Effects of Two Modes of Exercise Training Programme on Muscular Endurance of In-School Adolescents with Hearing Impairment in Ibadan Metropolis

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Abstract
The study examined the effects of two modes of exercise training programmes on muscular endurance of in-school adolescents with hearing impairment in Ibadan metropolis. The participants comprised of one hundred and twenty (120) secondary school students who willingly volunteered themselves to be involved in the study. The participants were divided into two experimental groups and a control group. The first experimental group received aerobic exercise training, while the second experimental group went through progressive resistance exercise training programme for twelve weeks (three times a week). Analysis of covariance (ANCOVA) and t-test were used to analyse the data obtained in this study. Findings of this study reveals that treatment had significant main effect on the endurance of in-school adolescents (F (3.116) = 22.599, P< 0.05 level of significance. There was a significant gender (t= 7.137) and age (t=249) difference in muscular endurance of participants. The study concluded that aerobic and progressive resistance exercise programmes have significant effect in improving the muscular endurance of in-school adolescents with hearing impairment. It was recommended that students with hearing impairment should be engaged in well supervised physical education programme so as to improve their level of physical fitness

Keywords*:* Hearing impairment, in-school adolescents, aerobic exercise, progressive resistance exercise, muscular endurance.

Introduction

Muscular endurance is one of the underlying factors that may contribute to an athlete's performance. It is the ability to resist fatigue while holding or repeating a muscular contraction. According to McGlynn (2004) muscular endurance is probably the most important components of physical fitness. It reflects the state of some of the physiological systems that are vital to the general health of an individual. He also asserted that it is the most important factor in human performance and it is a major factor in most sports and training adaptability. Lockwood (2010) defines muscular endurance as the ability or the capacity of a muscle group to perform repeated contractions against a load or sustain contraction. According to Nam (2003) muscular endurance is the ability of muscle or group of muscles to perform repeated contractions over an extended period of time. Nam (2003) also defines it as the ability of a muscle or groups of muscles to work against a moderate resistance for long periods of time. According to Chad (2001) muscular endurance is more often associated with individual muscle groups and is specific to performance. The endurance of a muscle is

dependent upon the quality of the muscles, the extensiveness of their capillary beds and the nerve mechanism supplying them.

Muscular endurance is an essential component of physical fitness and its importance is highly indicated in such athletic events that use many repetitions e.g. walking, jogging, running, skiing, and cycling. Even in weight training; the principle of lifting a load certain numbers of time through full range of motion implies isotonic muscular endurance. From the point of view of sport science, it has been shown by ACSM (2000) that people need endurance to perform well in prolonged activities. Ajidua (1990) opined that a good football team that has trained adequately for endurance stands a better chance of winning prolonged football matches.

Chado (1991) described muscular endurance as either anaerobic or aerobic. Anaerobic endurance depends on the intensity and duration of the sustained or repeated contractions, and on the metabolic pathway used. While some athletic events like distance running rely mainly on aerobic local muscular endurance, some other athletic events of short duration lasting under two minutes, may rely predominantly on anaerobic local muscle endurance. Many sports, particularly the ball games rely on both anaerobic and aerobic endurance in varying proportions to cope with the sustained level of play throughout the game. Anaerobic endurance is the ability to persist at a repeated high intensity task, for a short duration. Invariably, high intensity repeated task may rarely last beyond one minute. The rationale for categorizing this type of endurance as anaerobic should be obvious as the energy demand for this type of repeated exertion is predominantly from the anaerobic energy systems (Otinwa, 1998). Anaerobic endurance may hence be called short term endurance. Aerobic endurance on the other hand may be described as the ability to persist at a repeated task, usually of moderate to fairly heavy intensity for a long duration. This type of endurance is required in distance run lasting from two to many hours and even days. It may be referred to as long-term endurance (Owolabi, 1985 & Hanson, 2009).

Hearing impairment is a generic term that is used to describe all forms of hearing loss, like deafness and hard-of-hearing. Barker (2003) defines hearing impairment as impairment in hearing whether permanent or fluctuating that adversely affects child's educational performance. The World Health Organization (WHO) (2001) opined that hearing impairment is a broad term used to describe the loss of hearing in one or both ears. According to WHO (2005), hearing impairment refers to complete or partial loss of the ability to hear from one or both ears. It was also observed by WHO (2005) that there are two types of hearing impairment defined according to where the problem occurs (conductive hearing impairment), which is a problem in the outer or middle ear. This type of hearing loss is often medically or surgically treatable. While the other one is sensorineural hearing loss. It is usually due to a problem with the inner ear, and occasionally with the hearing nerve going from there to the brain. This type of hearing problem is usually permanent and requires rehabilitation, such as with a hearing aid.

Hutzler and Sherrill (2007) found out that 278 million people worldwide have moderate to profound hearing loss in both ears. They further stressed that 80% of deaf and people with hearing impairment live on low and middle –income countries. The number of people worldwide with all

levels of hearing impairment is rising due to a growing global population and longer life expectancies

Deaf and hard-of-hearing children do not, as a rule, need a different set of activities from typical children. However, in many instances, because of the limitations imposed by the hearing disorder, physical and motor development may be retarded. Therefore, it is wise to be aware of possible physical underdevelopment and poor motor coordination among deaf and hard-of-hearing persons. The objectives in a physical education programme for hard-of-hearing children are the same as those for normal children. However, loss of hearing, which impairs the ability to communicate effectively with others, is a great social handicap. Therefore, an objective that should be given priority is the provision of opportunity for social interaction through games with other students. Also, deaf children tend to have poor body mechanics and poor patterns of locomotion (Crowe, Auxter & Pyfer, 2004).

Regular physical activity and physical fitness are especially important in maintaining the health and well being of people of all ages. Research clearly indicates that virtually all individuals, including those with disabilities, can gain health benefits from regular physical activity. The health promotion and disease prevention needs of people with disabilities who have secondary health conditions may be complicated by specific medical aspects of disabilities. People with disabilities may be at greater risk of future problems e.g. individuals with spinal cord injuries are more likely to have to address pressure sores. For deaf individuals with no or minimal secondary health conditions, there are great potentials for effective participation in physical activity programmes.

In a study by Longmuir and Bar-or (2000), assessing the physical activity level of youths with disabilities, individuals with hearing loss had the highest level of physical activity participation compared to individuals with cerebral palsy, spinal bifida, muscular dystrophy, and other chronic medical conditions such as arthritis and kidney disease. Most of the participants in the study were recruited from schools for deaf youths that provide in-school and extracurricular physical activity programmes. Of the 105 individuals with hearing loss who completed the survey on physical activity levels, 87 individuals perceived themselves as active and 28 sedentary.

According to Crowe, Auxter and Pyfer (2004), children who are deaf may be prone to lower fitness because they tend to be sedentary. Low fitness not only has implications for poor functional health but also may limit or constrain any number of daily activities including participation in sports and recreation. Research on physical fitness (including strength) of children who are deaf remains inconclusive. Individuals with moderate to severe hearing loss were more likely than individuals without hearing loss to have impaired activities of daily living.

However, the deaf individual's experiences greater difficulties in performing motor functions or motor movement, locomotion coordination and speed. The deaf individual is also noted for poor posture, and balance, weakness in muscular control, strength and agility. Also, there is higher incidence of lateral preference (handedness) in the deaf population than in the hearing population (Suarau, 1992).

Methodology

Research Design

The randomized pretest-posttest control group research design was used for this study. The study was an experimental study in which participants were randomly assigned to experimental and control groups. The first group was exposed to aerobic exercise training while the second received progressive resistance exercise training programme. The two experimental groups and control group were given pretest - posttest evaluation. The control group received lecture on the importance of physical exercises. The random assignment to the treatment and control groups was to satisfy the condition of homogeneity of groups at entry.

Sampling Techniques

The sample for this study was one hundred and twenty (120) sedentary adolescent secondary school students with hearing impairment who volunteered themselves for this study. The volunteers came from two public secondary schools for hearing impairment within Ibadan. Purposive sampling technique was used to select all the participants because of their peculiar characteristics. Volunteers whose degree of hearing loss falls between 60 to 90dB and above were used for this study. The participants were screened with audiometer to determine their degree of hearing loss.

Research Instruments

1. **Weighing Scale:** Hana portable weight measuring scale (RA9012) made in England was used to measure the weight of the participants in kilogram (kg)
2. **Height scale:** This was used to measure subjects' height.
3. **Whistle:** The champion whistle made in China was used to start the participants
4. **Audiometer:** The Amplivos screening audiometer model 116 made by Sonic Innovations software Japan was used to measure the degree of hearing loss.

Validity and Reliability

The weighing scale and height meter scale have a reliability coefficient of 0.96 and 0.99 respectively. Audiometer has a reliability coefficient of 0.97. A reliability of 0.92 was reported for the Burpee test. To ensure that the instruments measure what they were supposed to measure, the instruments were recalibrated against other standardized instrument.

Burpee Test

The Burpee (Squat thrust) test: This was used to measure general body endurance. From a standing position, the participant bends at the knee, places his hands on the floor in front of his feet and then thrust his legs backward. Again, he returns to the squat position and straighten to a standing position. This represents one complete repetition. The number of repetitions made in one minute was recorded for each participant. According to Safrit and Wood (1995), a reliability of 0.92 was reported for this measuring instrument.

Procedures for Training Programme

The training programme comprised of aerobic exercise training programme for experimental group one and progressive resistance exercise training programme for experimental group two. The training programme lasted for 12 weeks. There were three sessions per week for each experimental group. The placement (days for training) were Mondays, Wednesdays and Fridays for the experimental group one, while

Tuesdays, Thursdays and Fridays for experimental group two. The time of training for the two schools took place in the morning (between 10.30 am and 12.30 pm) on the designated days for each school. The participants for the training programme were screened with audiometer to measure their level of hearing impairment a week before the commencement of the programme. Every training session was made up of three segments. They are general body warm-up, conditioning bout and cool down. All training and measurement took place in the sports ground of the two schools that were used for this study. The researcher with the help of six trained research assistants administered the treatment and measurements.

Data Analysis

The data collected were analyzed using the inferential statistics of Analysis of Covariance (ANCOVA), to test the effect of the treatments on hypothesis 1. The Scheffe post hoc analysis was also computed when the F statistics was significant. Independent t-test was used for hypotheses 2 and 3. Levels of significance were set at 0.05.

Table 1 Normative Data for Muscular Endurance (Burpee Test)
Males Values in ml/kg/min

Age	Very Poor	Poor	Fair	Good	Excellent	Superior
13-19	<35.0	35.0-38.3	38.4-45.1	45.2-50.9	51.0-55.9	>55.9
20-29	<33.0	33.0-36.4	36.5-42.4	42.5-46.4	46.5-52.4	>52.4
30-39	<31.5	31.5-35.4	35.5-40.9	41.0-44.9	45.0-49.4	>49.4
40-49	<30.2	30.2-33.5	33.6-38.9	39.0-43.7	43.8-48.0	>48.0
50-59	<26.1	26.1-30.9	31.0-35.7	35.8-40.9	41.0-45.3	>45.3
60+	<20.5	20.5-26.0	26.1-32.2	32.3-36.4	36.5-44.2	>44.2

Source: Cross fiteastsac.com

The mean score value of 38.77 was obtained by the participants in this study which falls under fair when compared with the norms.

Female Values in ml/kg/min

Age	Very Poor	Poor	Fair	Good	Excellent	Superior
13-19	<25.0	25.0-30.9	31.0-34.9	35.0-38.9	39.0-41.9	>41.9
20-29	<23.6	23.6-28.9	29.0-32.9	33.0-36.9	37.0-41.0	>41.0
30-39	<22.8	22.8-26.9	27.0-31.4	31.5-35.6	35.7-40.0	>40.0
40-49	<21.0	21.0-24.4	24.5-28.9	29.0-32.8	32.9-36.9	>36.9
50-59	<20.2	20.2-22.7	22.8-26.9	27.0-31.4	31.5-35.7	>35.7
60+	<17.5	17.5-20.1	20.2-24.4	24.5-30.2	30.3-31.4	>31.4

Source: Cross fiteastsac.com

The female participants in this study had a mean score value of 34.55 which falls under fair when compared with the norms.

Hypothesis 1: There will be no significant difference in the pretest-posttest muscular endurance between experimental and control groups following a 12 week aerobic and progressive resistance exercise training programmes.

Table 2: ANCOVA on effect of aerobic and progressive resistance exercises on Muscular Endurance of the participants

Source of Variation	Sum of Square	df	Mean Square	F	Sig.	Remark
Corrected model(Explained)	1567.418	3	522.473	300.668	,000	
Covariates	1327.701	1	1327.701	764.055	.000	
Treatment group (Main effect)	78.540	2	39.270	22.599	,000	Sig.
Error(Residual)	201.574	116	1.738			
Corrected total	1768.992	119				

Table 2 shows that there was a significant difference in the pretest-posttest muscular endurance based on the treatment groups ($F_{(3,116)}$= 22.599, P < 0.05 level of significance. The null hypothesis is therefore rejected. This reveals that aerobic exercise and progressive resistance exercise have significant effect on muscular endurance of adolescent students with hearing impairment. In order to determine the magnitude and direction of the differences as well as the contribution of the trainings on muscular endurance, MCA as presented below was applied.

Table 3: Multiple Classification Analysis showing the direction of the significant interaction effects. Grand mean=26.66

Variable category	N	Unadjusted Deviation	Eta	Adjusted for Independents + Covariates Deviation	Beta
AE	40	1.64		.48	
PRE	40	-1.81		.71	
Control	40	.17	.37	-1.19	.22
Multiple R Square					.886
Multiple R					.941

MCA in table 3 reveals a pattern similar to ANCOVA in table 4.21. From the table, experimental group of AE has an adjusted mean score value of 28.30(26.66+.48), experimental group of PRE has the adjusted mean score value of 26.83(26.66+.71) and control group has the adjusted mean score value of 24.85(26.66-1.19). The result indicated that AE was the most effective, followed by PRE and the control group was the least effective. Detailed explanations were shown in the next scheffe post hoc table.

Table 4: Scheffe Post hoc Analysis for Muscular Endurance

Variable	Treatment Groups	Treatment Groups	Mean Difference	Sig.

Muscular Endurance	AE	PRE Control	3.4500* 1.4750	.000 .194
	PRE	AE Control	-3.4500* -1.9750*	.000 .054
	Control	AE PRE	-1.4750 1.9750*	.194 .054

*=The mean difference was at 0.05 levels. The significant difference in muscular endurance as indicated by Scheffe in table 4 was between PRE and AE (P<0.05) and PRE and control (P<0.05)

Hypothesis 2: There will be no significant difference in muscular endurance of adolescent students with hearing impairment based on gender following aerobic and progressive resistance exercise trainings.

Table 5: t-test showing difference in Muscular Endurance based on gender following aerobic and progressive resistance exercise trainings

Source of variable	Gender	N	Mean	Standard Deviation	Cal-t	df	P	Remark
Post-Muscular Endurance	Male Female	60 60	28.7667 24.5500	3.5000 2.9483	7.137	118	.000	Sig.

The table above indicates t-test comparison of muscular endurance of the participants based on gender. The table shows that male has the mean score of 28.7667±3.5000 while the female has the mean score of 24.5500±2.9483. The t observed indicating difference between gender is 7.137; P < 0.05. Since the P value is less than 0.05, the null hypothesis 2 is therefore rejected. This result therefore shows that there is a significant difference in muscular endurance based on gender of adolescent students with hearing impairment.

Hypothesis 3: There will be no significant difference in muscular endurance of adolescent students with hearing impairment based on age following aerobic and progressive resistance exercise trainings

Table 6: t-test showing difference in Muscular Endurance based on age following aerobic and progressive resistance exercise trainings

Source of variable	Gender	N	Mean	Standard Deviation	Cal-t	df	P	Remark
Post-Muscular Endurance	Early Adolescents Late Adolescents	68 52	26.7353 26.5577	3.5476 4.2584	.249	118	.804	NS

Table 6 above indicates t-test comparison of muscular endurance of the participants based on age. The table shows that early adolescents have the mean score of 26.7353±3.5476 while the late adolescents have the mean score of 26.5577±4.2584. The t observed indicating difference between age is .249; P < 0.05. Since the P value is greater than 0.05, the null hypothesis 3is therefore accepted.

Discussion

AE and PRE significantly improve muscular endurance of the participants. It was evident in the

study that AE increases muscular endurance more than progressive resistance exercises. This support the findings of Pollock and Wilmore (1994) that aerobic exercise increase skeletal muscle endurance and size as does high resistance exercise such as weight training. This is because the endurance of a muscle is dependent upon the quality of the muscles, the extensiveness of their capillary beds and the nerve mechanism supplying them.

Based on gender, the results show that there was a significant difference in muscular endurance. The male participants in this study show greater improvement in muscular endurance than the females. The male participants had a mean score of 28.77 while the female mean score was 24.55. The difference might result because male had better muscular endurance that is dependent on the quality of the muscles, the extensiveness of their capillary beds and the nerve mechanism supplying them. This result agrees with the findings of Fleck and Kraemer (1997) that males show more significant improvement in muscle endurance than females.

Conclusion and Recommendation

Based on the outcome of this study, it was concluded that the 12 weeks aerobic and progressive resistance exercise training programmes significantly improved muscular endurance of in-school adolescents with hearing impairment. Also, it was found that gender have significant effect on muscular endurance of adolescent students with hearing impairment. It was recommended that students with hearing impairment should be engaged in well supervised physical education programme so as to improve their level of physical fitness.

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