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Review Article

Effects of Strength Training on People With Intellectual Disabilities: A Systematic Review

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Abstract

Intellectual disability is characterized by incomplete brain development, which affects cognitive abilities and functional skills during the developmental period. This condition influences overall intelligence levels and daily functioning. The present study aimed to evaluate the effects of strength training on individuals with intellectual disabilities through a systematic review of previous research. This study was conducted in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. Data were collected from indexed databases, including Google Scholar, PubMed, and SCOPUS, as well as from additional literature sources such as textbooks, anthologies, and other relevant publications. A total of 450 studies were initially identified, and after applying specific selection criteria, 13 studies were included in the final analysis. The findings suggest that strength training has beneficial effects on various parameters, including body composition, muscle strength, and overall physical performance. Extended training programs were particularly effective in improving body composition and muscle strength, whereas shorter programs resulted in notable enhancements in specific physical and cognitive abilities. This research provides valuable insights into optimizing training interventions for individuals with intellectual disabilities, ultimately improving their quality of life and contributing to the development of more effective physical activity programs.

Keywords: Intellectual disabilities, Resistance training, Body composition.

Introduction

Intellectual disability is defined as a condition characterized by incomplete brain development, resulting in impairments in cognitive, motor, language, and social abilities during the developmental period. These deficits affect overall intelligence levels and daily functioning. (World Health Organization, 1992). Recently, the term intellectual disability has been used more often instead of the term "mental retardation", because it is less offensive, more consistent with international terminology and better aligned with the current practices of professionals who deal with the functional behavior of individuals (Shree & Shukla, 2016). Among those with an intellectual disability, about 85% have a mild form of disability, 10% of people have a moderate form of disability, 4% have a severe form of disability, and 2% of people have a very severe form of disability (King et al,. 2009). Approximately 70% of people with severe intellectual disability and 50% of people with mild intellectual disability have a biological predisposition to their disorder (McLaren & Bryson, 1987). The most frequently occurring intellectual disability is Down syndrome, an anomaly observed in approximately 15 out of every 10,000 births. Less common forms include Prader-Willi syndrome and Rett syndrome. Additionally, intellectual disabilities may arise due to complications during pregnancy or as a result of certain infectious diseases (Katz & Lazcano-Ponce, 2008). Children with intellectual disabilities can often engage in various activities, such as playing, dancing, singing, and drawing, alongside their peers without intellectual disabilities (Beirne-Smith, Patton, & Kim, 2006).

Strength training is a form of physical activity that involves the use of resistance to cause muscle contractions, with the aim of strengthening and developing muscle mass, endurance and strength. Resistance can be in the form of free weights, elastic bands, gym equipment or even your own body weight. Resistance training includes a variety of exercises and techniques that can be adapted to different levels of physical ability, making it suitable for a wide population, including people with disabilities (Brooks, 2009). People with an intellectual disability have lower muscle strength, especially in the quadriceps (Horvat et al., 1999), compared to their peers without an intellectual disability (Carmeli, Imam & Merrick, 2012). They generally have lower muscle strength due to an inactive lifestyle (Borji et al., 2014; Hall & Thomas, 2008), but also due to the inability of the central nervous system to activate motor units and abnormal intrinsic muscle properties (Borji et al. , 2014). Improvement in muscle strength is associated with improvement in performance of functional activities in adults with Down syndrome (Carmeli et al,. 2002; Cowley et al., 2011) as well as improvement in performance of business tasks in people with intellectual disabilities (Zetts, Horvat & Langone, 1995).

In modern society, although human rights are known and legally regulated, people with disabilities may experience discrimination. This discrimination prevents them from normal and equal participation in important aspects of social life. One of those aspects is physical activity, organized or unorganized, which can be useful for preserving the health of people with disabilities. A training system, if properly designed in terms of choice and sequence of exercises, intensity, frequency of exercise and rest periods, can be very beneficial for people with disabilities. There is a large number of studies which suggest that resistance training has a positive impact on muscle strength and functional abilities of people with intellectual disabilities (Fjellstrom et al., 2022; Mendonca et al., 2011; Pastula et al., 2019). Because there are many studies which focus on this theme, there is a need for the classification based on the length and exercises used in these studies. In this context, the aim of this research was to evaluate the effects of strength training on individuals with intellectual disabilities through a systematic review of previous research.

Material and Methods

To investigate the effects of strength training in individuals with intellectual disabilities, data were collected from indexed databases, including Google Scholar, PubMed, and SCOPUS. Studies published between 2000 and June 2024 were searched. Additionally, references from all identified papers were reviewed to locate further relevant studies. In accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, a systematic review of the available literature was conducted (Moher et al., 2009). The search was performed using the following keywords: "intellectual disabilities," "resistance training," and "effects." The PRISMA flow diagram is presented in Figure 1.

Inclusion Criteria

Studies were included in the analysis if they investigated the effects of strength training in individuals with intellectual disabilities, included at least one experimental group or both experimental and control groups, reported data on initial and final measurements as well as tested parameters, provided detailed information about the exercise program, and were available in full-text format and published in either Serbian or English.

Exclusion Criteria

Studies were excluded from the analysis if they were systematic review articles, did not contain complete data on the exercise program, were not available in full-text format, or were not published in Serbian or English.

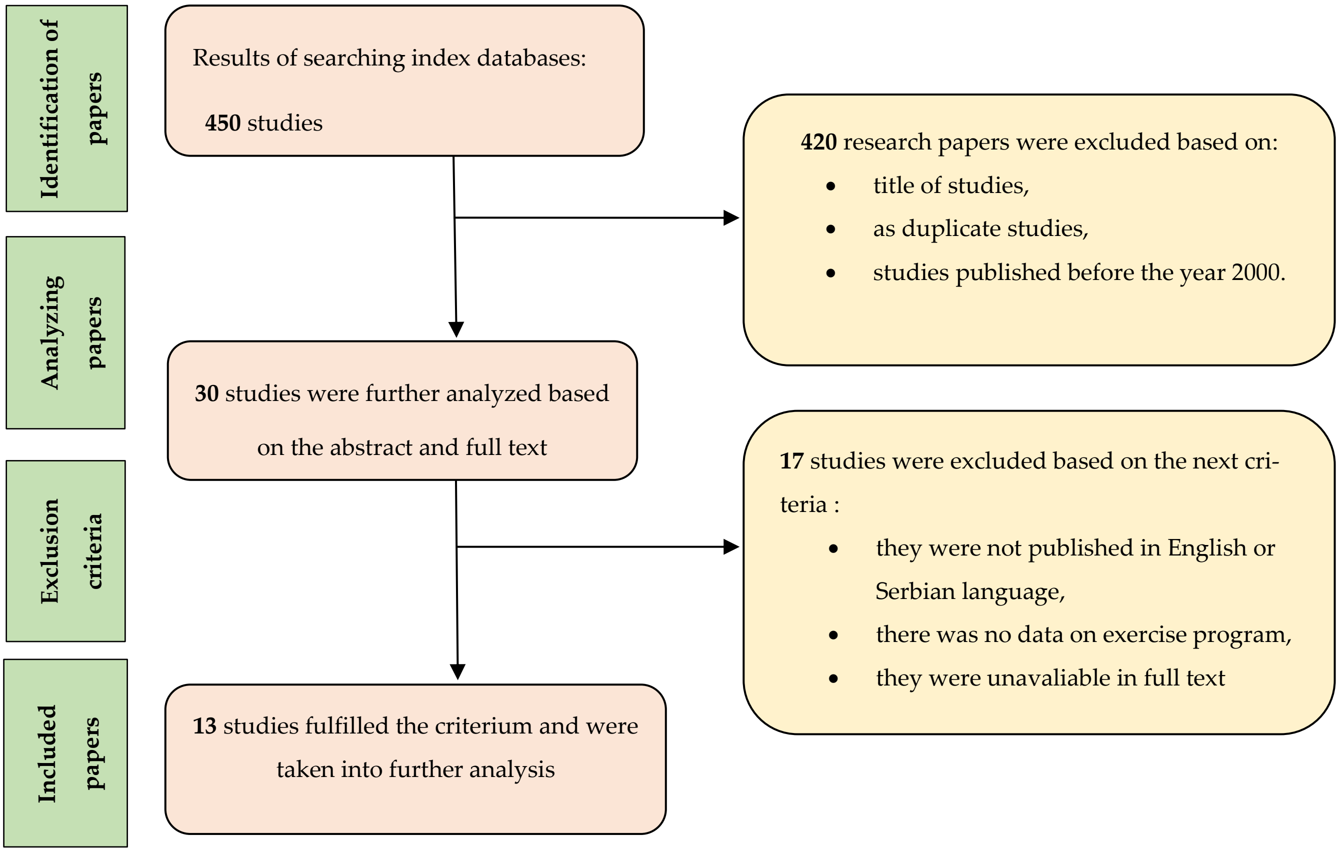

Figure 1. The PRISMA flow diagram.

The process of collecting, analyzing, and eliminating the identified studies is presented in Figure 1. A keyword-based search yielded a total of 450 papers. Of these, 420 studies were excluded immediately based on their titles, duplication, or publication date (prior to 2000), leaving 30 studies for further analysis. Following a more detailed examination of these 30 studies, 17 were excluded due to not being published in Serbian or English or lacking essential data on the exercise program.

The remaining 13 studies met the predefined criteria, specifically that they were published between 2000 and 2024, included participants with intellectual disabilities, and utilized strength training, specifically resistance training, as the core intervention.

Results

The studies presented in Table 1 demonstrate a range of sample sizes, from 8 participants in Dijkhuizen et al., (2019) to 64 in Shields et al., (2013), with participant ages spanning from 9 to 60 years. The youngest sample (9-13 years) was in Kachouri et al., (2016). Nine studies involved both experimental and control groups, while four focused solely on an experimental group (Calders et al., 2011; Cowley et al., 2011; Diaz et al., 2021; Jo et al., 2018; Kachouri et al., 2011; Kachouri et al., 2016; Rimmer et al., 2004; Shields et al., 2008; Shields et al., 2013). All of the studies incorporated strength training, and several added other exercise types such as flexibility, balance, or aerobic exercises (Calders et al., 2011; Fjellstrom et al., 2022; Gupta et al., 2011; Jo et al., 2018; Kachouri et al., 2016; Mendonca et al., 2011; Pastula et al., 2012; Rimmer et al., 2004).

Table 1. Presentation of research that passed the selection criteria.

First author and year editions	A sample of respondents	Experimental program	Tested/measured procedures	Results
Fjellström, Sanna et al., (2022)	n=28 36.4 years average	12 weeks; 3 times a week; 50 min Exercise without equipment (push-ups, squats, sit-ups, walking, jumping jacks, plank)	BC, WC, QoL, PA	↑ BC, WC Ø QoL, PA
Kachouri, Hiba et al., (2016)	n = 20 11.5 years average	8 weeks; 3 times a week; 45 - 60 min Exercises without equipment with your own body weight (squats, squat jumps, sit-ups, long jumps, jumps, running on stairs)	CoPVm , CoPLX, CoPLY	↑ CoPVm , CoPLX, CoPLY
Diaz et al., (2021)	n = 36 28.1 years average	12 weeks; 3 times a week; 50 min Exercising on equipment in the gym (arm curl, triceps extension, leg extension, seated row, leg curl, leg press)	BMI, WC, WHR, FM, MM, SMI, CK, Mb, LDH	↑ BMI, WC, WHR, FM, MM, SMI Ø CK, Mb, LDH
Shields et al., (2013)	n=64 17.9 years on average	10 weeks; 2 times a week; 45 - 60 min Exercising on equipment in the gym (l at pull down, seated chest press, seated row, leg press, knee extension, seated calf raise)	Box stacking test, Weight pail carry, Chest press (1RM), Leg press (1RM)	↑ Box stacking test, Weight pail carry, Chest press (1RM), Leg press (1RM)
Pastula et al., (2012)	n=16 19.4 years average	8 weeks; 3 times a week; 45 - 60 min Circular training method (Air squat, Squat jumps, Front lunge right leg, Front lunge left leg, Full range push up, Flip grip tricep kickback, Dumbbell Y, Dumbbell front raise, Straight sit ups, V-ups, Power sit up, Flutter kicks, Full supination concentration curl, Bent over dumbbell row)	Visual matching , Decision speed, Pair cancellation, Processing speed	↑ Visual matching , Decision speed, Pair cancellation, Processing speed
Mendonca, Pereira & Fernhall (2011)	n=13 36.5 years average	12 weeks; 2 times a week Circular training method (leg press, chest press, vertical traction, shoulder press)	BM, BSA, BMI, FM, FFM, RFM, VO_2 , RER	↑ BM, BSA, BMI, FM, FFM, RFM, VO_2 , RER
Shields et al., (2008)	n=20 26.8 years average	10 weeks; 2 times a week Exercising on equipment in the gym (shoulder press, seated chest press, seated row, seated leg press, knee extension, seated calf raise)	Chest press (1RM), Leg press (1RM), Chest press endurance, Leg press endurance, Timed up and down stairs test, Grocery shelving task	↑ Chest press (1RM), Leg press (1RM), Chest press endurance, Leg press endurance, Timed up and down stairs test, Grocery shelving task
Rimmer et al., (2004)	n=52 39.4 years average	12 weeks; 3 times a week; 45 min Exercise on equipment in the gym (bench press, seated leg press, seated leg curl,	Peak VO_2 , Peak HR, Bench Press, Leg Press, Hand	↑ Peak VO_2 , Peak HR, Bench Press, Leg Press, Hand grip(left

		triceps push-down, seated shoulder press, seated row, lat pull-down)	grip(left & right), BMI, Total skinfold measure	& right), BMI, Total skinfold measure
Gupta, Rao & Kumaran (2011)	n=23 13.3 years on average	6 weeks; 3 times a week Sandbag resistance exercises for hip flexors, abductors, extensors, knee flexors, and ankle extensors and plantar flexors.	HF, HE, HA, KF, KE, AP, BOTMP	↑ HF, HE, HA, KF, KE, AP, BOTMP
Cowley et al., (2011)	n=30 28 years average	10 weeks; 2 times a week Exercising on equipment in the gym (leg extension and flexion, leg press, shoulder press, chest press, bicep curl and triceps pushdown)	ISOKE PT, Walk speed, Time to descend 10 steps, Time to ascend 10 steps, Chair raise(30cm, 38cm, 43cm), Absolute peak VO_2, Relative peak V $_2$, MAX HR	↑ ISOKE PT, Walk speed, Time to descend 10 steps, Time to ascend 10 steps, Chair raise(30cm, 38cm, 43cm), Absolute peak VO_2, Relative peak VO_2, MAX HR
Dijkhuizen et al., (2019)	n=8 29.6 years average	10 weeks; 2 to 3 times a week The structure and intensity of the PRT program was determined according to the standards of the American College of Sports and Medicine. After the warm-up, participants trained their quadriceps strength on the leg extension machine according to the protocol.	Leg Extension (1RM)	↑ Leg Extension (1RM)
Jo, Rossow-Kimball, & Lee (2018)	n=23 31.2 years average	12 weeks; 2 times a week; 90 min Exercise with elastic resistance bands (crunches, reverse fly, bicep curl, lateral raise)	BMI, SMM, BFM, Strength, Flexibility, Step Test	↑ BMI, SMM, BFM, Strength, Flexibility, Step Test
Calders et al., (2011)	n=45 42 years average	20 weeks; 2 times a week; 70 min Exercise according to the regimen (strength training of the biceps brachii and triceps brachii (10 min), stepping (10 min), strength training of quadriceps and hamstrings (10 min), functional training of abdominal and back muscles (10 min))	Peak VO_2, Peak Power(Watt), Peak HR, 6MWD, Grip strength	↑ Peak VO_2, Peak Power(Watt), Peak HR, 6MWD, Grip strength

BC: Body Composition; WC: waist circumference; QoL: quality of life; PA: physical activity level; CoPVm: mean centre of pressure velocity; CoPLX: sum of CoP displacement in the Medio-lateral direction; CoPLY: sum of CoP displacement in the Antero-posterior direction; BMI: body mass index; WHR: waist to hip ratio; FM: fat mass; MM: muscle mass; SMI: skeletal muscle index; CK: creatine kinase activity expressed as U/L; Mb: myoglobin concentration expressed as ng/mL. LDH: lactate dehydrogenase activity expressed as U/L; 1RM: one maximal repetition; BM: body mass; BSA: body surface area; FM: fat mass; FFM: fat free mass; RFM: relative fat mass; VO_2 :oxygen consumption; RER: respiratory exchange ratio; Peak VO_2 :peak oxygen consumption; Peak HR: peak heart rate; BOTMP: Bruininks Osteresky Test of Motor Proficiency; HF: hip flexor strength; HE: hip extensor strength; HA: hip abductor strength; KF: knee flexor strength; KE: knee extensor strength; AP: ankle plantarflexor strength; ISOKE PT: isokinetic knee extensor peak torque; Relative peak VO_2: relative peak oxygen consumption; Absolute peak VO_2: absolute peak oxygen consumption; MAX HR: maximum heart rate; SMM: skeletal muscle mass; BFM: body fat mass; 6MWD: 6-minute walk distance; ↑: increase/development; Ø: no changes/development.

The duration of the experimental programs varied between 6 and 20 weeks, although most studies had a typical length of 8 to 12 weeks. Training occurred 2 to 3 times per week, with session durations generally lasting between 45 and 60 minutes, though some studies reported slightly longer sessions (see: Calders et al., 2011; Jo et al., 2018). The parameters assessed across studies included body composition (height, weight, BMI), strength (upper and lower extremities, grip strength), and other functional measures such as mobility and cognitive tests.

Across all 14 studies, strength training showed positive effects for individuals with intellectual disabilities, including increased muscle mass, improved upper and lower body strength, and enhanced functional abilities. Additionally, participants experienced reductions in body fat, lower blood pressure, and heart rate, alongside improvements in daily activities, demonstrating the overall benefits of strength training interventions.

Discussion

The aim of this study was to examine the positive effects of strength training on people with intellectual disabilities. The results from the analyzed studies indicate positive effects of strength training programs for individuals with intellectual disabilities, particularly in terms of increased muscle mass, improved strength, reduced body fat, and enhanced functional abilities. While these findings are consistent across the studies, several key factors may influence these outcomes and warrant discussion in this systematic review.

First, the variability in participant samples did not appear to significantly affect the overall results. The age ranges across the studies varied widely, from children (Kachouri et al., 2016) to adults up to 60 years old (Shields et al., 2013), which suggests that strength training programs can be applied across different age groups. However, specific age groups may respond differently to physical interventions, such as strength training. For example, younger participants (9-13 years) may benefit from improved motor skills and basic strength development, while older adults might experience more significant improvements in reducing body fat and cardiovascular parameters.

Another significant factor is the variation in program duration and training frequency. While the program durations ranged from 6 to 20 weeks, most studies used a typical length of 8 to 12 weeks. This suggests that both shorter and longer programs can be effective, though 8-12 weeks seems to be the most common and effective duration. Training frequency was consistent across the studies, with participants generally training 2 to 3 times per week, and session durations typically ranged from 45 to 60 minutes. Interestingly, only one study (Jo et al., 2018) extended the session duration to 90 minutes, suggesting that longer sessions may be beneficial in specific cases but are not necessarily required for achieving the desired outcomes. This finding supports recommendations for 45-60 minute sessions for the broader population of individuals with intellectual disabilities.

Regarding methodology, most studies used standardized measures to assess body composition and strength, such as body weight, BMI, upper and lower extremity strength, and grip strength. The results show that all studies observed similar outcomes in terms of increased muscle mass, strength, and functional abilities, highlighting the consistency of the effects of strength training in this population. Additionally, improvements in cardiovascular health, such as reduced blood pressure and heart rate, as well as better performance in daily activities, provide further support for the inclusion of strength training in interventions for individuals with intellectual disabilities.

However, the variation in additional components of the exercise programs, such as flexibility, balance, and aerobic exercises, could play a significant role in the overall results. For example, in some studies (Calders et al., 2011; Fjellstrom et al., 2022; Gupta et al., 2011; Jo et al., 2018; Kachouri et al., 2016; Mendonca et al., 2011; Pastula et al., 2012; Rimmer et al., 2004), combining strength training with flexibility and balance exercises may provide additional benefits in terms of coordination, balance, and functional skills, which could be particularly important for individuals with intellectual disabilities who struggle with these areas.

Although the findings of the analyzed studies are predominantly positive, several limitations must be acknowledged. Firstly, the relatively small sample sizes in some studies, coupled with heterogeneity in measurement methodologies, may limit the generalizability of the results. Moreover, the majority of studies have not examined the long-term effects of strength training programs, highlighting the need for further research to assess the sustained benefits of these interventions and establish more comprehensive recommendations. Additionally, there is a lack of studies investigating the specific effects of different exercise modalities in combination with strength training, which is crucial for understanding the factors influencing various outcomes within this population.

This study also has certain limitations. Only articles published between 2000 and 2024 were included in the search, which may have restricted the scope of the review. Furthermore, the literature search was conducted exclusively in English and Serbian, potentially leading to the omission of relevant studies published in other languages. Lastly, the search was limited to three databases—Google Scholar, PubMed, and SCOPUS—possibly affecting the comprehensiveness of the included literature.

Conclusions

Based on the analyzed studies, it is clear that strength training has a significant positive impact on physical and motor skills in people with intellectual disability. Research shows that exercise programs lasting at least eight weeks, with a frequency of two to three sessions per week, can lead to improvements in strength, endurance and motor coordination. These programs have also shown positive effects on anthropometric parameters such as BMI, MM, as well as on cardiovascular abilities, indicating multiple benefits of such training programs.

In addition to physical benefits, regular strength training has a significant impact on improving the psychological state and social integration of people with intellectual disabilities.

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Data Availability Statement: Data supporting this study is available from the authors upon reasonable request.

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