THE EFFECTS OF PHYSICAL ACTIVITY AND EXERCISE ON THE BALANCE OF INDIVIDUALS WITH INTELLECTUAL DISABILITIES: A SYSTEMATIC REVIEW & META-ANALYSIS

by

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Abstract

Background: Many different exercise interventions have been theorized to improve balance in individuals with intellectual disabilities. This review provides an overview of the efficacy and effectiveness of different exercise intervention types on the postural control of individuals with intellectual disabilities.

Methods: A literature search was performed in January 2021. Studies were included if they examined active interventions aimed to improve postural control of individuals with intellectual disabilities. Studies were excluded if they were a systematic review or meta-analysis, if English was not the first language, or if their participants were under the age of five.

Results: Twenty-three papers met the inclusion criteria and were evaluated for quality. Twenty-one papers with extractable data were evaluated for effectiveness. The most effective interventions had child or adolescent participants and involved multi-component static and dynamic balance activities as well as activities related to ADLs.

Conclusion: Participants benefitted most when they were between the ages of nine and sixteen, there was in-person instruction, the intervention involved more than one type of activity, and sensory inputs and ADLs were incorporated. Further research is needed to further apply these implications in an intervention and explore the retention and maintenance of postural control benefits.

Introduction

According to the Special Olympics (2018), there are approximately 6.5 million people living with an intellectual disability (ID) in the United States. These individuals experience limitations in their intellectual functioning and adaptive behaviors which greatly affect their daily lives (AAIDD, 2019; American Psychiatric Association, 2013). In order to be diagnosed with an intellectual disability, a person has to meet three criteria: 1) significant limitations in intellectual functioning; 2) significant limitations in adaptive behavior; and 3) an onset of the intellectual and adaptive deficits during the developmental period or before the age of 18 (AAIDD, 2019). According to the American Psychiatric Association (2013), adaptive functioning includes skills in the conceptual domain (language, reasoning, memory), social domain (empathy, social judgment, friendship), and practical domain (personal care, job responsibilities, money management). Intellectual disability is considered a chronic disability, and it often occurs alongside other mental or physical conditions (American Psychiatric Association, 2013). To indicate that other disabilities are present alongside intellectual disability, the broad term "intellectual and developmental disabilities" (IDDs) is often used (NICHD, n.d.). The levels of disability vary greatly, often being classified as mild, moderate, severe, or profound. The more severe the disability is, the more limitations occur in intellectual and physical development.

Intellectual disability can lower an individual's motor development often resulting in poor visual and motor coordination as well as limited precision of movements (Jankowicz-Szymanska et al., 2012). It is common for an individual with IDDs to develop skills and achieve motor milestones at a slower pace than their typically developing peers (CDC, 2020). This is often associated with poor postural balance, lower levels of physical activity and muscle performance, and higher frequency of falls when compared to their non-disabled peers

(Blomqvist, 2012). Individuals with intellectual disabilities often have poorer overall health than those without intellectual disabilities, which is partly due to their lower physical fitness levels and higher risk of injuries related to balance deficits (Robertson, 2014; Jankowicz-Szymanska et al., 2012). Along with these health concerns, balance deficits and delays in motor development can also limit one's autonomy and independence (Alesi et al., 2018; American Psychiatric Association, 2013).

Balance and balance deficits are measured by a variety of different tests and tools. These assessments help researchers and clinicians better understand a person's level of postural control. Postural control has been defined by Pollock et al. as "the act of maintaining, achieving, or restoring a state of balance during any posture or activity" (2000). There are typically two different types of balance examined in these assessments: static balance and dynamic balance. Static balance is the ability to maintain postural stability and control while one's body is at rest. Dynamic balance is the ability to maintain postural stability and control during movement. Both types of balance are important to postural control as they contribute greatly to the success of a person's reaction to a change in the environment.

To examine static balance, researchers frequently use a force platform. These force platforms allow for the measurement of center of pressure motion. On this platform, the participant can complete a variety of tasks such as double leg stance, single leg stance, standing on a firm surface, standing on a soft surface, standing with eyes open, and standing with eyes closed. These various tasks are completed to show where balance deficits may exist. In addition to force platforms, there are also a variety of task-related tests. These task-related tests such as the Berg Balance Scale, Tinetti Gait and Balance Instrument, and Bruininks-Oseretsky Test of Motor Proficiency test help assess dynamic balance.

There have been many studies concluding that overall physical training and the strengthening of the musculoskeletal system improves the health and balance of those with intellectual disabilities (Jankowicz-Szymanska, 2012). Physical activity has been shown to increase the cardiovascular health, musclular strength, balance, endurance, and range of motion of participants with an intellectual disability. According to Duplanty, "… physical fitness relates to better self-efficacy when performing activities of daily living (ADLs), which can lead to improved well-being and quality of life among persons with ID" (2014).

Given the importance of balance, it is necessary to better understand the role of different physical activity interventions in improving balance and postural control for people with intellectual and developmental disabilities. As stated by Jankowicz-Szymanska, "the reason for smaller stability of the body posture of people suffering from intellectual disability has not been unambiguously identified yet" (2012). The complex combination of characteristics that result in balance deficiency in those with intellectual disabilities is not fully understood yet. An initial step in improving balance in those with intellectual disabilities is to examine the effectiveness and evidence of existing interventions. The purpose of this study is to evaluate the efficacy and effectiveness of exercise interventions designed to improve balance and postural control in individuals with intellectual disabilities.

Methods

Data Sources & Search Strategy

A literature search was performed using the following electronic databases in January 2021 (2002-present): MEDLINE (PubMed), Medline (Web of Science), CINAHL Complete, Web of Science, SPORTDiscus, EMBASE and EMBASE Classic. Key words included "intellectual disability" AND "postural control" AND "exercise intervention."

Inclusion and Exclusion Criteria

Papers were included in this review when the following criteria were met:

- The paper was written in English as the first language.
- The paper was not a systematic review or meta-analysis.
- The study population consisted entirely of individuals with intellectual disabilities and did not include toddlers.
- The study focused on the effect of exercise interventions on the postural control of individuals with intellectual disabilities. Reviews of physical fitness tests, studies involving interventions other than some sort of exercise or physical activity, and studies focusing on aspects other than dynamic balance and postural control were not included.
- Intervention groups performed activities designed to improve balance or develop systems that contribute to balance (musculoskeletal system, sensorimotor training, visual or vestibular training). Balance training programs were either classified as static or dynamic depending on the nature of the exercises. Comparison groups were either a control group that did not receive any training or a group that undertook some other form of training (generally generic physical activity or muscular strengthening).

Data extraction

The papers were screened in a three-step process: 1) title and abstract, 2) full text, and 3) by a third supplementary investigator. The selection process was carried out by the first investigator, and uncertainties about inclusion were discussed with the second investigator until consensus was reached. A third supplementary investigator screened for eligibility and inter-rater reliability was 98%. Figure 1 is the PRISMA flow diagram of the search process.

Following full test screening, the first investigator systematically and critically read the selected papers and extracted the following data: study aims; study population (sample size, level of intellectual disability, age, gender, specific diagnoses or physical disabilities); methodological design (e.g. case study, randomized control trial, etc.); exercise intervention (duration, frequency, intensity, time, activities, and progression); balance assessments used; and balance assessment results (mean and standard deviation for experimental group and control group).

Results

Systematic Literature Search

A total of 74 abstracts were initially screened. Twenty-three papers, published between 2002-2021, met the inclusion criteria and were included in the systematic review. Twenty-one of these papers provided eligible balance assessment results (mean and standard deviation) and were included in the meta-analysis. One of these studies included two different interventions. Intervention effect sizes were calculated and compared for the remaining 22 interventions.

Participants

The sample size of the studies ranged from 17 (Tsimaras, V. K. et al., 2012) to 150 (Kovačič, T. et al., 2020) and age ranged from nine to 81 years. In eight papers, the study population was under 18 years (Borji, R. et al., 2018; Fotiadou, E. G. et al., 2017; Giagazoglou, P. et al., 2013; Gupta, S. et al., 2011; Kachouri, H. et al., 2016; Mikolajczyk, E., & Jankowicz-Szymanska, A., 2015-A; Mikolajczyk, E., & Jankowicz-Szymanska, A., 2015-B; Mikołajczyk, E., & Jankowicz-Szymańska, A., 2017), and in 11 papers participants were 18 years or older (Carmeli, E. et al., 2002; Carmeli, E. et al., 2003; Carmeli, E. et al., 2005; Cortés-Amador, S. et al., 2019; Crockett, J. et al., 2015; Fotiadou, E. G. et al., 2009; Hale, L. A. et al., 2016; Kovačič, T. et al., 2020; Oviedo, G. R. et al., 2014; Silva, V. et al., 2017; Van Hanegem, E. et al., 2014).

Participants in four papers fell into the age range of 13-20 years (Jankowicz-Szymanska, A. et al., 2012; Lee, K. et al., 2016; Tsimaras, V. K. et al., 2012; Wu, W. L. et al., 2017). In seven papers, participants with mild intellectual disability (generally defined as an IQ between 50-75) were included (Borji, R. et al., 2018; Carmeli, E. et al., 2002; Carmeli, E. et al., 2003; Carmeli, E. et al., 2005; Jankowicz-Szymanska, A. et al., 2012; Kachouri, H. et al., 2016; Lee, K. et al., 2016), in four papers participants with mild to moderate intellectual disability were included (Cortés-Amador, S. et al., 2019; Fotiadou, E. G. et al., 2017; Kovačič, T. et al., 2020; Oviedo, G. R. et al., 2014), and in four papers (Giagazoglou, P. et al., 2013; Mikolajczyk, E., & Jankowicz-Szymanska, A., 2015-A; Mikolajczyk, E., & Jankowicz-Szymanska, A., 2015-B; Mikołajczyk, E., & Jankowicz-Szymańska, A., 2017) the sample included participants with moderate intellectual disability (generally defined as an IQ range of 35-49). Two papers only specified IQs below 70 (Hale, L. A. et al., 2016; Van Hanegem, E. et al., 2014), two papers classified their participants as "mild to moderate ID" and defined that as an IQ range of 50-67 (Fotiadou, E. G. et al., 2009; Tsimaras, V. K. et al., 2012), and four papers did not report the level of intellectual disability (Crockett, J. et al., 2015; Gupta, S. et al., 2011; Silva, V. et al., 2017; Wu, W. L. et al., 2017). No individuals with severe or profound intellectual disability were included to ensure participants would be able to follow directions, give consent to participate, and walk independently. Participants with Down Syndrome (DS) were the exclusive study population in four papers (Carmeli, E. et al., 2002; Gupta, S. et al., 2011; Jankowicz-Szymanska, A. et al., 2012; Silva, V. et al., 2017), but individuals with Down Syndrome were excluded from participation in seven papers (Borji, R. et al., 2018; Carmeli, E. et al., 2002; Carmeli, E. et al., 2003; Fotiadou, E. G. et al., 2017; Kachouri, H. et al., 2016; Mikołajczyk, E., & Jankowicz-Szymańska, A., 2017; Tsimaras, V. K. et al., 2012). Nine papers (Carmeli, E. et al., 2003;

Cortés-Amador, S. et al., 2019; Fotiadou, E. G. et al., 2009; Fotiadou, E. G. et al., 2017; Hale, L. A. et al., 2016; Kachouri, H. et al., 2016; Lee, K. et al., 2016; Mikołajczyk, E., & Jankowicz-Szymańska, A., 2017; Wu, W. L. et al., 2017) excluded individuals with other disabilities (IDDs). Individuals with IDDs were allowed or not explicitly excluded in nine papers (Borji, R. et al., 2018; Carmeli, E. et al., 2005; Giagazoglou, P. et al., 2013; Kovačič, T. et al., 2020; Mikolajczyk, E., & Jankowicz-Szymanska, A., 2015-A; Mikolajczyk, E., & Jankowicz-Szymanska, A., 2015-B; Oviedo, G. R. et al., 2014; Tsimaras, V. K. et al., 2012; Van Hanegem, E. et al., 2014), but three of these papers excluded DS (Borji, R. et al., 2018; Carmeli, E. et al., 2005; Tsimaras, V. K. et al., 2012).

Methodological Descriptions

Twenty-one studies implemented one intervention, and two studies implemented two interventions (Borji, R. et al., 2018; Kovačič, T. et al., 2020). Duration of the interventions ranged from six weeks to six months, and the frequency of training per week ranged from once a week to daily. Individual intervention session lengths ranged from 20 minutes to 60 minutes. Twenty-three of these interventions were done with in-person instruction, but two interventions were self-guided (Hale, L. A. et al., 2016; Crockett, J. et al., 2015). Twelve interventions included strength training (Borji, R. et al., 2018; Carmeli, E. et al., 2003; Carmeli, E. et al., 2005; Cortés-Amador, S. et al., 2019; Crockett, J. et al., 2015; Gupta, S. et al., 2011; Hale, L. A. et al., 2016; Kachouri, H. et al., 2016; Kovačič, T. et al., 2020; Oviedo, G. R. et al., 2014; Silva, V. et al., 2017; Wu, W. L. et al., 2017), 15 interventions included balance training (Borji, R. et al., 2018; Carmeli, E. et al., 2003; Carmeli, E. et al., 2005; Cortés-Amador, S. et al., 2019; Crockett, J. et al., 2015; Fotiadou, E. G. et al., 2017; Giagazoglou, P. et al., 2013; Gupta, S. et al., 2011; Jankowicz-Szymanska, A. et al., 2012; Kovačič, T. et al., 2020; Lee, K. et al., 2016;

Mikolajczyk, E., & Jankowicz-Szymanska, A., 2015-A; Oviedo, G. R. et al., 2014; Silva, V. et al., 2017; Van Hanegem, E. et al., 2014), and aerobic training was included in seven interventions (Carmeli, E. et al., 2002; Carmeli, E. et al., 2003; Crockett, J. et al., 2015; Hale, L. A. et al., 2016; Kovačič, T. et al., 2020; Oviedo, G. R. et al., 2014; Wu, W. L. et al., 2017). Functional activities that relate to activities of daily living (ADLs) were included in three interventions (Mikolajczyk, E., & Jankowicz-Szymanska, A., 2015-A; Mikolajczyk, E., & Jankowicz-Szymanska, A., 2015-B; Mikołajczyk, E., & Jankowicz-Szymańska, A., 2017), and sensory stimuli was incorporated in 12 interventions (Borji, R. et al., 2018; Cortés-Amador, S. et al., 2019; Fotiadou, E. G. et al., 2009; Fotiadou, E. G. et al., 2017; Giagazoglou, P. et al., 2013; Jankowicz-Szymanska, A. et al., 2012; Kachouri, H. et al., 2016; Lee, K. et al., 2016; Mikolajczyk, E., & Jankowicz-Szymanska, A., 2015-A; Mikolajczyk, E., & Jankowicz-Szymanska, A., 2015-B; Mikołajczyk, E., & Jankowicz-Szymańska, A., 2017; Oviedo, G. R. et al., 2014). Dual-task, multi-component, or progression were involved in 13 interventions, including both Borji, R. et al. interventions (Borji, R. et al., 2018; Carmeli, E. et al., 2002; Giagazoglou, P. et al., 2013; Gupta, S. et al., 2011; Kachouri, H. et al., 2016; Lee, K. et al., 2016; Mikolajczyk, E., & Jankowicz-Szymanska, A., 2015-A; Mikolajczyk, E., & Jankowicz-Szymanska, A., 2015-B; Mikołajczyk, E., & Jankowicz-Szymańska, A., 2017; Oviedo, G. R. et al., 2014; Silva, V. et al., 2017; Van Hanegem, E. et al., 2014). The information for each intervention is available in table 1 (key: BBS = Berg Balance Scale; BOTMP = Bruininks-Oseretsky Test of Motor Proficiency; COP = center of pressure; DLS = double leg stance; EO = eyes open; TUG = timed up-and-go).

Fig. 1. The PRISMA flow diagram.

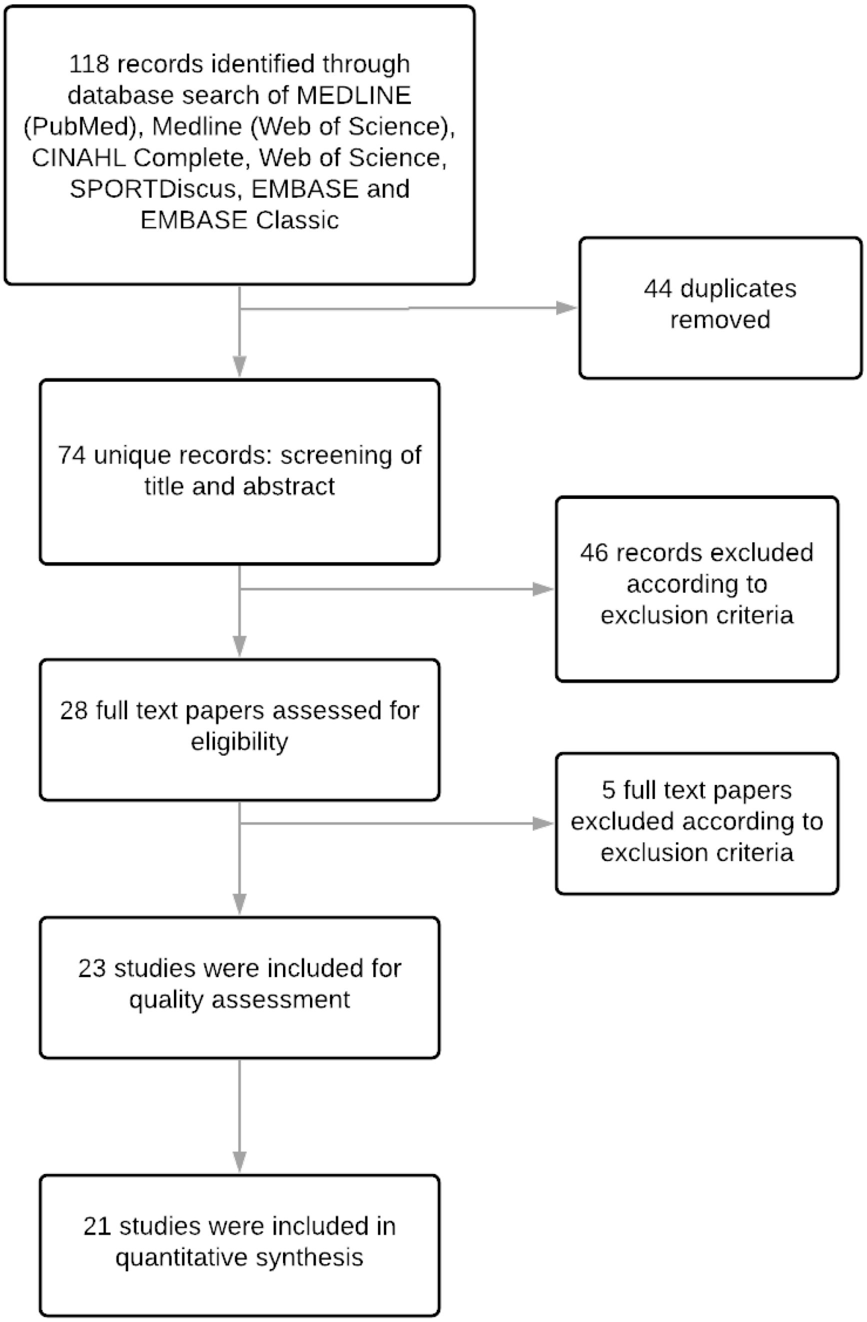


Table 1.1 Intervention characteristics.

First author (year)	Duration	Frequency	Paricipant age	Participant disabiliy	Activities	Balance assessment	Effect size	Lower CI	Upper CI
Borji, R. (2018) 1	8 weeks; 45 min per session	3 sessions/wk	under 18	mild ID; no DS	jumping program focused on strengthening leg muscles & main muscle groups, intensity & volume increased progressively	BBS	4.07	2.54	5.61
Borji, R. (2018) 2	8 weeks; 45 min per session	3 sessions/wk	under 18	mild ID; no DS	sensorimotor program: static balance situations, general dynamic activities, dual-task exercises, visual signals incorporated	BBS	2.43	1.27	3.59
Carmeli, E. (2002)	25 weeks; 45 min per session	3 sessions/wk	over 18	mild ID; all DS	treadmill walking, duration progressed as tolerated	TUG	1.03	0.19	1.87
Carmeli, E. (2003)	27 weeks; 25-60 min per session	5 sessions/wk	over 18	mild ID; no DS, no IDD	ball exercise to improve trunk strength & balance, treadmill training to increase walking tolerance, treadmill training progressed as tolerated	TUG	0.76	0	1.53
Carmeli, E. (2005)	6 months; 45 min per session	3 sessions/wk	over 18	mild ID; no DS	general dynamic activities & dynamic balance exercises, basic lower body muscle strengthening	modified TUG	0.53	-0.32	1.38
Cortés-Amador, S. (2019)	12 weeks; 45 min per session	2 sessions/wk	over 18	mild to mod ID; no IDD	vestibular physiotherapy: exercises to increase vestibulo-ocular reflex, postural control exercises, general conditioning	TUG	0.76	0.17	1.35
Crockett, J. (2015)	12 weeks; time not specified per session	6 sessions/wk	over 18	ID level not reported	general strengthening & balance exercises 3 sessions/wk; aerobic exercises 3 sessions/wk	Tinetti	0.23	-0.3	0.77
Fotiadou, E. G. (2009)	12 weeks; 45 min per session	3 sessions/wk	over 18	mild to mod ID; no IDD	rhythmic gymnastics program: included following different tempos & sequencing movements	stabilometer 60-second intervals	0.45	-0.49	1.39
Fotiadou, E. G. (2017)	16 weeks; 45 min per session	2 sessions/wk	under 18	mild to mod ID; no DS, no IDD	basic static and dynamic balance activities combined with rhythmic elements & sensory inputs from vestibular, proprioceptive, & visual systems	COPmax, A/P; DLS, EO	2.53	1.36	3.71
Giagazoglou, P. (2013)	12 weeks; 20 min per session	daily	under 18	mod ID	trampoline training program: challenging & basic exercises, static & dynamic activities, eyes opened & closed	COPmax, A/P; EO	0.77	-0.19	1.72
Gupta, S. (2011)	6 weeks; 45 min per session	3 sessions/wk	under 18	ID level not reported; all DS	progressive resistance exercises of lower limbs, balance training exercises	BOTMP	N/A	N/A	N/A
Hale, L. A. (2016)	6 months; session length set by	set by participant	over 18	IQ 70 or less; no IDD affecting PA	2-3 individualized exercises to do at home from physiotherapist, recommended PA once a week (swim or walk)	BBS	0.06	-0.48	0.59
Jankowicz-Szymanska, A. (2012)	12 weeks; 45 min per session	2 sessions/wk	16-18	mild ID; all DS	static balance training on multiple surfaces	COP path length; EO	0.23	-0.39	0.85

Table 1.2 Intervention characteristics cont.

First author (year)	Duration	Frequency	Paricipant age	Participant disabiliy	Activities	Balance assessment	Effect size	Lower CI	Upper CI
Kachouri, H. (2016)	8 weeks; 45-60 min per session	3 sessions/wk	under 18	mild ID; no DS, no IDD	strength exercises focusing on legs & main muscle groups, proprioceptive training, multiple surfaces, intensity & volume increased progressively	COP velocity; DLS, firm surface, EO	1.09	0.15	2.03
Kovačič, T. (2020) 1	16 weeks; 60 min per session	1 session/wk	over 18	mild to mod ID	multi-component balance-specific exercises	reported falls in 4 months	N/A	N/A	N/A
Kovačič, T. (2020) 2	12 weeks; 60 min per session	1 session/wk	over 18	mild to mod ID	dynamic exercises, treadmill walking or running, yoga	reported falls in 4 months	N/A	N/A	N/A
Lee, K. (2016)	8 weeks; 40 min per session	2 sessions/wk	14-19	mild ID; no IDD	static and dynamic balance training, multiple surfaces, eyes opened & closed, progressive activity training	COP A/P velocity; EO	0.32	-0.39	1.02
Mikolajczyk, E. (2015-A)	12 weeks; 45 min per session	3 sessions/wk	under 18	mod ID	dual-task functional exercises on various surfaces, designed after ADLs	COP path length	1.12	0.4	1.85
Mikolajczyk, E. (2015-B)	12 weeks; 45 min per session	3 sessions/wk	under 18	mod ID	dual-task functional exercises on various surfaces, designed after ADLs, exercises following verbal instruction	COP path length; EO	0.84	0.14	1.54
Mikołajczyk, E. (2017)	12 weeks; 45 min per session	3 sessions/wk	under 18	mod ID; no DS, no IDD	dual-task functional exercises on different surfaces, designed after ADLs	COP path length	1.37	0.62	2.12
Oviedo, G. R. (2014)	14 weeks; 60 min per session	3 sessions/wk	over 18	mild to mod ID	endurance training at 50-80% VO2peak, strength training of main peripheral muscles with progressing resistance, balance training on various surfaces	COP path length	0.39	-0.1	0.88
Silva, V. (2017)	8 weeks; 60 min per session	3 sessions/wk	over 18	ID level not reported; all DS	balance & isometric strength exercises from Wii games	flamingo balance test	0.82	0	1.64
Tsimaras, V. K. (2012)	16 weeks; 45 min per session	3 sessions/wk	16-20	mild to mod ID; no DS	learning & practicing of 10 traditional Greek dances	stabilometer 60-second intervals	0.2	-0.77	1.17
Van Hanegem, E. (2014)	10 weeks; 30 min per session	2 sessions/wk	over 18	IQ 70 or less	obstacle course: aimed to improve balance & coordination, simulated potentially hazardous situations and ADLs, complexity gradually progressed	TUG	0.26	-0.22	0.73
Wu, W. L. (2017)	12 weeks; 50 min per session	5 sessions/wk	13-19	ID level not reported; no severe IDD	15 trips of stairs, single aerobic device for 15-20 min, 50 sit ups, 3 consecutive jumps 15 times, no progression	bass dynamic balance score	0.15	-0.59	0.89

Table 2. The levels of evidence.

Level of evidence	# of studies	Study design(s)	First author (year)
I	1	Systematic review of randomized controlled trials (RCTs) Large RCT with narrow confidence interval (n > 100)	Kovačič, T. (2020)
II	19	Smaller RCTs (n < 100) Systematic reviews of cohort studies Very large ecological studies	Borji, R. (2018); Carmeli, E. (2002); Carmeli, E. (2003); Carmeli, E. (2005); Cortés-Amador, S. (2019); Fotiadou, E. G. (2009); Fotiadou, E. G. (2017); Giagazoglou, P. (2013); Gupta, S. (2011); Jankowicz-Szymanska, A. (2012); Kachouri, H. (2016); Lee, K. (2016); Mikolajczyk, E. (2015-A); Mikolajczyk, E. (2015-B); Mikołajczyk, E. (2017); Oviedo, G. R. (2014); Silva, V. (2017); Tsimaras, V. K. (2012); Wu, W. L. (2017)
III	0	Cohort studies (must have concurrent control group) Systematic reviews of case control studies	
IV	3	Case series Cohort studies without concurrent control groups Case-control study	Crockett, J. (2015); Hale, L. A. (2016); Van Hanegem, E. (2014)
V	0	Expert opinion Case study Bench research Expert opinion based on theory or physiological research Common sense anecdotes	

<u>Quality Assessment</u>

The 23 articles that met the inclusion criteria were placed into 1 of the 5 categories of levels of evidence from Sackett (1989). Category 1 is the greatest level of evidence and includes the large randomized control trial (RCTs) with 150 participants and a narrow confidence interval. Category 2, the next level of evidence, includes all of the smaller RTCs (n < 100). Finally, category 4 represents the studies without concurrent control groups. The classification of studies into their respective categories is found in table 2. One article was placed in category 1, 19 articles were placed in category 2, and three articles were placed in category 4.

<u>Statistical Methods</u>

Analyses were performed to determine the effect size of 22 interventions. The post-intervention means and standard deviations (SDs) were extracted from the intervention and control groups. If there was no control group used (n=3), pre-intervention and post-intervention means and SDs were used. The effect size of each study was estimated on the basis of the difference in balance measures (i.e. the differences between the control group's balance scores and the intervention group's balance scores post-intervention). The effect size was then adjusted to correct bias (hedges). Effect sizes were interpreted with Cohen's effect size interpretation which states that 0.2 is a small effect size, 0.5 is a medium effect size, and 0.8 is a large effect size (Héroux, 2018). See Figure 2 for effect sizes and confidence intervals (CIs) for each study.

Given that multiple studies reported several balance parameters, the balance assessment results were chosen in the following order: center of pressure total velocity, center of pressure (COP) velocity in anterior-posterior (A/P) direction, COP total path length, COP path length in the A/P direction, Berg Balance Scale (BBS), or Timed Up-and-Go test (TUG). If these balance assessments were not used, results were taken from the available balance assessment. In instances where assessments were done in varying conditions, data from double leg stance (DLS), firm surface, and open eye (OE) conditions was used. The assessment used for each intervention is available in Table 1.

Fig 2.1 Effect sizes with 95% confidence interval.

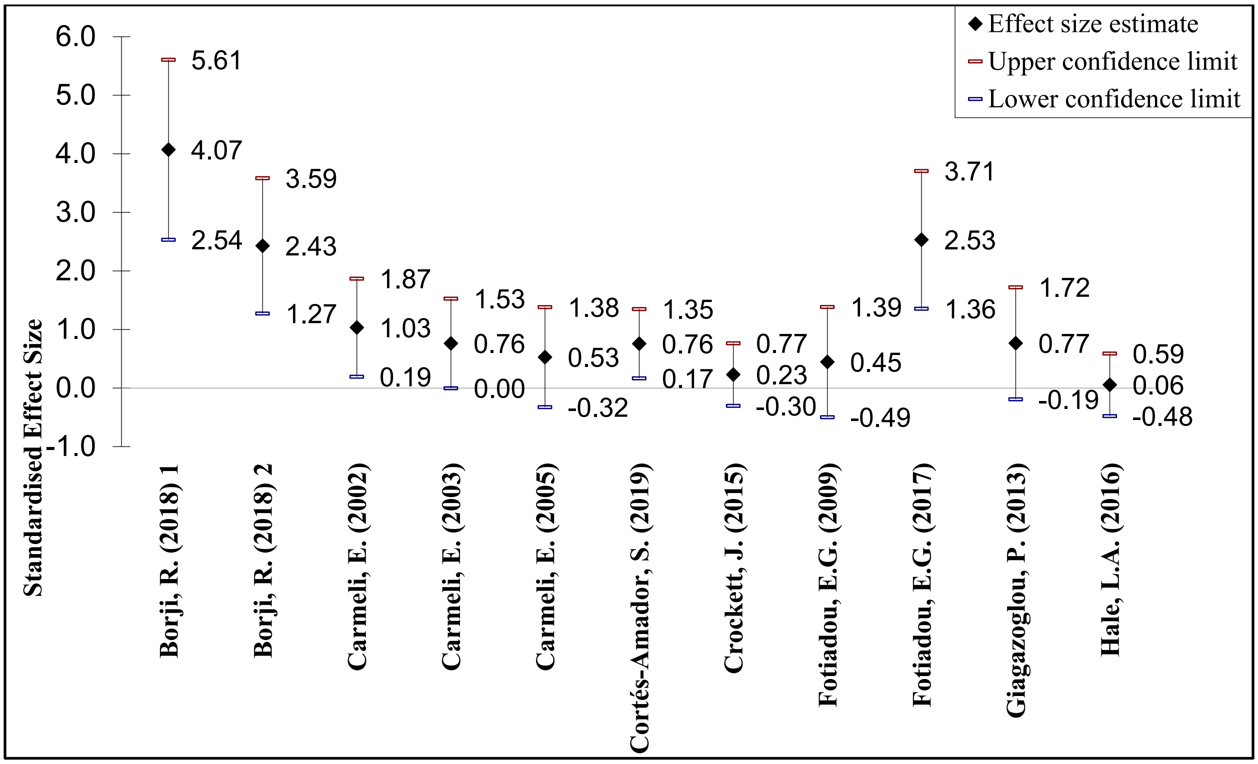
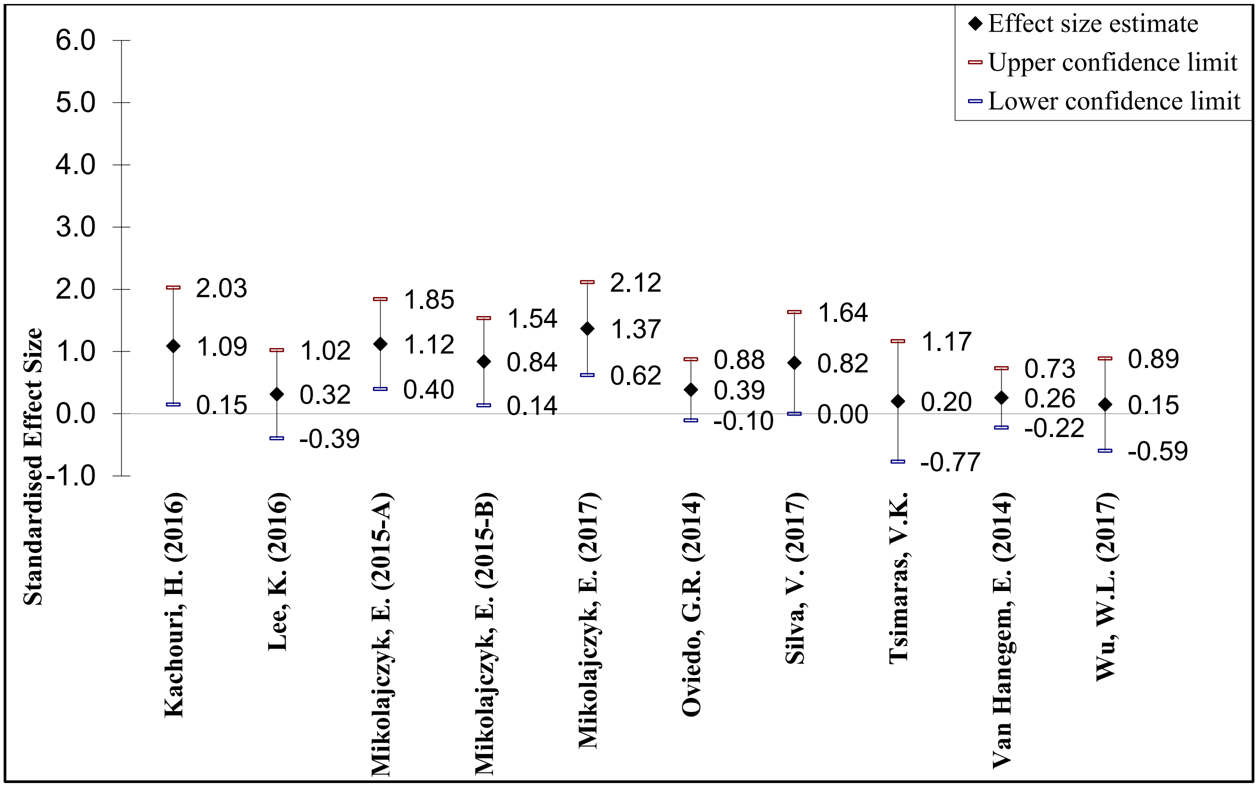


Figure 2.2 Effect sizes with 95% confidence interval cont.



Discussion

This review examined a range of exercise interventions that have been implemented in the attempt to improve the balance of individuals with intellectual disabilities. There were nine interventions including both Borji et al. interventions (Borji, R. et al., 2018; Carmeli, E. et al., 2002; Fotiadou, E. G. et al., 2017; Kachouri, H. et al., 2016; Mikolajczyk, E., & Jankowicz-Szymanska, A., 2015-A; Mikolajczyk, E., & Jankowicz-Szymanska, A., 2015-B; Mikołajczyk, E., & Jankowicz-Szymańska, A., 2017; Silva, V. et al., 2017) with large effect sizes (ES > 0.8), and seven of these nine interventions used participants ages nine to 16 (Borji, R. et al., 2018; Fotiadou, E. G. et al., 2017; Kachouri, H. et al., 2016; Mikolajczyk, E., & Jankowicz-Szymanska, A., 2015-A; Mikolajczyk, E., & Jankowicz-Szymanska, A., 2015-B; Mikołajczyk, E., & Jankowicz-Szymańska, A., 2017). On the other hand, there were nine interventions (Crockett, J. et al., 2015; Fotiadou, E. G. et al., 2009; Hale, L. A. et al., 2016; Jankowicz-Szymanska, A. et al., 2012; Lee, K. et al., 2016; Oviedo, G. R. et al., 2014; Tsimaras, V. K. et al., 2012; Van Hanegem, E. et al., 2014; Wu, W. L. et al., 2017) that had effect sizes below 0.5 (below a medium effect size), and five of these nine interventions (Crockett, J. et al., 2015; Fotiadou, E. G. et al., 2009; Hale, L. A. et al., 2016; Oviedo, G. R. et al., 2014; Van Hanegem, E. et al., 2014) used adult participants (18 years and older). Furthermore, two more of these studies only included participants over the age of 16 (Jankowicz-Szymanska, A. et al., 2012; Tsimaras, V. K. et al., 2012). More effective studies typically had two to four different categories of exercises and multiple activities included. Six of the nine most effective studies also incorporated sensory stimuli or functional exercises mimicking ADLs (Borji, R. et al., 2018; Fotiadou, E. G. et al., 2017; Kachouri, H. et al., 2016; Mikolajczyk, E., & Jankowicz-Szymanska, A., 2015-A; Mikolajczyk, E., & Jankowicz-Szymanska, A., 2015-B; Mikołajczyk, E., & Jankowicz-Szymańska, A., 2017). The two interventions which were self-guided rather than having in-person instruction (Hale et al., 2016; Crockett et al., 2015) both had low effect sizes.

Greater improvements were seen in child or adolescent groups rather than adult participants. It was generally more effective to use structured, multi-component interventions involving various sensory inputs, static and dynamic activities, and functional activities representing ADLs. Furthermore, participants benefitted from in-person instruction and interventions that included more than one type of activity. Sensory stimuli of the vestibular, proprioceptive, visual, and/or auditory systems was included in the majority of interventions with a greater effect size.

Based on the framework used, there are limitations of this review. Although a wide search of journal databases was conducted, there may be additional articles that focus on exercise interventions for balance improvements in those with intellectual disabilities that were not identified. In addition, articles addressing the research topic before 2002 were not included in the review. As a result, all available information on the topic may not be represented within this review. Furthermore, the nature of this study provides an additional limitation, as it only addresses the quality of the studies as classified by Sackett's levels of evidence, not an evaluation of the methodology behind the interventions. Effect size may also misrepresent the extent of balance improvement attained between balance scores that have different sensitivities. For example, a two second improvement in the Timed Up & Go test most likely represents a greater balance improvement than shortening one's center of pressure path length by two millimeters.

Conclusion

The purpose of this review is to evaluate the efficacy and effectiveness of exercise interventions designed to improve balance and postural control in individuals with intellectual disabilities. This review provides insight on the effect size and level of evidence of exercise and physical activity interventions designed to improve postural control in individuals with intellectual disabilities. The results indicated that interventions were typically more successful in children and adolescents. The more effective interventions generally included in-person instruction and more than one type of activity. Sensory stimuli and functional activities representing ADLs were also beneficial when included in interventions. Future research should apply these implications in an intervention to further examine effectiveness. Researchers should also explore the gap in knowledge regarding retention and maintenance of postural control benefits from various interventions.

Key Points

- Balance is a common impairment found in individuals with intellectual and developmental disabilities.
- Balance interventions are more successful in children and adolescents.
- Structured balance interventions are more effective than self-paced interventions.

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