Post-exercise Cardiovascular Status of Pupils in Ibadan

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Abstract

This paper comparatively examines the cardiovascular status measured in terms of heart rate, systolic blood pressure and diastolic blood pressure of primary school pupils in Ibadan after going through a 12-week progressive resistance exercise training.

A total of one hundred and twenty (120) volunteered pupils were drawn purposively from four (two public and two private) primary schools in Ibadan. The randomized classic experimental research design with one experimental and one control group was employed in the study. Systematic random sampling technique was used to allocate sixty (60) participants to each of the two groups, namely: the progressive resistance exercise (PRE) and the control groups. The PRE trainings adhered strictly to the American College of Sports Medicine guidelines on quality and quantity of exercise trainings. The control group did not partake in any organised training during the period. However, the pupils were not restricted from their normal daily activities. The cardiovascular variables measured were subjected to frequency counts, percentages, normative table scores, mean and standard deviation for analysis and discussions.

Results show that the average age of the pupils was 9 years 8 months, 68 (56.7%) of the participants were male while 52 (43.3%) were female; the post-training mean height of the participants in the PRE group is 1.36±0.09m while that of weight is 29.52± 5.82kg. It also reveals that post-exercise HR (81.86bpm within 80-120bpm) of the participants were at the normal level and their average post-exercise blood pressure (98.94/61.87mmHg) were normal within 100-120/60-75mmHg.

The post-exercise cardiovascular fitness level of the pupils in Ibadan is normal. Hence, they are apparently healthy to be able to cope with the rigour of training using PRE modus operandi

for any professional sports carrier. They should be exposed to vigorously healthy activities that will prepare them to live healthy and physically fit lifestyles in future.

Key words: Blood Pressure, Heart Rate, Progressive resistance exercise, Training, Primary school pupils

Introduction

The American Sports Medicine Institute (2008) declared that cardiovascular fitness represents the efficiency of the heart, lungs and vascular system in delivering oxygen to the working muscles so that prolonged physical work can be maintained. An individual with functional cardiovascular system is expected to have a decreased resting heart rate, lower blood pressure, increased stroke volume, increased cardiac output, and generally, increased heart function with an ability to pump more blood among other factors (Du et al, 2005; Dimkpa, 2009).

Cardiovascular function undergoes considerable change as children grow and age; and there are changes during sub-maximal and maximal exercise. The blood pressure is lower in children than in adults at rest and during sub-maximal exercise, but increases progressively during the late teens. Blood pressure is directly related to body size and larger people generally have higher blood pressure. Also children have a greater blood flow to active muscle than adult due to the fact that they have less peripheral resistance. Mahon, Anderson, Hipp and Hunt (2003) submitted that a child's smaller heart size and total blood volume result in a lower stroke volume both at rest and during exercise than an adult. In an attempt to compensate for this, the child's heart rate response to a given rate of sub-maximal training with absolute oxygen requirement. Cole, Blackstone, Pashkow, Snader, and Lauer (1999) earlier postulated that as the child ages, heart size and blood volume increase along with body size, and consequently stroke volume also increases as the body size increases, for the same amount of training. However the child's higher sub-maximal heart rate cannot completely compensate for the lower stroke volume (Cole, Foody, Blackstone and Lauer, 2000). Because of this the child's cardiac output is also lower than the adults for the same rate of exercise or oxygen consumption.

Ayenigbara (2010) submitted that regular participation in physical activity has been well established as an integral part of a healthy lifestyle in adults. It has been recognized that most diseases affected by exercise (such as coronary heart disease, hypertension, obesity, and osteoporosis) are a result of life-long processes, usually surfacing clinically in the older adult years (Corbin et al., 1998; National Centre for Chronic Disease Prevention and Health Promotion, 2000). Clinical markers of hypokinetic disease like obesity, high blood pressure, high cholesterol, osteoporosis, osteoarthritis and low back pain, have been observed in pupils (Boreham, Twisk, Savage, Cran and Strain, 1997; National Centre for Chronic Disease Prevention and Health Promotion, 2000). Magarey, Daniels and Boulton (2001) posited that the increased prevalence of overweight and obesity may be attributed to decreasing activity, increasing inactivity and a rising caloric intake of children. Morrow, Tucker, Jackson, Martin, Greenleaf and Petrie (2013) reported that children and adolescents should have a daily physical activity behaviours of 60 minutes or more as guidelines for cardiovascular fitness. They further reiterated that physical activity behaviours should include a minimum of 3 days per week of aerobic, muscle-strengthening and bone-strengthening activities.

Abass and Moses (2013) acknowledged that endurance capacity is an individual's ability to perform exercise at both submaximal and maximal intensities as demonstrated either by the ability to exercise longer at a similar workload or by increasing the workload attained at a given heart rate. Increased endurance capacity has been shown to be one of the indices of cardiovascular fitness (The American Sports Medicine Institute, 2008). Studies have also demonstrated that exercise endurance capacity is linearly related to heart rate reserve (HRR) (Ota, 2002; Singh, Rhodes, Gauvreau, 2008). Similarly, HRR is accelerated in endurance trained athletes (Otsuki, Maeda, Iemitsu, Saito, Tanimura and Sugawara, 2007). Increased cardiac output, increased stroke volume, decrease in resting blood pressure and resting heart rate are all evidences of cardiovascular fitness (The American Sports Medicine Institute, 2008). After aerobic exercise training, it has been reported that stroke volume at rest increases due to increase in end diastolic volume; resting HR decreases due to greater venous return to the heart and increases in autonomic control; cardiac output increases primarily due to increase in stroke volume; blood flow increases through the cardiovascular system and both resting

blood pressure and blood pressure during exercise are reduced (Mahon, Anderson, Hipp and Hunt, 2003).

Progressive resistance exercise (PRE) is a method of increasing the ability of muscles to generate force as compared to the continuous physical activity children naturally familiar with. The principles of PRE for increasing force production in muscles have remained virtually unchanged since they were described by DeLorme and Watkins (1948) almost 60 years ago. The question whether children benefit from progressive resistance exercise training to improve their cardio-respiratory system has been highly controversial, because several early studies indicated that training prepubescent children did not change their VO_2 max values (Oranugo, Igbanugo and Agbedara, 1992; Campos, Luecke and Wendeln, 2002; Dimkpa, 2009). Interestingly even without significant increases in VO_2max, the running performance of children studied did improve substantially with aerobic exercise. Children naturally participate in aerobic or continuous exercise and though easily fatigue but stay longer. Based on comparison between two training regimes, this study examined cardiovascular status measured in terms of heart rate, systolic blood pressure and diastolic blood pressure in primary public school pupils in Ibadan, Oyo State.

Methodology

Sample and Sampling Techniques

The study was a randomized classic experimental research design with one experimental and one control groups (Isaac and Micheal, 1981). A total of one hundred and twenty (120) volunteered pupils were drawn purposively from four (two public and two private) primary schools in Ibadan. The sample size of the pupils in each the classes proportionately were twenty (20) pupils in primary three, sixty (60) in primary four and forty (40) in primary five. Each of the schools had representation 30 pupils. Systematic random sampling technique was used to allocate sixty (60) participants to each of the two groups, namely: the progressive resistance exercise (PRE) and the control groups. The study was

conducted in the exercise physiology laboratory and sports complex of the University of Ibadan, Ibadan, Nigeria.

Training Modalities

The training was a twelve – week interval trainings in which participants in the experimental group were exposed to repeated periods of work, interspersed with rest periods three times per week (Armstrong and Welsman, 1997). The trainings adhered strictly to the American College of Sports Medicine guidelines (2007) on quality and quantity of exercise trainings. The ACSM (2002) recommended intensity of 70–80%HRmax workloads with increment at scheduled interval were used. The training protocol applied was on incremental number of repetitions (3 sets of 3 to 12 repetitions each) (Faigenbaum and Westcott, 2000). Appropriate overload was implemented, rate of progression was carefully considered, and resistance exercise training effect was monitored periodically to examine the programme. The training session involved ten minutes callisthenic exercise as a form of warm-up. Resistance was increased with each set. Participants were randomly divided into six lines of ten participants each. Seven exercises were given one after the other and lasted for between thirty to sixty minutes progressively under the guide of instructor. The control group did not partake in any organised training during the period. However, the pupils were not restricted from their normal daily activities.

Procedure for data Collection

The cardiovascular variables of heart rate (HR), systolic blood pressure (SBP) and diastolic blood pressure (DBP) of the pupils in this study were measured and recorded after training using Litman's stethoscope made in the United State of America (U.S.A.) and 2009 BOKANG Model of free style standing model sphygmomanometer calibrated from 0-300mmHg made in China by W.B.I.C.Wenzhou (CE0197) immediately after each training sessions. The average scores were subjected to analyses for discussions.

The heart rate of the participants was taken at the mitral area through auscultation in a sitting position. The researcher put on the headpiece

of the stethoscope over the mitral area of the participants without too much pressure exerted and listened to the sound that was heard. The heart sounds of "lub-dub" that was heard was counted for ten (10) seconds. The counted numbers were multiplied by six (6) to make one (1) minute count and recorded. To get the systolic and diastolic blood pressure of the participants, the cuff of the sphygmomanometer was wrapped evenly and snugly around the arm of the participants at 2.5cm above the site of brachial pulsation. The pressure at which the first sound (korotkoff) was heard was recorded as the systolic blood pressure. The researchers continued with the deflating of the cuff noting the point when the last sound was heard which was recorded as diastolic blood pressure both in mmHg. The researcher finally deflated the cuff and removed it from the participants' arm. The obtained data were subjected to frequency counts, percentages, normative table scores, mean and standard deviation for analysis and discussions.

Results

The results obtained on class distribution of the participants show that 20(16.7%) were in primary 3, 60 (50.0%) were in primary 4 and 40(33.3%) were in primary 5. On the participants' age, 6 (5.0%) pupils were 7 years, 18 (15.0%) were 8 years, 24 (20.0%) were 9 years, 42 (35.0%) were 10 years, 12 (10.0%) were 11 years while 18 (15.0%) were 12 years with average age of 9 years 8 months. The result on gender indicates that 68 (57.2%) of the participants were male while 52 (42.8%) were female which means that most of the participants used in this study were males. The post-training mean height of the participants in the PRE group is 1.36±0.09m while that of weight is 29.52± 5.82kg. The control group however had post-training mean height of the participants as 1.35±0.08m and weight as 26.78± 5.29kg.

Table 1: Post Exercise Heart Rate level of Primary School Pupils in Ibadan

Cardiovascular Group	Progressive Resistance Exercise Group			Control Group		
Variable	Pre-test Mean & Std	Post-test Mean & Std	MeanDiff.	Pre- test Mean & Std	Post-test Mean & Std	MeanDiff.
Heart Rate (bpm)	81.07 ±4.95	81.37±11.87	0.30	79.98±10.39	86.97±12.37	6.99

From table 1, the post-exercise mean of HR of primary school pupils in Ibadan in PRE group was 81.07±4.95bpm as against 86.97±12.37bpm for control group.

Table 2: Normative Values of Children Heart Rate with respect to Age

Age	Heart rate (bpm)
>1	110-160
1-2	100-150
2-5	95-140
5-12	80-120
>12	60-100

Jewkes, Luba and McCusker (2005)

Table 2 presents that heart rate of children decreases with age. The normative values are compared with the PRE post –test mean score in table 1 for discussions.

Table 3: Post Exercise Blood pressure level of pupils in Ibadan Cardiovascular Variables

	Progressive Resistance Exercise Group			Control Group		
	Pre-Test Mean & Std	Post-test Mean & Std	MeanDiff.	Pre- Test Mean & Std	Post-test Mean & Std	MeanDiff.
Systolic Blood Pressure (mmHg)	101.07±12.52	103.17±9.65	2.10	107.00 ±12.12	95.17±14.20	11.83
Diastolic Blood Pressure (mmHg)	65.12 ± 8.79	62.83±5.85	2.29	65.33 ±5.67	60.67±7.78	4.66

Table 3 reveals that PRE group had post-training mean SBP of 95.17±14.20mmHg as against the control group of 103.17±9.65mmHg. A score of DBP 65.33±5.67 mmHg was obtained in the PRE group while the control group had 65.12±8.79 mmHg.

Table 4: Normative Values of Children Blood Pressure with respect to Age

Age	Systolic Blood Pressure (mmHg)	Diastolic Blood Pressure (mmHg)
Premature	55-75	35-45
0-3 months	65-85	45-55
3-6 months	70-90	50-65
6-12 months	80-100	55-65
1-3 years	90-105	55-70
3-6 years	95-110	60-75
6-12 years	100-120	60-75
Over age 12	110-135	65-85

Source: Kliegman (2007)

Table 4 reveals the normative status of children blood pressures as they increase with age. These values were compared with the PRE post – training values in table 3 for discussion.

Discussions

The findings from this study reveal that post exercise HR (81.86bpm within 80-120bpm) of the pupils in this study was at the normal level because their age range (7-12 years) was within age 5-12 years showed in table 2 as reported by Jewkes, Lubas and McCusker (2005). The average post-exercise blood pressure (BP) (98.94/61.87mmHg) with average age of 9 years 8 months indicates that the pupils have normal blood pressure within 100-120/60-75mmHg rating of Kliegman (2007) showed in table 4. The heart rate and blood pressure status of the pupils show that they are apparently healthy and have good human functional capacities that comparable to their counterparts in European countries. These findings correlate positively well with the earlier submission of Agrawal (2010) that BP in pupils works in the opposite way as compared to the other physiological parameters in that it tends to increase as pupils age. Dimkpa (2009) reported that BP can be quite low in newborns and remain on the low side until pupils reach toddlerhood.

During developmental stage of children, the rate of energy consumption as a result of muscular contractions associated with physical activities increases leading to a corresponding improvement in cardiovascular

functioning. High aerobic capacity is associated with increase HR in exercise. HR of the PRE group was higher than the control group though both are normal. A number of studies have shown that physically active men or women demonstrated higher levels of HR compared with sedentary controls (Jensen-Urstad, Saltin, Ericson, Storck and Jensen-Urstad, 1997; Davy, DeSouza, Jones and Seals, 1998; Rossy and Thayer, 1998). Physical activity has shown to increase left ventricular mass (Maron, 1986; Levy, Cerqueira, Abrass, Schwartz and Stratton, 1993; Whyte, George, Nevill, Shave, Sharma and McKenna, 2004), which was related to maximal blood pressure during exercise (Michelsen, Knutsen, Stugaard and Otterstad, 1990; Molina, Elosua, Marrugat and Pons, 1999; Kamarck, Eranen, Jennings, Manuck, Everson, Kaplan and Salonen, 2000; Sung et al, 2003). The large increment of blood pressure during the maximum effort running exercise may be necessary for the physically active children to achieve great work capacity of fast treadmill running speed and high treadmill gradient.

Although mean difference of blood pressure after exercise was higher in the PRE group compared to the control group, their percent decrease of blood pressure after exercise was significantly greater than untrained controls'. This also reflects that the physically active individuals have a greater capacity of reflex cardiovascular modulation after exercise than untrained controls (Laukkanen et al., 2004).

Conclusion

Pupils in primary schools in Ibadan have functionally normal heart rate and blood pressure. They are apparently healthy and can cope with the rigour of incremental physical activities. They should be exposed to vigorously healthy activities that will prepare them to live healthy and physically fit lifestyles in future.

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