29 and 37.3 degrees Celsius respectively.

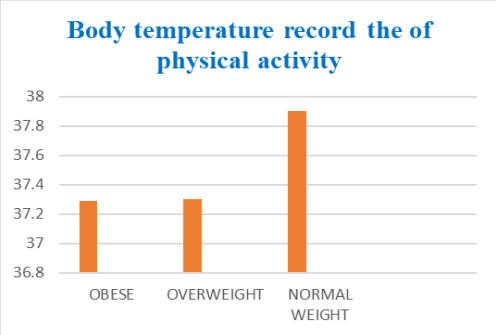

Fig. 4. *Values of the arithmetic means corresponding to the body temperature records at the end of physical activity*

Figure 5 shows the Values of the Arithmetic Means corresponding to the organic adaptation index at the end of physical activity. The lowest rate for recording the most unfavourable behaviour in cardiovascular adaptation was recorded by the obese with a value of 23.2%.

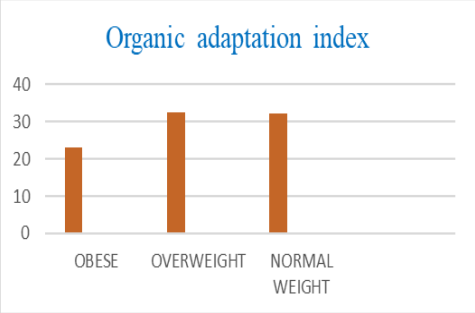

Fig. 5. *Values of the arithmetic means corresponding to the organic **adaptation** index at the end of physical activity*

Figure 6 shows the Values of the Arithmetic Means corresponding to oxygen consumption during physical activity. In the case of normal weight children, 36.48 milliliters/kilogram/minute were recorded, to double the value recorded for overweight children and triple the value corresponding to obese children. This shows that normal weight children triple the aerobic and respiratory metabolic capacity of obese children and double that of overweight children for similar physical activity.

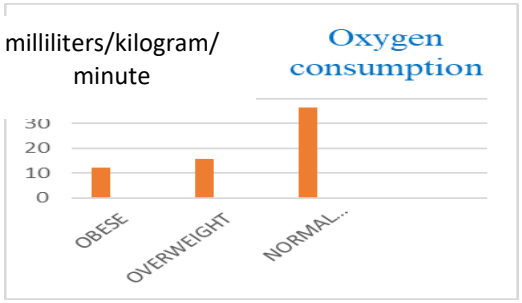

Fig. 6. *Values of the arithmetic means corresponding to oxygen consumption during physical activity.*

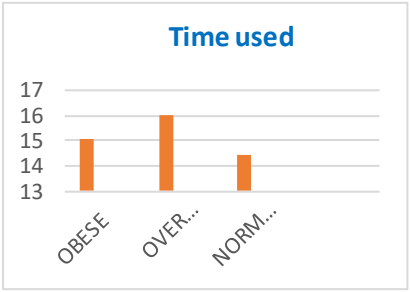

Fig. 7. *Values of the arithmetic means corresponding to the time used to travel the distance of the mile (1609 m)*

Figure 7 illustrates the mean values of the time taken to cover the distance of one mile (1609 m), highlighting differences between weight status categories. It is observed that subjects in the "Overweight" category had the highest average travel time, followed by

those in the "Obese" category, while those in the "Normal" category recorded the shortest time, suggesting a negative correlation between body mass level and performance in traveling over moderate distances.

4. Conclusions

The quasi-experiment demonstrated: that all temperature records average values of 37.24 degrees Celsius with a standard deviation of 0.13 with maximum and minimum values of 37.41 and 36.97 degrees Celsius respectively; The heart rate showed average values of 108 contractions per minute with a standard deviation of 25.28 and maximum and minimum values of 154 and 80 respectively. While the differences between the temperature values recorded at rest and the temperature taken at the end of physical activity turned out to be greater in the case of obese and overweight children, evidencing poor thermoregulatory functioning compared to normal weight children with the same physical activity.

Obese children registered an organic adaptation index of less than 30%, equivalent to 23.2%, which is classified as inadequate, which is not the case in normal weight and overweight children with 32.04% and 32.4% respectively. This shows unfavorable cardiovascular functioning in the case of obese children with the same physical activity.

The results of the **Rockport Test** for maximum oxygen consumption show values of 36.38 milliliters/kilogram/minute for normal weight children and 15.7 milliliters/kilogram/minute and 12.06 milliliters/kilogram/minute for overweight and obese children respectively, concluding that normal weight children double the oxygen consumption of overweight children and triple that of obese children, showing the children obese and overweight children have very poor respiratory metabolic functioning compared to normal weight children with the same physical activity.

5. Recommendations

Continue the study in the following years at the Cuba – Angola primary school and increase the sample to be treated in future quasi-experiments with children from other nearby schools.

Formulate an exercise proposal that considers the physiological limitations of these children to guarantee better incorporation and motivation of them with events where physical work is carried out, allowing them to be incorporated into continuous and linear weight loss.

References

1. Alfonso Guerra, J.P.: *Obesity Epidemic of the 21st Century*. Havana, Scientific and Technical Publishing House, 2008.
2. Aguilar Cordero, M. J., Ortegón Piñero A., Mur Villa, N., Sánchez García, J. García Verazaluce, J.J., García y Sánchez López, M.: *Physical activity programmes to reduce overweight and obesity in children and adolescents; a systematic review*. 2014 https://dx.doi.org/10.3305/nh.2014.30.4.7680
3. Boutari, C., Mantzoros, C.S.: A*n update on the epidemiology of obesity and a call to action: As its twin COVID-19 pandemic appears to be receding, the obesity and dysmetabolism pandemic continues to rage on*. In: Metabolism, Vol. 133, 2022, p.1-7;

http://doi:10.1016/j.metabol.2022.155217.

4. Gálvez Soler, J.L., Vázquez Sánchez, V.: *Cambios en el estado nutricional en escolares de La Habana con sobrepeso y obesos en dos años de seguimiento* (*Changes in nutritional status in overweight and obese schoolchildren in Havana over two years of follow-up)*. In: Nutr. clín. diet. hosp., Vol.39(4), 2019, p.162-167;
5. IPS Cuba. *Studies deepen warnings about obesity in Cuba*. 2024. https://www.ipscuba.net/salud-y-ciencia/estudios-profundizan-en-alertas-sobre-la-obesidad-en-cuba/
6. Jiménez, A.-S., Rodríguez, M.P., Machado, L.: *Practical Management of Overweight and Obesity in Children in Cuba.* In: Rev Cubana Med Gen Integr vol.34 no.2, 2018.
7. López-Alonzo, S.J., Gastelúm Cuadras, G., Islas Guerra, S., et al: *Relationship between physical activity and obesity in elementary school children in Mexico northern*. In: Rev Ib CC Act Fis Dep Vol. 10, no.1, 2021. p.15-25. DOI: 10.24310/riccafd.2021.v10i1.10650
8. Lim, C.Y.S., Foo, Y.W., Tok, C.L.X., Lim, Y.Y., Loke, K.Y., Lee, Y.S., Ng, N.B.H.: *Screening for metabolic complications of childhood and adolescent obesity: A scoping review of national and international guidelines.* In: Obes Rev 2022; 23(12):e13513. Available at: http://doi:10.1111/obr.13513.
9. Mancipe Navarrete, J.A., Villamil G.S. S., Bautista C.J.E., et al.: *Efectividad de las intervenciones educativas realizadas en América Latina para la prevención del sobrepeso y obesidad infantil en niños escolares de 6 a 17 años: una revisión sistemática* (*Effectiveness of educational interventions conducted in Latin America for the prevention of overweight and obesity in scholar children from 6-17 years old; a systematic review).* In: Nutr. Hosp., vol.31, no.1, 2015, p.102-114 https://dx.doi.org/10.3305/nh.2015.31.1.8146
10. Maset, J.: O*besidad y sobrepeso infantile.* 2023*.* https://cinfasalud.cinfa.com/p/obesidad-y-sobrepeso-infantil/
11. Moreno Aznar, L.A., Lorenzo Garrido, H.: *Childhood obesity.* In: Protoc diagn ter pediatra. 2023, 1, p. 535-542.
12. Moreno Aznar, L.A., Lorenzo Garrido, H.: *Growth, Exercise, Nutrition and Development*. Universidad de Zaragoza y Centro de Investigación Biomédica en red de Fisiopatología de la Obesidad y Nutrición (CIBERObn). Instituto de Salud Carlos III. Madrid Hospital Universitario Basurto. Universidad del País Vasco. Bilbao, 2023. https://www.aeped.es/sites/default/files/documentos/43_
13. Organisation for Economic Co-operation and Development: *The Heavy Burden of Obesity: The Economics of Prevention. OECD Health Policy Studies*. Paris: OECD Publishing, 2019. https://doi.org/10.1787/67450d67-en 3. NCD Risk Factor Collaborati
14. Pérez, F. J, Marcos, P. L.M., Bermúdez, A. K.: C*omportamiento de la obesidad en escolares atendidos en un área de salud de un municipio de la ciudad de La Habana*. Vol. 33, no 1, 2023, ISSN 1561-2929. RNPS 2221https://revalnutricion.sld.cu/index.php/rcan/article/view/1478

15. Romero, V.M., Gazquez, T.Y.A.: *Obesity and physiological behavior in second-year children at the Osvaldo Hernández Chávez Primary School during physical activity*. Final thesis, Havana, 2010.
16. Unifec: *Childhood Overweight: A Call for Prevention in Latin America and the Caribbean*, 2021. https://www.unicef.org/lac/media/29006/file/Sobrepeso-en-la-ninez-reporte-2021.
17. Velasco-Suárez, C.M., Rueda-Benavides, N.J., Hernández-Sarmiento, C.J., Gómez-Ayala, J.A.: *Obesity: Pathophysiology and Treatment. Literature Review*. In: MÉD. UIS. 2023; 36(3), p. 89-104. DOI: https://doi.org/10.18273/revmed.v36n3-2023008
18. Véliz, P., Tolentino, L., Barquera, S.: *Childhood Overweight: A Call for Prevention in Latin America and the Caribbean*. 2021, available at https://www.unicef.org/lac/media/29386/file/Overweight-report-2021.pdf
19. World Health Organization. (2024) Obesity and overweight. WHO, https://www.who.int/news-room/fact-sheets/detail/obesity andoverweight#:~:text=In%202022%2C%201%20in%208,million%20were%20living%20with%20obesity.
20. Zapata Galarza, M.V., Ramírez Ponc, D.Y.: *La promoción de la actividad física para disminuir el sobrepeso de los niños* (*Promoting physical activity to reduce overweight in children)*. In: Revista PODIUM, Vol.15(1), 2020, p.153-165.