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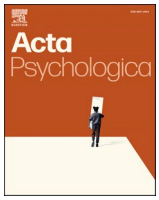

The impact of leisure physical activity on the physical fitness of young adults with intellectual disabilities

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ABSTRACT

Background: Individuals with intellectual disability are less physically active than individuals without intellectual disabilities, and rarely reach the recommended daily level of physical activity. There is sufficient scientific evidence for the beneficial effects of exercise on the cardiovascular and muscular fitness of young adults with mild-to-moderate intellectual disabilities.

The aim: To assess the impact of leisure physical activity on the physical fitness of adults with intellectual disabilities.

Method: 21 people (35,4 ± 11,61 years) with intellectual disabilities were allocated to two groups: I group (mean age 32,14 ± 9 years, 2 months, 1 t/week) and group II (mean age 38,25 ± 13,39 years, 2 months, 2 t/week). At the baseline and at the end of the intervention, the cardiorespiratory fitness, lower-body muscular strength and endurance, mobility and balance were assessed with 6-min walking (6MWT), lateral step-up (LSUT), sit-to-stand (30CST), Timed Up and Go (TUG) and Tinetti balance tests.

Results: Both groups showed improvements in cardiorespiratory endurance, muscular strength, and balance. Significant improvements were observed in Group I in the TUG ($p = 0.002$), LSUT ($p = 0.001$), and 6MWT ($p = 0.004$) results. Group II also demonstrated progress in TUG ($p = 0.010$), LSUT ($p = 0.008$), and 6MWT ($p = 0.012$), though they did not reach recommended physical activity benchmarks. Significant differences between the groups were observed in leg strength and mobility ($p < 0.05$). These findings suggest that short-term, low-frequency interventions may be insufficient for individuals with low baseline fitness.

Conclusion: This study fills a gap in the literature by focusing on young adults with ID and shows that leisure PA can yield meaningful functional improvements. However, higher frequency and longer-duration interventions are likely needed to achieve recommended physical activity levels. The findings offer practical insights for developing inclusive, evidence-based PA programs for this underserved population.

Lay summary: For individuals with intellectual disabilities, physical capability is often assessed through abilities essential to daily living—such as coordination, balance, muscular strength, endurance, and flexibility. As people age, functional strength and exercise tolerance tend to decline.

This study showed that in young adults with mild to moderate intellectual disabilities, leisure physical activity improves fitness and mobility and can reduce some cardiovascular risk factors. Programs should prioritize exercises that improve gait, balance, and physical function to lower fall risk and support greater independence. These findings highlight that leisure physical activity is a simple, cost-effective way to promote health in this population.

1. Introduction

Intellectual disability (ID) is a term used when a person has certain restrictions of cognitive functioning and skills, including communication, social and self-care skills (AAIDD, 2022). People with an intellectual disability tend to take longer to learn and may need support to develop new skills, understand complex information, and interact with other people. The level of support an individual needs depends on specific factors. For example, a person with a mild intellectual disability may only require assistance with straightforward tasks, such as

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participating in a sports club. However, someone with a severe or profound intellectual disability may need full-time care and support with every aspect of their life – they may also have physical disabilities. In addition, the extent to which an individual is unable to face the demands established by society for the individual's age group can be further classified as: mild, moderate, severe, and profound (American Psychiatric Association aww, 2013).

The highest priorities for the majority of people with intellectual disabilities in all countries are likely to include basic health care, adequate nutrition and housing, education, civil rights, and political, social and economic stability. An international perspective on healthy aging for persons with intellectual disabilities must acknowledge that the available literature largely reflects the experiences of clinicians and researchers in industrialized countries. Research indicates that specific populations of people with intellectual disabilities have particular health risks (Evenhuis et al., 2000). We highlight some crucial points country specific notes about the priorities and challenges faced by people with intellectual disabilities. An international perspective on healthy aging for persons with intellectual disabilities important to continue advocating for inclusive policies and practices that address these priorities and challenges. The resulting lifestyle and environmental issues and health promotion/disease prevention practices may directly cause, or interact with, hereditary factors, to protect against or confer specific health risks. People with intellectual disabilities, and their carers, need to receive appropriate and ongoing education regarding healthy living practices in areas such as nutrition, exercise, oral hygeine, safety practices, and the avoidance of risky behaviors (Evenhuis et al., 2000).

It's know, that individuals with intellectual disability are less physically active than individuals without intellectual disability, and rarely reach the recommended daily level of physical activity (PA) (Hansen et al., 2021; Kreinbucher-Bekerle et al., 2023). It is understood that both social interaction and the ability to perform physical work affect participation in daily activity as well as PA. Individuals with intellectual disability generally have a higher risk of hypertension and obesity-related cardiovascular diseases than individuals without intellectual disability (Hansen et al., 2021). Adults with intellectual disabilities often experience multiple health conditions. In a study of 1,424,378 adults, only 31.8 % of those with intellectual disabilities had no other conditions, compared to 51.6 % without intellectual disabilities (Cooper et al., 2015). Individuals with intellectual disability also have a higher average body mass index (Yanardag et al., 2013), higher prevalence of cardiovascular risk factors such as high blood pressure and obesity (Walsh et al., 2017), decreased motor skills, both with respect to gross and fine motor skills (Pitetti et al., 2017) and tend to have less developed balance control than their peers (Collins & Staples, 2017). Adults with an intellectual disability may be particularly at risk for declining health associated with aging and low physical capability (Cuesta-Vargas et al., 2011; Graham & Reid, 2000). More severe intellectual disability is an important barrier for being active in adults with intellectual disability. Presence of physical health problems is an important barrier for being active in adults with intellectual disability (Vancampfort et al., 2022).

Leisure physical activity (PA) refers to movement that is not essential to daily living but is voluntarily chosen by the individual. Such activities include sports participation, exercise conditioning or training, and recreational activities such as going for a walk, dancing, and gardening. Evidence shows there is a significant participation gradient between people with and without disability in relation to physical activity due to multiple barriers faced regarding access, choice of activities offered, and attitudes of others. For many people with disability it should be possible to engage in various forms of physical activity without the need for adapted equipment or facilities (Bull et al., 2020). For example, only 9 % of the target population fulfilled the minimum recommendation of 150 min of moderate-to-vigorous PA (MVPA) per week (Dairo et al., 2016). In spite of clear guidance about the need for an active lifestyle, several studies in the literature reported absence of regular PA in adults with intellectual disabilities (Draheim et al., 2002).

In addition to the widely cited recommendation of at least 150 min of moderate-intensity aerobic physical activity per week, the World Health Organization (WHO) also emphasizes the importance of engaging in muscle-strengthening activities involving all major muscle groups on two or more days per week (WHO, 2020). These complementary recommendations are especially relevant for adults with intellectual disabilities, whose physical inactivity and low muscle strength are strongly associated with reduced physical functioning and overall health risks.

Physical activity has a close relationship with physical capability. Physical capability affects a person's health, and health status influences physical activity and physical capability. Movement has a positive effect on the musculoskeletal system, strengthens the circulatory system, as well as the digestive system and the respiratory system. Physical activity enhances physical, mental and social health (Strukčinskienė et al., 2018). Human physical activity is determined by physical characteristics that are general and fundamental. General physical characteristics include: balance, agility, coordination, while fundamental physical characteristics include: strength, endurance, flexibility, and these are the general physical characteristics that are crucial for human physical activity (Radzevičienė et al., 2016). The development of muscular strength and endurance is strongly related to the improvement of physical capability. Physical activity such as walking, climbing, and the ability to control a wheelchair improves functional capability. Functional movement (grocery shopping, gardening) increases energy, improves physical health, motivation, energy.

A decline in physical capability has a negative impact on a person's health, leading to reduced physical activity. Daily activity habits, routines, genetic factors, marital status, psychological well-being, chronic pain, diet also have a significant impact on the development of physical capability, as well as on the improvement of health and quality of life. There is a direct correlation between the increase in co-morbidities and quality of life. As the magnitude of co-morbidities (e.g. urinary tract infections, chronic pain, respiratory dysfunction, muscular atrophy, etc.) increases, the quality of life decreases (Petry et al., 2009; Van Timmeren et al., 2016).

Adults with disabilities tend to spend more time sitting, increasing their risk of developing chronic diseases by a factor of 4–5 (Thorpe, 2009). Research shows (Kuo et al., 2021) that for people with intellectual disabilities, participation in muscular endurance training increased cardiovascular and respiratory endurance, improved quality of life, and reduced depression and anxiety. Resistance training interventions (especially when not combined with other exercises) are effective in promoting muscle strength in adults with intellectual disability. The limited number of studies and the low quality score of the studies indicate a potential risk of bias, which limits the interpretation of the results and calls for further research (Obrusnikova et al., 2022). There is still a lack of evidence on how leisure physical activity affects the physical health, risk of falls (Lankhorst et al., 2015), and the effectiveness of interventions on physical-functional characteristics for improving their health (O'Brien et al., 2016). The main focus is on the health and sport-related physical capacity of children, adolescents (Golubović et al., 2012; Hartman et al., 2014) and elderly, old adults (Hilgenkamp et al., 2012; Kinnear et al., 2018) with intellectual disabilities.There is a lack of research examining the components of physical capacity and the effects of leisure-time physical activity in young adults with intellectual disabilities and how it may change with increasing age. Such information is critical to families, health care providers, and public health policymakers at all levels to improve quality of care for this group of people. To close the information gap, the aim to assess the impact of leisure physical activity on the physical and functional capability of young adults with disabilities.

2. Methods

2.1. Design and setting

The research was carried out between June and August 2022. The experiment took place in 5 stages (Fig. 1):

2.1.1. Phase I - search for subjects

The invitation to participate in the study was distributed to the following local communities: Guboja and Friends of Klaipėda; The hope of Klaipėda. 41 people filled out the questionnaire to participate in the study.

2.1.2. Phase II - selection of the subjects

Selection criteria: mild and moderate intellectual disability, age 18–45, the ability to independently engage in the physical activity intervention (sufficient verbal communication skills and physical capacity to follow instructions and complete all the tests independently) and informed consent and active cooperation from participants and their legal guardians. *Exclusion criteria:* acute conditions contraindicated in physiotherapy, acute inflammatory processes, bleeding, electrolyte imbalance, active endocarditis, unstable angina, aortic stenosis, threatening cardiac rhythm disturbances, aneurysm with unblocking, pronounced cardiac insufficiency, myocarditis and pericarditis, arterial hypertension (systolic >200, diastolic >110 mmHg), atrial fibrillation, complete ventricular block, coronary stenosis, hypertrophic cardiomyopathy, tachycardia, pulmonary embolism, renal insufficiency, uncontrolled metabolic diseases (diabetes), hemophilia, anemia. The contingent of the research sample after the selection of the subjects according to the selection criteria - 30 subjects. The subjects were introduced to the purpose of our investigation, as well as the methods, procedures, and possible inconveniences. The informed consent form was signed by the participant and co-signed by a parent or guardian after an explanation of the research study and what would be expected of them.

2.1.3. Phase III - assessment of the subjects' physical fitness

Individual physical exertion, functional muscle strength, tolerance to physical exertion, balance, coordination were assessed for persons with disabilities of different ages. After the first test the whole group was randomly divided into two groups of the same size (15 participants), according to physical capacity: group I - sufficient physical capacity; group II - insufficient physical capacity.

2.1.4. Phase IV - the experiment was carried out in the public space of Klaipėda city at the Disabled Beach

Physical activity training was held for group I - 1 time/week, for group II 2 times/week. The duration of the lesson was 90 min (WHO, 2020). Activities improving aerobic capacity, anaerobic endurance, balance, coordination, mobility, and joint mobility training methods

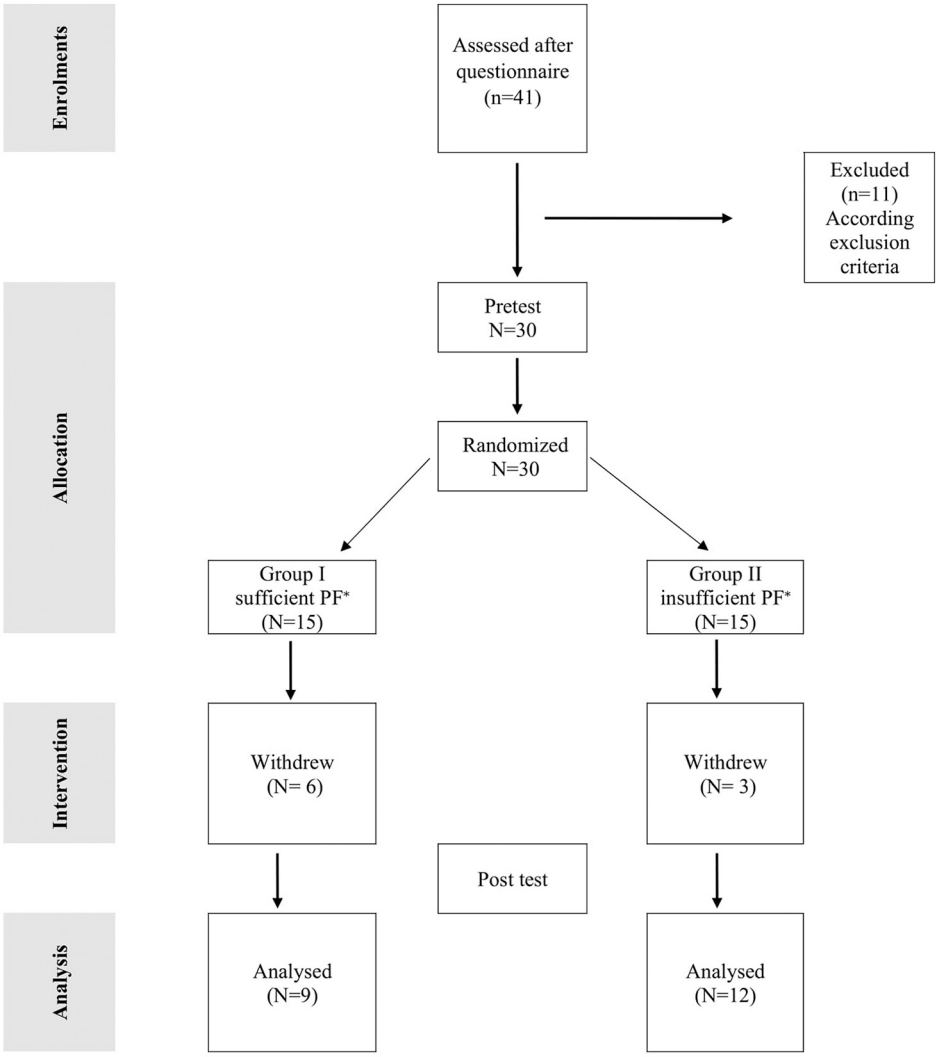

Fig. 1. Flow chart of study participants – experimental process (PF* - physical fitness).

were applied. Importantly, muscle-strengthening exercises were included in every session, targeting all major muscle groups at moderate to above moderate intensity, in accordance with the WHO recommendation to engage in muscle-strengthening activities at least two times per week, in addition to 150 min of moderate-intensity aerobic physical activity (Piercy et al., 2018). An example of the physical activity content is shown in Fig. 2.

2.1.5. Phase V - repeated assessment of the subjects' physical-functional capacity

We conducted our research in accordance with the convention of the human rights and dignity in medicine approved on 19 November 1996 (The Convention of Human Rights and Biomedicine) (Roders & Bousingen, 2001). The Bioethics Committee of the Department of Holistic Medicine and Rehabilitation, Klaipėda University (No. HMRK-BE-22-15) issued the permit for biomedical research.

Section	Exercise Prescription	Time, min	Exercise	Set/ Repetitions
Warm up*	Nature walking at a moderate pace	3-5	Breathing: Continuous, Not Forced	3x30 s Rest between repetitions: 5–10 seconds
	Upper and lower extremity stretching	10	Stretching performed unilaterally	Stretching must last 15 s per limb, 2x each Rest between repetitions: 5 seconds
Main part	Active range of motion exercises for arms, legs and trunk (for mobility, and joint mobility training)	15	Crunches/Sit ups	3 × 10
			Back extensions	3 × 15
			Squats (with no extra weights)	3 × 15
	The functional aerobic training	3-5	Jogging/mild running up and down on stairs	2×up/down
		3-5	Leaps forward	2×15 jumps
		3-5	Stair climbing	2×up/down
		3-5	Changing direction, and stepping over obstacles, walking backward.	Each exercise 3×12 (or until muscle fatigue).
	Muscle strength exercises***	3	Lateral step up (performed unilaterally	3×12 (or until muscle fatigue).
		3	Sit to stand (performed bilaterally	3×15
		3	Stand from half kneel (performed unilaterally)	3×12 (or until muscle fatigue).
Cool down*		3-5	Breathing exercise	Deep inhalations followed by relatively longer exhalations ("sighs")
		5-10	Nature walking at a moderate pace	

Fig. 2. An example of physical activity session
* A 15 min warm-up of the lower limb muscles was be performed by all participants at the beginning and end of each session
**Participants were allowed material support (support, railing, bench)
***180 s rest will be given between each exercise.

2.2. Participants

After inviting 41 subjects to participate in the study, a total of 30 adults with a mild and moderate intellectual disability were included. The flow diagram of the inclusion process can be found in Fig. 1. The main reasons for drop out were challenging behavior, cognitive issues, and motor development issues. 21 people with disabilities took part in the research. Table 1 showed the demographic characteristics of the participants, there were 12.3 % female and 85,7 % were male. The average age of the subjects was 35,4 years (SD = 11,61, range 19–45).

2.3. Measures

2.3.1. Cardiorespiratory fitness

A 6-min walking test (6MWT) was used to test functional capability. It is sensitive for people with disabilities, reliable, accurate, and a simple testing tool for those with low levels of functional capability, and has been widely used in epidemiological studies (Nasuti et al., 2012). This test was selected because it allows for a practical and objective evaluation of submaximal aerobic capacity in real-world settings. It directly reflects daily functional performance (e.g., walking endurance), which is highly relevant for people with intellectual disabilities who may experience reduced cardiorespiratory fitness. Measuring this capacity helps assess one of the core components of physical functioning targeted by the intervention.

2.3.2. Lower-body muscular strength and endurance

The lateral step-up test (LSUT) measures the functional muscle strength and endurance of the lower limbs. The test is performed for 30 s and records how far the subject climbed up the step or stepladder while facing it laterally (Hedgecock et al., 2023).

Sit-to-stand test (30CST). This is part of the Fullerton Fitness Test which measures physical fitness abilities. The Sit To Stand Test (also known as 30CST) was developed to measure functional lower body strength & endurance—which is the greatest indicator of your likelihood of falling down. The subjects were asked to stand and sit from the bench within 30 s. The result is recorded when the buttocks touch the base of the bench (Oppewal et al., 2015; Hilgenkamp et al., 2012).

These two tests were chosen because lower-body strength and endurance are directly linked to mobility, independence, and fall prevention in individuals with intellectual disabilities. LSUT and 30CST are validated, simple-to-administer, and require minimal equipment—making them ideal for use in this population. Additionally, these tests are sensitive to intervention-induced changes, allowing for meaningful comparison of physical improvements over time.

In accordance with the World Health Organization's physical activity guidelines, these muscle strength and endurance tests are relevant, as they assess performance related to major muscle groups. WHO recommends that, in addition to 150 min of moderate-intensity aerobic activity per week, adults—including those with intellectual disabilities—should perform muscle-strengthening activities involving all major muscle groups on two or more days per week (WHO, 2020). Therefore, the use of LSUT and 30CST in this study is directly aligned with global health guidelines and supports the evaluation of intervention outcomes focused on both aerobic and muscular components of physical capacity.

Table 1
Distribution of subjects by age, sex, number and group.

	I group	II group
Age (avg., SD)	32,14 ± 9 y	38,25 ± 13,39 y
Gender (N)	M-9	W-7, F-5
Total (N)	9	12

2.3.3. Mobility and balance

Timed Up and Go (TUG) test is designed to determine functional mobility and risk of falls. Participants were asked to stand up from a chair, walk three metres in a straight line, turn around, walk back in a straight line to the chair, turn around and sit down on the chair. The test is completed when the gluteal muscles touch the chair support (Enkelaar et al., 2013; Nordin et al., 2006). The duration of the task is assessed up to a maximum of 30 s; if >30 s, the subject requires assistance from another person in daily activities. A score of ≥14 s has been shown to indicate high risk of falls (Heyward, 2010).

Tinetti balance test mobility tool assesses balance, gait, more oriented towards older adults. The test includes 14 tasks that assess gait manoeuvres, position changes-functional movements found in everyday activities, for example: from a seated position to a standing position, climbing over an obstacle, 0-cannot perform, 2-normal performance, maximal score-16. The sum of 16 points obtained after testing means a good balance, there is no risk to fall (Heyward, 2010).

The TUG and Tinetti tests were included to evaluate dynamic balance and functional mobility, which are essential for safe and independent movement. These aspects are especially important for adults with intellectual disabilities, who have a higher fall risk due to reduced motor coordination, muscle weakness, and sedentary lifestyle. The use of these tests allows us to detect balance impairments and mobility limitations that may respond to physical activity interventions. Thus, they directly address the research question on how leisure physical activity influences physical-functional capacity.

2.3.4. Statistical methods

The data were processed using arithmetic average, *t*-test for independent samples (Student's t-test) and standard deviation. The Student's t-test was used to compare key characteristics between groups. Statistical reliability, i.e. a statistically significant difference between the data to be compared, for testing statistical hypotheses was defined when p is <0.05. All statistics are expressed as mean ± standard deviation (SD). Differences were considered statistically significant if the probability value of the error is $p < 0.05$.

2.4. Results

Table 2 illustrates the differences in physical fitness test results between the groups. In all of the fitness variables, the subjects of the group I, who had better physical capacity before the study, were better than the subjects of the group II. Mobility, lower leg strength improved statistically significantly in both adult groups ($p > 0.05$). These results demonstrate that balance and gait can be effectively improved in individuals with ID through targeted interventions. To summarize the results of the research by groups, the following positive developments can be identified: significant differences were found between the two groups in the following test scores: lower leg muscular strength, mobility (except for Tinetti balance test). While both group I and group II showed improvements in Timed up and Go, LSUT test, 6MWT (measured steps), with all *p*-values <0.05. Group I showed improvements including a 20 bpm reduction in heart rate during the 6MWT, a 2.71-s decrease in TUG completion time, 97.05 more steps in the 6MWT, and 8 additional repetitions in the LSUT with all *p*-values <0.05. Similarly, the group II improved by 66.7 m and 117 steps in the 6MWT, 2,17 s in TUG test, 4 repetitions in LSUT, with all *p*-values <0.05.

3. Discusion

The aim - to assess the impact of leisure physical activity on the physical and functional capability of adults with disabilities. The subjects were assessed cardiorespiratory fitness, for leg functional muscle strength and endurance, mobility and balance. For intellectual disabilities the assessment of physical capability focused on those components of physical capability that are related to daily living skills, such as body composition, coordination, reaction time, balance, muscular strength, muscular endurance, flexibility, and functional capability (Oppewal & Hilgenkamp, 2015). Thorpe (2009) also claims that it is appropriate to focus on function, work, leisure activities, and physical activity promotion with the aim of preserving capability, function and managing secondary conditions. There is little evidence on exactly which of the components of health, the determinants of health, are most effective and important in determining the maintenance of function for people with disabilities. According to the Department of Physiotherapy guidelines (Hedgecock et al., 2023), sessions of 8–12 weeks duration, frequency of 2–3 sessions per week, 45–60 min are recommended to improve physical health and the ability to perform movement skills. Based on these recommendations, due to the lack of physical capability of the subjects with intellectual disabilities, an 8-week, twice-weekly session of 90 min was

Table 2
Mean (±SD) values for between-groups differences in physical fitness.

Variable	Group 1 Mean ± SD		Group 2 Mean ± SD		Effect size
	Before research	After research	Before research	After research	Hedges' *g*
Six-minute walk test (steps)	588.8 ± 181.43	685.85 ± 83.39*	532.12 ± 24.29	649.33 ± 35.80*	0.43 before 0.67 after
Six-minute walk test (m)	370.85 ± 95.88	417.14 ± 21.14	247.47 ± 73.29#	314.17 ± 19*#	1.47 before 5.16 after
Heart rate (bpm)	89.14 ± 20.35 (pre 6mwt) 99.71 ± 23.13 (post 6mwt)	69.71 ± 15.80* (pre 6mwt) 93.14 ± 13.40 (post 6mwt)*	85 ± 14.81 (pre 6mwt) 93.37 ± 12.76 (post 6mwt)	80.25 ± 12.71 # (pre 6mwt) *98* ± 16,56 (post 6mwt)	0.23 before research pre 6mwt 0.35 before research post 6mwt 1.00 after research pre 6mwt 0.31 after research post 6mwt
Timed Up and Go test (s)	8.87 ± 2.21	6.17 ± 1.95*	11.47 ± 2.38#	9.28 ± 2.66*#	1.12 before 1.30 after
Tinneti test (score)	16	16	14	16	
Sit-to-stand test (repetitions)	15.28 ± 2.36	17.85 ± 3.38	10.87 ± 2.79#	11.83 ± 3.18#	1.68 before 1.84 after
LSUT (repetitions, L/R)	23/20	26/28*	11/11#	14/15*#	

#p < 0.05 compared between groups.
$d \leq 0.5$ is a small effect size.
$0.5 < d < 0.8$ is a medium effect size.
$0.8 \leq d < 1.3$ is a large effect size.
$1.3 \leq d$ is a very large effect size.
* $p < 0.05$ comparing before with after.

chosen.

3.1. Effect on cardiorespiratory fitness

The six-minute walk test (6MWT) was also used to measure cardiorespiratory endurance in the current study. The 6-min walk test showed significant improvements in both groups, particularly among participants with higher initial functional capacity. Instead of focusing on numerical comparisons with other studies, it is important to highlight that participants demonstrated increased walking endurance over time. These results suggest that even moderate-intensity interventions can improve aerobic capacity, which is crucial for independent mobility. While our values were lower compared to normative data for adults without intellectual disabilities (e.g., Pitetti & Campbell, 2017; Yanardag et al., 2013), and also somewhat lower than similar studies with participants with ID (Hung-Shih et al., 2021), the observed within-group progress is clinically meaningful. Lower endurance in our sample reflects reduced habitual activity—a known issue in this population (Temple & Walkley, 2003).

Rather than emphasizing numeric differences across studies, we highlight the functional gain through walking-based interventions, which aligns with existing evidence that walking improves aerobic capacity in adults with ID (Bouzas et al., 2018; Draheim et al., 2002) and remains a practical method due to low joint strain and low fall risk.

3.2. Effect on lower-body muscular strength and endurance

Muscular endurance is essential for the performance of daily life and recreational activities, as well as for work capacity. Lower muscular endurance could restrict physical activity patterns of individuals with ID (Yanardag et al., 2013). In the present study, the lower extremity muscle strength was evaluated by the LSUT, 30CST. Improvement in lower-body muscle endurance was observed in both groups, as measured by the LSUT and 30CST. Group I, which had higher initial capacity, demonstrated stronger results in both tests before and after the intervention, while Group II showed significant improvement relative to their baseline. Compared with similar age groups from other studies (Shen et al., 2024; Gurses et al., 2018; Lein et al., 2022), our participants had lower 30CST results, which reflects their lower initial physical capacity. Rather than listing all comparative data point-by-point, we summarize that although results were below normative healthy population values, the intervention led to measurable and functionally relevant improvements in strength—especially important considering its relationship with mobility and fall risk (Enkelaar et al., 2012). This supports the use of lower-limb strengthening as a key target in physical activity interventions for adults with ID.

3.3. Effect on mobility and balance

Group I demonstrated faster test completion times both at baseline and post-intervention, while Group II showed moderate, yet meaningful, improvements. These findings align with previous research (Enkelaar et al., 2013), which highlights the TUG test as a valid tool for monitoring functional changes and intervention effects in individuals with ID. Rather than emphasizing exact second-by-second changes, we focus on clinical significance: improved TUG performance reflects gains in mobility and balance, which are critical for fall prevention in this population. Balance and gait naturally decline with age due to reductions in muscle strength and sensory input (e.g., vision, proprioception, vestibular function). Compared to the general population, individuals with ID experience similar age-related changes, but often at an earlier age (Evenhuis et al., 2000; as cited in Enkelaar et al., 2012). Moreover, people with ID tend to be less physically active (Enkelaar et al., 2012), which further limits the development and maintenance of endurance, balance, and strength. Consequently, these deficits can lead to reduced physical functioning and increased dependency.

3.4. Age and leisure physical activity

While numerous studies have examined physical fitness in children with intellectual disabilities (ID) (Golubović et al., 2012; Hartman et al., 2014) and in older adults (Hilgenkamp et al., 2012; Kinnear et al., 2018), there is a relative lack of research focused on young adults. Our findings indicate that moderate-intensity exercise training can improve the physical fitness of young adults with ID; however, these improvements often fall short of meeting recommended health benchmarks. Therefore, increasing leisure physical activity (PA) levels in this population is essential to align with national guidelines (Kreinbucher-Bekerle et al., 2023). Our results are consistent with those of Hilgenkamp et al. (2014) and Walsh et al. (2017), who reported that adults with ID (mean age 33.01 $\pm$ 11.09 years) with higher PA levels performed better in tests assessing balance, walking speed, lower-limb muscular endurance, and cardiorespiratory fitness. In contrast, Cuesta-Vargas et al. (2011) found no significant differences in physical fitness between more and less active adults with mild ID. Similarly, Gawlik et al. (2017) observed that age and ID level were not significantly associated with aerobic capacity among adults aged 20–40 years. Participants in Group II of our study, who exercised twice per week for two months, exhibited lower performance in the side step, sit-to-stand, and 6MWT tests when compared to children in similar interventions (Aertssen et al., 2018; Wouters et al., 2020). These findings support previous evidence suggesting that individuals with ID experience earlier and more rapid functional decline, often beginning around 40–50 years of age (Lin et al., 2011; WHO, 2020). Reduced physical fitness has been identified as a contributing factor to accelerated aging and earlier onset of age-related health conditions in this population. Although participants with lower baseline fitness showed significant post-intervention improvements, the current study confirms that a two-month, twice-weekly program is insufficient for individuals with low physical capacity to reach recommended levels. These results reinforce the need for early, sustained, and appropriately dosed physical activity interventions to counteract premature physical decline in adults with ID.

3.5. Leisure PA intervention, frequency, and duration

In a systematic review, Bondár et al. (2020) found that 85 % of eligible studies described physical activity (PA)-based interventions. Only two studies included sport-based activities (Lante et al., 2011; Perez et al., 2018), with one combining exercise with sport and recreational components (Lante et al., 2011), and another proposing a swimming-based program (Perez et al., 2018). Intervention characteristics varied considerably, with durations ranging from 8 weeks to 10 months, session frequencies from 1 to 3 times per week, and individual session lengths between 45 and 70 min. Despite these differences, most interventions included a structured warm-up and cool-down phase. Several studies, including Asonitou et al. (2018), suggest that shorter programs (6–12 weeks) may not be sufficient to produce stable, long-term improvements in physical fitness. Consistent with this, our study demonstrated that two sessions per week over two months did not lead to substantial improvements in physical capacity for participants with lower baseline fitness. While some gains were observed, they were not enough to close the gap with participants who started with higher functional abilities. Kuo et al. (2021) found that a 12-week intervention significantly improved aerobic capacity and cardiovascular function, reducing metabolic disease risk. In contrast, Shields et al. reported no significant difference between experimental and control groups after an 8-week, 150-min/week moderate-to-intense PA program. They suggested that this could be due to the physical demands required to sustain the recommended intensity throughout the intervention period.

In line with the World Health Organization's (WHO) guidelines, it is important to emphasize that, beyond the recommendation of 150 min of moderate-intensity aerobic activity per week, adults—including those with intellectual disabilities—should also engage in muscle-

strengthening activities involving all major muscle groups at least twice weekly. This recommendation is particularly relevant for individuals with ID, as muscular strength is strongly associated with improved mobility, balance, and fall prevention.

4. Conclusion

Leisure PA interventions can lead to meaningful functional improvements in adults with ID, especially in cardiorespiratory endurance, mobility, and lower-body strength. Reducing sedentary behavior and promoting participation in personalized, accessible programs is essential. Our findings highlight the importance of integrating both strength and endurance components in PA programs—particularly for young adults with ID, who remain underrepresented in current research but face high risks of physical decline.

4.1. Practical implications

Leisure physical activity (PA) requires little to no equipment and represents a valuable component of a holistic approach to health promotion. It offers a low-cost, portable, and accessible method for increasing physical activity levels among individuals with disabilities across all age groups and ability levels. Given that individuals with intellectual disabilities (ID) often experience impaired balance and gait compared to their age-matched peers, targeted leisure PA programs can play a critical role in improving these functions. The results of this study demonstrate that balance and gait are not only affected in this population but are also trainable through appropriate intervention. These findings support the inclusion of balance- and mobility-focused components in leisure PA programs to enhance functional independence and reduce fall risk in individuals with ID.

4.2. Strengths and limitations of the study

Most of the assessment tools used in this study have been previously validated and applied in similar research involving individuals with intellectual disabilities. Their reliability and suitability for this population have been established in prior studies (Enkelaar et al., 2013; Hilgenkamp et al., 2012). However, this study also has several methodological limitations that should be acknowledged. The primary limitation was the small sample size, which limits the generalizability of the findings. Future studies should aim to include larger and more diverse participant groups to strengthen external validity. Due to practical constraints, strict randomization of participants was not feasible. In a fully randomized controlled trial, every eligible participant would have an equal chance of being assigned to any study group. The lack of full randomization in this study introduces potential selection bias and reduces internal validity. Additionally, the statistical power of the study is relatively low, which further limits the ability to generalize the results to the broader population of individuals with intellectual disabilities. Participants were included only if they did not have severe musculoskeletal, neurological, or cardiovascular conditions and were willing to take part in the intervention. As such, there may be a motivational bias, with more engaged or physically able individuals opting in. Finally, the study did not include a control group. This limitation restricts the ability to determine whether observed changes in physical fitness were due specifically to the intervention, the natural aging process, or other external factors such as daily activity levels.

4.3. Clinical messages

In young adults with lifelong mild to moderate intellectual disabilities, leisure physical activity has a positive effect on physical fitness, mobility, and cardiovascular health. Such activity should specifically target gait, balance, and overall physical function, as improvements in these areas can help reduce fall risk and promote greater independence. However, the study findings suggest that when baseline physical capacity is low, a short-term intervention—such as two sessions per week over two months—may not be sufficient to achieve the recommended physical activity levels. Longer duration and higher frequency interventions are likely needed to produce clinically significant and lasting improvements in functional capacity.

4.4. Study value and contribution

This study contributes to the limited body of evidence on the physical fitness outcomes of leisure physical activity interventions in young adults with intellectual disabilities (ID), a population often overlooked in current research. While many studies focus on children or elderly individuals with ID, this research addresses a critical gap by evaluating the effectiveness of a real-world, low-cost intervention tailored to young adults. The findings emphasize that even modest interventions can lead to measurable improvements in mobility, balance, and muscle strength—key components of daily functioning and fall prevention. By highlighting the insufficiency of short-term programs for individuals with low baseline fitness, the study provides practical guidance for designing more effective, long-term interventions. Overall, the value of this manuscript lies in its real-life applicability, population-specific insights, and its contribution to the development of inclusive, evidence-based physical activity guidelines for adults with intellectual disabilities.

CRediT authorship contribution statement

Laura Žalienė: Writing – original draft, Supervision, Resources, Project administration, Methodology, Investigation, Formal analysis. **Giedrė Tumosienė:** Writing – review & editing, Formal analysis, Conceptualization. **Jurgita Boltutienė:** Writing – review & editing, Supervision, Resources, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data availability

The data that has been used is confidential.

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