Influence Of Core Stabilization Training On Selected Physical Fitness Variables Among Children With Intellectual Disabilities

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ABSTRACT

The aim of this study was to investigate the effect of a 12-week core stabilization training programme on the selected physical fitness variables in children with intellectual disability. Forty-four male children with intellectual disabilities age range 12–20 years were randomly divided into two groups: the experimental group (n = 22) and the control group (n = 22). The experimental group underwent a core stabilization training programme three times a week for 12 weeks while the control group performed their normal daily activities.

Aerobic capacity, abdominal strength, back muscle strength, upper limb strength and trunk flexibility were the criterion variables. The Brockport Physical Fitness Test battery was used to determine physical fitness. Pre and post test measurements were taken. Descriptive statistics, One-Way Analysis of Variance (ANOVA) and Analysis of Covariance (ANCOVA) (with pre-test scores as covariates) were used to analyse the data.

Results: The results revealed statistically significant improvements in favour of the experimental group in aerobic capacity [$F(1,41) = 37.30$, $p < .001$], abdominal strength [$F(1,41) = 53.80$, $p < .001$], back muscle strength [$F(1,41) = 180.90$, $p < .001$], upper limb strength [$F(1,41) = 39.20$, $p < .001$] and trunk flexibility [$F(1,41) = 15.40$, $p < .001$].

Conclusion: It was concluded that a twelve-week core stabilization training programme is highly effective in improving physical fitness among children with intellectual disabilities. The findings support the integration of core stabilization exercises into adapted physical education and rehabilitation programmes.

Keywords: core stabilization training, intellectual disabilities, physical fitness, adapted physical education

Introduction

Physical fitness is an essential part of all people's health, functional independence and quality of life. Physical fitness is of particular importance for children with intellectual disabilities as it affects their mobility, participation in everyday activities, social interactions and wellbeing. Children with intellectual disabilities consistently have lower levels of physical fitness than children without intellectual disabilities, in terms of cardiorespiratory endurance, muscular strength, muscular endurance, flexibility and motor performance (Winnick, 2021; Auxter et al., 2020).

Several factors have been cited for the lower level of physical achievement among children with intellectual disabilities, such as less participation in physical activity, lower levels of motivation, limited availability of adapted physical education programmes, and limitations in motor competence due to developmental delays. This can be associated with sedentary behaviour, obesity, adverse health and limited functional independence (Shen et al., 2022).

Over the last few years, more and more focus has been placed on the importance of core stability for physical performance. Core stability is the capacity of the muscles of the trunk, pelvis, and lumbar spine to control posture and provide stability for movement. The core musculature (transversus abdominis, multifidus, diaphragm, pelvic floor muscles, and others that stabilize the core) is important in transmitting force, controlling posture and improving movement efficiency (McGill, 2010).

Core stabilization exercises have been used extensively in sports conditioning and rehabilitation programs to enhance the strength, coordination and efficiency of the body's movements. Previous studies have demonstrated positive effects of core stability training on athletic ability, and injury prevention (Zhou et al., 2024; Janbozorgi et al., 2024). However, few studies have focused on the effect of core stabilization exercises on several aspects of physical fitness at the same time in children with intellectual disabilities.

Better core stability could be linked to improved muscle strength, movement mechanics, flexibility and efficiency when engaged in physical activity. Children with intellectual disabilities may be especially vulnerable to these fitness components and improvements in these areas may be especially beneficial. The wider implications of core stabilisation training can help teachers, therapists and rehabilitation professionals to create effective intervention programs.

The Brockport Physical Fitness Test (BPFT) is a standardized, widely used, and validated fitness assessment battery that has been specifically designed for children and youth with disabilities. It is considered to be an appropriate assessment tool to determine the physical fitness status of children with intellectual disabilities and offers reliable measures of health-related physical fitness components.

Therefore, the aim of the present study was to explore the effects of a 12-week core stabilization exercise programme on some physical fitness variables in children with intellectual disability.

Objectives of the Study

The study was designed to determine the influence of a twelve-week core stabilization training programme on the following variables:

1. Aerobic capacity.
2. Abdominal strength.
3. Back muscle strength.
4. Upper limb strength.
5. Trunk flexibility.

Hypotheses

The following null hypotheses were formulated for the study:

H1 : Core stabilization training would significantly improve aerobic capacity among children with intellectual disabilities.

H2 : Core stabilization training would significantly improve abdominal strength.

H3 : Core stabilization training would significantly improve back muscle strength.

H4 : Core stabilization training would significantly improve upper limb strength.

H5 : Core stabilization training would significantly improve trunk flexibility.

Methodology

Research Design

The study employed pre-test and post-test control group design. Participants were randomly assigned to either an experimental group or a control group. Both groups were assessed before and after the twelve-week intervention period.

Participants

A total of forty-four male children with intellectual disabilities participated in the study. Study participants' ages ranged from 12 to 20 years, with a mean age of 16.3 years. The participants were selected from Central Institute on Mental Retardation, Trivandrum. Subjects in the sample were children with mild, moderate and severe intellectual disabilities who were able to follow simple instructions and participate with physical activity.

The experiment was replicated by randomly assigning participants to an Experimental Group (22 participants) and a Control Group (22 participants). Children who had orthopaedic disorders, severe medical conditions or physical impairments which might hinder their exercise participation were excluded from the study.

Training Programme

The experimental group participated in a structured core stabilization training programme for twelve weeks. Training sessions were conducted three times per week, with each session lasting approximately 45–60 minutes. The core stabilization exercise programme comprised the following exercises:

- Bridging exercises
- Front plank
- Side plank
- Crunches
- Russian twists
- Hip crossovers
- Swiss ball knee tucks
- Jackknife exercises
- Inverted hamstring exercises

Each training session included a warm-up (5–10 minutes), core stabilization exercises (30–40 minutes), and cool-down activities (5–10 minutes). Exercise intensity and volume were progressively increased throughout the intervention period in accordance with the principles of overload and progression. The control group did not participate in any structured exercise programme and continued their routine daily activities.

4.4 Criterion Variables and Measurement Tools

The following variables and measurement tools were selected for the study:

Variable	Test	Unit of Measurement	Interpretation
Aerobic capacity	1-mile run/walk	Minutes/seconds	Lower score = better
Abdominal strength	Curl-up test	Number of repetitions	Higher score = better
Back muscle strength	Trunk lift test	Centimeters	Higher score = better
Upper limb strength	Flexed arm hang	Seconds	Higher score = better
Trunk flexibility	Sit and reach test	Centimeters	Higher score = better

Statistical Analysis

The collected data were analysed using SPSS software (Version 25.0). Descriptive statistics, including means and standard deviations, were calculated for all variables. One-Way Analysis of Variance (ANOVA) was employed to determine whether significant differences existed between the experimental and control groups at baseline. Analysis of Covariance (ANCOVA) was used to compare adjusted post-test scores between groups while controlling for pre-test differences, with pre-test scores treated as covariates. The level of significance was set at $\alpha = 0.05$.

Results

Participant Characteristics

All forty-four male participants successfully completed the twelve-week intervention programme. Twenty-two participants were assigned to the experimental group and twenty-two to the control group. No participant withdrew from the study, and no adverse events were reported during the training period.

Baseline Comparability

One-Way ANOVA was conducted on pre-test scores to determine whether significant differences existed between groups prior to the intervention. The results indicated that both groups were generally comparable at baseline. Although a significant difference was observed for abdominal strength (Curl-Up Test), this baseline difference was statistically controlled through ANCOVA, with pre-test scores serving as covariates.

Table 1 : *Descriptive Statistics of Pre-Test and Post-Test Scores*

Variable	Group	Pre-Test Mean	Post-Test Mean
Aerobic Capacity (min)	Experimental	13.0	11.0
	Control	12.0	12.0
Abdominal Strength (reps)	Experimental	10.0	17.0
	Control	6.0	8.0
Back Muscle Strength (cm)	Experimental	8.0	20.0
	Control	6.0	8.0
Upper Limb Strength (sec)	Experimental	0.0	2.0
	Control	0.0	1.0
Trunk Flexibility (cm)	Experimental	−2.0	6.0
	Control	−3.0	0.0

Note : Aerobic capacity is scored in minutes (lower values indicate better performance). All other variables are scored such that higher values reflect better performance.

ANCOVA Results

ANCOVA was conducted to compare adjusted post-test scores between the experimental and control groups after controlling for baseline differences. The results are presented in Table 2.

Table 2 : *Summary of ANCOVA Results for All Criterion Variables*

Variable	F(1,41)	p-value	Partial η^2
Aerobic Capacity (One-Mile Run/Walk)	37.30	< .001	.094
Abdominal Strength (Curl-Up Test)	53.80	< .001	.129
Back Muscle Strength (Trunk Lift Test)	180.90	< .001	.615
Upper Limb Strength (Flexed Arm Hang)	39.20	< .001	.488
Trunk Flexibility (Sit-and-Reach Test)	15.40	< .001	.111

Note : All F-values are significant at $p < .001$. η^2 = partial eta squared (effect size). — indicates value not reported for this variable.

All variables demonstrated statistically significant improvements in favour of the experimental group after adjusting for pre-test scores.

Discussion

Aerobic Capacity

Aerobic capacity was assessed using the One-Mile Run/Walk Test. Following the intervention, the experimental group demonstrated a reduction in average completion time from 13 minutes to 11 minutes, whereas the control group exhibited minimal change. Since lower completion times indicate superior aerobic fitness, this reduction reflects improved cardiorespiratory endurance. ANCOVA revealed a statistically significant between-group difference after controlling for baseline scores, $F(1,41) = 37.28$, $p < .001$. These findings suggest that core stabilization training may improve movement efficiency and reduce energy expenditure during locomotor activities, thereby enhancing aerobic performance.

Abdominal Strength

Abdominal strength was evaluated using the Curl-Up Test. Participants in the experimental group increased their average score from 10 repetitions to 17 repetitions, whereas the control group improved only marginally. ANCOVA demonstrated a significant treatment effect, $F(1,41) = 53.76$, $p < .001$. These findings indicate that core stabilization exercises effectively strengthen the abdominal musculature, leading to improved muscular endurance and trunk stability.

Back Muscle Strength

Back muscle strength was measured using the Trunk Lift Test. The experimental group demonstrated substantial improvement from a mean score of 8 cm to 20 cm, whereas only minor changes were observed in the control group. ANCOVA revealed a highly significant between-group difference, $F(1,41) = 180.93$, $p < .001$, with a large effect size ($\eta^2 = .615$). This finding represents the strongest treatment effect observed in the study and highlights the direct influence of core stabilization exercises on the lumbar extensor musculature.

Upper Limb Strength

Upper limb strength was assessed using the Flexed Arm Hang Test. Most participants were unable to maintain the hanging position at baseline. Following the intervention, the experimental group demonstrated measurable improvements in hanging duration. ANCOVA revealed a significant between-group difference, $F(1,41) = 39.20$, $p < .001$. The results suggest that improved trunk stabilization enhanced postural control and muscular coordination, contributing to better upper-limb performance.

Trunk Flexibility

Trunk flexibility was measured using the Sit-and-Reach Test. The experimental group improved from a mean score of −2 cm to 6 cm, while the control group showed negligible change. ANCOVA demonstrated a significant treatment effect, $F(1,41) = 15.43$, $p < .001$. The findings indicate that participation in core stabilization exercises contributed to improved flexibility of the lower back and hamstring musculature.

General Discussion

The results of this study clearly showed the significant effects of a structured core stability training programme of 12 weeks duration on aerobic capacity, muscular strength and trunk flexibility in children with intellectual disabilities. The improvements seen may be due to improved activation and coordination of the deep stabilizing muscles of the trunk – transversus abdominis, multifidus, diaphragm and pelvic floor muscles. These muscles can be strengthened to provide a stable base of movement, increase inter-segmental force transfer and increase overall movement efficiency.

The enhancement in the aerobic capacity is similar to the results of Shen et al. (2022) who found that adaptive physical activity programmes have positive effects on health-related fitness among adolescents with intellectual disabilities.

One of the most significant results was the significant increase in trunk lift performance, with the largest effect size of all variables ($\square^2$ = .615). This finding indicates that core stabilization training can have a general functional benefit beyond simply improving muscle strength and may play an important role in improving movement competence and daily functioning.

Practical Implications

The findings of this study carry important practical implications for adapted physical education teachers, physiotherapists, rehabilitation specialists, and caregivers working with children with intellectual disabilities. Core stabilization exercises are inexpensive, easy to administer, and require minimal equipment; therefore, they can readily be incorporated into school-based physical education programmes, clinical rehabilitation settings, and home-based exercise programmes. The significant improvements observed across multiple fitness domains suggest that core stabilization training represents a highly efficient intervention capable of simultaneously enhancing strength, flexibility and aerobic fitness in this population.

Limitations

Certain limitations of the present study should be acknowledged. First, the study included only male participants, which limits the generalizability of the findings to females with intellectual disabilities. Second, long-term follow-up assessments were not conducted, making it impossible to determine the persistence of training-induced adaptations following programme completion. Third, Flexed Arm Hang scores exhibited a restricted range because many participants were initially unable to maintain the hanging position; accordingly, upper limb strength findings should be interpreted with some caution. Future investigations should examine larger and more diverse samples, include long-term follow-up assessments, and compare core stabilization training with alternative exercise modalities.

Conclusions

Based on the findings of the present study, the following conclusions were drawn:

1. A twelve-week core stabilization training programme significantly improved aerobic capacity among children with intellectual disabilities.

2. Core stabilization training significantly improved abdominal muscular strength and endurance as measured by the Curl-Up Test.

3. Core stabilization training significantly improved back muscle strength as measured by the Trunk Lift Test.

4. Core stabilization training significantly improved upper limb strength as measured by the Flexed Arm Hang Test.

5. Core stabilization training significantly improved trunk flexibility as measured by the Sit-and-Reach Test.

Overall, the findings demonstrate that a twelve-week core stabilization training programme is an effective intervention for improving multiple components of health-related physical fitness among children with intellectual disabilities. The substantial improvements observed in trunk strength suggest that core stabilization exercises may play a central role in enhancing functional movement capacity and physical performance in this population.

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