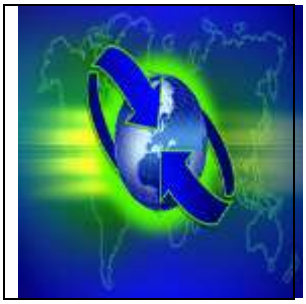

Effects of Physical Exercise on Metabolic Health of Children and Adolescents in Calabar Metropolis, Cross River State, Nigeria

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Abstract

The purpose of the study is to investigate the effects of physical exercise on children and adolescent metabolic health in Calabar Metropolis, Cross River State, Nigeria. The objectives were to compare the results of the children's and adolescents' Body Mass Index (BMI) and metabolic health implications at pre-training programme and at post-training programme. The BMI served as a measure of the metabolic health status. To achieve this, the body measure of pupils and students from four primary schools and secondary schools were taken from ages between 11-16 years. The schools were randomly selected using simple random sampling techniques, where, where 400 samples was selected for the study comprising, 200 children from primary schools and 200 adolescent from secondary schools between the ages of 11-13 and between 14-16 years of age. There were ten primary schools selected and 10secondary schools selected within the Calabar metropolis (Simple Random sampling technique). A stadiometer was used for measuring the standing height (stature); and a standardized weighing scale for body weight, recorded in the metric system. The subjects were first measured and weighed and those who scored at or above BMI 85th percentile were identified as being either overweight or obese, and taken to participate specially in the 6-week training programme. After the 6-week training programme of aerobics, they were again measured and weighed. The Training programme consisted of physical exercises of aerobic nature to reduce body weight and eventually BMI. The Descriptive (Frequency and Percentage) Statistical analysis was used to investigate the differences before and after the 6-week training. The results showed children (11-13yrs) had 22 identified overweight /obese subjects at pre-training programme. The adolescents (14-16yrs) had 15 identified overweight /obese subjects at pre-training programme. The children (11-13yrs) had 11 identified overweight /obese subjects out of 22 subjects at post-training programme. The adolescents (14-16 yrs) had 11 identified overweight /obese subjects out of 15 subjects at post-training programme. The study concluded that regular physical exercises properly organized to affect the muscular body would improve metabolic health of children and adolescents in terms of their BMI. The fact that some of the children and adolescents were able to bring down their body weights proves that metabolic health can become better with correct regular organized physical activities. That means the type of exercises; the intensity and duration are to be considered in maintaining good metabolic health. The study recommended among others that the school sports programme be seriously re-organized to provide opportunities to all students to avail themselves of better metabolic health. Keep fit programme of the schools should be enacted for the pupils; and children and adolescents should be enlightened of the need to take to recreation to reduce academic stress.

Keywords: Body Mass index (BMI), metabolic health; metabolic syndrome; obesity; physical exercises.

Introduction

Generally, the metabolic health of athletes are measured using health indicators like blood sugar, triglycerides, cholesterol, waist circumference, blood pressure; improving any one of these indicators may improve metabolic health and help to prevent future diseases (Hashida, Kawaguchi, Bekki, 2017). Poor metabolic condition re commonly called metabolic syndrome and there are cluster of conditions that occur together, increasing the risk of heart disease, stroke, and type 2 diabetes. These conditions include increased blood pressure, high blood sugar, excess body fat around the waist, overweight, obesity and abnormal cholesterol or triglyceride levels. For children and adolescents, it becomes a health risk in future as they grow into adulthood.

Regular physical exercises can reduce the risks for developing overweight and obesity (Katzmarzyk, 2021) and other metabolic health complications and diseases associated with obesity, including non-alcoholic fatty liver disease (NAFLD) and type 2 diabetes. Physical exercise has great effects on metabolism, not only because of its well-known effects on skeletal muscle metabolism, but also as a result of the metabolic adaptations it confers on multiple other tissues. Physical exercise is a powerful tool for the prevention of metabolic disease as it exerts its protective effects by improving the metabolism of non-skeletal-muscle tissues, including the liver, vasculature, adipose tissue and pancreas (Hodson & Karpe, 2019). Multi-tissue adaptations can occur not only through physical exercise activating intrinsic signaling events in each tissue but also through the unique, exercise-induced integration of inter-tissue communication by a variety of signaling molecules, hormones, cytokines, changes in substrate flux and blood flow.

A certain minimum volume of exercise or physical activity is required for normal metabolic function in children, adolescents and adults. The author has long observed that unfortunately the school sports programme does not offer enough physical activity to the children and adolescents. They are therefore exposed to sedentary behaviour.

The Body Mass Index (BMI) - for- age remains a handy measurement tool to investigate the extent of underweight, normal weight and obesity in children and adolescents. The BMI-for-age is recommended as the measure that can be used continuously for children and teenagers aged 2 to 20 years to screen for obesity, overweight, healthy weight, or underweight. The BMI – for age is arranged as follows ((National Centre for Chronic Health Statistics and Health Promotion, 2000; as in Appendix II). See table 1

Table 1: Children and adolescent body mass index classification

S/N	BMI percentile range	Health Implications
1	Less than 5^{th} percentile	Underweight
2	5^{th} to 8^{th} percentile	Healthy weight
3	85^{th} to 94^{th} percentile	Over weight
4	At or above 95^{th} percentile	Obese

Ignity, (2019). Studies have shown that children with body mass index within the overweight and obese level suffer from heart attack or complications in the future, when people participate in regular exercises, it improves their health, increase the normal functioning of the vital organs like the heart, the brain, the skeleton among others for the proper functioning of the entire human system (Stanford & Goodyear, 2016; Pedersen & Febbraio, 2022).

Children and adolescents who consistently enjoy sedentary lifestyle are prone to having poor metabolic health (Thyfault & Rector, 2020). Insulin resistance which is the inability of insulin to effectively stimulate glucose uptake into metabolic tissues (skeletal muscle, adipose and liver), thereby stirring up hepatic glucose production; and reducing the adipose lipolysis (digestion of fats), becomes a primary event underlying type 2 diabetes. When this starts off in the younger ages, insulin resistance will not only contribute to hyperglycaemia in type 2 diabetes but also putatively plays a role in the inappropriate excess storage of fat (ectopic) in the liver called hepatic steatosis (Pedersen & Febbraio, 2022). In turn, a higher level of ectopic storage of

lipids in muscle and the liver is also associated with insulin resistance. This effect is witnessed in people who transit from highly active to very inactive lifestyles for 1–2 weeks, and display elevated insulin responses paired with rapid gains in adiposity (Stanford & Goodyear, 2016).

Children and adolescents' overweight and obesity has been of great public health concern (Egan & Zierath, 2021) and physical exercise has consistently been advised to be a preventive measure of metabolic health problems which treatment should begin early in life with participation in physical exercises. Children and adolescents of recent years are getting engrossed in too much indoor passive recreational activities and the effect is over-feeding and adiposity of the body (Stanford & Goodyear, 2016). Type 2 diabetes, overweight and obese statuses are among the metabolic health syndromes of sedentary children and adolescents, and can be prevented with regular physical exercises. The BMI –for-age will rise accordingly as adiposity increases. It is on this background that the researcher undertook to investigate the effects of physical exercise on the metabolic health of children and adolescents in selected schools in Calabar Metropolis.

Purpose and Objectives of the Study

The purpose of the study is to investigate the effects of physical exercise on the metabolic health of children and adolescents after 6 weeks physical training. The objectives are to:

i. Find out the extent of children's Body Mass Index (11-13 years old) and metabolic health implications at pre-training programme.
ii. Find out the extent of adolescents' Body Mass Index (14-16 years old) and metabolic health implications at pre-training programme.
iii. Find out the extent of children's Body Mass Index (11-13 years old) and metabolic health implications at post-training programme.
iv. Find out the extent of adolescents' Body Mass Index (14-16 years old) and metabolic health implications at post-training programme.

Research designs and Methods

The body measurements' design was used for the study. The design was useful as it helped the researcher to collect the data of the study from the independent variables that needed to be measured of their heights and body weights. The area of study is Calabar Metropolis, where the children and adolescents were found in the 4 Primary and 4 Secondary schools as the subjects.

The target ages of subjects of the study were children and adolescent between the ages of 11-13 and 14 to 16 years commonly found respectively in primary and secondary school levels in Calabar Metropolis.A total sample size of 400 subjects were selected by random sampling technique; consisting of 200 children (11- 13 years of age) from primary schools and 200 adolescents (14 – 16 years of age) from secondary schools.

Instrument(s) for Data Collection: the instruments used were:

i. A stadiometer for measuring the standing height (stature).

ii. A standardized weighing scale for the body weights.

iii. Collection of Age (11-13 and 14 -16 years of age). (The Data Collection Form is in Appendix II).

Validity of the Instrument: **t**he study instruments are all valid for what they are used for, having been used consistently by other experts as a standardized instrument.

Method of Data Collection: each subject's standing height and body weight were measured in the metric system, using standardized techniques. A stadiometer (measuring tape) capable of measuring to accuracy of 0.1 cm. was used to assess the heights of the subjects. The subject were made to stand without footwear with the feet parallel and with heels, buttocks, shoulders and occiput touching the measuring tape, hands hanging by the sides. The head was held comfortably upright with the top of the head making firm contact with the horizontal head piece. A portable weighing balance (scale) with accuracy of 100 grams was used to record the weight of the subjects.

The children and adolescents were instructed to stand on the balance with light clothing and without footwear and with feet apart and looking straight. Body weight was recorded to the nearest 0.5kg value. The data were then calculated into the BMI Collection Form**.** The subjects were measured and weighed before they participated in training programme that lasted for 6 weeks; 3 times in a week between 3 to 6 pm after school hours (Mondays, Wednesday and Saturdays). Those who scored after the measurements at BMI 85th percentile; being identified to be either overweight or obese were then selected to participate specially in the training programme. After the 6-week training programme those identified subjects who were overweight and obese subjects were again measured and weighed. The two pre-training and post-training data of the selected subjects were then collected for statistical analysis.

Training programme: The physical exercises used were:

i. Skipping for time (5 minutes x 5 times) with 2 minutes rest
ii. Bicycle ergometre sub-maximal riding for 15 minutes x 5 times with 5 minutes rest.
iii. Aerobic dancing for 35 minutes x 5 times (by series of fast tempo dances choreographed by all subjects) with 10 minutes rest.

Method of Data Analysis: the data generated from the study were processed and analyzed accordingly. The Descriptive (Frequency and Percentage) Statistical analysis was used to answer the research questions.

Results and Discussion of Findings

Result: In Table 1, out of the 200 children (11-13 years), 8 (4%) were underweight; 170 (85%) were of normal weight; 16 (8%) were overweight and 6(3%) were obese. Therefore 22(11%) subjects among the children (11-13 years) were identified to be overweight or obese.

Table 1**:** Descriptive statistical analysis of the extent of children's (11-13 years) BMI and metabolic health implications at pre-training programme. N = 200

Variable (BMI)	Underweight	Normal weight	Overweight	Obese
Nos.	8 (4%)	170 (85%)	16 (8%)	6 (3%)

Table 2: Descriptive statistical analysis of the extent of adolescents' (14-16 years) BMI and metabolic health implications at pre-training programme. N = 200

Variable (BMI)	Underweight	Normal weight	Overweight	Obese
Nos	12 (6%)	173 (85%)	10 (5%)	5 (2.5%)

Result: In Table 2, out of the 200 adolescents (14-16 years), 12(6%) were underweight; 173 (86.5%) were of normal weight; 10 (5%) were overweight and 5(2.5%) were obese. Therefore 15(7.5%) subjects among the adolescents (14-16 years) were identified to be overweight or obese.

Table 3: Descriptive statistical analysis of the extent of children's (11-13 years) BMI and metabolic health implications at post-training programme. N = 200

Variable (BMI)	Underweight	Normal weight	Overweight	Obese
Nos	-	-	9 (4.5%)	2 (1%)

Result: In Table 3, out of the 22 identified overweight /obese children (11-13yrs), 15 were affected by the training programme. The overweight has 9 (4.5%) and the obese has 2(1%) subjects; showing that 11 (5.5%) subjects were able to reduce their BMI status; while 11 (5.5%) were still overweight

and obese.

Table 4**:** Descriptive statistical analysis of the extent of adolescents' (14-16 years) BMI and metabolic health implications at post-training programme. N = 200

Variable (BMI)	Underweight	Normal weight	Overweight	Obese
Nos	-	-	8 (4%)	3 (1.5%)

Result: In Table 4, out of the 15 (7.5%) identified overweight /obese adolescents (14-16yrs), 4(2%) were affected by the training programme. The overweight has 8 (4%) and the obese has 3(1.5%) subjects; showing that 4(2%) subjects were able to reduce their BMI status.

Discussion of the Findings

The children of (11-13yrs) had 8 underweight children and 22 identified overweight /obese subjects at pre-training programme. This is obvious because no children' group can ever be with the same metabolic health profiles. Definitely, some children have to be under-weight due to poor feeding and malnutrition as noted by Deem and Gilroy (2019). In a developing country like Nigeria, socio-economic statuses differed. Many children are not well-fed especially from the poor families. This is in line with studies of (Penedo and Dahn, 2022); and Sampson, 2020), who found that family status counts a lot in providing good foods to children. Similarly, the adolescents (14-16yrs) also had underweight subjects suffering from same reasons. The 22 identified overweight /obese subjects of the children were either products of overfeeding and sedentary lifestyle or hormonal problems of possible impending diabetes. The children are not having enough physical training in schools. The adolescents (14-16yrs) had 15 identified overweight /obese subjects at pre-training programme. The same reasons can be attributed to the adolescents who were overweight or obese.

The finding of the study is that regular physical exercises do improve metabolic health of the children and adolescents (Frankish, *et al.*, 2018; Hills, *et al.*, 2019). Exercises that improve aerobic fitness surely improve the endurance fitness components of the body. Children and adolescents are to be made to participate in sports and recreational activities to stay healthy and strong. Regular aerobic exercises help to reduce body weight as they gain muscular endurance (Ignity, 2019).

The fact that some of the children and adolescents were able to bring down their body weights proves that metabolic health can become better with correct regular organized physical

activities. That means the type of exercises, the volume (load), intensity and duration of exercise are to be considered in maintaining good metabolic health (Donnelly *et al*. 2019). The BMI was particularly chosen as they are not yet adults and was possible to improve their health quickly through physical activities.

Summary of Findings

1. The children (11-13yrs) had 22 identified overweight /obese subjects at pre-training programme.
2. The adolescents (14-16yrs) had 15 identified overweight /obese subjects at pre-training programme.
3. The children (11-13yrs) had 11 identified overweight /obese subjects out of 22 subjects at post-training programme indicating a process of weight reduction.
4. The adolescents (14-16 yrs) had 11 identified overweight /obese subjects out of 15 subjects at post-training programme indicating a process of weight reduction.

Conclusions

The study provided the conclusion that the correct regular physical exercises properly organized to affect the muscular body especially endurance-exercises improved the metabolic health of children and adolescents especially in the study area. The practical implication is that children and adolescent that participated in the pre-training and training programme gained some weight loss, while some could not get weight loss, meaning that regular physical exercise assist in the improvement of the metabolic health of children and adolescent in both primary and secondary schools in Calabar metropolis of Cross River State, Nigeria

Recommendations

1. The study hereby recommended that the school sports programme be seriously re-organized to provide opportunities to all students to avail themselves of better metabolic health through sports and games programme.

2. Keep fit programme of the schools should be enacted for the pupils. Children and adolescents should be enlightened of the need to take to recreation after enough academic stress.

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