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Original Research Article

Effectiveness of Physical Fitness Training in Students with Disabilities

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ABSTRACT

Background and Objective: Inadequate physical fitness is a major problem affecting the function and health of students with disabilities. The purpose of the study was to describe the effectiveness of Physical fitness training program in students with disabilities.
Method: For the study Pre-experimental - one group pre and posttest design, Prospective Interventional Method was used. 37 students, 16 to 25 years of age with physical and developmental disabilities from Al Noor Training Centre for Persons with Disabilities in Dubai, UAE participated in a 10 week fitness training held 3 times per week followed by a 2 week home exercise program. Body Mass Index, Energy Expenditure Index and Modification of the Rockport fitness walking test were measured at 3 different time points : T1-before the onset of the physical fitness training, T2-at the end of the physical fitness training and T3-after the completion of home exercise program. Statistical analysis of the data was done with dependent 't- test'.
Results: The results showed a significant difference in Body Mass Index and Modification of the Rockport fitness walking test at training period. The majority of improvements in walking efficiency, and function occurred during the training at 5% level of significance.
Conclusion: Considering the statistical data analysis, clinical observation and the parental feedback the program adherence was high during the training period than the home program. The study concluded that Physical fitness training program had a beneficial effect on the measured parameters.
Key words: Physical fitness, Disabilities, Exercise Training, Body Mass Index, Energy Expenditure Index, Rockport fitness test

INTRODUCTION

The World Health Organization (WHO) and the World Bank estimate that more than a billion people live with some form of disability, which equates to approximately 15% of the world's population. Among these, between 110 million (2.2%) and 190 million (3.8%) adults have very significant difficulties in functioning. [1]

According to the World Health Organization (2010), children with disabilities have the same activity requirements as children without disabilities. All children need to accumulate 60 minutes or more of moderate vigorous intensity activity throughout the day (World Health Organization, 2012).

According to the Healthy Children 2010 report, people with disabilities are less likely to participate in sustained or vigorous exercise than people without disabilities. Children with chronic diseases are among the least active subgroup of children and are at additional risk for a variety of health conditions associated with a sedentary

lifestyle. Regular physical fitness activity throughout life is encouraged as being important for preventing diseases and promoting physical and emotional well-being. [2] Children with disabilities tend to be weaker and more susceptible to early fatigue than their peers. They have higher metabolic, cardio respiratory and mechanical costs of mobility, which cause early fatigue and decreased exercise performance. [3] Strength (force generating capacity of muscle) training and endurance training are components of physical fitness that may prevent secondary disorders, lower energy costs of movement and enhance quality of life for children with disabilities. [4]

The amount of time that youths spend in physical activity has decreased markedly over the past decades. Children with disabilities are at even greater risk for decreased activity and fitness levels. [2]

For children with disabilities, the direct benefits of a fitness program include improved participation in daily living activities, increased strength and cardiovascular fitness, improved self-esteem and improved social competence. The indirect benefits may include decreased pharmacological and surgical interventions, improved independence with activities of daily living and decreased likelihood of secondary conditions. [3]

The American College of Sports Medicine (ACSM) recommends 30 minutes of moderate intensity aerobic exercise 3-4 times a week for children with and without disabilities (2010). The benefits of physical activity are universal for all children, including those with disabilities. Children with disabilities who participate in sports and recreational activities have opportunities that promote inclusion, minimized conditioning, optimize physical functioning, and enhance overall well-being (Murphy, Carbone, and the Council on Children with Disabilities, 2008). [5]

METHODOLOGY

For the study Pre-experimental - one group pre and posttest design, Prospective Interventional method was used. Thirty seven students with physical and other developmental disabilities between the ages of 16 and 25 years [6] participated in a physical fitness program. The students were selected based on GMFCS Level I and II [7] (Level I – can walk indoors, outdoors and climb stairs without using hands for support, can perform usual activities such as running and jumping, has decreased speed, balance and coordination. Level II – can climb stairs with a railing, has difficulty with uneven surfaces, inclines or in crowds, has only minimal ability to run or jump.) [8] The Data collection was started after obtaining the Medical Clearance Certificate from the Registered Medical Practitioner and Informed consent from the Parents or Guardians. The Medical histories of these students were also reviewed to determine whether they had any exercise restrictions. None of the children had a medical or surgical procedure in the prior 6 months of the start of this program or during the Physical fitness program. [4]

Examination

The initial examination was completed before the intervention. To familiarize students with testing and to establish a stable estimate of each student's abilities, measurement were taken 3 times and then averaged. The first intervention consisted of an exercise program 3 times per week for 10 weeks [9] and was followed by a 2 weeks home program consisting of written home exercises. Energy Expenditure Index, Body Mass Index and Modification of the Rockport fitness walking test were measured at 3 different time points: T1 (before the onset of the physical fitness training), T2 (at the end of the physical fitness training) and T3 (after the completion of home exercise program).

Intervention: Physical Fitness Program

The exercise sessions held for 45 min, 3 times per week, for 10 weeks. The Physical fitness program included a 5

minutes of warm-up, 15-20 minutes of exercise training, 15-20 minutes of aerobic training and 5 minutes of cool down. [4] The warm-up exercises was free general body exercises such as arm circles, marching and leg kicks etc.

Exercise training was done for muscles of upper limbs, lower limbs and trunk such as leg press, leg extensions, prone leg curls, arm curls, pectoral fly, lateral pull, real deltoid fly, shoulder press, back extension and abdominal curls using the multi-gym equipment's. For the first exercise session, students started with 6 repetitions and increased by 2 repetitions per week until they reached 15 repetitions. The amount of weight lifted was determined by data from the strength testing and by using a 6-repetition maximum. For the first week, the students started with 5 activities, and over a 3-week period, they progressed to completing all 10 activities. The weights, repetitions, and number of activities were decided according to recommended guidelines. [4]

For aerobic training, students were used a static cycle, cross trainer and treadmill. The aerobic training period was 10 minutes for the first week and progressed to 20 minutes by the end of the third week. The target heart rate intensity started at 50% to 60% maximum heart rate and increased each week so that the students were at 75% to 80% maximum heart rate by week 5. We used recommendations from the American College of Sports Medicine to design an aerobic program intensity that would be tolerated by students with low fitness levels. [4] The maximum heart rate was calculated using the following formula: Maximum Heart rate = 220 – Age. [10]

Cool down activities which consisted of walking at a slow speed on the treadmill for 2 minutes before stopping or one to two laps around the gym or slow movement activities in a standing position, followed by stretching were incorporated based on individual students capability of doing these task.

Protocol			
Exercises	**Duration**	**Frequency**	**Intensity**
A. Physical Fitness Program	45 min	3 times/week	10 weeks
1. Warm up Exercises	5 min		
2. Exercise Training	15 – 20 min		
3. Aerobic Training	15 – 20 min		
4. Cool down Exercises	5 min		
B. Home Program	45 min	3 times/week	2 weeks

Physical Fitness Program: Exercise Training			
Weeks	**Activities**	**Repetitions**	**Weight**
Week 1	5	6	6 repetition max
Week 2	7	8	
Week 3	10	10	
Week 4	10	12	
Week 5	10	15	
Week 5 - 10	10	15	

Physical Fitness Program: Aerobic Training			
Weeks	**Equipment's**	**Duration**	**Target Heart Rate (HR)**
Week 1	Treadmill/Static cycle/ Cross Trainer	10 min	50% – 60% of Max HR
Week 2		15 min	55% – 65% of Max HR
Week 3		15 - 20 min	60% – 70% of Max HR
Week 4		15 - 20 min	65% – 75% of Max HR
Week 5		15 - 20 min	75% – 80% of Max HR
Week 5 - 10		15 - 20 min	75% – 80% of Max HR

Home Program: The students were given written home physical fitness exercise program which consists of warm-up, exercise training, aerobic training and cool-down activities. The

Program frequency of 3 times per week was chosen because it was the same as that in the intervention program, for 2 weeks period. The activities were similar to the activities that were done in the intervention

program. For a record of home program adherence, the parents were given home program recording flow sheet and parental feedback form.

Outcome Measurements:

Body Mass Index (BMI): It is a measure of body composition. BMI is calculated by taking a student weight and dividing by their height. BMI was calculated by using the following formula BMI = weight/height (kg/m^2). [11]

Energy expenditure index: Walking efficiency was measured using the energy expenditure index (EEI). After 3 minute sitting rest period, a resting heart rate (HR) was recorded. Students walked continuously for 3 minutes. A working HR and the distance covered in the 3 minutes were recorded. EEI was calculated using the following formula: (Working HR – Resting HR)/Speed. The EEI, which uses HR to evaluate the energy cost of walking. [12]

Modification of the Rockport fitness walking test: To estimate maximum oxygen consumption (VO_2 max), Modification of the Rockport fitness walking test was used. Students were made to walk on the treadmill for 400 meters with slow to brisk pace. The duration and HR was recorded. Modification of the Rockport fitness walking test was calculated using the following formula: 132.853 – (0.0769 x weight) – (0.3877 x Age) + (6.315 x Gender) – (3.2649 x time) – (0.1565 x Heart rate). [13]

Statistical Analysis:

To determine whether physical fitness of students had improved or declined, we calculated for those outcome variables with available test retest data. The minimal detectable change is the magnitude of change over and above measurement error of 2 repeated measures at a specified confidence level.

Descriptive statistical analysis was carried out in the present study. Outcome measurements analyzed are presented as mean ± SD. Significance is assessed at 5 % level of significance with p value was set at 0.05 less than this is considered as statistically significant difference. Dependent 't' test as a parametric and Kolmogorov Smirnov test as a non-parametric test have been used to analysis the variables. The Statistical software namely SPSS 25.0 was used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

RESULT

The outcomes for T1 (before the onset of the physical fitness training), T2 (at the end of the physical fitness training) and T3 (after the completion of home exercise program) are summarized in the tables and figures. After the physical fitness program all of the students made improvements in 2 (BMI and MRFWT) of the measured outcomes. Minimal declination of physical fitness were recorded at T3 (after the home exercise program) in 3 (BMI, EEI and MRFWT) of the measured outcomes.

Body Mass Index (BMI)

Table 1: Normality of BMI scores at different time points by Kolmogorov Smirnov test

Time points	Z-value	p-value
Week 0	0.5330	0.9390
Week 10	0.6660	0.7670
Week 12	0.5990	0.8650
Week 0 - Week 10	0.8610	0.4480
Week 0 - Week 12	0.8520	0.4630
Week 10 - Week 12	0.7160	0.6840

Note: BMI scores at different time points follow a normal distribution. Therefore, the dependent t test was applied.

Table 2: Comparison of Week 0, Week 10 and Week 12 with respect to BMI scores by dependent t test

Time points	Mean	Std.Dv	Mean Diff.	SD Diff.	% of change	Paired t	p-value
Week 0	27.87	6.55					
Week 10	27.15	6.68	0.73	1.40	2.61	2.7552	0.0104*
Week 0	27.87	6.55					
Week 12	27.47	6.73	0.41	1.45	1.47	1.4896	0.1479
Week 10	27.15	6.68					
Week 12	27.47	6.73	-0.32	0.50	-1.18	-3.3709	0.0023*

*p<0.05

From the results of the above table, it can be seen that,

A significant difference was observed between Week 0 and Week 10 time points with respect to BMI scores (t=2.7552, p<0.05) at 5% level of significance. It means that, a significant change/decrease was seen in BMI from Week 0 to Week 10 (2.61%).

Non-significant difference was observed between Week 0 and Week 12 time points with respect to BMI scores (t=1.4896, p>0.05) at 5% level of significance. It means that, a non-significant change/decrease was seen in BMI from Week 0 to Week 12 (1.47%).

A significant difference was observed between Week 10 and Week 12 time points with respect to BMI scores (t=-3.3709, p<0.05) at 5% level of significance. It means that, a significant change/increase was seen in BMI from Week 10 to Week 12 (1.18%).

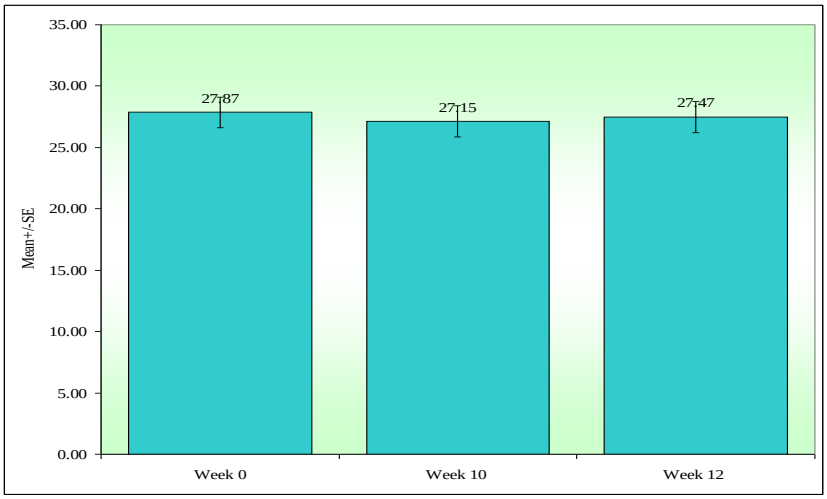

Figure 1: BMI

Energy Expenditure Index (EEI)

Table3: Normality of Energy Expenditure Index scores at different time points by Kolmogorov Smirnov test

Time points	Z-value	p-value
Week 0	0.4840	0.9730
Week 10	0.6630	0.7710
Week 12	0.9970	0.2730
Week 0 - Week 10	0.5840	0.8850
Week 0 - Week 12	0.7370	0.6490
Week 10 - Week 12	1.0650	0.2060

Note: Energy Expenditure Index scores at different time points follow a normal distribution. Therefore, the dependent t test was applied.

Table 4: Comparison of Week 0, Week 10 and Week 12 with respect to Energy Expenditure Index scores by dependent t test

Time points	Mean	Std.Dv.	Mean Diff.	SD Diff.	% of change	Paired t	p-value
Week 0	0.59	0.35					
Week 10	0.44	0.24	0.15	0.45	24.97	1.7297	0.0951
Week 0	0.59	0.35					
Week 12	0.49	0.31	0.09	0.36	15.70	1.3576	0.1858
Week 10	0.44	0.24					
Week 12	0.49	0.31	-0.05	0.39	-12.35	-0.7398	0.4658

*p<0.05

From the results of the above table, it can be seen that, Non-significant difference was observed between Week 0 and Week 10 time points with respect to EEI scores (t=1.7297, p>0.05) at 5% level of significance. It means that, a non-significant change/decrease was seen in EEI from Week 0 to Week 10 (24.97%).

Non-significant difference was observed between Week 0 and Week 12 time points

with respect to EEI scores (t=1.3576, p>0.05) at 5% level of significance. It means that, a non-significant change/ decrease was seen in EEI from Week 0 to Week 12 (15.70%).

Non-significant difference was observed between Week 10 and Week 12 time points with respect to EEI scores (t=-0.7398, p>0.05) at 5% level of significance. It means that, a non-significant change/ increase was seen in EEI from Week 10 to Week 12 (12.35%).

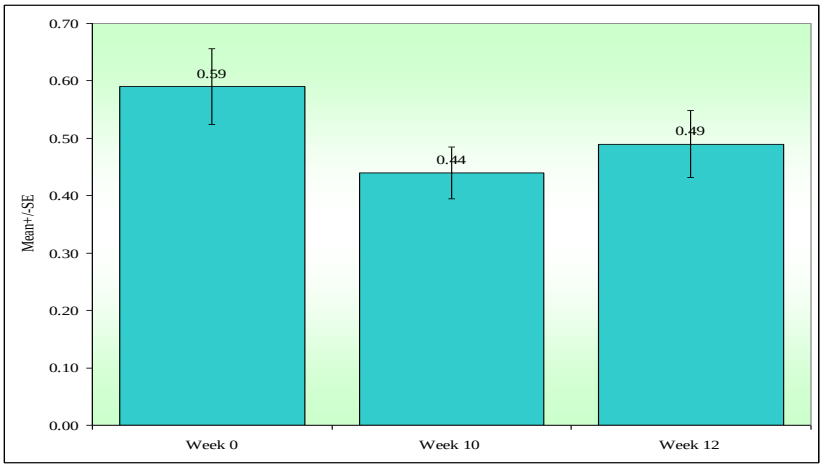

Figure 2: EEI

Modification of the Rockport fitness walking test (MRFWT)

Table 5: Normality of Modified Rockport fitness walking test scores at different time points by Kolmogorov Smirnov test

Time points	Z-value	p-value
Week 0	0.4990	0.9650
Week 10	0.5610	0.9110
Week 12	0.9830	0.2880
Week 0 - Week 10	0.6420	0.8040
Week 0 - Week 12	0.6250	0.8300
Week 10 - Week 12	0.8820	0.4190

Note: Modification of the Rockport fitness walking test scores at different time points follow a normal distribution. Therefore, the dependent t test was applied.

Table6: Comparison of Week 0, Week 10 and Week 12 with respect to Modified Rockport fitness walking test scores by dependent t test

Time points	Mean	Std.Dv.	Mean Diff.	SD Diff.	% of change	Paired t	p-value
Week 0	-36.18	32.78					
Week 10	-10.03	27.70	-26.15	25.71	72.28	-5.3819	0.0001*
Week 0	-36.18	32.78					
Week 12	-12.51	32.63	-23.67	32.89	65.43	-3.8085	0.0007*
Week 10	-10.03	27.70					
Week 12	-12.51	32.63	2.48	24.89	-24.72	0.5272	0.6024

*p<0.05

From the results of the above table, it can be seen that,

A significant difference was observed between Week 0 and Week 10 time points with respect to Modification of the Rockport fitness walking test scores (t=-5.3819, p<0.05) at 5% level of significance. It means that, a significant change/increase was seen in Modification of the Rockport fitness walking test from Week 0 to Week 10 (72.28%).

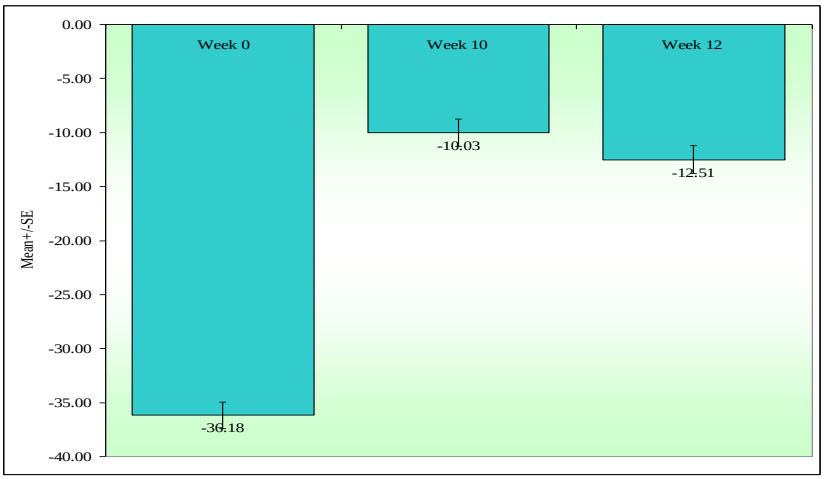

Figure 3: MRFWT

A significant difference was observed between Week 0 and Week 12 time points with respect to Modification of the Rockport fitness walking test scores ($t=-3.8085$, $p<0.05$) at 5% level of significance. It means that, a significant change/increase was seen in Modification of the Rockport fitness walking test from Week 0 to Week 12 (65.43%).

Non-significant difference was observed between Week 10 and Week 12 time points with respect to Modification of the Rockport fitness walking test scores ($t=-0.5272$, $p>0.05$) at 5% level of significance. It means that, a non-significant change/decrease was seen in Modification of the Rockport fitness walking test from Week 10 to Week 12 (24.72%).

DISCUSSION

Inadequate physical fitness is major problem affecting the function and health of students with physical and other developmental disabilities. Lack of optional physical activity may contribute to development of secondary conditions such as chronic pain, fatigue and osteoporosis. The number of physical fitness programs designed specifically for students with disabilities is limited.

The results of this physical fitness program support the work of previous studies that indicates that youths with physical and other developmental disabilities. Nine of the Thirty seven students have not completed the physical fitness program due to lack of attendance in non-compliance to wear prescribed uniform, few students got withdrawn from the center and few students went early for the vacation. During the physical fitness program, the majority of students spent an average of 40 minutes training. Ten parents reported that it was difficult to get the students to do the exercises at home. Most parents reported that their child did not perform the formal exercises.

Maria A Fragala-Pinkham et al (2005) [4] conducted a study on A Fitness Program for Children with Disabilities and observed more improvement in group exercises program than the home program in many of the outcome measures. Connie C Johnson (2009) [2]conducted a study on The Benefits of Physical Activity for Youth with Developmental Disabilities and observed improvement in aerobic capacity, gross motor function, level of participation and parental feedback. Joe Schreiber et al *(*2004) [3] conducted a study on The Implementation of a Fitness Program for Children with Disabilities and demonstrated reduction in energy expenditure index and improvement in maximum running velocity.

The results in our study showed a significant difference in BMI and Modification of the Rockport fitness walking test at training period and non significant difference in EEI and Modification of the Rockport fitness walking test at home program period. The majority of improvements in walking

efficiency, and function occurred during the training.

Limitations of the study:

Control group was not included in our study, to determine whether changes Physical fitness are due to the exercise program, maturation or some other factor.
Follow-up was not done therefore long term effects were not found.

Recommendation for future research:

More studies are needed to identify appropriate training strategies and outcome measures for a wider spectrum of functional impairments (e.g., GMFCS levels III, IV and V).
Modified outcome measures are needed for children with mobility impairments.
Studies are needed to determine the most effective training intensity, duration, and activities.

CONCLUSION

The present study concludes that 10 weeks of Physical fitness training period found significant effective in improvement of fitness levels. This report supports the physical fitness training to improve the physical fitness for these young children with disabilities. Considering the statistical data analysis, clinical observation and the parental feedback the program adherence was high during the training period than the home program.

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