

# Effects of an 8-week combined jump rope and walking intervention on physical fitness in students with intellectual disabilities

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## Abstract

**Background and Study Aim** Individuals with intellectual disabilities (ID) face obstacles in performing physical activity. This negatively affects their fitness and quality of life. Therefore, training programs for individuals with ID need to be developed. The present study aims to determine the effects of combining step rope jumping and walking.

**Material and Methods** The study used a two-group pre-test and post-test quasi-experimental design. Thirty students with ID (age = 16.5 ± 1.9 years) participated. They were divided into two groups: an experimental group (n = 15) and a control group (n = 15). The experimental group received an intervention combining step rope jumping and walking. The intensity was 70%–85% of maximum heart rate for 20–30 minutes. The instruments used were sit-and-reach for flexibility, push-ups for chest and arm muscle strength, sit-ups for abdominal strength, back-ups for back strength, and a 1600-meter run/walk for cardiovascular endurance. Data were analyzed using ANCOVA. Assumption testing (normality, homogeneity, and linearity) was conducted before performing ANCOVA.

**Results** The results show  $p < 0.001$ ;  $\eta^2_p > 0.14$ ;  $\text{pholm} < 0.001$ , indicating a significant difference between groups with a large effect.

**Conclusions** An eight-week combined jump rope and walking exercise program for individuals with ID led to improvements in flexibility, chest and arm strength, abdominal and back strength, and cardiovascular endurance. These findings suggest that the intervention can improve physical fitness in this population. The study contributes to knowledge about exercise interventions for individuals with ID. Future research should explore other types of exercise suitable for this group to support their fitness and health.

**Keywords:** disability exercise, intellectual disability, jump rope step, physical fitness, walking

## Introduction

Physical activity contributes to maintaining physical fitness and general well-being, particularly in individuals with developmental conditions. Individuals with intellectual disabilities (ID) often experience challenges in performing physical activities, which may limit their functional capacity and overall health. Although various exercise programs are applied in this population, their relative effectiveness in improving specific components of physical fitness remains a subject of practical interest. The present study aims to determine the effects of combining step rope jumping and walking.

In context, Individuals with intellectual disabilities (ID) often experience reduced levels of physical activity compared to the general population. As a result, they face increased risk of walking difficulties, impaired balance, and various health conditions [1, 2]. These include a higher prevalence of obesity, multimorbidity, and metabolic syndrome, along with more sedentary behavior

in adulthood [3, 4]. One approach to improving mobility in individuals with ID is the introduction of structured motor skill tasks [5]. Gradual increases in physical activity can help reduce sedentary patterns and support functional health. Enhancing physical activity in this population is associated with improvements in fitness, daily functioning, and overall well-being [6, 7, 8]. Since physical fitness influences both productivity and health status [9, 10], regular engagement in physical activity is considered a necessary part of health maintenance and daily performance [11].

Academics have made efforts to provide recommendations for safe physical activities to improve the fitness of people with intellectual disabilities. Yoga has been shown to improve balance, anthropometric parameters, and lung function in individuals with intellectual disabilities (ID) [12]. Strengthening and aerobic exercises given to students with intellectual disabilities have benefits for walking ability, balance, and functional independence [13]. Recreational activities are beneficial and provide health benefits for people with intellectual disabilities [14]. Traditional sports games are considered suitable recreational options for people with intellectual disabilities [15]. Physical

activity in the form of exercise can also improve cognitive abilities in people with disabilities [4]. Several exercise programs tested in previous studies have provided benefits in improving the fitness of students with ID. However, trials of other exercise models need to be conducted to increase the variety of options for people with ID. A range of exercise models can offer alternatives for developing motor skills and physical fitness.

Other exercise models such as jump rope have benefits for developing coordination, strength, agility, and cardiovascular endurance in non-disabled individuals [16]. These benefits may also apply to people with disabilities, once the activity is adapted to inclusive criteria. Jumping rope is a complex movement that requires multisensory coordination, balance, and synchronized movement rhythm [17]. Exercise models that support coordination and balance can help improve both physical fitness and motor skills in students with ID. Meanwhile, other models such as walking are simpler and can improve physical ability and body mass index (BMI) [18, 19]. Combining complex and simple exercise types is one way to make complex activities more manageable for students with ID. Alternating between simple and complex tasks allows rest periods and reduces fatigue caused by repetitive movements. Exercise models for students with ID must take their specific characteristics into account. This helps to achieve training goals and reduce the risk of injury [20]. People with disabilities face higher injury risks due to low strength and balance. For this reason, exercise programs should consider the needs and limitations of this population [21].

Providing exercise programs and using fitness equipment for people with disabilities requires further exploration to ensure safety [2]. Interventions for people with disabilities also require caution [22]. This is due to the limited availability of literature on exercise programs and related equipment for individuals with intellectual disabilities [23].

Analysis of research findings has shown that various physical activity programs can support the development of motor skills, physical fitness, and cognitive functioning in individuals with intellectual disabilities. Researchers emphasize that combining structured and adaptive exercise types may offer additional benefits, especially when tailored to the specific needs of this population. At the same time, there is still a need to continue exploring effective and safe program models. This gap continues to limit the development of accessible and sustainable interventions designed to enhance physical functioning in students with intellectual disabilities. The limited theoretical basis and lack of diverse exercise alternatives for this population remain a challenge for researchers aiming to develop more inclusive and adaptable interventions. Therefore, this study aims to determine the effects

of combining jump rope and progressive walking for individuals with intellectual disabilities, by applying the principles of frequency, intensity, time, and type of exercise (FITT).

## Material and Methods

### *Participants*

The inclusion criteria in this study included students with low ID levels according to a doctor's diagnosis, no comorbidities, no mobility limitations (injuries), not being regional athletes, and agreeing to be research subjects. The exclusion criteria included students with moderate to high levels of ID, those with comorbidities (such as psychiatric and behavioral, neurological, or physical health), regional athletes, those with mobility limitations, and those who were unable to participate in the study.

The research subjects were teenagers with intellectual disability (ID) in a School for Students with Special Needs (SLB N 1 Bantul). Forty students with ID were selected according to the inclusion criteria. Ten students met the exclusion criteria: 3 students had high-level ID, 4 had psychiatric and behavioral comorbidities, and 3 had neurological comorbidities.

Thirty students who met the inclusion criteria were randomly assigned to the experimental group (n = 15) and the control group (n = 15) at a 1:1 ratio. The randomization process was conducted using a computer to ensure allocation confidentiality.

A research team explained the procedures and actions to be taken during the study to all representatives or parents of the students. The explanation included information about data privacy and security. The consent form was completed in a face-to-face session between the research team and the representatives or parents. The completed forms were reviewed by other team members to ensure the accuracy and completeness of the collected data.

This study was assessed for ethical standards based on the seven ethical principles of the WHO under the number T/93.3/UN34.9/PT.01.04/2025.

### *Study Design*

The present study used a two-group pre-test and post-test quasi-experiment design. It aimed to examine the influence of step rope jumping combined with walking exercise. The experimental group (EG) received exercise interventions three times a week for eight weeks. The control group (CG) received no specific treatment. Both groups underwent pre-test and post-test measurements. The detailed research design can be seen in Figure 1.

The instrument used in this study was a fitness test battery. It consisted of a sit-and-reach test to measure flexibility, 1-minute push-ups to measure chest and arm muscle strength, 1-minute sit-ups to measure abdominal muscle strength, 1-minute

back-ups to measure back muscle strength, and a 1600-meter run/walk to measure cardiovascular endurance. The fitness test battery had been tested for feasibility in previous research.

*Measurement and Training Protocols.* A hall with a flat, non-slippery floor was used for the initial data collection (pre-test) and final data collection (post-test). Measurements were taken using a fitness test battery consisting of five items: sit-and-reach, 1-minute push-ups, 1-minute sit-ups, 1-minute back-ups, and a 1600-meter run/walk. There were five measurement stations. Each station had three research assistants who understood the procedures and were responsible for data collection. Measuring tools such as the sit-and-reach box and stopwatches were calibrated to confirm their accuracy.

The initial measurement (pre-test) began with registration. The research team at the registration station provided participants with assessment forms. These were submitted to the measurement team at each station. Before taking measurements, participants were given time to stretch and warm up. After warming up, they proceeded to the first station for flexibility testing.

At each station, the assigned team explained the measurement procedures. After receiving instructions, participants began testing. The measurement team recorded the results on both the research team's form and the participant's own form. The participant then brought the form to the next station. After completing station 1, a rest period of up to two minutes was given before moving on to the next station. All five test items had to be completed in order.

The data collection team verified that each participant followed the procedure and completed each item correctly. Failure to complete one or more items resulted in invalid data or exclusion of that measurement. After finishing the measurements, participants returned the forms to the registration team and began a cool-down period.

To minimize assessment bias, outcome evaluators were blinded to group allocation during both the pre-test and post-test. Evaluators at each testing station were not informed of participants' group assignments.

After completing the measurements, experimental group were given an intervention consisting of a combination of step rope jumping and walking (step rope jump for 1 minute followed by walking for 1.5 minutes, repeated for 20-30 minutes) with an intensity of 70%-85% of maximum heart rate. Students performed static and dynamic warm-ups before and after the intervention was given. Intervention performed three times a week for eight weeks. The control group must complete 24 training sessions, with the tolerance of replacing training sessions with research assistants if they are unable to attend according to the schedule. A total of

10 research assistants and 3 teachers accompanied each training session to monitor training adherence to the established protocol. Two health care workers and one therapist were also present at each training session and measurement session to be prepared for any emergencies that might occur. After the intervention was completed, a final measurement (post-test) was conducted. The procedure and location for the post-test were the same as for the initial measurement (pre-test). Specifically, the pre-test and post-test were conducted outside the intervention period. Measurement and training protocols can be clearly seen in Figure 1. No participants dropped out during the intervention period. All 30 students completed both pre- and post-test assessments. As such, no imputation or data replacement was required for missing values.

#### *Statistical analysis*

Data analysis techniques were performed using ANCOVA. ANCOVA was used to compare differences between groups while considering other factors, specifically the baseline measurement results. The significance level was set at 0.05. The partial eta-squared ( $\eta^2_p$ ) value was reported to indicate the proportion of explained variance. A post hoc test (pholm) was conducted to determine differences between groups. Assumption testing, in the form of a normality test, homogeneity test, and linearity test, was a prerequisite before conducting ANCOVA. Data analysis was performed using the JASP application.

## **Results**

Table 1 presents the sample characteristics, including age, gender, ID level, training background, and comorbidities.

Table 2 presents descriptive statistics for five measurements based on the mean and standard deviation of baseline and post-test results for each group. The post-test mean increased in both the experimental and control groups. However, the increase was greater in the experimental group. The complete differences are presented in Table 2.

Table 3 presents the results of the assumption checks for the ANCOVA test, which include three components: the normality test (Shapiro-Wilk), the homogeneity test (Levene's), and the linearity test (linear regression). The p-values in the Shapiro-Wilk test were greater than 0.05, indicating that the data were normally distributed. The Levene's test p-values were also greater than 0.05, indicating homogeneity of variance.

In the linear regression test, the correlation coefficient (R) was greater than 0.8 or close to 1, indicating a strong relationship. The p-values in this test were below 0.05, showing a statistically significant relationship between the dependent and independent variables. These results confirm that the assumptions of normality, homogeneity, and linearity were met, validating the use of ANCOVA.

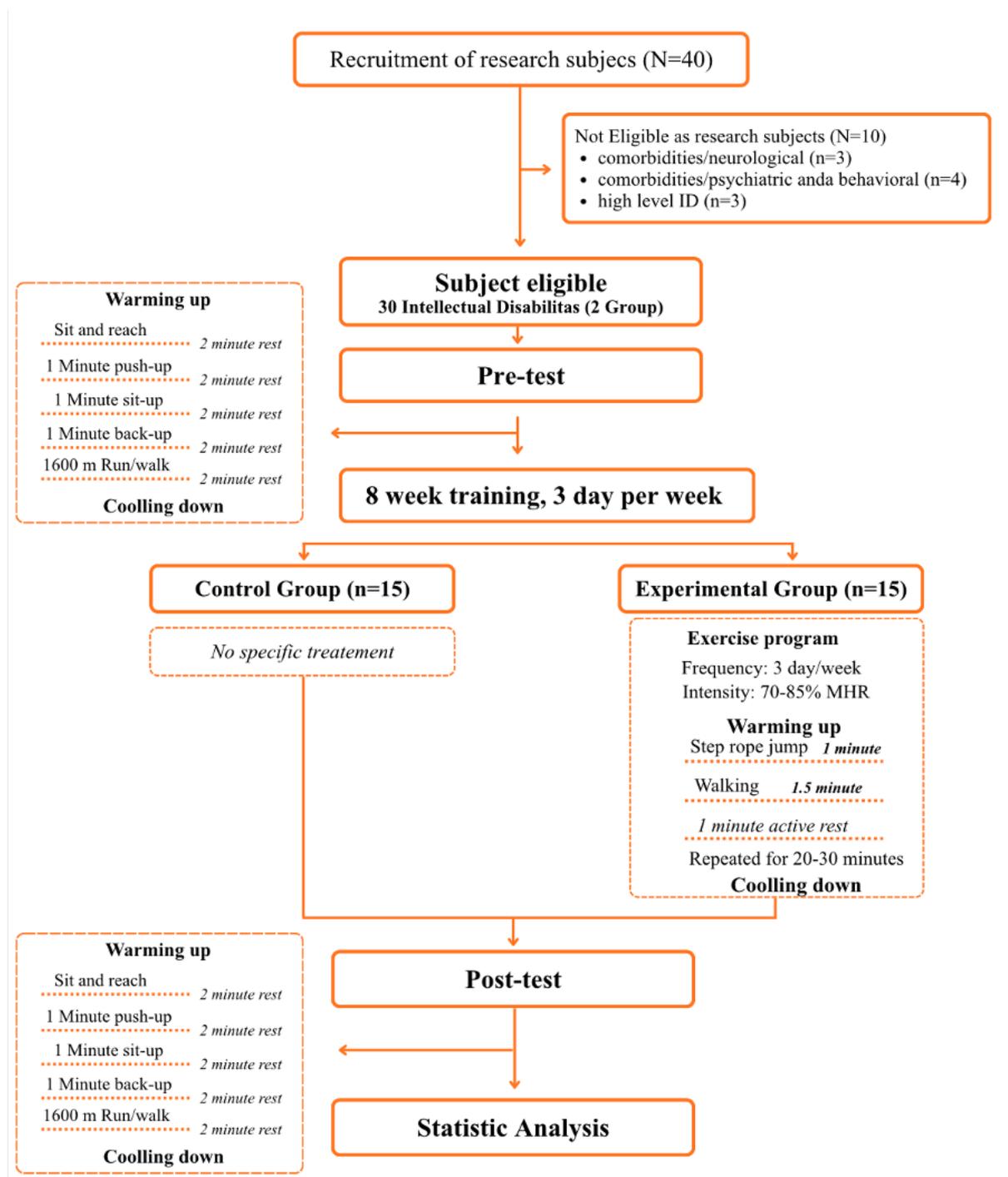


Figure 1. Experimental design

Table 1. Sample Characteristics

Characteristic	Total Sample (n = 30)	CG (n = 15)	EG (n = 15)
Age M (SD)	16.53 (1.93)	16.67 (1.74)	16.40 (2.09)
<b>Gender, n (%)</b>			
Male	22 (73%)	11 (73%)	11 (73%)
Female	8 (27%)	4 (27%)	4 (27%)
<b>ID Level, n (%)</b>			
High	0 (0%)	0 (0%)	0 (0%)
Moderate	0 (0%)	0 (0%)	0 (0%)

**Table 1.** (Continued)

Characteristic	Total Sample (n = 30)	CG (n = 15)	EG (n = 15)
Low	30 (100%)	15 (100%)	15 (100%)
<b>Training Background, n (%)</b>			
Occasional (0–1 h/week)	17 (57%)	8 (53%)	9 (60%)
Regular (1–3 h/week)	13 (43%)	7 (47%)	6 (40%)
Intense (>3 h/week)	0 (0%)	0 (0%)	0 (0%)
<b>Comorbidities, n (%)</b>			
Psychiatric and behavioral	0 (0%)	0 (0%)	0 (0%)
Neurological	0 (0%)	0 (0%)	0 (0%)
Physical health	0 (0%)	0 (0%)	0 (0%)

Note. EG = Experimental Group; CG = Control Group; n = number of participants.

**Table 2.** Descriptive Statistics

Physical Fitness Indicator	Group	Baseline Mean	SD	Post-test Mean	SD
Flexibility (cm)	CG	10.80	5.63	12.47	5.26
	EG	13.27	6.47	16.27	7.19
Arm strength (rep/min)	CG	15.53	5.38	15.87	5.45
	EG	16.67	4.05	19.73	4.25
Abdominal strength (rep/min)	CG	14.40	7.07	15.93	6.93
	EG	14.67	4.78	18.53	4.78
Back strength (rep/min)	CG	22.47	7.48	25.07	7.03
	EG	22.53	7.57	31.53	5.84
Cardiovascular endurance (min)	CG	16.45	3.76	15.25	3.74
	EG	14.72	3.00	12.07	2.89

Note. EG = Experimental Group; CG = Control Group; SD = Standard Deviation. Flexibility (cm): higher values indicate better results. Strength (repetitions/minute): higher repetitions indicate better results. Cardiovascular endurance (minutes): lower values indicate better results.

**Table 3.** Assumption Check Results

Physical Fitness Indicator	Shapiro-Wilk p (EG)	Shapiro-Wilk p (CG)	Levene's p	R	Linear Regression p
Flexibility (cm)	0.45	0.16	0.47	0.99	< 0.001
Arm strength (rep/min)	0.26	0.37	0.90	0.91	< 0.001
Abdominal strength (rep/min)	0.33	0.41	0.52	0.97	< 0.001
Back strength (rep/min)	0.44	0.72	0.06	0.81	< 0.001
Cardiovascular endurance (min)	0.21	0.52	0.09	0.98	< 0.001

Note. EG = Experimental Group; CG = Control Group; R = Multiple Correlation Coefficient; p = significance level. For Shapiro-Wilk and Levene's tests, p > 0.05 indicates assumption met. For linear regression, p < 0.05 indicates significance.

**Table 4.** ANCOVA Analysis Results

Physical Fitness Indicator	N	F (1, 27)	p-value	$\eta^2_p$	95% CI for $\eta^2_p$	pholm
Flexibility (cm)	15	11.47	< 0.001	0.34	0.08 – 0.56	< 0.001
Arm strength (rep/min)	15	15.25	< 0.001	0.36	0.09 – 0.58	< 0.001
Abdominal strength (rep/min)	15	19.95	< 0.001	0.43	0.15 – 0.63	< 0.001
Back strength (rep/min)	15	16.65	< 0.001	0.38	0.11 – 0.59	< 0.001
Cardiovascular endurance (min)	15	29.49	< 0.001	0.52	0.25 – 0.69	< 0.001

Note. F(1, 27) = ANCOVA test statistic controlling for pre-test scores. p = significance level (p < 0.05);  $\eta^2_p$  = partial eta-squared: 0.01 = small effect, 0.06 = moderate effect, 0.14 = large effect; pholm = Holm-adjusted post hoc test (significant if pholm < 0.01); CI = Confidence Interval.

ANCOVA was performed with the baseline score as a covariate. Partial eta-squared ( $\eta^2_p$ ) values were reported to indicate the proportion of variance explained. Post hoc tests were conducted to determine differences between groups (Table 4). The p-values for flexibility, arm and chest strength, abdominal strength, back strength, and cardiovascular endurance were all below 0.01. This indicates a significant effect between the experimental group (step rope and walking intervention) and the control group, after adjusting for baseline differences.

An  $\eta^2_p$  value greater than 0.14 indicates a large effect size. The post hoc test results using the Holm adjustment showed  $p_{\text{holm}} < 0.001$ , indicating significant differences between the groups.

## Discussion

Theoretically, physical fitness is influenced by age, gender, and training. Programmed exercise is a common method used by practitioners to improve fitness. This study aimed to determine the effects of combining jump rope and progressive walking for individuals with intellectual disabilities by applying the principles of frequency, intensity, time, and type of exercise (FITT). The results of the present study showed improvements in physical fitness among children with intellectual disabilities after eight weeks of the jump rope and walking intervention. These changes were evident in flexibility, cardiovascular endurance, muscular strength, and muscular endurance. Exercise is an activity that requires planned, structured, and repetitive physical effort to maintain or improve health and fitness [24, 25]. The combination of jumping rope and walking given to individuals with disabilities was a planned exercise that followed key elements of a training program. To improve physical fitness, the exercise dose must be tailored to individual needs and based on four components: frequency, intensity, time, and type of exercise (FITT) [26]. FITT is a framework used in physical conditioning programs that affects cardiorespiratory endurance, muscular strength and endurance, and flexibility [27]. The results of this study, which showed improvements in each physical fitness indicator, support the effectiveness of the structured exercise program applied.

These experimental results align with other studies showing that progressive rope jumping exercises improve physical fitness and cardiovascular health, as well as increase exercise tolerance in adolescent students with moderate intellectual disabilities [28]. In addition, skipping and walking provided benefits not only for individuals with intellectual disabilities but also for non-disabled individuals by improving their physical fitness [29]. Skipping was also applied to physical education students and was found to increase cardiovascular efficiency and lower leg muscle strength [30]. Step

rope jumping is a simple and economical exercise believed to improve cardiovascular capacity. It is also considered an alternative form of training for individuals with limited time for physical activity [29]. Step rope jumping exercises also provide benefits for individuals with obesity and may reduce the risk of cardiovascular disease [31]. Another study found that step rope jumping had a greater impact on motor components of fitness, especially lower leg muscle explosive power [32]. Although step rope jumping showed short-term benefits for cardiovascular fitness, other training methods, such as jogging, were found to be more effective in improving cardiovascular capacity [33].

Besides step rope jumping and jogging, walking can also strengthen muscles, improve body flexibility, and increase motivation in individuals with intellectual disabilities to engage in physical activity [1]. An intervention combining walking with multicomponent communication was shown to be effective in increasing physical activity among people with disabilities [2]. Various forms of intervention such as jumping rope, jogging, and walking, implemented with different durations and training methods, have been reported to produce benefits for physical fitness. The differences in effects observed between exercise programs are influenced by movement style, muscle focus, and the nature of the activity. In this study, the intervention combined jumping rope and walking, using the FITT principle as the basis for program design. This approach has not been widely applied in previous studies involving individuals with intellectual disabilities. The results clearly show positive effects on each physical fitness indicator.

An increase in physical activity has a positive impact on the well-being of individuals with intellectual disabilities [6]. This finding is consistent with the present study, which showed that combining step rope jumping and walking had a positive impact on flexibility and muscle strength. Training interventions that combine multiple exercise models are believed to be more effective in improving functional capacity, cardiorespiratory fitness, and muscular strength in individuals with intellectual disabilities [34]. Policymakers should integrate walking programs into health promotion strategies and provide training for professionals or caregivers to ensure that such programs are implemented safely for individuals with intellectual disabilities [35]. Caregivers and professionals need to understand the fundamentals of exercise, given its benefits for this population. Exercise is an effective way for anyone to maintain fitness and health. However, individuals with intellectual disabilities are generally less active compared to those without disabilities [36]. Psychological, environmental, and resource-related barriers often prevent participation in physical activity among

people with disabilities. This lack of participation raises health concerns in the disabled population. As a result, practitioners and academics continue to develop safe and adaptable exercise options for this community.

The development of economical equipment, tailored training methods, and evaluations to monitor training progress has supported individuals with disabilities in maintaining their health [37]. In the present study, the authors developed a step rope jumping exercise combined with walking to provide an alternative physical activity for individuals with intellectual disabilities. Although the findings indicated positive effects on physical fitness, further testing involving a larger and more diverse sample is needed. In addition to evaluating the benefits of step rope jumping and walking, future studies should explore other types of exercises to increase the variety of accessible training options for this population. This is particularly important because individuals with intellectual disabilities are vulnerable to both physical and mental health problems and require accessible, holistic therapies [12].

The application of a training model that combines jump rope and walking, based on the FITT principle and adapted to individuals with intellectual disabilities, has both pedagogical and clinical implications.

First, jump rope and walking exercises following the FITT framework can be considered by stakeholders when designing interventions for students with ID.

Second, structured exercise programs support the development of motor skills.

Third, such programs help students learn basic concepts and rules.

Fourth, group-based interventions may improve social interaction skills.

Fifth, designing programs according to the specific characteristics of students with ID contributes to creating an inclusive learning and training environment.

#### *Limitations of the Study*

Although this study was designed in accordance with research standards, several limitations were beyond the researchers' control.

First, the small sample size and the inclusion of only participants with low levels of intellectual

disability may limit the generalizability of the findings.

Second, participants may have experienced acute physical or psychological responses to the intervention, potentially influencing the results.

Third, external factors such as changes in weather conditions during the intervention period could have affected performance.

Fourth, limitations in available measurement equipment restricted the ability to conduct laboratory-based physiological assessments, and there was a possibility of recording errors during data collection.

## **Conclusions**

An eight-week combined jump rope and walking exercise program for individuals with intellectual disabilities resulted in improvements in body flexibility, arm and chest muscle strength, abdominal and back muscle strength, and cardiovascular endurance, based on comparisons with baseline measurements. These baseline measurements indicated that both the control and experimental groups had relatively similar initial physical fitness levels.

Therefore, it can be concluded that the intervention effectively improved the physical fitness of the experimental group. The findings of this study contribute to the growing body of knowledge on exercise interventions suitable for individuals with intellectual disabilities. As such interventions require careful design and adaptation, future research should continue to explore different types of exercise, supported by theory, to develop appropriate strategies for maintaining health and fitness in this population. Supporting physical fitness is essential for improving their overall quality of life.

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## **Conflict of Interest**

The authors declare no potential conflicts of interest.

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