Muscle strength, flexibility and cardiorespiratory endurance in children with human immunodeficiency virus on antiretroviral therapy: A case control study

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Abstract

Background: Paediatric human immunodeficiency virus (HIV) is the leading cause of mortality and morbidity in children. Adequate physical fitness is required in children to perform any physical activity. There is conflicting evidence on physical fitness in children with HIV receiving antiretroviral therapy (ART).

Objectives: To determine the muscle strength, flexibility and cardiorespiratory endurance in children with HIV and to compare it with age and gender matched typically developing children.

Method: Children with HIV in the age group of 6-18 years, residing in homes for HIV and receiving ART for more than 3 months were included in this study. Muscle strength using hand-held dynamometer, flexibility by modified sit and reach test and cardiorespiratory endurance by 6-minute walk test were assessed for both groups and their results were compared.

Results: There were statistically significant differences in muscle strength, flexibility and cardiorespiratory endurance between both groups ($p<0.05$). Children with HIV were less physically fit when compared with normal children.

Conclusions: The present study concludes that muscle strength, flexibility and cardiorespiratory endurance are reduced in children with HIV receiving ART.

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Introduction

Human immunodeficiency virus (HIV) infection is a global health challenge with nearly 37.9 million people living with HIV of which 6.5% are children[1]. Mother-to-child transmission is the major source of HIV infection in children[2]. The rate is 5.7% with about 23,000 newly born HIV infected children annually[3]. Growth and nutrition are severely affected in children with HIV[4]. Malnutrition results from abnormal weight loss and weight gain[5,6]. Children with HIV may be inclined to deconditioning due to sedentary lifestyle, nature of disease and exposure to antiretroviral therapy (ART)[7]. Long-term use of ART has led to complications such as muscle wasting, generalized muscle weakness, lactic acidosis, mitochondrial toxicity, cardiac abnormalities and other changes in the body composition[8]. Wasting in HIV is followed by reduced muscular strength and functional performance[9]. These impediments result in a poor quality of life and physical fitness[10,11].

Studies have shown that active children have comparatively better muscular strength, motor performance and cardiovascular fitness than inactive sedentary peers[12]. Appropriate muscle strength alleviates activities of daily living[13]. Skeletal muscle involvement is dependent on the immunologic status and ART[14]. There is conflicting evidence on the effect of ART on muscle strength. A few studies suggest reduced muscle strength, while a few suggest no effect on muscle strength in children undergoing ART[11,13,15]. Studies on HIV infection and cardiovascular fitness suggest that children with HIV are at higher risk when compared to typically developing children[16,17]. A study done in Florida found that muscle strength, flexibility and cardio-respiratory endurance are affected in HIV children that might limit their physical activity[7]. To the best of our knowledge, the extent of musculoskeletal impairment and cardio-respiratory fitness in these children is not known in the Indian population.

Objectives

The present study was done to determine the muscle strength, flexibility and cardiorespiratory endurance

in children with HIV and to compare them with those of age and gender matched typically developing children.

Method

This observational study was conducted in two 'homes for HIV' Non-Governmental Organisations (NGOs) and two private schools in Belagavi after obtaining permission from the heads of these institutions. All participants were evaluated by the investigator.

Inclusion criteria: Asymptomatic children with HIV in the age group of 6-18 years and receiving ART for more than 3 months were included.

Exclusion criteria: Those children who were medically unstable, those with any acute or chronic neurological disturbances, those having any central nervous system (CNS) or peripheral nervous system disorders and cardiopulmonary or metabolic disorders were excluded.

Sample size: This was kept open-ended. Children with HIV were screened from two NGOs based on the inclusion and exclusion criteria. Fifty-five children with HIV and 55 typically developing children, age and gender matched, were taken into the study

Outcome measures were assessed by a research assistant during the child's free hours in the institution/ school.

The demographic characteristics such as age, gender, height, weight and body mass index (BMI) were recorded for all the children.

HIV history like cause of infection, age when diagnosed, family history, duration of receiving ART, drug history and personal history like diet, appetite and weight loss were recorded for children with HIV.

This was followed by evaluation of muscle strength using push-pull hand held dynamometer to measure strength of biceps, triceps, hamstrings and quadriceps muscles bilaterally. This instrument has mean intra-rater and interrater reliability of 0.75-0.98 and mean concurrent validity of 0.78-0.93 in children and the adolescent population[18]. Muscle strength of biceps and triceps was assessed in supine lying position with elbow flexed to 90^0; dynamometer was placed on the volar and dorsal aspect respectively and child was asked to push. Muscle strength of quadriceps and hamstring muscle was assessed in a high sitting position with dynamometer placed on the medial and lateral aspect respectively. The test was demonstrated to the child in the beginning. Three trials were performed and the best reading was noted. Readings were taken in kilogrammes

Flexibility of the hip region, including lower back and hamstring muscles, was assessed by Modified Sit and Reach Test. Test was performed one side at a time with opposite leg flexed and foot flat on the floor. Child was asked to reach forward with shoulders flexed at 90^0, elbow extended and maintaining the position for at least 2 seconds. Distance reached forward by the child was recorded in inches for both sides.

Cardiorespiratory endurance was assessed by the 6 Minute Walk Test (6MWT). Child was instructed to walk on a 30metre pathway to and fro for 6 minutes. Heart rate and respiratory rate were taken before and after the test. Distance covered in 6 minutes was recorded in metres. Instructions were given to the children by the research assistant before conducting all the tests.

Ethical issues: Approval for the study was obtained from the Research and Ethics Committee of K.L.E. University's Institute of Physiotherapy (No. 438) on 05.12.2019. Informed written consent from the parents/guardians and informed verbal assent from the children were taken before recruiting them into the study.

Statistical analysis: This was done using Statistical Package of Social Sciences version 23 (IBM Corp., Armonk, NY, USA). Mean and standard deviation were used to explain the demographic data. Between group analysis was done using the independent t-test. The level of significance was set at 0.05.

Results

In the present study, a total of 55 children with HIV (33 males and 22 females) were included. The mean age of the children was 13.27 ± 2.85 years. All the children with HIV were infected through vertical transmission (MTCT) and were receiving ART since a mean duration of 55.09 ± 35.89 months.

Table 1 depicts the demographic characteristics of the children.

Table 2 depicts the comparison of muscle strength in both groups.

Table 3 shows the flexibility of study participants between groups using independent t-test.

Table 4 shows the distance covered in 6-MWT between group analysis.

Table 1: ***Demographic characteristics of study participants***

Characteristic	Group	Mean ± SD	t-value	p-value
Age (years)	Group A	13.27 ± 2.85		
	Group B	13.27 ± 2.85	0.001	1.000
Height (m)	Group A	1.38 ± 0.15		
	Group B	1.48 ± 0.12	4.003	0.001*
Weight (kg)	Group A	31.23 ± 8.49		
	Group B	35.98 ± 10.84	2.557	0.012*
Body mass index (kg/m^2)	Group A	16.17 ± 2.52		
	Group B	16.71 ± 4.41	0.7885	0.432
Waist circumference (cm)	Group A	61.49 ± 6.80		
	Group B	61.51 ± 7.19	0.014	0.989
Hip circumference (cm)	Group A	69.42 ± 7.71		
	Group B	72.87 ± 8.57	2.223	0.028*
Waist to hip ratio	Group A	0.88 ± 0.04		
	Group B	0.84 ± 0.09	2.861	0.006*

**p<0.05 statistically significant; Group A- Children with HIV; Group B – Typically developing children*

Table 2: ***Muscle strength of study participants between group analysis using independent t-test***

Muscle tested	Groups	Muscle strength (kg) Mean ± SD	t-value	p-value
Biceps	Group A	9.65 ± 2.40		
	Group B	14.42 ± 3.64	8.109	0.001*
Triceps	Group A	8.28 ± 1.83		
	Group B	10.25 ± 2.10	5.232	0.001*
Hamstrings	Group A	8.06 ± 1.63		
	Group B	9.86 ± 2.01	5.173	0.001*
Quadriceps	Group A	9.28 ± 1.98		
	Group B	12.61 ± 2.23	8.281	0.001*

**p<0.05 statistically significant; Group A- Children with HIV; Group B – Typically developing children*

Table 3: ***Flexibility of study participants between groups using independent t-test***

Groups		Flexibility (inches) Mean ± SD	t-value	p-value
Group A	Right	8.39 ± 1.73	2.237	0.027*
Group B		9.17 ± 1.93		
Group A	Left	8.38 ± 1.71	2.220	0.029*
Group B		9.15 ± 1.91		

**p<0.05 statistically significant; Group A- Children with HIV; Group B – Typically developing children*

Table 4: ***Distance covered in the 6-Minute Walk Test between group analysis***

Groups	Distance covered (m) Mean ± SD	t-value	p-value
Group A	499.84 ± 82.94		
Group B	566.33 ± 88.13	4.075	0.001*

**p<0.05 statistically significant; Group A- Children with HIV; Group B – Typically developing children*

Discussion

The present study was done to find the muscle strength, flexibility and cardiorespiratory endurance in children with HIV on ART in the age group of 6-18 years. The least duration for which ART was received in this study was 11 months and the maximum duration was 180 months.

Children with HIV are at a greater risk for aberrant body composition[19]. In the present study, there were statistically significant differences in height, weight, hip circumference and waist to hip ratio of children with HIV as compared to typically developing children. These variations in the growth and nutrition could be due to factors like inadequate nutrient intake, chronic inflammation, recurrent infections and endocrine factors[20]. Waist circumference was not significant statistically which could be due to central obesity commonly seen in children with HIV on ART.

There were statistically significant differences in muscle strength in all the muscle groups between the cases and control groups. A pilot study, done to

compare muscle strength in 16 children receiving highly active antiretroviral therapy (HAART) and 16 children not receiving HAART, reported that the group not receiving HAART was stronger than the group receiving HAART. The study concluded that weight reduction and its impact on muscle bulk was directly associated with muscle strength[11]. In contrast, studies done to assess strength and anaerobic and aerobic power conclude no difference in strength in case and control groups[13,15]. Flexibility in the children with HIV was less than the typically developing children. It may be attributed to sedentary behaviour of these children and reduced physical activity[7]. Cardiorespiratory fitness is affected in children and adolescents with HIV. These children carry cardiovascular risks for later life. Studies have found decreased cardiorespiratory endurance in adults and children when assessed with V02 max[12,16]. The present study showed decreased cardiorespiratory fitness based on the sub maximal 6MWT.

A similar case control study done on 45 children with a mean age of 16.1 years showed lesser VO2 peak, muscular strength, endurance and flexibility[7]. However, our study varies in terms of the sample size, mean age and terms of outcome. This study can be continued further with a larger sample size and geographical area and testing more components of physical fitness in this population and age group. This study can further help in starting early intervention for children with HIV undergoing ART to increase their physical fitness.

Conclusions

The present study concludes that muscle strength, flexibility and cardiorespiratory endurance is reduced in children with HIV receiving ART as compared to typically developing children in the age group of 6-18 years.

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