Effectiveness of Exercise Program on Selected Fitness Components Among Individuals With Intellectual Disabilities: a Scoping Review

Norhasmira Othman[1], Willince Mojiin[1], Nur Syamsina Ahmad[1], Rosniwati Ghafar[1], Nurul Azuar Hamzah[1], Adam Abdul Malik[1]

[1] Universiti Sains Malaysia, Malaysia

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CORRESPONDING AUTHOR:
Nur Syamsina Ahmad;
nursyamsina@usm.my

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ABSTRACT:

Lack of physical activity could lead to health issues, obesity, and poor quality of life, particularly among individuals with intellectual disabilities (ID). This review aims to examine the effectiveness of various exercise programs on physical fitness outcomes in individuals with ID. A systematic literature search was conducted following PRISMA guidelines across PubMed, Web of Science, Scopus, and ProQuest databases. Thirteen studies met the inclusion criteria, comprising four on children, three on adolescents, and six on adults with ID. The duration ranged from six weeks to six months. Exercise intervention included circuit training, balance and strength training, sprint interval training, endurance exercise, aquatic exercise, virtual exercise, recreational game, sensory integration exercise, and Brailletonik exercise. Reported outcomes demonstrated improvement in body composition, flexibility, balance, muscle strength, and physiological markers. These findings highlight the importance of structured, enjoyable, and individualized exercise programs tailored to the abilities and needs of individuals with ID. Such programs can enhance fitness, promote healthy body weight, reduce non-communicable disease risks, and improve sports performance. Developing well-planned exercise prescriptions with appropriate intensity and duration is essential to encourage sustained participation and support overall health and well-being among individuals with intellectual disabilities.

Keywords: Intellectual Disability, Flexibility, Body Composition, Strength, Cardio, Stride Length

INTRODUCTION

Statistically, 16-62% of people living with disabilities (PLWD) were at higher risk of serious health problems related to inactivity than people without disabilities (Ginis et al., 2021). The series paper provides a global overview on the benefits and promotion policies towards physical activity among people with disabilities based on meta-analysis. The participation of this population in physical activities and sports were highly recommended to increase health level and provide social networking. Additionally, physical activity has been shown to have benefits on cardiovascular fitness. Previous study found that the health benefits can be achieved with 150 minutes of physical activity in a week. However, there is a list of guidelines for this population due to the difference in level of physical appearance and mental condition. People with disabilities may start slowly based on their fitness level and abilities. Progression monitoring was needed to avoid lack of motivation to achieve the goals in sports or physical activities. Aerobic physical activity can be modified to suit disabilities condition. Aerobic physical activity provides benefits such as reducing the risk of heart attack, obesity, and diabetes. Other aerobic physical activities include brisk walking, aquatic therapy, seated volleyball and wheelchair basketball or tennis can be introduced too. Current study by Wee et al. (2021) revealed that the participation of people with disabilities were motivated by satisfaction, socialization, achieving fitness and enjoyment. However, most people with disabilities not participating in physical activities due to lack of social support, lack of facilities and accessibility. Study by Aydoğan & Hadi (2020) reported that the factors of resilience of disabilities people were social support, spiritual and belief and positive outlooks. Several factors influence participation in physical activity among individuals with ID, including social and moral support, availability and accessibility of facilities, and cooperation between the public and private sectors. Addressing these factors alongside structured exercise programs can enhance opportunities for participation and long-term engagement.

LITERATURE REVIEW

Several prior investigations have demonstrated the benefits of exercise programs for populations with different types of disabilities. For instance, aerobic and resistance training have been linked to improved cardiovascular fitness and reduced risk of metabolic disorders among people with physical disabilities (Pollock et al., 1998; Tulppo et al., 2003). Similarly, in individuals with Down syndrome, weight training and aerobic interventions have shown positive effects on body composition and inflammatory markers (Florentino Neto et al., 2010; Ortiz-Ortiz et al., 2019; Rosety-Rodriguez et al., 2021). However, these studies often target specific clinical conditions, and there is limited synthesis of evidence regarding individuals with intellectual disabilities who may not share the same physical limitations but face distinct barriers such as difficulties with motor skills transfer, reduced balance, and motivation (Enkelaar et al., 2012; Messent et al., 1999). By focusing on intellectual disabilities specifically, the current scoping review expands the theoretical framework beyond existing studies and highlights the unique interplay between exercise prescription, functional outcomes, and social participation in this population. Individuals with intellectual disabilities present distinct characteristics that influence their participation in physical activity. Cognitive limitations can affect understanding and retention of exercise instructions, often requiring simplified demonstrations, repeated practice, and structured routines (Messent et al., 1999). Motor impairments are also common, with many individuals displaying poor balance control, slower reaction times, and difficulty generalizing skills learned in one setting to another (Enkelaar et al., 2012). Furthermore, psychosocial factors such as low self-confidence, social stigma, and dependence or caregivers for transportation and support can further limit opportunities for physical activity (Wee et al., 2021). These characteristics highlight the necessity of designing adapted exercise programs that account for not only the physical but also the cognitive and social dimensions of intellectual disability. Jacinto et al. (2024) reported significant improvements in physical fitness outcomes, supporting the integration of both strength and endurance components in training programs. A proper instruction on correct technique and safety at the beginning of the training are necessary to reduce the risk of injury as well as other health-related complications, this instruction also can be received from professionally trained and certified trainers. According to the coaching association of Canada, there are recommendations for coaching individuals with Intellectual disabilities (ID). These includes a proper planning on drills or activities that are age appropriate, teaching the prerequisite skills for example basic motor skills, do not overload participants with instructions, check regularly for understanding and teach the specific skills. The individuals with ID may have difficulty transferring skills from one environment to another. Provide

repetition, structure, and routine to support their memory. Aside from health-related components of physical fitness, an individual also requires well developed skill-related physical fitness components, such as coordination, balance, speed, agility, reaction time and power so that they be able to perform activities of daily living. Resistance exercise programs for individuals with mental retardation are important because they have a positive impact on quality of life (Draheim et al., 2002). Coaches are needed to give extra attention to the principle of motor learning when introducing a new skill because they tend to forget whatever skills they have learned before (Messent et al,. 1999). A coach should use simple one-part or two-part directions to introduce new skills gradually and review their progress frequently. Demonstrations of the right technique are extremely important in explaining every skill. Since people with ID cannot read or write properly, or even differentiate between each limb well, a coach needs to explain repeatedly how to execute every skill.

METHODS AND MATERIAL

Data sources

Related studies were searched electronically using the following databases: PubMed, Web of Science, Scopus, and ProQuest. Briefly, the selected studies were hand searched using the same selection criteria as described below. In addition, cross- referencing on related previously published study was performed to obtain additional information. Peer-reviewed articles in English language from 2010 until 2024 were used. The article chosen are only in English, original article and open access. No attempts were made to contact authors for additional information. Comparable searches were made for the other databases.

Study selection

The search was conducted according to the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines (Liberati et al., 2009). The following keywords were used during the search: #intellectual disabilities and (#exercise OR #physical activity). Studies were screened for engaging varieties of exercise prescription as intervention, and intellectual disability as group population. Randomized Controlled trials, pre and post interventional study and a quasi- experimental studies in individuals with ID were included in this review. The interventions comprised of training or exercise prescription while intellectual disability described as: (i) children with ID, (ii) adolescent with ID, (iii) adult with ID and (iv) athletes with ID.

Participants criteria

The inclusion criteria for this study are: (i) physically active; (ii) mild category ID individuals (i.e., slow learner, dyslexia and autism) ; (iii) age below 18 years old (children) and above 18 years old (adult); (iv) identified as disabled by general practices before aged 18 years old.

The exclusion criteria are: (i) participants who are on medication or taking any supplement prior to the study period; (ii) having any health problems (such as asthma, cardiac problem, diabetes, spinal cord injury); (iii) and having history of physical injuries in the past 6 months.

Data extraction

The titles and abstracts of retrieved articles were reviewed using the criteria specified to determine whether full texts were required for further analysis. Each full text manuscript was evaluated systematically according to the study: (i) objective/s, (ii) characteristics of the study (study design, participants, age and sample size), (iii) contents of intervention (intervention types, length of intervention or mode of exercise tested), (iv) targeted outcome/s and (5) main findings. The outcomes extracted from those studies were not combined, reanalysed or changed due to the nature of this systematic review.

RESULTS

Search results

The initial search from the databases identified 715 potential articles from selected search engine. After removing duplicates, 583 article were assessed based on titles and abstracts against the selection criteria. A total of 312 articles were excluded because they did not investigate the effectiveness of exercise program among ID people. After detailed analysis of the 154 full-text articles another 141 articles were excluded due to a number of reasons such as the study involve the patient or unhealthy participant, not involved any training intervention or recruited Down syndrome participants in the study protocol. Therefore, only 13 were included in this scoping review. Figure 1 describes the PRISMA flow diagram for the study selection.

From the 13 studies reviewed, six studies were conducted on adult with ID while remaining four among children and three among adolescents. The scope of the study from the retrieved articles was primarily on the effects of training program on cardiovascular (Ayers, 2024; Park et al., 2024, body composition (Wu et al., 2010; Tomé et al., 2024) and physical fitness (Ariffin et al., 2020; Ndayisenga, 2019; Lee et al., 2016; Zhao et al., 2024; Kwan et al., 2024; Janbozorgi et al., 2024) in Table 1.

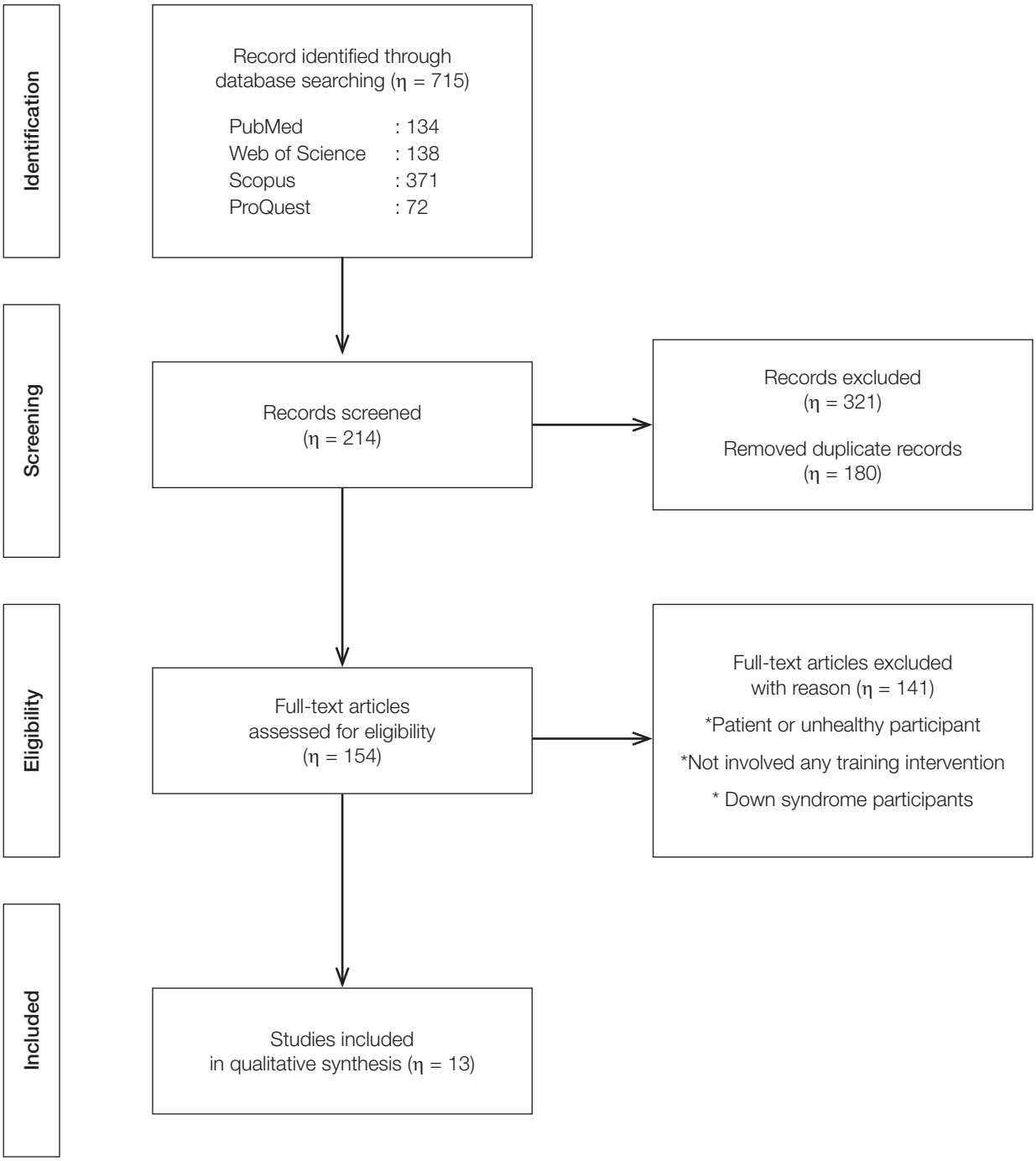

Figure 1. PRISMA flow for study selection

Another study investigated the effects of training program on physiological markers (Kim & Lee, 2016; Boer et al., 2014; Calders et al., 2011) in Table 2.

The type of training prescribed consisted of circuit training (Ariffin et al., 2020; Ndayisenga, 2019; Kim & Lee, 2016), balance and functional strength training (Lee et al. 2016), sprint interval training (Boer et al., 2014), endurance training (Calders et al., 2011), aquatic exercise (Zhao et al., 2024), virtual/video exercise (Ayers, 2024; Kwan et al., 2024), recreational game and sport (Wu et al., 2010; Tomé et al., 2024), sensory integration exercise (Park et al., 2024) and Brailletonik exercise (Janbozorgi et al., 2024).

The present study will produce a guidelines for educators, sports scientist and coaches to plan a specific training program for ID individuals. Also, the results of this study will provide recommendations to educators working with disabled poeple focusing on healthy lifestyle, and push them to their peak of individuals' physical performance. This present study also could enhance the ability and open more opportunities for disabled people to be involved in physical activities.

Table 1. **Effect of exercise program on cardiovascular, body composition and physical fitness among individuals with intellectual disabilities (ID)**

No.	Authors	Study Design	Population	Intervention/ Exercise Program	Outcome Measure/ Fitness Test	Main finding
1.	Ariffin et al. (2020)	Randomised controlled trial, Exercise group (η=19), Control group (η=19)	Adult with intellectual disabilities (ID) (18 to 30 years old)	Circuit training 6 stations 6 weeks: 2 x week Intensity: 40-60% HRR	Anthropometry and Body composition: i. body weight ii. height iii. body fat iv. fat free mass v. BMI	Increase in vertical jump in exercise group but 13.3 ± 29.3% significant reduction in jumping height in control group
					Physical fitness tests: Muscular strength and power: i. Biodex isokinetic dynamometers ii. Vertical jump height iii. Standing long jump	6 weeks of intervention could give significant improvement on muscular strength.
2.	Ndayisenga (2019)	Pre and post interventional study (N=15)	Children with intellectual disabilities (ID) (15 to 17 years old)	Intervention programme of the circuit training 6 weeks 6 stations:	Physical fitness tests: i. Cardiorespiratory fitness ii. Leg muscle strength iii. Static balance	Significantly increased in cardiorespiratory fitness, leg muscle strength, and static balance at the end of the 6 weeks of intervention programme of the circuit training.
3.	Lee et al. (2016)	Randomised controlled trial, Training group (η = 15), Control group (η = 16).	Adolescents with intellectual disabilities (ID) (14 to 19 years old)	Balance and functional strength training 8 weeks: 2 x week	Physical fitness tests: i. Postural balance ii. Muscle strength	Significant improvements in the balance training group as compared to baseline
						postural balance and muscle strength showed no significant improvements in the control group after 8 weeks of postural balance and functional strength training.
4.	Wu et al. (2010)	Pre and post interventional study (N= 146)	Adults with intellectual disabilities (ID) (19 to 67 years old)	6 months healthy physical fitness programs Program interventions : daily 40 min healthy physical fitness activities (4 x week) : activities of sports, acrobatic, jogging, dancing, walking, and up the stairs	Anthropometric measurement: i. Height ii. Weight iii. BMI Physical fitness measurement tools: i. V-shape ii. Sit and reach test, iii. Sit-up 30 s, iv. Sit-up 60 s, v. Shuttle run	Statistical decreases in individual's weight, BMI score, BMI category, and positive improvement in V-shape sit and reach test, sit-up in 30 s and 60 s tests after 6-month interventions.
						No significant improvement in Shuttle run test

5.	Zhao et al. (2024)	Randomised controlled trial Aquatic exercise group (n-14), Floor curling group (n=14), control group (=-14)	Children with ID (9-12 years old)	Aquatic exercise or floor curling 12 weeks, 3 x week, (60 min)	Physical fitness tests: Balance: i. Berg Balance test	The findings of this study validate the positive effects of aquatic exercise and floor curling on the balance ability and lower limb muscle strength of children with intellectual disabilities.
					Lower limb muscle strength: i. Handheld dynamometer	The aquatic exercise group demonstrated an average improvement of 10.84% in balance ability and an overall average improvement of 16.28% in lower limb muscle strength.
						The floor curling group showed an average improvement of 9.04% in balance ability and an overall average improvement of 15.67% in lower limb muscle strength.
6.	Tomé et al. (2024)	A quasi-experimental design (N=17)	Intellectual and development disabled people (18 to 57 years old)	9 weeks intervention 1 x week (60-90 minutes)	Anthropometric and body composition: i. Height, ii. Weight, iii. Body mass index (BMI) iv. Muscular mass (mm)	The intervention program seems to have contributed positively to improving the perception of autonomy in ADLs and body composition.
					Functionality in ADL: i. (WHODAS 2.0 questionnaires)	
					Physical fitness tests: Muscular strength: i. Handgrip test, ii. Sit and Stand iii. Timed up and go	Significant improvements were found after the physical exercise intervention program in the functionality and body composition variables but not in the physical fitness variables
7.	Ayers (2024)	A quasi-experimental design Group A (one building at the center) (n=6), Group B (a second building at the center) (n=4), and Group C (an all-virtual group) (n=3)	Adults with intellectual disabilities (ID) (>18 years old)	6-weeks virtual exercise/dance program 2 x week (1 hour)	Body mass index (BMI)	Improved cardiovascular and muscular fitness using Standing Long Jump (SLJ) and 6 Minute Walk Test (6MWT).
					Physical fitness tests: Muscular strength: i. Standing long jump Cardiovascular fitness: i. 6-minutes walk test	No improvement was noted in Body Mass Index measurements.

8.	Kwan et al. (2024)	A multicenter controlled trial Exercise group (n=160), Control group (n=20).	People with intellectual disabilities (ID) Aged >15 years old	Video-based exercise program with a series of short duration and moderate intensity exercise sessions with progression over 8 weeks 2 x week (60 mins)	Body composition: i. BMI ii. Waist girth	Significant improvements in their physical performance including 30-s chair stand repetitions and five-time chair stand duration, 4-m comfortable walk time and also 6-min walk test, within the exercise group (all $P < 0.05$).
					Physical fitness tests: Lower extremity strength: i. 30-s chair stand repetitions ii. 5-time chair stand duration test Gait speed: i. 4-meters comfortable walk time	Approximately 39% of the participants in the exercise group also showed significant improvement in standing static balance level.
					Mobility and submaximal exercise performance: i. 6-min walk test Balance: i. Standing static balance test	No significant differences were found when compared with the control group participants who did not have any regular exercise participation.
9.	Park et al. (2024)	Pre and post interventional study (N=14)	Children with intellectual disabilities (ID) (9 to 13 years old)	7-weeks evidence-based exercise program i. Sensory integration exercises ii. Aerobic exercise (Circuit) iii. Resistance exercises	Body compositions: i. BMI, ii. WHR % (Waist to hip ratio), iii. Body weight (kg)	Participating in the evidence-based exercise program developed in this study was found to significantly improve cardiovascular fitness (6-minute walk), agility (standing long jump), and muscular function (sit-ups), but did not yield significant results in terms of flexibility (sit-and-reach).
					Physical fitness tests: i. 6-minutes walk ii. Sit-ups iii. Sit and reach iv. Standing long jump	Additionally, the exercise program showed significant results in terms of reducing problem behaviors. The parents of children with developmental disabilities were all satisfied with the exercise program and its outcomes.

10.	Janbozorgi et al. (2024)	Randomised controlled trial Individual BPAM (n=15), and Pair BPAM (n=15)	Children with intellectual disabilities (ID) (8-12 years old)	Training sessions 7-weeks 21 sessions Each training sessions: 30 min Brailletonik exercises: Individual and paired BPAM (Brailletonik physical activity program) included:	Physical fitness test: Static balance: i. Stork stand test	The results showed that individual and paired exercise groups had significant progress from pre-test to posttest in both variables of balance and reaction time (p=0.001).
					Reaction time: i. Simple reaction time software	The comparison of the performance of the groups in the post-test showed that the average performance of the paired exercise group was significantly better than the individual exercise group in the balance variable (p=0.03) and in the reaction time variable (p=0.01).
						BPAM in paired groups has a greater effect on the balance and reaction time of children with ID.

Table 2. **Effect of exercise program on physiological markers among individuals with intellectual disabilities (ID)**

No.	Authors	Study Design	Population	Intervention/ Exercise Program	Outcome Measure/ Fitness Test	Main finding
1.	Kim & Lee (2016)	Randomised controlled trial circuit exercise group (n=6), control group (n=6)	Adolescents with intellectual disabilities (14 and 16 years old)	12-week of circuit exercise program 4 x week (40 min)	BAP (biological antioxidant potential) levels and i. The d-ROM (derivatives oxygen metabolite) levels	12-week CE program increased significantly physical fitness (P< 0.05).
					Anthropometry and body composition: i. Height, ii. Body mass (kg), iii. Body fat percentage (%) Physical fitness tests: Muscular strength: i. Hand grip ii. Back strengths Measure muscular endurance: i. sit-up Flexibility: i. sit and reach	CE program improved physical fitness, and reduced the d-ROM levels, and increased the BAP levels of the adolescents with intellectual disabilities

2.	Boer et al. (2014)	Randomised controlled trial sprint interval training (n = 17), continuous aerobic training (n=15) and control (n=14).	Adolescents and adults with intellectual disabilities (ID) (17 years old)	Sprint interval training 15 weeks 2 x week three blocks of 10 minutes at ventilatory threshold (blocks 1 and 3: 10 sprint bouts of 15 seconds, followed by 45 seconds relative rest; block 2: continuous training) Continuous aerobic training three blocks of 10 minutes continuous training. After eight weeks, intensity was increased to 110% of ventilatory threshold.	Metabolic fitness: ii. Blood pressure iii. Lipid profile i. HOMA-IR	Significant positive effect on waist circumference, percentage of fat, systolic blood pressure, lipid profile, fasting insulin, assessment of insulin resistance homeostasis models, VO2 peaks, Watt tops, ventilatory thresholds compared to control group.
					Physical fitness tests: i. Maximal cardiopulmonary ii. Exercise test Strength: Sit-to-stand test iii. Six-minute walk test	Positive effect on 6-minute walking distances and muscle fatigue resistance compared to control group.
					American Thoracic Society guidelines	
3.	Calders et al. (2011)	Randomised controlled trial Combined exercise training group (combination of strength and endurance exercises) (n=15), Aerobic exercise training group (endurance training) (n=15), Control group (n=15)	Adults with intellectual disabilities (ID) (18 and 60 years)	A group of combined exercise (strength and endurance) training (n =15) and endurance training (n = 15) 20 weeks 2 x week (70 mins)	cholesterol levels, resting systolic blood pressure	Results showed compared to no training, combined exercise training has significant positive effects on total cholesterol levels, aerobic capacity, muscle strength and resting systolic blood pressure
					Physical fitness tests: i. Aerobic capacity, Muscle strength	Endurance exercise training has significant effects on aerobic capacity and resting systolic blood pressure.

DISCUSSION

Effect of exercise and body composition among intellectual disabilities

Exercise has been shown to have a positive impact on body composition in individuals with ID. People with ID are at a higher risk of obesity, cardiovascular disease, and other health problems related to poor body composition. Exercise helps to improve body composition by reducing body fat and increasing muscle mass. Two studies found were conducted among Down-syndrome participants (Florentino Neto et al., 2010; Ortiz-Ortiz et al., 2019). Regarding to the data recorded in the study by Florentino Neto et al. (2010), the study was to examine the changes in body composition resulting from weight training among individuals with Down Syndrome in 12 weeks; 3 × per week; 60 min/session. The results showed significant decrease of fat percentage (-2.0%, p = 0.036) and absolute fat (-1.4kg; p = 0.000). The controls presented unfavourable increase in fat percentage (+1.0%, p = 0.043) and absolute fat (+0.8kg, p = 0.004). Regarding lean mass (LM), besides, the effect of a physical fitness program on body composition and isometric strength in children with Down syndrome was reported by Ortiz-Ortiz et al.2019, which measured isometric handgrip strength, body height, weight, triceps, and the medial calf skin folds. The physical fitness program was performed for 16 weeks, five times per week, for 55-min sessions. The results showed significant pre- to post- intervention reductions in BMI in both exercise group (22.2 ± 2.5 vs. 20.7 ± 2.5 kg/m2), and control group (23.3 ± 4.9 vs. 21.9 ± 4.6 kg/m2). Similarly, the results reported to be statistically significant at pre- post-intervention in medial calf skinfold and isometric strength in the exercise group (14.9 ± 5.5 vs. 14.6 ± 3.2 mm) and control group (2.4 ± 4.0 vs. 9.2 ± 2.0 kg), respectably. Rosety-Rodriguez et al. 2013 in the study of resistance circuit training reduced inflammatory cytokines in a cohort of male adults with Down syndrome with six stations, 3 days per week for 12 weeks. Plasma levels of leptin, TNF-α, and IL-6 were significantly decreased after the completion of the training program. No sports-related injuries or withdrawals from the program were reported during the entire study period. No changes were observed in the control group. However, there is a study to evaluate the effects of 9 weeks playful game intervention had reduced overall body composition (Tom**é** et al., 2024). It is important to note that exercise programs for individuals with intellectual disabilities need to be tailored to their individual needs and abilities. This may involve modifications to the exercise program, such as using equipment that is easy to use or adapting exercises to be less complex. Such modifications ensure inclusivity and help maintain motivation, allowing participants to gradually achieve improvements in body composition, flexibility, balance, muscle strength, and physiological health markers.

Effect of exercise on flexibility among intellectual disabilities

Exercise has been shown to have a positive effect on flexibility in individuals with ID. Regular physical activity can improve range of motion, reduce muscle stiffness, and increase the overall flexibility of the muscles and joints. This in turn can improve mobility and reduce the risk of injury. Wu et al. (2010) in the study of the effectiveness of healthy physical fitness programs on people with intellectual disabilities living in a disability institution: Six month short-term effect, the study collected information on disability condition (type and level), height, weight, BMI, and physical fitness status (includes V-shape sit and reach test, sit-up 30 s, sit-up 60 s, and shuttle run) at the beginning and 6 months later of the program intervention. The results showed that there were statistical decreases in individual's weight, BMI score, BMI category, and positive improvement in V-shape sit and reach test, sit-up in 30 s and 60 s tests after 6-month interventions. As a result, the aerobic activity such as jogging, dancing, and walking 40 min exercise, 4 time per week have positive improvement on flexibility after 6 month but found to have no significant effect in shuttle run. In contract, recent study conducted by Park et al. (2024) did not yield significant result in term of flexibility but found to significantly improve cardiovascular fitness (6-minute walk). It showed that combination of aerobic exercise (circuit) with resistance training outranged the effect of aerobic exercise alone even though after 7 weeks of intervention. Taken together, these findings support the conclusion that regular physical activity improves range of motion, reduces muscle stiffness, and increases overall flexibility of the muscles and joints among individuals with ID.

Effect of exercise on balance, muscular strength and power among disabilities

Physical exercise has been shown to have many benefits for people with ID including improvements in muscular strength and power. However, the extent of the improvements may depend on the specific characteristics of the individual and the type of exercise being performed. Studies have shown that both resistance training and aer-

obic exercise can improve muscular strength and power among individuals with ID (Park et al., 2024). Resistance training, which involves using weights or other forms of resistance to build muscular strength, has been found to be particularly effective in improving upper body strength, lower body strength, and overall muscle power. Previously, Zetts et al (1995) in their study, showed a progressive resistance exercise program on the productivity of individual simulation work among moderate to severe ID found a comparable percentage of muscle strength on the dominant and non-dominant muscle group. Ariffin et al. (2020) found that there were 9.1 ± 36.8 % increase in vertical jump in exercise group but 13.3 ± 29.3% significant reduction in jumping height in control group after 6 weeks of circuit training which revealed that 6 weeks of intervention could give significant improvement on muscular strength. Similarly, study by Ndayisenga (2019) also showed significantly increased cardiorespiratory fitness, leg muscle strength, and static balance at the end of the 6 weeks of intervention programme of the circuit training physical activity among intellectual disabilities children. Additionally, combination balance and functional strength training in Lee et al (2016) research showed significant improvements in the balance training group as compared to baseline; but postural balance and muscle strength showed dropped poorly in the control group after 8 weeks. Interestingly, a recent study by Zhao et al. (2024) identified that aquatic exercise or floor curling, both demonstrated positive changes in balance ability, and lower limb strength more that 10% at 12 weeks intervention among children with ID. Video based exercise program among adolescent seem to show similar effects, which could significantly improved in their standing static balance level by 39% and overall physical performance such as 30-s chair stand repetitions and five-time chair stand duration, 4-m comfortable walk time and also 6-min walk test (Kwan et al., 2024). Enjoyable activities could attract younger participants to be more adherence to the activity.

Effect of exercise on physiological markers among disabilities

Furthermore, the results in Kim & Lee (2016) study indicated that the 12-week of circuit exercise program improved physical fitness, biological antioxidant potential (BAP) levels and the derivatives oxygen metabolite (d-ROM) levels among adolescents with intellectual disabilities. In similar targeted population, a study by Boer et al. (2014) assessed the effects of sprint interval training for 15 weeks on metabolic and physical fitness showed additional significant positive effect on waist circumference, percentage of fat, systolic blood pressure, lipid profile, fasting insulin, assessment of insulin resistance homeostasis models, VO_2 peaks, Watt tops, ventilatory thresholds, 6-minute walking distances and muscle fatigue resistance compared to control group. Next, a study by Calders et al. (2011), a group of combined exercise (which attended a combination of strength and endurance exercises) training (n=15) and endurance training (n=15) were performing selected exercise twice a week for 70 minutes per session for 20 weeks and there was also no training group (n= 15). Results showed compared to no training, combined exercise training has significant positive effects on total cholesterol levels, aerobic capacity, muscle strength and resting systolic blood pressure, while endurance exercise training has significant effects on aerobic capacity and resting systolic blood pressure. Compared to endurance training, combined exercise training resulted in a significantly better evolution of total cholesterol (mean differences: -18 versus -3 mg/dl), 1RM upper (+6 versus +1 kg) and lower limb (+25 versus +8 kg) and abdominal muscles (+15 versus +1kg), hand grip strength (+9 versus +2 kg), muscle fatigue resistance (+11 versus +5 sec), sit-to-stand (+5 versus +2/30 sec) and systolic blood pressure (-15 versus -10 mmHg). These findings are in line with recent meta-analysis evidence by Jacinto et al. (2024), who confirmed that combined training interventions yield substantial benefits in fitness and health markers among individuals with ID.

Specific guidelines for exercise prescription among disabled people

The promotion of adapted physical activities for disabled people were investigated by Barak et al. (2014) and Jaarsma et al (2014). Martin (1999) reported that there were variety factors to determine and increase the optimal athletic development and sports success for disabled people. Firstly, characterized their weakness and strength in terms of their disabilities. It is to ensure that their muscle and general fitness was slowly adapted to training program (exercise). This is due to lack of experience in sports or physical activities. Hence, number of exercises with low intensities recommended such as wheelchair walking, yoga and walking. These types of exercises could enhance their motivation and happiness during physical activities. Martin (2012) revealed that sport psychologists have started to emphasize the value of mental strength like self-confidence for disability sports athletes in last 10 - 20 years. A lot of benefits of exercises to disabled people either children or adults including increased

strength and mobility, prevent weight gain and improve social interactions. Pollock et al., (1998) stated there were specific guidelines that have been written to prescribe the exercises for certain conditions. Rest interval was a crucial element in training session to avoid injury and allows muscles to recover enough. At the same time, rest interval on normal people was different than disabled people. Normally, rest interval on disabled people was longer due to their different physical disabilities. As mentioned by Willardson (2008), a difference of rest period in strength training affected body metabolisms, physiologically and muscular strength development depends on the training phase and goals. Then, lack of recovery can be manifested by the disabled people such as injury, fatigue, stress, sleepy and other negative effects. Normally, the amount of rest period depends on big components such as volume, intensity, and training history. De Sallas et al. (2009) in their studied stated rest interval was one of main factors that affected strength training to prevent the injury. A rest interval must be well-planned in creating the strength training program. Aerobic training also suggested to enhance their general physical fitness such as aquatic therapy, brisk walking, and swimming. Aerobic training can improve their aerobic capacity during physical activities. A variation in exercises was recommended to activate many muscles parts and avoid them feeling bored. Pearson et al. (2000) suggested that the exercises can be changed every 2 - 3 weeks or can use two program variations on alternate training. Frequency of training is also one of the factors in training session. The frequency of training refers to the numbers of training sessions. The frequency may depend on goals, level of performance and sports. In conclusion, a well-planned training program was needed to enhance and motivate this population to get involved in sports and physical activities. Hence, coaches or sports practitioners must characterize their strengths and weakness in terms of their disabilities. This is because a training program given was specific to sports and individual. It is important to ensure that this population were slowly adapted to the exercises to avoid injury or accident. Therefore, a few guidelines must be given to them to perform the exercises with proper techniques. At the same time, general principles of training must be applied in their training session such as intensity, rest and recovery, overload, and training duration to ensure that their general fitness was slowly adapted physically and physiologically. In conclusion, a well-planned and individualized exercise prescription is essential to motivate participation, ensure optimum fitness level, maintain ideal body weight, reduce the risk of non-communicable diseases, and support performance in sports among individuals with ID.

Limitation

This review is limited by the small number of included studies and their relatively small sample sizes. In addition, heterogeneity in study designs, interventions, and outcome measures makes direct comparisons difficult. Most studies also lacked long-term follow-up, which limits its understanding of sustained effects.

CONCLUSION

Participation of individuals with ID in physical activity is highly encouraging, provided that social support, accessible facilities, and collaboration between the public and private sector are in place. National disability strategies and international frameworks such as the United Nations Convention on the Rights of Person with Disabilities (UNCRPD) already highlight the right to equal participation in physical activity, and future programs should build on these commitments to create sustainable opportunities for this population (United Nations, 2006). A well-planned, individualized exercise prescription is therefore essential to ensure their optimum fitness, maintain healthy body weight, minimize the risk of non-communicable diseases, and enable individuals with ID to perform successfully in sports and physical activities.

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CONFLICT OF INTEREST

The author declares no conflict of interest.

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REFERENCES

Ariffin, N. S. I., Fariq, F. I. M., Hamzah, N. A., & Ahmad, N. S. (2020). Effects of Circuit Training on Muscular Strength and Power, Jumping Height and Body Composition in Intellectual Disabilities Individuals. *Journal of Social Science and Humanities*, *3*(2), 14-24.

Aydoğan, D., & Hadi, G. (2020). Resilience in Turkish Physically Disabled Athletes: The Role of Sport Participation. *Turkish Journal of Sport Sciences, 3*(1), 1-12.

Ayers, M. (2024). A 6-week virtual exercise/dance program impacts fitness levels for adults with intellectual disabilities: *Delaware Journal of Public Health*, *10*(1), 90–96. https://doi.org/10.32481/djph.2024.03.11

Barak, S., Hutzler, Y., & Dubnov-Raz, G. (2014). Physical exercise for people with cerebral palsy: effects, recommendations and barriers. *Harefuah, 153*(5), 266-272.

Boer, P. H., Meeus, M., Terblanche, E., Rombaut, L., Wandele, I. D., Hermans, L., & Calders, P. (2014). The influence of sprint interval training on body composition, physical and metabolic fitness in adolescents and young adults with intellectual disability: A randomized controlled trial. *Clinical rehabilitation*, *28*(3), 221-231. https://doi.org/10.1177/0269215513498609

Calders, P., Elmahgoub, S., de Mettelinge, T. R., Vandenbroeck, C., Dewandele, I., Rombaut, L., Vandevelde, A., & Cambier, D. (2011). Effect of combined exercise training on physical and metabolic fitness in adults with intellectual disability: a controlled trial. *Clinical rehabilitation*, *25*(12), 1097-1108. https://doi.org/10.1177/0269215511407221

De Salles, B. F., Simão, R., Miranda, F., da Silva Novaes, J., Lemos, A., & Willardson, J. M. (2009). Rest Interval between Sets in Strength Training. *Sports Medicine*, *39*(9), 765–777. https://doi.org/10.2165/11315230-000000000-00000

Draheim, C. C., Williams, D. P., & McCubbin, J. A. (2002). Prevalence of physical inactivity and recommended physical activity in community-based adults with mental retardation. *Mental retardation*, *40*(6), 436-444. https://doi.org/10.1352/0047-6765(2002)040

Enkelaar, L., Smulders, E., van Schrojenstein Lantman-de Valk, H., Geurts, A. C., & Weerdesteyn, V. (2012). A review of balance and gait capacities in relation to falls in persons with intellectual disability. *Research in Developmental Disabilities*, *33*(1), 291-306. https://doi.org/10.1016/j.ridd.2011.08.026

Florentino Neto, J., Pontes, L. M. D., & Fernandes Filho, J. (2010). Body composition alterations resulting from weight training in subjects with Down Syndrome. *Revista Brasileira de Medicina do Esporte*, *16*, 9-12. https://doi.org/10.1590/S1517-86922010000100001

Ginis, K. a. M., Van Der Ploeg, H. P., Foster, C., Lai, B., McBride, C. B., Ng, K., Pratt, M., Shirazipour, C. H., Smith, B., Vásquez, P. M., & Heath, G. W. (2021). Participation of people living with disabilities in physical activity: a global perspective. *The Lancet*, *398*(10298), 443–455. https://doi.org/10.1016/S0140-6736(21)01164-8

Jaarsma, E. A., Dijkstra, P. U., Geertzen, J., & Dekker, R. (2014). Barriers to and facilitators of sports participation for people with physical disabilities: A systematic review. *Scandinavian Journal of Medicine & Science in Sports, 24*(6), 871–881. https://doi.org/10.1111/sms.12218

Jacinto, M., Rodrigues, F., Monteiro, D., Diz, S., Morquecho Sánchez, R., Morales-Sánchez, V., & Antunes, R. (2024). Effects of combined training in individuals with intellectual and developmental disabilities: A systematic review and meta-analysis of randomized controlled trials. *Disability and Rehabilitation, 47*(7), 1615-1630. https://doi.org/10.1080/09638288.2024.2381598

Janbozorgi, Z., Khalaji, H., & Moradi, J. (2024). The effect of individual and paired Brailletonik exercises on balance and reaction time in children with intellectual disability. *BMC Sports Science, Medicine and Rehabilitation*, *16*(1), 103. https://doi.org/10.1186/s13102-024-00891-9

Kim, C. G., & Lee, J. S. (2016). Effect of startup circuit exercise on derivatives, reactive oxygen metabolites, biological antioxidant potential levels, and physical fitness of adolescent boys with intellectual disabilities. *Journal of Exercise Rehabilitation*, *12*(5), 483–491. https://doi.org/10.12965/jer.1632710.355

Kwan, R., Szeto, G., Ho, E., Wu, A., Wong, L., Ho, G., Lau, R., Wong, E., Kwok, A., & Cheung, D. (2024). The effectiveness of video-based exercise training programs for people with intellectual disability: a multicenter study. *Frontiers in Sports and Active Living*, *6,* 1378126. https://doi.org/10.3389/fspor.2024.1388194

Lee, K., Lee, M., & Song, C. (2016). Balance training improves postural balance, gait, and functional strength in adolescents with intellectual disabilities: Single-blinded, randomized clinical trial. *Disability and Health Journal*, *9*(3), 416-422. https://doi.org/10.1016/j.dhjo.2015.12.004

Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gotzsche, P. C., Ioannidis, J. P. A, Clarke, M., Devereaux, P. J., Kleijnen, J., & Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *Annals of Internal Medicine, 151*(4), 65-94. https://doi.org/10.7326/0003-4819-151-4-200908180-00136

Martin, J. N. (1999). A personal development model of sport psychology for athletes with disabilities. *Journal of Applied Sport Psychology*, *11*(2), 181–193. https://doi.org/10.1080/10413209908404199

Martin, J. N. (2012). Mental Preparation for the 2014 Winter Paralympic Games. *Clinical Journal of Sport Medicine*, *22*(1), 70–73. https://doi.org/10.1097/JSM.0b013e31824204cc

Messent, P., Cooke, C. B., & Long, J. (1999). Primary and secondary barriers to physically active healthy lifestyles for adults with learning disabilities. *Disability and rehabilitation*, *21*(9), 409-419. https://doi.org/10.1080/096382899297396

Ndayisenga, J. (2019). Circuit training intervention for adaptive physical activity to improve cardiorespiratory fitness, leg muscle strength static and balance of intellectually disabled children. *Sport Mont*, *17*(3), 97-100. https://doi.org/10.26773/smj.191019

Ortiz-Ortiz, M., Terrazas-Ordorica, K. I., Cano-Rodríguez, L. E., Gómez-Miranda, L. M., Ozols-Rosales, A., & Moncada-Jiménez, J. (2019). Effect of an intensive physical conditioning program on body composition and isometric strength in children with Down syndrome. *Journal of Physical Education and Sport*, *19*, 897-902. https://doi.org/10.7752/jpes.2019.s3129

Park, Y.-M., Kang, N., Kim, Y.-S., & Kim, D.-I. (2024). The effects of exercise intervention on physical fitness and problem behaviors in children with developmental disabilities: focused on the development of an evidence-based exercise program. *Exercise Science*, *33*(2), 223–233. https://doi.org/10.15857/ksep.2024.00241

Pearson, D., Faigenbaum, A., Conley, M., & Kraemer, W. J. (2000). The National Strength and Conditioning Association's Basic Guidelines for Resistance Training of Athletes. *National Strength and Conditioning Journal 22*, 14–27.

Pollock, M. L., Gaesser, G. A., Butcher, J. D., Després, J., Dishman, R. K., Franklin, B. A., & Garber, C. E. (1998). ACSM Position Stand: The recommended quantity and quality of exercise for developing and maintaining cardiorespiratory and muscular fitness, and flexibility in healthy adults. *Medicine and Science in Sports and Exercise, 30*(6), 975–991. https://doi.org/10.1097/00005768-199806000-00032

Rosety-Rodriguez, M., Bernardi, M., Elosegui, S., Rosety, I., Diaz, A. J., Rosety, M. A., Brenes, F., Oliva-Pascual-Vaca, A., Alvero-Cruz, J. R., & Ordonez, F. J. (2021). A short-term resistance training circuit improved antioxidants in sedentary adults with down syndrome. *Oxidative Medicine and Cellular Longevity*, 8811153. https://doi.org/10.1155/2021/8811153

Rosety-Rodriguez, M., Camacho, A., Rosety, I., Fornieles, G., Rosety, M. A., Diaz, A. J., Brenes, F., Frias, M., & Ordonez, F. J. (2013). Resistance circuit training reduced inflammatory cytokines in a cohort of male adults with Down syndrome. *Medical Science Monitor, 19*, 949–954. https://doi.org/10.12659/MSM.889362

Tomé, A., Antunes, R., Monteiro, D., Matos, R., Rodrigues, F., Amaro, N., & Jacinto, M. (2024). Efeitos de um programa de exercícios na autonomia, independência e aptidão física de pessoas com deficiência intelectual e de desenvolvimento - Um estudo piloto [Effects of an exercise programme on the autonomy, independence and physical fitness of individuals with Intellectual and Developmental Disabilities – A Pilot Study]. *Retos*, *53*, 147–156. https://doi.org/10.47197/retos.v53.102003

Tulppo, M. P., Hautala, A. J., Makikallio, T. H., Laukkanen, R. T., Nissila, S., Hughson, R. L., & Huikuri, H. V. (2003). Effects of aerobic training on heart rate dynamics in sedentary subjects. *Journal of Applied Physiology*, *95*(1), 364-372. https://doi.org/10.1152/japplphysiol.00751.2002

United Nations. (2006). *Convention on the Rights of Persons with Disabilities and Optional Protocol*. United Nations.

Wee, E. H., Anak, R., Fatt, T., Kang, M. K., Ler, H. Y. and Chin, N. S. (2021). Physical activity and sport participation among persons with disabilities in Malaysia: motivation and constraint. *Physical education and sport for children and youth with special needs researches–best practices-situation. Bratislava, Slovakia: Slovak Scientific Society for Physical Education and Sport and FIEP,* 125-136.

Willardson, J. M. (2008). A Brief Review: How much rest between sets? *Strength and Conditioning Journal*, *30*(3), 44–50. https://doi.org/10.1519/SSC.0b013e31817711a4

Wu, C. L., Lin, J. D., Hu, J., Yen, C. F., Yen, C. T., Chou, Y. L., & Wu, P. H. (2010). The effectiveness of healthy physical fitness programs on people with intellectual disabilities living in a disability institution: Six-month short-term effect. *Research in Developmental Disabilities*, *31*(3), 713-717. https://doi.org/10.1016/j.ridd.2010.01.013

Zetts, R. A., Horvat, M. A., & Langone, J. (1995). Effects of a community-based progressive resistance training program on the work productivity of adolescents with moderate to severe intellectual disabilities. *Education and training in mental retardation and developmental disabilities*, 166-178.

Zhao, P., Zhu, G., Chen, S., Pan, Y., Chen, K., Huang, L., & Guo, L. (2024). Effects of Aquatic Exercise and Floor Curling on Balance Ability and Lower Limb Muscle Strength in Children with Intellectual Disabilities: A Pilot Study in China. *Children*, *11*(1), 85. https://doi.org/10.3390/children11010085