

Influence of cardiorespiratory fitness on blood pressure among teenagers in Kano: North Western Nigeria

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Abstract

This study investigated the influence of cardio respiratory fitness (CRF) on blood pressure (BP) among teenagers in Kano state. The research design used for the study was a cross-sectional design. Random sampling was used to recruit a total of five hundred and twenty (520) teenage students of ages 13 – 19 years from twelve (12) public secondary schools in Kano state. Weight, height, and BP of all the subjects were measured using weighing scale, calibrated wall meter, and mercury sphygmomanometer respectively. CRF was determined using PACER tape, and the scores were converted to peak VO₂ score using regression equation by Leger et al. On the basis of each subject peak VO₂ value, subjects were divided into two (2) groups: those with peak VO₂ value of greater than or equals to 39.4ml/kg/min were considered as fit group, and those with less than 39.4ml/kg/min were considered as unfit group. Data collected were summarized using descriptive statistics and was analyzed using inferential statistics of independent t-test, and Pearson product moment correlation at an alpha level of 0.05 with statistical package for social science (SPSS) version 15.

The findings of the study shows a significant influence of CRF on systolic BP (SBP) ($t=7.783$, $df=518$, $p<0.05$), and on diastolic BP (DBP) ($t=16.679$, $df=518$, $p<0.05$). A significant relationship between CRF and SBP ($r= -0.317$, $P<0.05$) as well as between CRF and DBP ($r=0.583$, $P<0.05$) was found. Based on the study findings, it is therefore recommended that CRF should be considered while assessing teenage patients.

Key words: Cardiorespiratory Fitness, Blood Pressure, Teenagers

Introduction

Blood pressure (BP) is also referred to as arterial blood pressure, is the pressure exerted by circulating blood upon the walls of blood vessels [1]. High blood pressure (HBP) also known as hypertension, is a sustained systolic blood pressure (SBP) of greater than or equals to 140mmHg or sustained diastolic blood pressure (DBP) of greater than or equals to 90mmHg [2]. Worldwide, HBP or hypertension is now regarded as a “silent killer” (because it usually causes no symptoms until it

reaches life-threatening stage) [3], and is the leading risk factor for stroke, cardiovascular diseases, renal disease, and death [4]. Hypertension is considered as a major public health problem [3] which complicates other diseases as well as increases surgical risk and disturbs growing adolescent [5]. It has been reported that hypertension has changed from a minor cause of mortality and disability to a major cause of diseases worldwide [6]. Risk factors for HBP or hypertension include alcohol drinking, obesity, and sedentary life style [7].

HBP is measured as SBP (numerator) and DBP (denominator). If SBP or DBP measurement is higher than the accepted values for the age of the individual its considered as pre-hypertension or hypertension [8]. It has been explained that, it is easier to diagnosed HBP in children can be diagnosed by considering their age, gender, and height percentile [9]. As in a study by Balogun, Obajuluwa, Olaogun, and Aberejo on children between the age of 8 and 20, they found the 95th percentile BP of the children to be 133/92mmHg, and they postulated that Nigerian children with sustained BP greater than or equals to 133/92mmHg should be considered hypertensive [10]. There is an increase in the prevalence of hypertension in developed countries than in developing countries [4]. In Nigeria, high prevalence of hypertension was reported in Ibadan, Lagos, Enugu, and Kano [11] [12], and highest rate of hypertension and high level of plasma cholesterol in teenagers was found to be more in Kano [12]. A study on teenagers in Kano, Nigeria by Mijinyawa et al (2008) showed hypertension prevalence to be 72% [13].

Cardio respiratory fitness (CRF) is the ability to perform dynamic moderate to high intensity exercise that involves large muscles groups for prolonged periods of time [14]. CRF is an independent predictor of hypertension, and maximal oxygen consumption (or VO_{2max}) is an important measure of CRF [15]. Measuring VO_{2max} involves physical effort (like graded exercise) in which intensity is progressively increased while measuring ventilation, oxygen, and carbon dioxide concentration of inhaled and exhaled air, until when the oxygen consumption remains at steady state despite an increase in the workload [14]. It was documented that regular physical activity leads to CRF, and is an effective way in reducing the relative risk of developing hypertension by 19% to 30% [16], whereas low CRF in middle age is associated with a 50% greater risk of developing hypertension

in both male and female [15]. Furthermore, Blair et al (1984) stated that person risk of developing hypertension is associated with his or her fitness level, with less active or unfit persons having 30-50% greater risk of developing hypertension [17]. Another study in Nigeria where BP of children living in urban areas was compared with those in rural areas, and found that both the SBP and DBP of the children living in urban areas were consistently higher than those living in rural areas, and the differences in the BP between the two groups was attributed to be due to environmental factors and fitness level [18].

Materials and method

Participants

All male and female teenage students of ages 13 to 19 years, in day public secondary schools in Kano state participated in the study.

Research Design

Cross-sectional research design was used in the study

Inclusion and Exclusion Criteria

Only male and female students of ages between 13 to 19 years in day public secondary schools in Kano state were included in the study.

Sample Size

A total of five hundred and twenty (520) students from selected day public schools in Kano state participated in the study.

Data Collection Instruments

- Mercury Sphygmomanometer and Stethoscope: KBK SM-300 (made in Japan) was used to measure blood pressure in mmHg.
- Height scale: Calibrated wall meter was used to measure height in meters (m).
- Weight scale: Orbit bathroom scale (model: supreme, serial number 0399104033) was used to measure weight in kilograms (kg).
- Pacer Tape: It was used in assessing cardio respiratory fitness (CRF)

Sampling Technique

The subjects of the study were drawn from twelve (12) public day secondary schools using simple random sampling technique. The twelve schools were selected using simple random sampling technique from the fourteen (14) educational zones in Kano State

Data Collection Procedure

Firstly, an introductory letter was obtained from the department of Physical and Health education, Bayero University, Kano, and sent to Kano state secondary schools management board for approval to conduct the research in the selected schools. A permission letter to conduct the research was given, and distributed to all the selected secondary schools. The purpose of the study was explained to every principal of the selected schools, and consent forms were giving to the selected students. A total of 520 students across the selected schools returned their signed forms (by their parents/guardians) and participated in the study. The following measurements for each participant were taken:

- *Height:* The height of each participant was measured using calibrated wall meter as stated by the American College of Sports Medicine [14]. Each participant was asked to stand on the base of the wall meter bare footed with the head upright and eyes facing forward. The back was straight against the calibrated wall and the hands by the sides. The measurement was taking by placing a ruler on the participant head to point the exact number on the calibrated wall meter, and the reading was recorded in meter (m).
- *Weight:* The weight of each participant was measured using orbit weighing scale, where each participant stand bare footed on the scale (after removing any heavy object) with the head looking straight and hands by the sides [14]. The reading was recorded in kilograms (kg).
- *Body Mass Index:* Body mass index (BMI) of the participants was measured by computing each participant weight and height as $\text{weight}/\text{height}^2$. The reading was recorded kg/m^2 .
- *Blood Pressure:* The blood pressure (BP) of each participant was measured using a stethoscope and sphygmomanometer according to the procedure by the American College of Sports Medicine [14]. Each participant sat for 10 minutes, then deflated cuff of sphygmomanometer was wrapped round the right hand approximately 2.5cm to 5cm above the cubital fossa, and inflated gradually. The diaphragm of the stethoscope was placed over the brachial artery and the air piece inserted into the ears. The valve of the sphygmomanometer was gradually release until a first sound was heard (systolic BP) and when the sound disappeared (diastolic BP). The reading was recorded in mmHg. BP reading equals to or greater than 133/92mmHg was considered high blood pressure or hypertensive.
- Cardio respiratory fitness (CRF) assessed using 20 meter multi-stage shuttle run test (20-MST) also called progressive aerobic cardiovascular endurance run (PACER). A 20-meter course marked on the students' playground with two restraining lines at the beginning and end of the 20 meter interval. The PACER was performed using a PACER tape in accordance with the one minute protocol by Leger and Lambert [19]. The participants lined up behind a start line and the tape was switched on, and then ran forth and back between the start and finishing line. As subjects ran between the lines, a beep sounded that indicated when to turned around and ran back to the other line. They continued until they could no longer reach the line before the beep sounded. Scores were the number of laps completed, and were converted to peak VO_2 scores using regression equation as :

Peak VO₂ = 31.025 + 3.238 (final speed in km/hr) – 3.248 (age in years) + 0.1536 (final speed x age)

Participants with scores greater than or equals to 39.4ml.kg/min were categorized as fit, and those with scores less than 39.4ml.kg/min were categorized as unfit.

Data Analysis

Descriptive statistics of mean, standard deviation, and tables was used to summarize the data. The data was analyzed using inferential statistics of independent t-test to compare BP across the CRF groups (fit and unfit), and Pearson product

moment correlation (PPMC) to determine if there was significant relationship between CRF and BP (SBP and DBP). All the statistical analysis was carried out at an alpha level of 0.05 with statistical package for social science (SPSS) version 15.

Results

The results of the study are presented in the tables below.

The physical and physiological characteristics of all the participants are presented in a descriptive statistics of mean (X) and standard deviation (SD) in table 1.

Table 1: Physical and physiological characteristics of all participants (N=520)

Variables	X±SD
Age	15.94±1.992
Weight	48.58±9.689
Height	1.55±0.103
Body mass index	20.10±3.030
Systolic blood pressure	121.33±12.607
Diastolic blood pressure	81.20±13.453
Cardio respiratory fitness	39.43±1.309

X ±SD = mean ±standard deviation

The physical and physiological characteristics of the participant in respects to their CRF group are presented in a descriptive statistics of mean and standard deviation in table 2.

Table 2: Physical and Physiological characteristics of participants by their CRF groups

Variables	CRF group	N	X±SD
Age (13-19years)	Unfit	282	15.99±2.046
	Fit	238	15.89±1.929
Weight (kg)	Unfit	282	49.21±10.22
	Fit	238	47.84±8.983
Height (m)	Unfit	282	1.54±0.108
	Fit	238	1.55±0.097
Body Mass Index	Unfit	282	20.34±3.044
	Fit	238	19.81±2.994
Systolic BP	Unfit	282	125.00±13.346
	Fit	238	116.97±10.244
Diastolic BP	Unfit	282	88.40±12.047
	Fit	232	72.67±9.454

Key: CRF = Cardio respiratory fitness, BP= blood pressure.

To compute for influence of CRF on blood pressure (systolic and diastolic BP), independent t-test was used as presented in table 3.

Table 3: t-test summary on participant SBP and DBP by CRF group

Variables	CRF group	N	X±SD	t	P
Systolic BP	Unfit	282	125.00±13.246	7.783*	0.05
	Fit	238	116.97±10.244		
Diastolic BP	Unfit	282	88.40±12.047	16.679*	0.05
	Fit	238	72.67±9.454		

t(518)=1.972; P<0.05.

Key: BP= blood pressure, CRF=Cardio respiratory fitness

Table 3 above showed an independent t-test comparing the mean score of fit and unfit CRF groups, and showed a significant difference between the means of the groups (t = 7.783, df=518, p<0.05) exist between systolic and diastolic BP.

Pearson product moment correlation was computed to determine if there was significant relationship between CRF and BP (SBP and DBP) as presented in table 4.

Table 4: Correlation summary of CRF by BP

Blood Pressure	Variable	R	P
Systolic BP	CRF	-0.317*	0.05
Diastolic BP	CRF	-0.583*	0.05

R(518)=0.062; p<0.05.

Table 4 above showed that the relationship between CRF and SBP (R=-0.317, p<0.05) as well as between CRF and DBP (r= -0.583, p<0.05) are negative, and this implies that as SBP and DBP increases, CRF will decrease.

Discussion

The objective of this study was to determine the influence of cardio respiratory fitness (CRF) on blood pressure (BP) among teenagers in Kano state. A total number of 520 students from 12 selected public secondary schools in Kano participated in the study. Among the 520 participants, 282 (54.2%) were unfit and 238 (45.8%) were fit.

A significant influence as well as significant relationship between CRF and BP (SBP and DBP) among teenagers in Kano was found in this study. A negative relationship was found between the CRF and the BP, which implies that with increase

in CRF, BP will decrease, and vice versa. The finding is similar with that of Kwee and Willmore (1990) who established a negative correlation between SBP and physical fitness [20]. This is also in consistent with the work of Barlow (2006) on his study of CRF as an independent predictor of hypertension among initially normotensives women, who found that women with poor CRF have higher BP than fit women [15]. Similarly, Blair et al (1984) in their study on physical fitness and incidence of hypertension, reported that person's risk of developing high BP is associated with his or her fitness level, with less active or unfit

people having 30-50% greater risk of developing hypertension [17].

Conclusion

The outcome of the study revealed that cardio respiratory fitness (CRF) has an influence on blood pressure (systolic blood pressure and diastolic blood pressure) among teenagers in Kano state. As the CRF increases, the blood pressure decreases.

Recommendation

It is recommended that CRF should be considered while assessing teenage patients.

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