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ASSESSMENT OF CARDIORESPIRATORY FITNESS OF PRESCHOOL CHILDREN BEFORE AND AFTER INTERVENTION WITH STRUCTURED PHYSICAL ACTIVITY

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Abstract: The development of cardiorespiratory fitness in preschool children is important in preventing obesity and the onset of chronic degenerative diseases in childhood and throughout life. Current studies emphasize the importance of regular practice of physical activity to improve cardiorespiratory fitness, however few studies have sought to observe changes in cardiorespiratory condition before and after intervention with physical activity in preschool children. The objective of this study was to evaluate the cardiorespiratory fitness of the participants after an intervention period with structured physical activity. Longitudinal observational study carried out at Centro Universitário de João Pessoa – Unipê, with children aged 4.3±1.2 years participating in an intervention with physical activity lasting 10 weeks, twice a week and 45 minutes/session. The children were evaluated for body composition (bioimpedance) and cardiorespiratory fitness test (ShuttleRun PREFECTIVE). The software used was SPSS 20.0. Data were compared inter-groups with Student's t tests and significance value of 0.05. There was no statistically significant difference in BMI, in Fat Mass (kg), in $Vo_{2máx}$ and in the speed of the children evaluated in this period, however, there was an improvement in the performance of the children in the test, where the results showed significant differences in the total number of laps ($p<0.019$) and stage reached ($p<0.033$).

Keywords: Cardiorespiratory fitness, preschoolers, obesity.

INTRODUCTION

It is known in the literature that the practice of physical exercise since childhood has positive effects on the current condition of the individual.[1]. Studies indicate positive changes, especially in insulin resistance, hyperglycemia and dyslipidemia, in addition to the great focus on morbidity and mortality

in the overweight and obese population[2]. Physical exercise practiced as a regular habit can become an effective way to reduce weight, thus bringing health benefits. In the case of functional capacity, regardless of age, physical exercise contributes to its improvement, development and recovery for practitioners who have limitations or difficulties to develop it.[3].

The importance of regular physical exercise at all stages of life has been very evident in recent years. In 2010, the World Health Organization (WHO) published guidelines on how structured physical activity guidance must be for each age group, from childhood to old age, aiming at benefits for the population[4]. There are recommendations for preschoolers to practice 60 minutes of daily structured physical activity and 60 minutes of daily unstructured physical activity[5]. Several factors are closely linked to physical exercise regardless of the practitioner's age, contributing to the quality of life, preventing chronic diseases and reducing the risk of fractures, in addition to developing and improving the performance of the cardiorespiratory and muscular systems, and consequently promoting the maintenance of the body weight[6].

Even with so many government social programs to encourage the practice of regular physical activity, in Brazil the rate of sedentary behavior is still quite high. Knowing this prevalence, he decided to carry out a study in Rio de Janeiro, going to households in the city, and he highlighted that, individuals aged 12 or more, 59.8% of men and 77.8% of women, stated that they do not practice physical activity in leisure[7]. Another study, which observed the practice of physical activity in preschool children, stated that these children are exposed to a low level of physical activity, affecting approximately two out of three children, and concluded by stating that one of the main factors that are associated with this is, the lack of physical space to participate in outdoor activities and games in the residential vicinity, which constitutes a risk factor for low levels of physical activity and structured activities[8].

The lack of habit of practicing regular physical activity is seen as a risk factor for cardiovascular diseases, being one of the responsible for the main causes of death, only due to the lack of capacity to maintain health[9]. Sedentary behavior contributes to increased risk of morbidity and mortality and the onset of chronic diseases[10]. Both physical inactivity and the high routine of sedentary behavior are closely linked to health damage.[11]. This behavior favors the appearance of cardiovascular diseases, diabetes, obesity, hypertension, osteoporosis, depression, anxiety and other psychosomatic diseases, thus contributing to an increase in cases of morbidity and mortality.

A reduced practice of physical exercise can influence the lower physical and motor performance, and contribute to the decrease in physical performance, producing frustration and withdrawal from physical education classes or leisure activities, in addition, obese children are more likely to become adults obese[2]. On the other hand, improvement in physical fitness performance becomes an important factor for health in childhood and youth, since well-structured levels of cardiorespiratory fitness, strength, muscular endurance, flexibility and adequate fat level become important for health. and to prevent chronic degenerative diseases[12].

Cardiorespiratory fitness is a physical capacity that indicates the degree of aerobic conditioning of the individual, since when starting the regular practice of physical exercise and showing improvements in this capacity, there is an improvement in performance in carrying out tasks that involve a certain degree of physical effort., as well

as metabolic improvements directly linked to functional components, which are body composition, blood pressure and heart rate, as well as this physical capacity contributes to the reduction of risk factors in the development of cardiovascular diseases[13].

The practice of physical exercise in childhood aims to prevent childhood obesity and provide a better performance in their motor, cognitive and socio-emotional development[3]. Knowing this, we have as a hypothesis the improvement of cardiorespiratory capacity of preschool children after a period of intervention with structured physical activities. Therefore, the objective of this study was to evaluate the impact a period of structured physical activities had directly on cardiorespiratory fitness and body composition after the end of this intervention.

METHODOLOGICAL PROCEDURES

This study was longitudinal and observational, with a non-probabilistic sample.[14]. The studied population consisted of preschool children aged between three and six years, who were evaluated before and after the intervention period with structured physical activity.

Data collection was carried out with children enrolled in the extension project of the Centro Universitário de João Pessoa – UNIPÊ, where structured physical activity sessions took place twice a week and lasted 45 minutes. The study included children aged between three and six years, who did not practice structured physical activity for at least three months before the data collection period, who were available to participate in data collection as well as in structured physical activity sessions. As criteria for discontinuity, the non-signing of the Free and Informed Consent Form (TCLE) by those responsible were considered, in addition to the child presenting some musculoskeletal limitation during the data collection and intervention period.

As part of the ethical procedures, this project was sent and approved to the Research Ethics Committee (CEP) of ''Centro Universitário João Pessoa" (UNIPÊ) under the number 84317517.9.0000.5176 and all those responsible for the research participants were instructed about the data collection procedures and soon after, they were invited to sign the Free and Informed Consent Form (TCLE).

STUDY DESIGN

When invited to participate in this research, parents and children were instructed about the data collection procedures and, with their acceptance of their child's participation in this study, they were invited to sign the TCLE. After the delivery of the TCLE duly signed, the next step was the collection of initial data prior to the intervention period, in which an adaptation of the ShuttleRun 20 meters15 test was applied to the children who were present in this period, which is an indirect test for the prediction of the estimate of the $VO_{2máx}$, through the newly developed equation to be used as an indicator of the level of aerobic capacity of preschool children[16]. Body composition data were also collected through the bioimpedance method.

After initial data collection, we started the intervention with structured physical activities, lasting 10 weeks, two days a week and duration/session of 45 minutes, with recreational activities with emphasis on locomotion, manipulation and stabilization. At the end of the mentioned period, the estimated data of the $Vo_{2máx}$ and body composition.

The intervention was carried out at the premises of the physical education course at the institution and higher education Centro

Universitário de João Pessoa (UNIPÊ), where children could experience and participate in recreational and pleasurable activities in the form of a circuit or collective, which stimulate locomotion, object manipulation and stabilization. The intervention took place on Tuesdays and Thursdays from 6 pm to 7 pm with 45-minute sessions of structured physical activities.

TESTS AND PROTOCOLS

BIOIMPEDANCE

Body composition was assessed using the INBODY 720 System from the Physical Assessment Laboratory UNIPÊ/SANNY located at ''Centro Universitário João Pessoa" (UNIPÊ), which uses bioimpedance technology. It is a technique that does not expose the patient to ionizing radiation.[17], bioimpedance offers a simple means of estimating lean mass tissue[18]. This method is considered the best for the assessment and body composition when also used in large populations. The bioimpedance evaluation method consists of using electrodes that trigger an electric current that is injected at a frequency of 50KHZ, where it is released at the extremities of the lower and upper limbs, and will circulate throughout the body, from the wrist to the ankle, with the purpose of estimating the total amount of water, bone mass, amount of fat mass and fat-free mass. So the impedance will be calculated by measuring the current and voltage following Ohm's Law (V=RxI)[18].

This instrument has high scientific accuracy that provides body composition assessment results with proven accuracy. He is a precious assistant in areas as diverse as sports, clinical or research, among others. Many of the most prestigious hospitals and sports clubs in the world use the INBODY720 as a working tool.

Figure 1. Sistema Inbody 720® - otobonni

This instrument can be used with individuals aged from 6 to 99 years and weight range from 10 to 250 kg[18]. Data are analyzed according to body mass, skeletal muscle mass; Fat free mass and Fat mass. Before the bioimpedance test, the individual underwent the following procedures: The test was performed 4 hours after the last meal; used the bathroom before the test to decrease the volumes of urine and feces; did not exercise before the test; remained standing for about 5 minutes before the test; used the sauna or shower before the test; individuals were barefoot and wearing as little clothing as possible.

TEST SHUTTLERUN 20 METERS ADAPTED

After observing the application of the original protocol in 4-year-old children, they observed that most children were unable to complete more than one turn, and based on this experience, an adaptation of the original test created by Dr. Léger at the University of Montreal[15]. The adaptation of the protocol was based on the PREFECTIVE 20-meter round-trip test (Assessment of aptitude in preschool children). In this adapted version, the speed of the first lap is 6.5 km/h and is increased by 0.5 km/h every minute[15.]

The ShuttleRun 20 meter round trip PREFECTIVE is a test that requires an open space of 20 meters, free of obstacles that could make the procedure difficult, so that children can run from one side to the other for the distance requested by the test. In the application of this test, we used an amplified sound box, for the sound execution of the

orientation beeps at the time of the test, in addition to a stopwatch to count the time of each child's test.

During the test, the individual covered distances of 20 meters back and forth, thus forcing him to slow down and change direction, returning to the previous point and accelerating once more, going from stage to stage until he reached fatigue and could no longer continue. A file with the sound signal already recorded was used for speed control. The test result was calculated by Microsoft Excel using the equation for estimating the maximum oxygen consumption ($Vo_{2máx}$), where he used an equation that needs the maximum speed and age from the mean value 48.38 ml kg – 1 min – 1. Where, the resulting equation to estimate:Vo_{2max} (Y, ml kg – 1 min – 1) through maximum speed:20mSRT-PREFITIVO (X_1, km h^{-1}) and age (X_2), $Y = 44.657 + 1.795X_1 - 2.601X_2 + 0.0852X_1X_2$, which was recently derived by collaborators in a study that sought to examine the comparability of discriminatory power in preschoolers in performing the ShuttleRun 20m original and ShuttleRun 20m PREFECTIVE tests, in children aged five and six years[16].

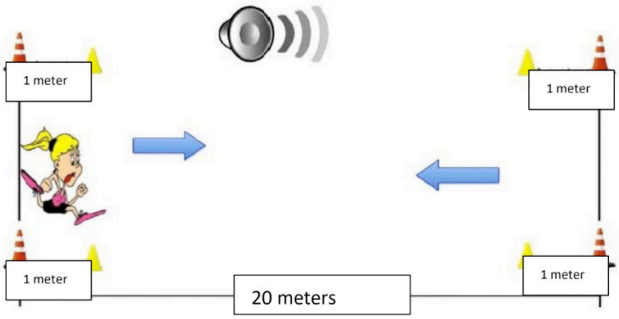

Figure 2. Illustrative demonstration of the correct way for the ShuttleRun 20m PREFECTIVE test to be applied in practice.

STATISTICAL TREATMENT

After collecting data, they were tabulated and evaluated for their normality and homogeneity with the respective tests, Shapiro Wilk and Levene. Then, the data considered normal, the mean and the standard deviation of the mean were adopted during the descriptive analysis of the data.

For the intergroup comparison process, Student's T Test was adopted for dependent samples. The software used was SPSS version 20.0 and the significance level adopted was 95% ($p<0.05$).

RESULTS

The descriptive characteristics of age, body mass index (BMI), body composition and fat mass are presented in table 1, reporting that there was no statistical difference between the data. According to these data found and when compared to other findings in the literature, these children were classified as eutrophic[19].

Variables \ moments	PRE (N=9)	POST (N=9)
Age years)	4,3 ± 1,2	4,4 ± 1,1
Body mass index (kg/m²)	16,0 ± 1,2	16,3 ± 1,6
Fat mass (kg)	4,5 ± 1,8	3,7 ± 2,1

Kg – kilograms; m^2 – square meter; N – sample.

Table 1. Descriptive characteristics of the sample before and after the intervention period. Data shown as mean ± standard deviation.

In addition, data resulting from the physical test to assess cardiorespiratory fitness are shown in figures 3 and 4. Figure 3 shows data on maximum oxygen consumption ($Vo_{2máx}$) of children who were studied before and after the intervention period to assess what impact there was on the cardiorespiratory fitness of these children.

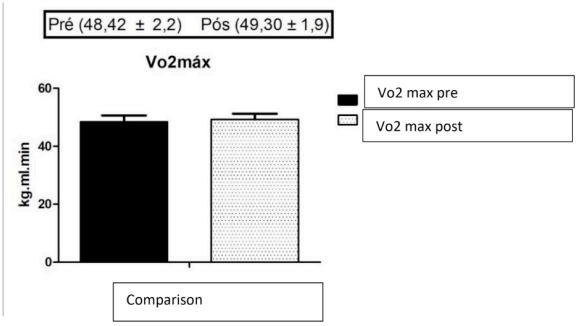

Figure 3. Comparison of maximum oxygen consumption ($Vo_{2máx}$) during the performance of the ShuttleRun 20m PREFECTIVE test, in which they are distributed in samples before the intervention period (Pre) and after the intervention period (Post).

Observing the values of maximum oxygen consumption ($Vo_{2máx}$) during the test, it is possible to verify that there was an increase of this variable in the final data compared to the initial data, which can be characterized as a positive difference, however, there was no significant difference between the two samples. The increase in $Vo_{2máx}$ can be expressed by the improvement in the cardiorespiratory fitness of preschoolers where they were able to perform more laps and increase the speed in the execution of the test, which was calculated from the equation: $Y = 44.657 + 1.795X_1 - 2.601X_2 + 0.0852X_1X_2$.

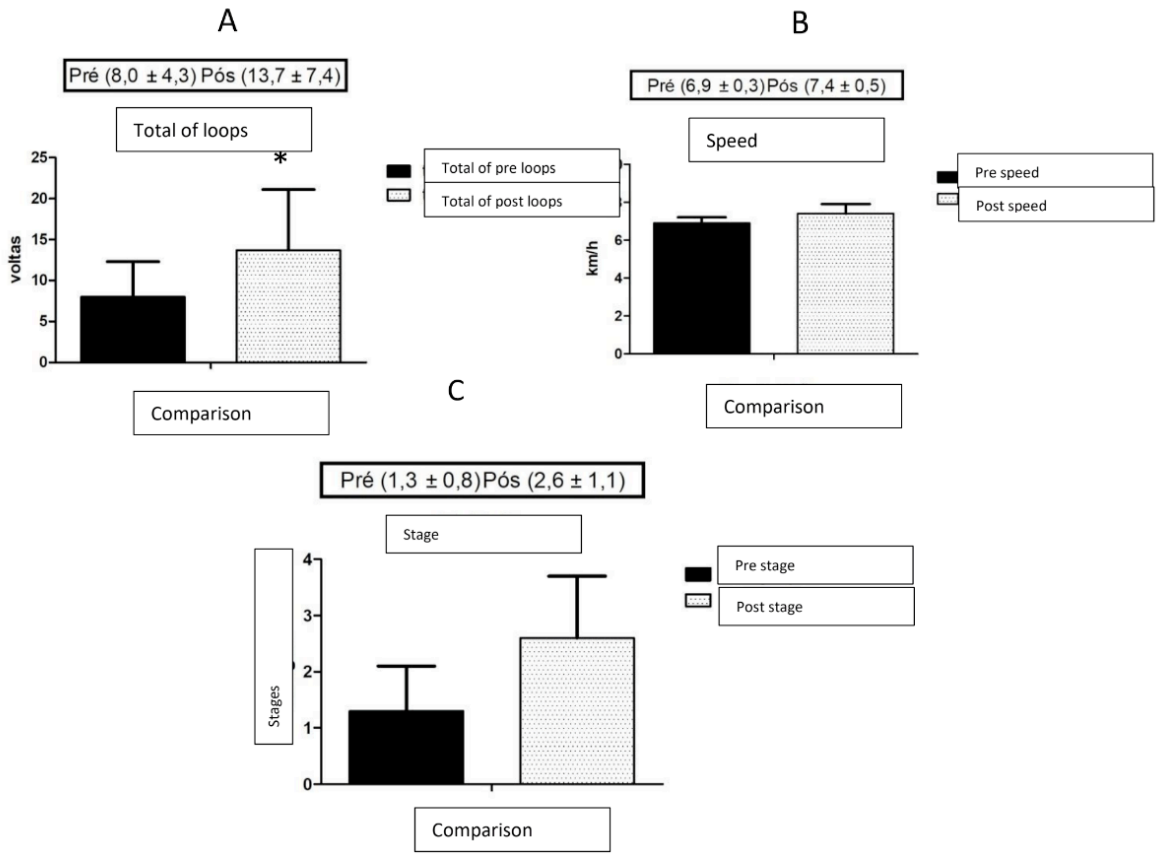

Figure 4. Data on the number of laps, speed and stage of the Shuttle Run 20m PREFECTIVE Test are presented.

Figure 4 is composed of the results referring to the variables related to the physical test, which include the analyzes of the number of laps performed, maximum speed reached in the test and stage reached by the children. In figure 4A, it is possible to observe the comparison of the number of turns of both collections, where it was observed that there was a significant improvement in the increase in the number of final turns when compared to the initial one.

Figure 4B is composed of results equivalent to the maximum speed reached by the children at the end of the physical effort, where the speed was measured in km/h and after analyzing these results, it implies that there was an increase in the ability to perform the test at a speed greater than the of the previous test, even though there was not much statistical difference.

In figure 4C we have the stages referring to the test applied, which varies depending on the maximum number of turns achieved by each participant. After studying the results of this variable, it is possible to state that there was a positive difference between the tests performed, ensuring that the children managed to obtain a better performance in the retest, causing them to reach a higher stage. Preschoolers were able to complete the laps within the limit of each one's performance, and at the end of the analyzes a minimum of one lap and a maximum of 24 laps were computed in both evaluations, obtaining an average of (8.0 ±4.3) laps and in the final evaluation an average of (13.7±7.4) laps, demonstrating a significant improvement in the number of laps performed before and after the intervention (p=0.019).

DISCUSSION

The results of the study showed a positive impact on preschoolers who participated in the entire intervention, where improvements were found in cardiorespiratory fitness during the test after this period. Based on these findings, it is possible to state that ludic and pleasurable physical activity, in order to contribute to the improvement of motor skills at this age, also contributes to the improvement of cardiorespiratory condition, thus favoring the fight against childhood obesity and the prevention of chronic diseases. degenerative[12].

Knowing that the literature is poor in studies with the follow-up of children in this age group, the study had the high importance of being a longitudinal study, since studies with a longitudinal design are, in this case, useful for understanding the risks and protection, resources and difficulties in the development20 of these children in this period of observation on the structured activities, with an incentive to the regular practice of physical activity and being able to observe the performance between the pre and post-intervention analyses.

A study that used the same test in preschool children considered the ShuttleRun 20m PREFECTIVE test as an important indicator of maximum aerobic capacity16 for this age group. Based on this information, the test was used to estimate the Vo2max of the participants, where the results are presented in tables and divided into pre and post-intervention periods, without division by gender, age or body mass and with good assimilation of children at the time of explaining the test, with the right to rehearse and a duration of 3 to 5 minutes for its presentation. The ideal is to apply it with a maximum of 4 or 5 children at the same time, as they are very motivated to participate, and end up making the test something fun.

A total of nine children were evaluated from those who presented themselves in the two collections, with an average age of 4.3±1.2 in the initial collection, and in the final one of 4.4±1.1 of both genders, containing 4

boys and 5 girls, and height and body weight were measured to verify the impact of the intervention on the Body Mass Index (BMI), where we initially characterized an average of16±1,2 kg\m^2 and after the end of the intervention in the final sample obtaining the mean value of 16,3±1,6 kg\m^2 concluding that the intervention time with structured physical activities did not show significant differences as an important aid in reducing BMI in preschool children. This fact mitigates the need for further studies, with a larger number of children, and greater attention to observing the nutritional condition of these children during the intervention period, but, always taking into account that this age group undergoes a process of body development, and in the expectation of having more impactful results.

For the analysis of $Vo_{2máx}$, the equation formula was used: $Y = 44{,}657 + 1{,}795X_1 - 2{,}601X_2 + 0{,}0852X_1X_2$ ($r = 0{,}77$; $r^2 = 0{,}59$; SEE = 1,25 ml kg^{-1} min^{-1} or 2.59% of the estimated average of the VO2max = 48,38 ml kg^{-1} min^{-1}), where X_1 is the maximum speed of 20mSRT-PREFIT (km h – 1) e X_2 is the age of the participants [16]. After the children were submitted to the test, all the data were collected to make the estimate and a solid value of the mean of this variable was arrived at, to obtain the initial mean of the test. $Vo_{2máx}$ of preschool children, having in the initial evaluation 48.42±2.2 ml.kg.min and in the final 49.30±1.9 ml.kg.min, where it was possible to observe a positive change between the moments of collection of data, but there was no significant difference, leaving here the suggestion to carry out new studies with more time in the duration of the intervention, in order to generate significant results.

$Vo_{2máx}$ is a variable that discusses the maximum oxygen consumption during exertion, being an important marker of cardiorespiratory fitness[16]. And according to the duration of the test, there are studies that approach different values in their conclusion, where the original protocol of the shuttleRun 20m ORIGINAL was performed [21, 22]. For the estimation of $Vo_{2máx}$ through an indirect test protocol it is important to point out that it normally takes about 2 minutes to reach the plateau of the $Vo_{2máx}$ in children in this age group [23], leading to believe that those who performed the test with a time below 2 minutes were unable to obtain accuracy in the result of the $Vo_{2máx}$, because they stop $Vo_{2máx}$ in the ascending phase[16, 23].

So, when the test is performed in a time below that previously informed time, it can be considered as an anaerobic marker, knowing that the objective is to seek the maximum of the aerobic capacity, which in a study carried out with the ShuttleRun 20m PREFECTIVE test protocol obtained average duration of 5-6 minutes[16]. After presenting the data of this present study, one can take into account everything that was informed to imply in studies that can be carried out using more variables to obtain more accurate results, since many studies are carried out with adults and few with pre-school children. schoolchildren, and we suggest that new studies be carried out with these variables, investigating the duration of the child during the test and with the longest intervention.

In order to evaluate the children's performance in the test performed, the total number of laps, speed and stage reached during the test were also observed, variables that represent markers for the individual's performance in carrying out the physical effort. Initially, the children obtained an average of 8.0±4.3 in the number of laps performed, and in the final collection of 13.7±7.4, already at the speed evaluated in (km\h) we concluded the initial test with 6, 9±7.3 km/h and final of 7.4±0.5 and in relation to the maximum stage reached by the participants, we computed

the initial value with 1.3±0.8 and ending the intervention with 2.6±1, 1 expressing through these data that there was an improvement in the cardiorespiratory fitness of these preschoolers.

This study had the positive point of highlighting that it had a longitudinal characteristic with a period of three months of intervention with physical activity attributed to the development of children in this age group, with the encouragement of the practice of physical activity that led the children to adopt a weekly routine active during this time period. Very few studies assess physical fitness and cardiorespiratory fitness in preschoolers[15,16,21,22].

Finally, this study had some limitations, such as the sample size, which was relatively small, since, when the sample is larger, it is possible to obtain more robust results; The duration of the intervention, based on the premise that by intervening in the routine of children with physical activity for a longer period, the results could prove to be more significant; The lack of a control group, having in the present research only an experimental group to guarantee that the changes found in the cardiorespiratory condition would come from the intervention applied in the sample. Therefore, it is interesting to provoke other researchers with these suggestions to establish studies with more concrete results when talking about cardiorespiratory fitness in preschoolers.

CONCLUSION

Based on the results found in this study, it can be observed that an intervention with physical activity for children of preschool age promotes changes in the cardiorespiratory condition after 10 weeks.

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