

Effects of sixteen week of resistance exercises on some selected cognitive variables development in adolescents with intellectual disabilities

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Abstract. Intellectual disabilities a serious problem in the entire world and its prevalence is high in school-age children. These difficulties can influence cognitive, social and emotional areas of functioning and has led their families to suffer in economic and social disadvantages than those without disabilities. The main objective of this study was to investigate the effect of sixteen week resistance exercise on cognition developments of school children with intellectual disabilities in Desse & Kombolcha, Amhara region, Ethiopia. In this Pre-test and post-test study design eighteen adolescents with intellectual disabilities were participated in the study. Paired t-test was fitted to analyze the pre-test and post-test data of the study participants. In order to measure cognitive variables digit span backward, digit span forward, vocabulary and similarity test batteries were used to measure working memory, short term memory, vocabulary knowledge and comparative reasoning respectively before and after sixteen week of the training intervention. After sixteen week of intervention, a significant mean score change was observed in working memory, short term memory, vocabulary knowledge and comparative reasoning respectively ($p < 0.05$) after training when compared with before training. We concluded that resistance exercise can improve the cognitive skills of adolescents with intellectual disabilities.

Keywords. Cognition developments, intellectual disabilities, resistance exercise.

Introduction

Intellectual disabilities (ID) a serious problem in the entire world (World Health Organization, 1996) and caused by Down's syndrome, fetal alcohol syndrome, central nervous system malignancy (Campbell et al., 2003) and characterized by having motor difficulties and limitations expressed in the performance of sports skills (World Health Organization, 2011) influencing cognitive, social or emotional areas of functioning therefore, to whatever extent a special physical activity and adapted to be able to move forward and towards independent living (Bechara & Grosb, 2016). These difficulties can influence cognitive, social and emotional areas of functioning and has led their families to suffer in economic and social disadvantages than those without disabilities (Emerson et al., 2010) and discrimination, access to justice and education are the challenges of ID in Africa (Njenga, 2009).

The health benefits of exercise are well studied but the cognition variables improvement benefits of physical exercise are emerging and again needs further study (Pastula et al., 2012). Physical exercise also reported to be beneficial for youth individuals with intellectual disabilities and needs study with

greater scientific rigor including larger sample sizes, control groups and physical exercise should be recommended based on the area of disability type (Johnson, 2009).

Despite some gaps in the current knowledge, there is enough evidence to support the physical exercise as an intervention to generally prevent cognitive impairment (Porto, 2018). However, exercises with high intensity can result poor in cognition improvements (Smith et al., 2016). The impact of physical exercise on cognition performance development depends on the frequency duration, intensity and type of an exercise (Oertel-Knöchel et al., 2014).

Thus, the physical exercise level of children and adolescents both in the intellectual standards and with intellectual disabilities still remain unsatisfactory (Bryl et al., 2013) and needs further investigations to address the effects of physical exercise on cognition development in terms of design of exercise, training regimens, dose response relationships such as intensity, frequency, types and time of intervention (Chang et al., 2012; Bherer et al., 2013).

To increase the success of a physical activity program for persons with intellectual disabilities, a number of factors such as instructional strategies, activity modification, and motivational strategies such as verbal praise or providing tangible rewards are necessary in order to improve the physical fitness qualities (Frey et al., 2008). Based on this an effective exercise therapy at moderate level may speed up the integration of individuals with intellectual disabilities into society while also significantly lowering their health care costs (Pastula et al., 2012) and can improve the cognition function of children cognition (Lees & Hopkins, 2013; Fernandes et al., 2018).

The socio economic condition ID in Ethiopia in terms of social life, education, occupation, and economic level is generally poor (Ayele, 2016) and parents face emotional, social economic and material challenges while raising their children with ID

(Weldeab & Opdal, 2007). Considering the factors affecting the attainments of the goals of a country in relation to create productive human power, the most important approach might be identifying, the parts of a society that needs special treatment in order to develop their productivity at large. Therefore, we identified school children with intellectual disabilities that require more attention in social and economic advantages are to be optimized and lead independent way of life.

To the knowledge of the researcher, no research has been done specifically on the effect of resistance cognitive development among individuals with intellectual disability in Ethiopian. Therefore, we deeply saw the importance of this study participants and their contribution to the development of their countries at large and the lack of studies in this and other related topics in Ethiopia, conducting a study by giving an appropriate volume of exercise intervention can take a step in the field of fast development and improvement of cognitive performance of individuals with ID. Therefore, we motivated to address some selected cognition variables such as verbal knowledge, comparative reasoning, working memory and short term memory in school children with ID using resistance exercise intervention in Desse & Kombolcha, Amhara region, Ethiopia.

Methods

Study Setting and Ethical Approval

Ethical approval was obtained from Mekelle University College of Health Sciences; Health Research Ethics Review Committee (HRERC) with Ref. ERC 1078/2017 dated 26/06/2017 in accordance with Helsinki declaration. A written consent from study participants and assent from their families/guardians was obtained which stated confidentiality and requirements for this study. The study was conducted in Dessie and Kombolch north eastern Ethiopia.

Study Design and Participants

Pre-test post-test study design on the effects of resistance exercise intervention adolescents with intellectual disabilities in Dessie-Kombolcha was employed. The participants of this study were free from epilepsy and autism disorders. The whole numbers of these participants were eighteen and placed purposively in to resistance exercise intervention group. After explanation of the purposes of the study and the privacy of information for the participants and their parents/guardians were completely satisfied to cooperate in the participation of the study. When inviting the participants to participate in the process of orientation about how to conduct resistance exercise intervention before the beginning of the main exercise protocol, the parents/guardians of the study participants committed that these study participants can participate in the sixteen week resistance exercise intervention process of this study.

Procedure

In order to measure cognitive variables digit span backward, digit span forward, vocabulary and similarity test batteries were used to measure working memory, short term memory, vocabulary knowledge and comparative reasoning respectively before and after sixteen week of the training intervention..

The training program consisted of sixteen week of progressive intensity of resistance exercises intervention and conducted after receiving the parental consent. These exercises were performed three sessions a week and each session took forty five

minutes. These are ten minutes of warm-up exercises, fifteen to thirty minutes of main resistance workout and five minutes cool-down exercises.

Data Analysis

Data were entered to an excel spread sheet and cleaned. Statistical analysis was performed using Statistical Package for Social Science (SPSS) version 20. Test results were computed using mean, mean difference and standard deviation. In this study paired t- test was used to compare the pre-test and post-test data of the group on the effects sixteen week resistance exercise intervention on cognition variables in children with intellectual disabilities. The significance level was considered at $P \leq 0.05$.

Results

In this study 18 students with intellectual disabilities were studied. Table 2 shows the mean and standard deviation of age, height and mass of the students with ID. The age, height and mass of the students with ID treated with resistance exercise intervention are age ($M = 14.25$; $SD = 1.136$), height in meter ($M = 1.51$; $SD = 0.038$) and mass in kilogram ($M = 49.24$; $SD = 5.89$).

Table 2

Demographic characteristic of adolescents with intellectual disabilities.

Variables	Mean \pm SD
Age (year)	14.25 \pm 1.136
Height (m)	1.51 \pm 0.038
Mass (kg)	49.24 \pm 5.89

Table 1

Training protocol.

Training phases	Weeks	Frequency	Repetition	Time (min)	Exercises
Phase-1	1-4	3	3-5	15-18	Back bridge, Wall seat, Heel raise, Triceps press,
Phase-2	5-8	3	5-8	19-22	Overhead, Arm press, Leg press in doorway, Trunk lift,
Phase -3	9-12	3	9-12	23-26	Bent knee push up, Side leg rises, Reverse curl, Wall
Phase -4	13-16	3	13-16	27-30	squat, Pelvic tilt, Isometric Side Bridge

Table 3

The paired t-test analysis on the effect of resistance exercise on cognitive variables.

Variables	Tests	Mean \pm SD	t	df	p
Working Memory	Pre-test	2.166 \pm 0.707	-4.267	17	0.001*
	Post-test	2.778 \pm 0.878			
Short Term Memory	Pre-test	3.44 \pm 0.856	3.344	17	0.004*
	Post-test	4 \pm 1.215			
Vocabulary Knowledge	Pre-test	14.3889 \pm 3.146	2.322	17	0.033*
	Post-test	15.1111 \pm 3.7399			
Comparative Reasoning	Pre-test	6.611 \pm 2.033	2.749	17	0.014*
	Post-test	7.278 \pm 1.903			

T3 = triiodothyronine, T4 = Tetraiodothyronine, TSH= thyroid stimulating hormone, DF= degree of freedom, M = mean and SD = standard deviation.

*The mean difference is significant at ($p < 0.05$).

Table 3 was shown the mean score results at ($p < 0.05$) between the pre-test and post- test in Working memory ($p = 0.001$), Short term memory ($p = 0.004$), Comparative reasoning ($p = 0.014$) and Vocabulary knowledge ($p = 0.033$).

Discussion

The objective of this study was aimed to investigate the impact of resistance exercise on vocabulary knowledge; comparative reasoning, working memory and short term memory of school children with intellectual disabilities. The finding revealed that 16 week of resistance exercise intervention had shown statistically a significant mean score difference at ($p < 0.05$) in vocabulary knowledge ($p = 0.033$), comparative reasoning ($p = 0.014$), working memory ($p = 0.001$) and short term memory ($p = 0.004$) treated with resistance exercise following the intervention when compared with before intervention.

The results in this portion of the study are in line with the previous studies (Peig-Chiello et al., 1998; Lachman et al., 2006; Cassilhas et al., 2007; Busse et al., 2008; Bherer et al., 2013) reported that resistance exercise has shown improvement in children cognition. Thus, resistance exercise showed improvements in short term memory and working

memory performance (Busse et al., 2008); total memory (Lachman et al., 2006); comparative reasoning and memory (Cassilhas et al., 2007); information processing speed, attention and memory (Chang et al., 2012).

Doing progressive resistant training 2-3 times a week can improve physical and function limitation (Liu & Latham, 2009). Resistance exercise program designed two to three times per week one to three sets of six to fifteen repetitions with combination of upper and lower body exercise are recommended for youngsters (Swain et al., 2014). Resistant exercise intervention designs in load 60-80%-1RM with twice per week for six months can positively affect information processing speed, attention memory function and specific types of executive function (Chang et al., 2012). It can prevent and protects from brain damage through increased uptake of circulating IGF-1 by the brain (Carro et al., 2001). These cognitive development benefits might be influenced by many biological mechanisms insulin like growth factor (IGF-1) induced by resistance-exercise training and this hormone is very important to the production of brain derived neural factor (Chang et al., 2012) and prevent the loss of brain tissue (Cotman & Berchtold, 2002). Although, brain derived neuron trophic factor plays a great role in the developments of central nervous system and

plasticity of the brain (Autry & Monteggia, 2012) and regulates synapse function in the central nervous system (Numakawa et al., 2014).

Conclusion

Resistance exercise can improve cognitive variables such as working memory, short term memory, comparative reasoning and vocabulary knowledge in adolescents with intellectual disabilities.

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Declaration of Interest

The authors report no conflict of interest.

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