

# Effect of an Aerobic Fitness Programme Intervention on the Motor Proficiency of Children with Mild and Moderate Intellectual Disabilities in India

Ritu Kalgotra<sup>1\*</sup>, Jaspal Singh Warwal<sup>1</sup>

1. Department of Education, University of Jammu, India

## ABSTRACT

**Purpose:** *The study aimed to assess the effect of an Aerobic Fitness Programme intervention on children with mild and moderate intellectual disabilities in Jammu, India.*

**Method:** *In a pre-test post-test control group design, 66 children with mild and moderate intellectual disabilities, who fulfilled the inclusion and exclusion criteria, were placed in control and experimental groups. A validated tool, the Test of Motor Proficiency, was used as a pre-test and post-test measure to assess the effect of the intervention.*

**Results:** *The mean difference between the two groups of children with mild and moderate intellectual disabilities was significant. ANCOVA analysis indicated  $F(1,28) = 312.13, P = .00$  in children with mild intellectual disabilities, and  $F(1,32) = 22.540, P = .00$  in children with moderate intellectual disabilities. The intervention was effective in developing visual motor control, upper limb speed and dexterity, running speed and agility, balance, strength, and upper limb coordination. It was ineffective in improving bilateral coordination in both groups of children with intellectual disabilities.*

**Conclusion:** *This intervention programme can be introduced into the daily curriculum of children with intellectual disabilities at special schools. It would be helpful in compensating for the lack of physical activity due to classroom-based teaching.*

**Keywords:** *Bilateral coordination, dexterity, intellectual disability, intervention, motor proficiency*

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\* **Corresponding Author:** Department of Education, University of Jammu, India. Email: ritusatya7@rediffmail.com

## INTRODUCTION

Children with intellectual disabilities tend to be sedentary and inactive at the beginning of their lives, due to which their motor abilities and overall functioning levels are low (Horvat & Franklin, 2001; Seagraves et al, 2004). Adults with an intellectual disability are also less physically active than the general community (Temple & Walkley, 2003; Emerson, 2005; Stanish et al, 2006) and this contributes to physical and mental health problems (Krahn et al, 2006). Limitations and impediments in motor development (Frey & Chow, 2006; Hartman et al, 2010; Vuijk et al, 2010) cause numerous deficiencies in different domains of functioning and result in lower levels of physical fitness at all stages of life (van de Vliet et al, 2006; Skowronski et al, 2009). For example, some children do not learn how to stand on a single leg until around 6-9 years of age (Sherrill, 2006) and have low cardiovascular and muscular fitness (Pitetti et al, 2013). Individuals with intellectual disabilities performed low on standard fitness tests for the assessment of endurance, strength, flexibility, motor coordination and cardiovascular endurance (Chaiwanichsiri et al, 2000; Graham & Reid, 2000; Guideti et al, 2010). Children with mild intellectual disabilities had lower scores on locomotor skills than children with borderline intellectual disability (Hartman et al, 2010) and typically developing children of the same chronological age (Horvat et al, 1998; Pitetti et al, 2001; Pitteti & Yarmer, 2002).

Children with intellectual disability can achieve acceptable levels of fitness (Pitetti et al, 2000) and can obtain higher performance scores in motor coordination tests (Guideti et al, 2010). However, without regular motor testing, the objective of attaining physical strength or fitness cannot be achieved (Lorenzi et al, 1999; Horvat & Franklin, 2001; Pitetti et al, 2001; Pitetti, 2002). Researchers need to develop well-designed, accessible, preventive health promotion strategies and test interventions that encourage individuals with intellectual disability to initiate and maintain physical activity (Rimmer et al, 1996; Rimmer & Braddock, 2002). Carefully tailored exercise programmes should aim at improving the physical fitness of each child with intellectual disabilities (Golubovic et al, 2012) because the special education they receive has paid relatively little attention to their physical fitness as compared to intellectual functioning in memory, learning, language and in the acquisition of functional skills (Gabler-Halle et al, 1993). Limited opportunities for these children to participate in various movement programmes (Sherrill, 1998) can cause inactivity among children at special schools (Horvat & Franklin, 2001).

Therefore, through the introduction of a specifically planned Aerobic Fitness Programme, the present research aimed to assess the effect of the intervention on different domains of motor proficiency of children with mild and moderate intellectual disabilities. The research questions were:

1. Does an Aerobic Fitness Programme intervention have a significant effect on the motor proficiency of children with mild and moderate intellectual disabilities?
2. Does the Aerobic Fitness Programme intervention have a higher effect on the motor proficiency of children with mild intellectual disabilities than on children with moderate intellectual disabilities?

## **METHOD**

### **Study Setting**

Five special schools in Jammu district of Jammu & Kashmir state, in India, were randomly selected, with a total population of children with mild intellectual disability (N=45, male=30, female =15), children with moderate intellectual disability (N= 58, male =36, female= 22), and children with severe intellectual disability (N= 26, male= 17, female= 09).

### **Study Design**

Pre-test post-test control group design was used in quasi-experimental research where participants fulfilling inclusive and exclusive criteria were placed in either experimental or control groups. Due to limited sample size and complications associated with intellectual disability, randomised matching of children was practically not possible. Hence, to avoid inconvenience, the children were not disturbed from their natural settings; also, this increases the degree of external validity and decreases the likelihood of ethical and conditional concerns. The children with both mild and moderate intellectual disabilities were placed separately in the experimental and control groups, thus forming 4 non-equivalent groups. Differences in these non-equivalent groups were controlled during the estimation of effects of an intervention by using Analysis of Covariance in the data analysis.

## **Ethical Considerations**

Ethical approval was obtained from the Department of Education, University of Jammu, India. Information forms and consent forms were developed in concise and comprehensible language. The study procedure was explained in detail to the legal guardians who then signed the consent forms. Participants were allowed to voluntarily withdraw from the trial at any time during the study.

## **Selection Criteria**

The inclusion criteria were:

- Presence of intellectual disability as per the International Classification of Diseases-10 (WHO, 1992) criteria,
- Children with mild and moderate intellectual disabilities as identified by an IQ test,
- Children from 6 to 17 years of age,
- Children who completed 4-minutes Walk and Hop test for 20 seconds, and who could follow instructions and perform aerobic exercises safely,
- Children attending special schools five days per week for 5 hours a day.

The exclusion criteria included:

- Current symptoms of cerebral palsy, physical disabilities, multiple disabilities, severe behaviour disorders or destructive behaviour,
- Current use of sedative medication,
- Children with severe and profound intellectual disabilities, as they were unable to respond to instructions in the Test of Motor Proficiency.

## **Participants**

Seguin Form Board Intelligence test was administered by the researcher to all the children at 5 special schools of Jammu district to determine their IQ. It was a single-blind experiment. On the basis of their IQ scores, children were categorised as having mild, moderate and severe intellectual disability as per the International Classification of Diseases-10 criteria. Only children with mild and moderate intellectual disability were selected for the study. The selected children were given the Walk and Hop test, performed indoors on a flat and hard surface.

The children were encouraged to walk for 4 minutes and hop for 20 seconds. Those who completed the Walk and Hop test were then placed in control and experimental groups as per the research design. Sixty-six children were placed in the control and experimental groups, thus forming 4 groups (Table 1).

**Table 1: Distribution of Children with Mild and Moderate Intellectual Disabilities selected for Aerobic Fitness Programme intervention**

Type of Disability	Group	Male	Female	Total
Mild	Control	04 (4*)	09(8*, 1**)	13
Mild	Experiment	13 (11*, 2***)	05 (5*)	18
Moderate	Control	12 (8*,1**, 3***)	08 (5*,1**, 2 ***)	20
Moderate	Experiment	11(9*, 2***)	04 (4*)	15
Total		40	26	66

\* Children with intellectual disabilities

\*\* Autistic

\*\*\* Down Syndrome

In the control group, 66.7% of the sample represented the urban area whereas 33.3% represented the rural area. In the experimental group, 42.4% of the sample represented the urban area whereas 57.6% represented the rural area. Thus, a total of 54.5% of the sample belonged to the urban area and 45.5% of the sample belonged to the rural area.

### Instruments

1. Seguin Form Board Test (Goel & Bhargava, 1990) was used to assess intelligence quotient (IQ) through visual discrimination, matching, speed, accuracy, eye-hand coordination and visual-motor skills. It consists of ten geometrically shaped wooden blocks and a large form board with recessed corresponding shapes. The children were asked to match wooden blocks on the form board and place them on their corresponding shapes. Test-retest was done after a time interval of 20 days so as to check the reliability of the scale  $r(25) = 0.81$ .
2. Socio-economic Status Scale (Meenakshi, 2004) was used to assess socio-economic status of Indian children under four domains: finance, property,

education and social status. It is a standardised point-scale, with points ranging between 3 and 10 depending upon the component of the variable under assessment. For testing validity, test-retest was done by the researcher  $r(35) = .81, p < .01$  with a time interval of 30 days.

3. Investigators devised Test of Motor Proficiency with 38 items that assessed fine and gross motor skills of children with mild and moderate intellectual disability. The scale assessing seven domains of motor proficiency was administered to a sample of 60 children with mild and moderate intellectual disability, from different special schools of the Jammu district. The overall mean for all the domains was  $M = 53.95, SD = 10.73$ . The measures of reliability were calculated by Cronbach's alpha, for  $N = 60$  which was  $.823$ , indicating very good reliability. Test-retest reliability was calculated for the  $N = 60$  sample, which was evaluated at intake and again after a mean duration of 4.5 months ( $r(58) = .78, p < .01$ ) indicating good test-retest reliability.

### **Aerobic Fitness Programme**

The programme aimed to improve motor proficiency and positive motivational strategies towards physical fitness. The final version of the intervention module was finalised after getting feedback from the caretakers, Heads of institutions, and teachers. To enable replication of the intervention programme, the investigators used the TIDieR checklist and guide (Hoffmann, 2014). Activities were performed under the supervision of two instructors who were initially trained for a few days by the physical instructor, as the programme did not require any special or complex training procedures. Supervision was provided through weekly meetings between instructors and investigators.

### **Teaching Strategies**

Instructors followed teaching strategies adopted from Applied Behaviour Analysis such as verbal instructions, modelling of the desired skill, role-playing, prompting (clueing, physical prompt, verbal prompts), rewards (primary rewards, social rewards, material rewards, activity rewards and privileges) and feedback. The activity selected was modelled by the instructor and then each child was motivated to role-play, which was helpful in engaging children's interest and provided opportunities for practice and feedback. Prompting helped children with intellectual disabilities to learn specific target behaviour. After every activity, the child was rewarded so that the behaviour was repeated. The

instructors did not criticise the children who failed to understand a particular skill; instead, they modelled the desired skill accurately once again and practised it with the children, while continuing to praise their efforts.

### Time Schedule

Each activity was allotted a total of 90 minutes. A 90-minute session included 45 minutes for activities and 45 minutes for instructions, break, relaxation and review. At the start of the session, there was 10 minutes for motivating and instructing children, 5-10 minutes for each activity, a break of 5 minutes in between every activity, 10 minutes for relaxation at the end, and 10 minutes for review. All the experimental conditions were carried out during school hours, five days a week for six months. Schedule of Aerobic Fitness Programme is listed in Table 2.

**Table 2: Schedule of Aerobic Fitness Programme**

No.	Aerobic Fitness Activities	Time (min.)	Frequency
1.	Walking (outdoors)	10	5 days/week
2.	Running/jogging (outdoors)	05	5 days/week
3.	Jumping rope (outdoors)	10	3 days/week
4.	Stationary cycle riding (indoors)	10	4 days/week
5.	Dance on aerobic exercises with music (indoors)	10	4 days/week

### Intervention Fidelity

Instructors implemented the programme as planned but were flexible to individual needs. All the instructors adhered to a single training protocol to ensure standardised delivery of the training across schools. In addition, the investigators observed the first two training sessions in each school and provided feedback to further standardise the intervention. The intervention programme was evaluated against the checklist that was framed with the intervention programme module. This ensured that the instructors covered important activities on time and reasons were recorded if there were any lapses.

### Procedure

Data on the Socio-economic Status Scale was collected from the parents/guardians of selected children with mild and moderate intellectual disabilities during the

parent-teacher meeting. Test of Motor Proficiency (pre-test) was administered to the control and experimental groups by the researchers with the help of the teachers/instructors/caretakers of the school, and the scores were recorded on the scoring sheet. The intervention was introduced sequentially for six months to the experimental groups, and the children in the control groups continued with their everyday activities without involvement in any additional physical activity during the experimental treatment. Test of Motor Proficiency was administered again as a post-test after the completion of the intervention programme on both the control and experimental groups.

### Statistical Analysis

Statistical analysis of the data obtained with different scales was performed using the Statistical Package for Social Sciences, version 16.0 for Windows (Pallant, 2007).

## RESULTS

### Sample Characteristics

Characteristics of the participating children with intellectual disabilities (Age and IQ) and their socio-economic status are shown in Table 3.

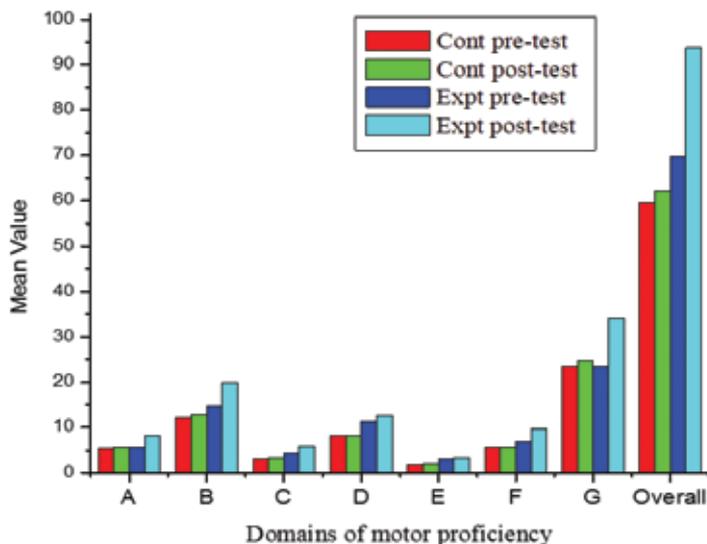
**Table 3: Characteristics of Children with Mild and Moderate Intellectual Disabilities (Age, Intelligence Quotient and Socio-economic Status) selected for Aerobic Fitness Programme intervention**

Type of Status Disability	Group	N	Age (yrs)		IQ		Socioeconomic (percentage)
			Mean	SD	Mean	SD	
Mild	Control	13	11.71	3.03	56.84	4.14	23 (A), 69 (BA), 08 (P)
	Experiment	18	14.09	3.02	58.32	3.94	39 (A), 56 (BA), 05 (P)
Moderate	Control	20	11.83	2.64	41.82	3.13	35 (A), 45 (BA), 20 (P)
	Experiment	15	12.15	2.69	41.99	3.29	07 (A), 40 (BA), 53 (P)

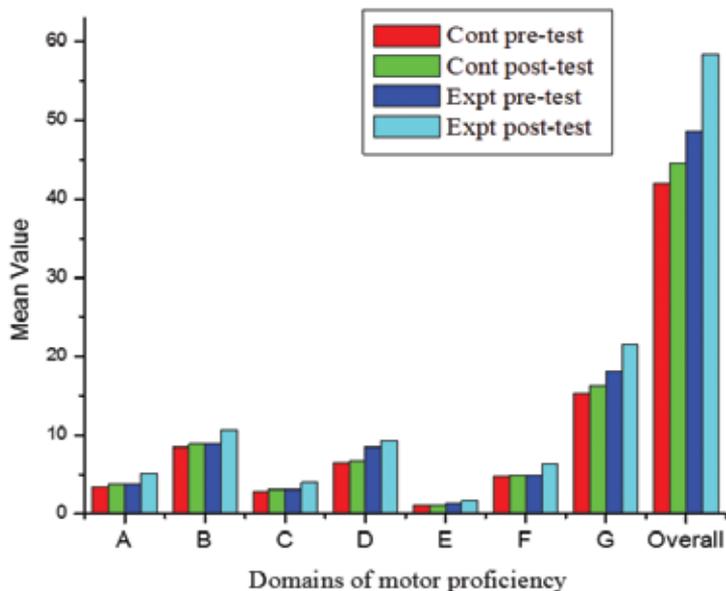
A=Average, BA= Below Average, P= Poor

The comparison of mean pre-test and post-test scores of different domains of the control and experimental groups of children with mild and moderate intellectual disabilities are represented in Figures 1 and 2.

**Figure 1: Comparison between Pre-test and Post-test Scores of Control and Experimental Groups of Children with Mild Intellectual Disability on the Test of Motor Proficiency**



**Figure 2: Comparison between Pre-test and Post-test Scores of Control and Experimental Groups of Children with Moderate Intellectual Disability on the Test of Motor Proficiency**



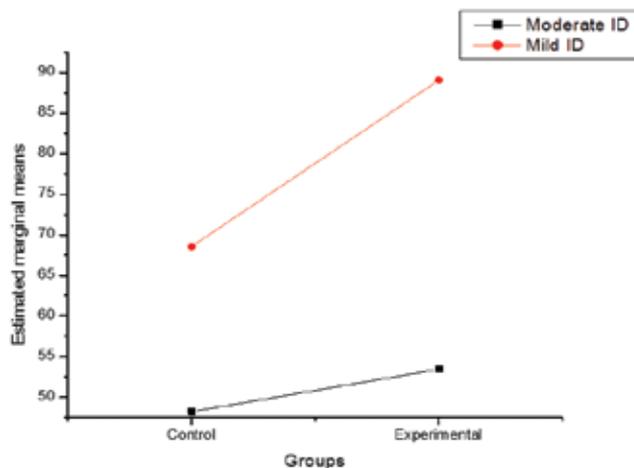
The pre-test scores of children with mild intellectual disabilities were higher than those of the children with moderate intellectual disabilities, which indicated that children with mild intellectual disabilities have better motor skills than children with moderate intellectual disabilities on different domains of motor proficiency. Similar results were demonstrated among children with moderate intellectual disabilities on different domains of motor proficiency. On comparing the results of mean scores of children with mild and moderate intellectual disabilities, it was found that the children with mild intellectual disabilities had higher post-test scores (mean) in the experimental group as compared to children with moderate intellectual disabilities on all the domains of motor proficiency.

**Table 4: Summary of ANCOVA of Motor Proficiency by considering Pre-motor Proficiency as a Covariate on Test of Motor Proficiency**

Type of Disability		Sum of Squares	df	Mean Square	F	Effect Size
Mild	Contrast	2171.80	1	2171.80	312.135*	.918
	Error	194.82	28	6.958		
Moderate	Contrast	190.37	1	190.37	22.540*	.413
	Error	270.27	32	8.44		

\* Significant at 0.01 level

**Figure 3: Graphical Representation of Estimated Marginal Mean of Post-test of Children with Mild and Moderate Intellectual Disabilities as measured on the Test of Motor Proficiency**



Results of ANCOVA of children with mild intellectual disabilities ( in Table 4) indicated that adjusted  $F(1, 28) = 312.13$ ,  $p = .00$  is significant at .01 level which shows that adjusted mean scores of motor proficiency of the experimental and control groups differ significantly. The adjusted mean score of Test of Motor Proficiency of the experimental group was 89.03, which is significantly higher than the adjusted mean score of the control group which was 68.56. Covariates appearing in the model were evaluated at the pre-test 65.45. Similarly, results of ANCOVA of children with moderate intellectual disabilities(in Table 4) indicated that adjusted  $F(1, 32) = 22.54$ ,  $p = .00$  is significant at .01 level, which shows that adjusted mean scores of motor proficiency of the experimental and control groups differ significantly. The adjusted mean score of Test of Motor Proficiency of the experimental group was 53.44, which is significantly higher than the adjusted mean score of the control group which was 48.22. Covariates appearing in the model were evaluated at the pre-test 44.82. These findings answered the first research question as the results demonstrated positive significant effects of the Aerobic Fitness Programme intervention on children with mild and moderate intellectual disabilities.

**Table 5: Results of Analysis of Covariance on different Domains of Test of Motor Proficiency of Children with Mild and Moderate Intellectual Disabilities**

Type of Disability		Domains	df	F	p	Effect Size
Mild	A	Visual motor control	1,28	119.61*	.000	.810
	B	Upper limb speed and dexterity	1,28	69.70*	.000	.713
	C	Running speed	1,28	19.55*	.000	.411
	D	Balance	1,28	13.77*	.001	.330
	E	Bilateral coordination	1,28	1.84	.186	.062
	F	Strength	1,28	14.65*	.001	.343
	G	Upper limb coordination	1,28	10.82*	.000	.882

Moderate	A	Visual motor control	1,32	22.25*	.000	.410
	B	Upper limb speed and dexterity	1,32	45.62*	.000	.588
	C	Running speed	1,32	5.64**	.024	.150
	D	Balance	1,32	1.01	.322	.031
	E	Bilateral coordination	1,32	3.72	.062	.104
	F	Strength	1,32	17.19*	.000	.349
	G	Upper limb coordination	1,32	10.82*	.002	.253

\* Significant at 0.01 level

\*\* Significant at 0.05 level

Results in Table 5 indicate that intervention in Aerobic Fitness Programme produced significant changes in the domains of visual motor control, upper limb speed and dexterity, running speed and agility, balance, strength, and upper limb coordination of children with mild intellectual disabilities; however their control group did not show any significant difference on these domains of the Test of Motor Proficiency. Among children with moderate intellectual disabilities, intervention in Aerobic Fitness Programme produced significant changes in the domains of visual motor control, upper limb speed and dexterity, running speed and agility, strength, and upper limb coordination; however their control group did not show any significant difference on these domains as measured on the Test of Motor Proficiency. Children with both mild and moderate intellectual disabilities did not show any significant change in bilateral coordination. Since a significant difference was found in the adjusted mean scores of motor proficiency of the control and experimental groups, the effect size was also calculated. The effect size for intervention in Aerobic Fitness Programme was .918 for the children with mild intellectual disabilities and .413 for the children with moderate intellectual disabilities, which indicated a small effect of the intervention (Table 4). After comparing the effect size of intervention in Aerobic Fitness Programme for the children with mild and moderate intellectual disabilities on all the domains of motor proficiency, a higher effect size of the intervention was found among the children with mild intellectual disabilities as compared to children with moderate intellectual disabilities. This answers the second research question.

## DISCUSSION

The influence of Aerobic Fitness Programme on fine and motor skills of children with intellectual disabilities has been widely investigated in western countries but there is little evidence-based research in India. The present study is an effort to highlight beneficial effects of the Aerobic Fitness Programme intervention on children with intellectual disabilities in India.

There have been studies similar to the present research. The effects of water exercises and swimming on the physical fitness of nine trainable and seven educable male children with intellectual disabilities was studied by Yilmaz et al (2009), and pre-test and post-tests measurements reported significant improvement ( $p < 0.05$ ) in muscle endurance, speed, static balance, and agility. Data analysis indicated a significant difference between pre-test and post-test mean scores of all children with intellectual disabilities including both males and females in terms of perceptual-motor capabilities (Ameri, 2012). The effects of carefully designed physical exercise programmes on the physical fitness of children with intellectual disabilities and typically growing children were studied through Eurofit Test Battery and the results indicated that children with intellectual disabilities score lower on physical fitness tests than typically developing children even after exercise participation (Golubovic et al, 2012). The efficacy of a peer-guided aerobic exercise, weight training, and stretching activities for increasing health-related physical fitness among adolescents with intellectual disabilities for one-hour exercise sessions, 2 days a week for 15 weeks, in a pre- and post-test fitness testing, indicated significant improvements in curl-ups, and 6-minute walk (Stanish & Temple, 2012).

In a study by Top, (2015), methodology similar to the present research was adopted where Bruininks–Oseretsky Test of Motor Proficiency (BOT-2) was performed on thirty individuals with mild intellectual disabilities between 15-18 years of age, as pre-test and post-test, to determine the effect of swimming exercise (aerobic exercise) on motor development level in adolescents with intellectual disabilities and the results observed no statistically significant difference between pre-test and post-test on upper limb coordination, manual dexterity, speed and agility, and upper limb coordination was observed, but in fine motor precision, fine motor integration parameters, bilateral coordination parameter, balance parameter and strength, a significant statistical difference was found ( $p < .05$ ). Regularly applied exercise programmes improve the quality of life of individuals with mild intellectual disability through contributing

to their motor development level (Top, 2015). It was also proved that regular physical education or a training programme under expert supervision can have a fundamental effect on the standard of fitness in children and young people with mild intellectual disability (Chantias et al, 1998; Yilmaz et al, 2002). A programme of planned physical exercise contributed to the development of abilities enabling successful performance of motor tasks, strength, coordination of upper and lower limbs, movement control, equalisation and regulation of muscle tone and spatial orientation (Golubovic et al, 2012).

In the present research, it is inferred that the Aerobic Fitness Programme, with different teaching strategies adopted from Applied Behaviour Analysis, is a practical, feasible and effective intervention tool for improving motor proficiency of children with intellectual disability in a special school setting. Hence, the programme with healthy exercises has positive fitness effects on people with intellectual disability, as concurred by Wu et al, 2010.

To improve the motor skills of children with intellectual disabilities, developing countries need to promote their participation in interventions such as the Aerobic Fitness Programme. The activities in this programme are safe and cost-effective as they are simple exercises which do not require expensive equipment. Skipping ropes and stationary cycles are usually available with the special schools, and service providers can be trained on instructional strategies and safety measures. Even the walking programme is a cost-effective and convenient physical activity for individuals with intellectual disability as seen in studies by Stanish & Draheim, (2005) and Jones et al, (2007).

The introduction of the exercise programme into the daily curriculum of children with intellectual disabilities at special schools can reduce inactivity caused by classroom-based teaching. Participation in exercise programmes has been associated with the decrease of frequency of challenging behaviours and increase in alertness and quality of life, which reflects the necessity of exercise and physical activities in the special education programme (Jones et al, 2007).

This programme could also be introduced in inclusive education schools as it would help children with intellectual disabilities to integrate with the typically developing children.

### **Limitations**

The current research called for testing of motor proficiency within a limited

time. This could have created anxiety among the participating children. Children perform better when they are familiar with the trainer or tester, and it was difficult to control factors such as lack of interest in the Aerobic Fitness Programme intervention and motivation level of children during the testing. Furthermore, the results could not pinpoint the reason for no improvement in motor skills at different levels of intellectual functioning after training. Further monitoring was required for this. Also, there was no follow-up after the post-test as the critical aspect of physical education programmes is that children are unwilling to introduce activities into their lifestyle after completion of the programme.

These limitations could be addressed in future research. Researchers could use qualitative techniques to assess the impact of Aerobic Fitness Programmes and also study its effect on the academic achievements and behaviour disorders of children with intellectual disabilities.

## ACKNOWLEDGEMENT

The authors thank the Heads of the special schools, staff and children for their unconditional cooperation during the data collection and experimental intervention. Sincere thanks also to the experts who reviewed the intervention module. The authors did not receive any financial support or sponsorship.

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