Adapted Physical Activity Quarterly, (Ahead of Print)
https://doi.org/10.1123/apaq.2022-0201

First Published Online: July 26, 2023

Human Kinetics
ORIGINAL RESEARCH

Assessing the Fundamental Movement Skills of Children With Intellectual Disabilities in the Special Olympics Young Athletes Program

Hayley Kavanagh,[1,2] Mika Manninen,[1] Sarah Meegan,[1] and Johann Issartel[1,3]

[1]Faculty of Science and Health, School of Health and Human Performance, Dublin City University, Dublin, Ireland; [2]Special Olympics Ireland, Sport Ireland Campus, Dublin, Ireland; [3]MoveAhead Limited, DCU INVENT, Dublin, Ireland

Mastering the ability to move proficiently from a young age is an important contributor to lifelong physical activity participation. This study examined fundamental movement skill (FMS) proficiency in children with intellectual disabilities ($n = 96$, 60% boys, age 5–12 years) and typically developing children ($n = 96$, 60% boys, age 5–12 years). Participants were assessed using the Test of Gross Motor Development–3rd edition and balance subtest from the Bruininks–Oseretsky Test of Motor Proficiency 2. The FMS proficiency of typically developing children including mastery/near mastery level (combined variable representing mastery, which is achieving all criteria for the skill, over both trials and near mastery, wherein a participant performs all but one of the components of the skill correctly) was significantly higher than for children with intellectual disabilities. A similar observation was made with multiple linear regression analysis testing the interaction effect of participant group and age/gender on all three FMS subcomponents. The results presented will help establish a baseline of FMS proficiency and guidelines for future intervention for children with intellectual disabilities.

Keywords: mastery/near mastery, motor-skill proficiency, motor-skill assessment, TGMD-3, BOT-2

Mastering the ability to move proficiently from a young age is well documented as an important contributor to lifelong physical activity participation and overall improved well-being (Hulteen et al., 2018; Lubans et al., 2010). In addition, proficiency in fundamental movement skills (FMS) enables children to play and interact with their peers across multiple environments leading to the development of social adaptation skills (Schalock et al., 2010; Tassé et al., 2012) and enhanced cognitive development

Manninen https://orcid.org/0000-0002-5281-7309
Issartel https://orcid.org/0000-0003-1016-1409
Kavanagh (hayley.kavanagh7@mail.dcu.ie) is corresponding author, https://orcid.org/0000-0002-8940-0443

(Capio & Eugia, 2021; Ommundsen et al., 2010; Piek et al., 2008). FMS are defined as "gross motor skills that involve the large force producing muscles of the trunk, arms and legs" (Clark, 1994, p. 245). Research indicates that children with low FMS proficiency engage in less social play interactions, are less physically active (Logan et al., 2018), and tend to have higher levels of obesity (Okely et al., 2004). All of the aforementioned risks associated with poorer FMS proficiency levels in youth impact future well-being and quality of life, extending far beyond childhood.

The condition of intellectual disability (ID) is defined by the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.) as "neurodevelopmental disorders that begin in childhood and are characterized by intellectual difficulties as well as difficulties in conceptual, social, and practical areas of living" (Boat & Wu, 2015). Advancements in cognitive development and adaptive skills are extremely important for children with IDs (CwID) who are recognized as having significant limitations in both of these areas (Boat & Wu, 2015; Schalock et al., 2021; Tassé et al., 2012).

CwID often demonstrate delays in achieving motor milestones (Jeoung, 2018) which manifest as decreased mastery in FMS (Capio & Eugia, 2021; Eguia et al., 2015). FMS encompass three domains of movement known as locomotor (e.g., running and jumping), ball skills (e.g., catching and kicking), and balance (e.g., stability) skills (Barnett et al., 2016; Logan et al., 2018). FMS do not develop naturally over time unless children are provided with opportunities to learn, reinforce, and practice their skills (Barnett et al., 2016; Clark, 2005; Robinson & Goodway, 2009).

The challenges faced by CwID when attempting to learn new motor skills include poor control of their bodily movements, decreased body awareness, and motor sequencing deficits (Cavanaugh, 2017). According to Gkotzia et al. (2017), CwID are 65% more likely to have lower FMS proficiency than their aged-matched typically developing peers. Studies from Hartman et al. (2010), Westendorp et al. (2011), and Zikl et al. (2013) examined the difference in FMS proficiency levels between children with borderline ID, mild ID, and typically developing children (TDC) using the Test of Gross Motor Development—Second Edition (TGMD-2). The results derived from all three studies found that CwID performed significantly lower in ball skills and locomotor scores than the TDC. Large effect sizes were seen for children with mild ID, and moderate to large effect sizes were seen for children with borderline ID (Westendorp et al., 2011). The FMS of balance were assessed by Sretenović et al. (2019) using the Bruininks–Oseretsky Test of Motor Proficiency (BOT) assessment tool, and they concluded that CwID scored significantly lower for overall balance (static and dynamic) compared to TDC. Awareness of this vast gap in FMS proficiency between CwID and their typically developing peers may affect CwID motivation for participating in sport and physical activity, which has a direct consequence on motor skill acquisition and may decrease the child's perceived competence and confidence (Skinner & Piek, 2001).

In addition to the challenges already experienced by CwID when learning new motor skills, biological factors of age and gender may also play a role in FMS performance. While these factors have been thoroughly explored among TDC (Barnett et al., 2010; Behan et al., 2019; Hardy et al., 2010), a gap in the literature exists for CwID. An example of this includes Gallahue and Ozmun (2006) reporting that TDC have the ability to master majority of the FMS by 6 years

of age. Similarly, gender differences in FMS performance for TDC have been widely discussed with researchers presenting findings of boys achieving higher ball skills scores, while girls demonstrate elevated proficiency in locomotor and balance skills (Behan et al., 2019; Hardy et al., 2010). Studies investigating gender differences in FMS performance among CwID are relatively scarce. A recent study by Jeoung (2013) on the influence of gender and age on ball skills scores among CwID reported that gender had no effect while age only affected the dribbling subskill. Further research is required to explore gender differences in all three subcomponents of FMS for CwID to establish if differences exist and, if so, are the patterns similar to those seen among TDC.

FMS proficiency differences between CwID and TDC have thoroughly been explored (Hartman et al., 2010; Magistro et al., 2018). However, only one study to date has evaluated the development of FMS in terms of percentage mastery, allowing the readers to grasp the level of proficiencies and deficiencies. Mastery of FMS is when a participant performs all components of a skill correctly, while near mastery is when the participant performs all but one of the components of the skill correctly (van Beurden et al., 2002). Rintala and Loovis (2013) examined mastery of FMS in a sample of 40 Finnish children (20 CwID and 20 TDC) and found that only 20% of CwID achieved mastery across three skills, namely running, sliding, and catching. The analysis indicated that 0% of the CwID group mastered the skills of the hop, horizontal jump, leap, underhand throw, and striking a stationary ball. The conclusions drawn from this study clearly showed that FMS proficiency of CwID is significantly lower than their age-matched typically developing peers. This demonstrates the extent to which motor skill acquisition for CwID is significantly delayed and that certain motor skills are entirely outside of their repertoire.

The aim of this study was threefold: (a) to assess and compare the FMS proficiency of a large sample of CwID and their typically developing peers aged 5–12 years, (b) to investigate the role of age and gender on FMS proficiency between these groups, and (c) evaluate the mastery/near mastery of FMS for both CwID and TDC. Overall, this study will provide an in-depth analysis on the FMS proficiency and mastery levels of CwID from a large sample size, in order to increase the statistical power and generalizability of results for this population. This research will provide insight for coaches, physical education teachers, and movement practitioners on the ground and will highlight where the proficiency deficiencies exist between CwID and TDC.

Methods

Participants

Cross-sectional data were collected as part of the "SO Fun" project with Special Olympics Ireland. Fifteen Special Olympics Young Athletes clubs were contacted with 10 clubs agreeing to participate in the study. The eligibility criteria for participating in this study included CwID who are registered with the Special Olympics Ireland Young Athletes program, aged 5–12 years, who are fully mobile, and can walk without the use of an aid.

The Young Athletes program is a yearlong "play and sports activity programme" (Favazza et al., 2013) that takes place on a weekly basis and introduces

CwID to a wide range of play activities in a supportive, fun environment (Special Olympics, i.e., 2022). The program was designed to provide CwID with an introduction to FMS (Special Olympics, i.e., 2022).

Participants, CwID ($n = 96$, 60.5% boys, aged 5–12 years, mean age 7.7 ± 2), were then recruited from the clubs across eight counties. The clubs were situated in each of the four provinces of Ireland and Northern Ireland. 65.7% of the CwID were reported as having Down syndrome (DS), and all other participants reported their condition as ID. Data were collected during the period of October 2021 to June 2022. Data from a sample of TDC ($n = 96$, 60.5% boys, aged 5–12 years, mean age 7.7 ± 2) were obtained from the anonymized data set of a national physical literacy study called "Moving Well-Being Well" (Behan et al., 2019) to be used as a comparison group. Data from this control group were collected from March to June 2017 in primary schools across the four provinces of Ireland and Northern Ireland by a team of researchers from Dublin City University (Behan et al., 2019). We used propensity score matching (predicted probability of belonging to a group; Ho et al., 2007) to create the sample of 96 TDC from the data of Behan et al. (2019) to accurately estimate the differences between CwID and TDC in FMS. Propensity score matching is a technique used with observational data that aims to reduce the effect of confounding variables when comparing two groups in respect of an outcome of interest. In this study, the outcome of interest was FMS proficiency and the confounding variables were age and gender. As the first step, we fitted a logistic regression model to estimate a propensity score of each participant to be categorized as CwID using two covariates of gender and age. Next, the computed propensity scores were used to match the TDC with CwID participants on a ratio of 1:1 using the nearest neighbor method and without replacements. Lastly, we inspected the covariate balance between the two groups visually and via Welch's t tests, and average absolute standardized differences. All analyses indicated the two groups to be perfectly matched in terms of age and gender (average absolute standardized difference equaled zero). All propensity score matching procedures were done with the MatchIt package in R (Ho et al., 2011).

Ethical approval was obtained from Dublin City University, Research Ethics Committee (DCUREC/2021/100). The coaches of each of the participating clubs provided initial consent for the research team to visit the club, while parental consent and participant assent were also obtained and required in order for participants to partake in the study. Anonymity was maintained with each participant assigned a unique numerical code.

Measures

Participants' demographics including age and gender were collected through the consent forms and questionnaires completed by parents (see Table 1). Proficiency of participants' FMS was assessed using a subset of the process-oriented battery, the Test of Gross Motor Development–Third Edition (TGMD-3), established clinical validity (Pitchford & Webster, 2021; Temple & Foley, 2017), instructional sensitivity (Staples et al., 2021), and reliability ($\alpha = .81$) for children with and without ID in this age cohort (Rey et al., 2020; Magistro et al., 2018). The TGMD-3 is an individually administered test which focuses on two subcategories of FMS, locomotor, and ball skills (Ulrich, 2019). In this study, the subset of skills we used

Table 1 Descriptive Statistics by Group (CwID and TDC) of Motor Skill Proficiency Level

	M ± *SD*					
	CwID	TDC	Score range	*F*	Sig. $p < .05$	ES
Locomotor	12.2 ± 7	22.7 ± 6.1	0–30	124.4	.001	1.61
Ball skills	14.88 ± 9.7	25.39 ± 9.7	0–44	56.6	.001	1.1
Balance	0.70 ± 1.8	6.57 ± 1.6	0–8	596.5	.001	3.6
Age	7.7 ± 2	7.7 ± 2				
Gender	60.5% M	60.5% M				

Note. ES = effect size (Cohen's *d*); CwID = children with intellectual disabilities; TDC = typically developing children; M = male; Sig. = significance.

were as follows: locomotor skills (run, skip, horizontal jump, and hop) and ball skills (catch, kick, overhand throw, underhand throw, stationary dribble, and one-hand strike; Ulrich, 2019).

A known limitation of the TGMD assessment tool despite its widespread use globally is the absence of a stability component (Rudd et al., 2015). Therefore, in order to ensure the authors gathered a holistic measure of children's motor skill competency, balance was assessed using a subtest of the BOT-2 Short Form. The BOT-2 Short Form measures the motor skill performance of gross and fine motor skills in children who may experience motor impairments or delays (Baharudin et al., 2020). Nocera et al. (2021) found that the BOT-2 Short Form demonstrates excellent reliability ($\alpha = .75$) when assessing motor competence in CwID. The balance assessment consisted of two tasks, single-leg stand on a balance beam with the eyes open and walking forward heel-to-toe on the line. The TGDM-3 and the BOT-2 were the preferred motor competence assessment tools for use in this study as a recent review found them to be the most psychometrically appropriate tools for assessing FMS proficiency in CwID in field settings (Downs et al., 2020).

"Mastery" of the skills within the process-oriented locomotor and ball skills subtests and product-oriented balance subtests is defined as achieving all criteria for the skill, over both trials (van Beurden et al., 2002). "Near Mastery" is defined as achieving all but one of the criteria correctly, over both trials (van Beurden et al., 2002). Any participant who failed to meet the criteria to achieve mastery or near mastery status was classified as "poor" (van Beurden et al., 2002). An additional variable was created, and the raw scores for each skill were coded into mastery/near mastery or poor, for both groups (Okely & Booth, 2004). Frequencies were calculated to report both mastery/near mastery and poor percentages for each individual skill and group.

Data Collection

All members of the research team undertook formal training in order to ensure an in-depth understanding of the skill assessment batteries, in addition to establishing consistency when visually demonstrating the skills to each participant. The visual

demonstration of the skill was in line with Ulrich's (2013) and Bruininks's (2005) protocols that are frequently documented in the literature (Maïano et al., 2019). The TGMD-3 was individually administered to each participant during their Young Athletes club training session. No cues or verbal feedback were given to the participants. Participants performed a practice trial to become accustomed with each skill, followed by two opportunities to perform the skill. All the participants' performances were video recorded.

A trained member of the research team observed each trial retrospectively, and assessed and scored each skill component. A score of 1 was given if the participant successfully performed the criteria, and a 0 was recorded if the participant failed to meet the criteria. Participants' raw scores per skill were calculated by collating the scores from both trials. Once all skills were assessed, raw subtest scores for locomotor and ball skills were calculated and were then combined to provide a total raw FMS score.

The balance subtests were scored based on their performance outcome. Walking forward heel-to-toe on the line was graded based on the number of steps taken by the participant, while adhering to strict criteria (Bruininks, 2005). Participants were then awarded points based on the number of successful steps taken, for example, six continuous steps in line with criteria, equals a top score of 4 points. The single-leg stand on the balance beam was graded on the amount of time the participant could maintain their balance while adhering to the strict criteria (Bruininks, 2005). Participants were then awarded points based on the time they maintained their balance, for example, maintaining balance for 10 s in line with the criteria equals a top score of 4 points. Second trials were only carried out if the maximum score was not reached in the first trial.

Data Analysis

All data were analyzed using SPSS (version 27; IBM Corp., 2022) and R (R Core Team, 2022). To describe the characteristics of the data, means, standard deviations, and bivariate correlations on the variables of interest were computed. The main analyses were undertaken on the locomotor, ball skills, and balance subtest scores. The impact of ID level on participants locomotor, ball skills, and balance was assessed using a simple linear regression analysis. Furthermore, a multiple linear regression model was used to test the interaction effect of participant group and gender/age on FMS proficiency. The percentage of CwID and TDC who had achieved mastery or near mastery in each skill was examined by producing descriptive statistics and frequency tables. Cohen's d (Cohen, 1992) was used as the effect size in group mean difference measures, and an alpha level of .05 was established for all statistical analysis. Finally, potential differences between the groups' mastery and near mastery of the skills within the locomotor, ball skills, and balance subtests were assessed using chi-square analyses. Cramér's V (Cramér, 1946) measure of association between two nominal variables and corresponding significance levels was reported based on the chi-square analysis (Table 2). Cramér's V ranges from 0 to + 1, and a value of 0 means no effect or association. To summarize, Cohen's d effect sizes were used to describe the continuous variables while Cramer's V was used to describe the categorical variables.

Table 2 Comparison of Mastery/Near Mastery Between Children With Intellectual Disabilities and Typically Developing Children

	Children with intellectual disabilities		Typically developing children				
	Mastery/ near mastery	Poor	Mastery/ near mastery	Poor	Chi-square	Cramer's *V*	Sig.
Locomotor subset							
Run	60.4%	39.6%	92.7%	7.3%	27.893	0.381	.001
Hop	16.7%	83.3%	37.5%	62.5%	10.549	0.234	.001
Horizontal jump	27.1%	72.9%	41.7%	58.3%	4.525	0.154	.033
Skip	8.3%	91.7%	68.8%	31.3%	73.968	0.621	.001
Ball-skills subset							
One-hand strike	10.4%	89.6%	41.7%	58.3%	24.338	0.356	.001
Dribble	19.8%	80.2%	44.8%	55.2%	13.721	0.267	.001
Catch	32.3%	67.7%	60.4%	39.6%	15.269	0.282	.001
Kick	22.9%	77.1%	53.1%	46.9%	18.588	0.311	.001
Overhand throw	6.3%	93.8%	38.5%	61.5%	28.799	0.387	.001
Underhand throw	21.9%	78.1%	36.5%	63.5%	4.941	0.160	.026
Balance subset							
Total balance	0%	100%	75%	25%	115.2	0.775	.001

Note. Sig. = significance.

Results

A simple linear regression was carried out to investigate whether ID level was a predictor of FMS proficiency. Results of the simple regression analysis revealed that there was a statistically significant difference in the locomotor score $F(1, 190) = 124.446$, $p < .001$; ball skills score $F(1, 190) = 56.615$, $p < .001$; and balance score $F(1, 190) = 596.485$, $p < .001$. Balance demonstrated the largest effect size of all of the skill subsets. Across all the models, TDC scored significantly higher in all subsets compared with CwID ($p < .001$; Table 1). Correlations presented in Supplementary Tables S1 and S2 (available online) demonstrate how individual subskills relate to each other, for both CwID and TDC. In addition, the correlations provide insight into how the variables of age and gender are linearly related to the three subskills. These correlations will be valuable for researchers interested in implementing more complex modeling and statistics, for example, in a meta-analysis.

A multiple regression was carried out to investigate whether the interaction of age and participant group was a predictor of FMS proficiency. The model demonstrated a significant interaction effect was found to predict locomotor score $F(3, 188) = 61$, $p < .001$, $R^2 = .49$; ball skills score $F(3, 188) = 33.99$, $p < .001$, $R^2 = .34$; and balance $F(3, 188) = 233.5$, $p < .001$, $R^2 = .79$. Across all the models, the significant interaction between age and participant group indicates that the gap between the groups FMS proficiency level increases as the children's age increases (see Figure 1).

A multiple regression was carried out to investigate whether the interaction of gender and participant group was a predictor of FMS proficiency. No significant interaction effect was found for locomotor score $F(3, 188) = 42.36$, $p = .193$, $R^2 = .39$ nor ball skills score $F(3, 188) = 19.87$, $p = .134$, $R^2 = .23$. However, a significant interaction effect was found for balance $F(3, 188) = 218.5$, $p < .001$, $R^2 = .77$. The post hoc test with a Tukey family-wise error correction indicated that a gender difference exists with females outperforming the males in the CwID group ($p < .001$) but not in the TDC group ($p = .976$; see Figure 2). Descriptive statistics of the gender differences for the FMS subtests can be found in Supplementary Table S3 (available online).

In addition, we examined the degree to which CwID "mastered" the skills within the locomotor, ball skills, and balance subtests compared with their typically developing peers. Comprehensive analysis of the mastery/near mastery across both participant groups and the percentage of participants demonstrating poor performance by skill can be seen in Table 2. The percentage of participants demonstrating poor performance is noteworthy for both groups, particularly for the CwID. Poor performance in the individual skills ranges from 39.5% to 100% for CwID. The percentage difference in mastery/near mastery between TDC and CwID is represented for each skill (see Table 2).

Discussion

At a macroscopic level, this study demonstrates with a large sample size, the vast FMS proficiency differences that exist between CwID and TDC. FMS are the

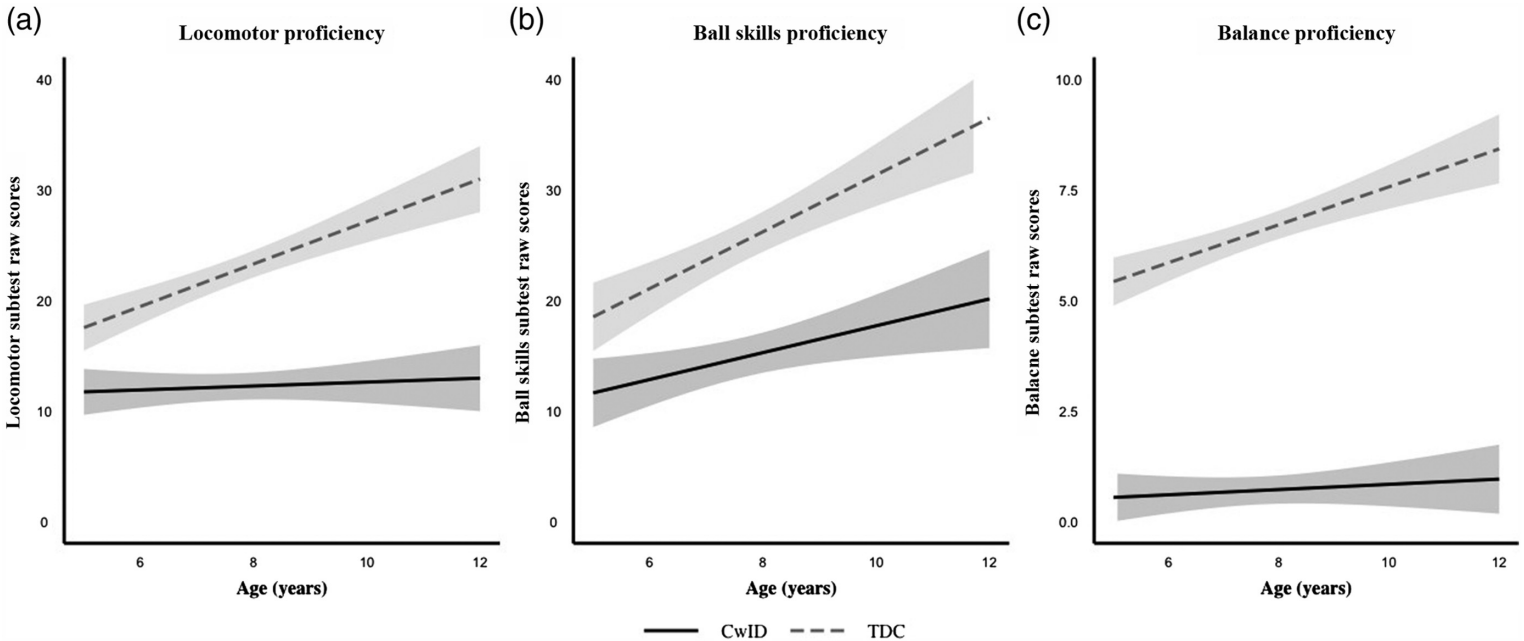

Figure 1 — Interaction effect of participant group (CwID and TDC) and age on locomotor proficiency (a), ball-skills proficiency (b), and balance proficiency (c). Gray areas shown are the confidence intervals. CwID = children with intellectual disabilities; TDC = typically developing children.

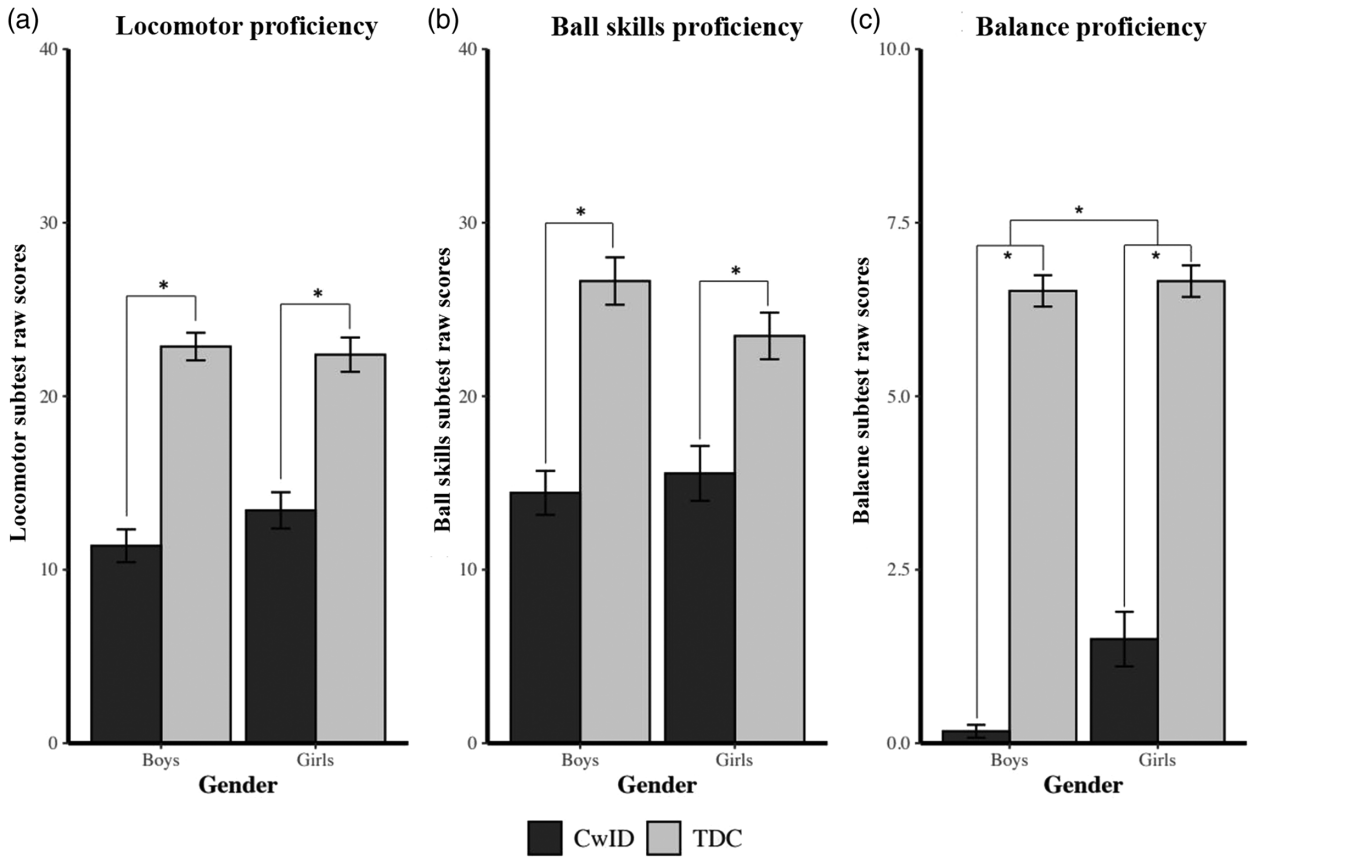

Figure 2 — Differences in fundamental movement skills between genders and participant groups (CwID and TDC) for locomotor proficiency (a), ball skills proficiency (b), and balance proficiency (c). Standard error bars shown. *Statistically significant differences found in balance proficiency. CwID = children with intellectual disabilities; TDC = typically developing children; FMS = fundamental movement skill.

"building blocks" required to participate in sport and physical activity (Behan et al., 2019). Low FMS proficiency levels have the potential to impact lifelong sport and physical activity participation (Hulteen et al., 2018; Lubans et al., 2010) for CwID. Further insight into FMS proficiency levels for both groups is seen by the mastery/near mastery calculations, which demonstrate on an individual skill level those skills in which CwID are exhibiting poor performance. These findings are beneficial for coaches, PE teachers, and movement practitioners to identify at an individual skill level basis where CwID are failing to perform to an adequate level. These skills can be incorporated into FMS interventions to increase overall FMS proficiency levels.

FMS Proficiency

First, the findings showed a significant difference between CwID and TDC with very low levels of proficiency in all three subskills for CwID (Table 1). CwID demonstrate lower levels of FMS proficiency compared with their typically developing peers, and these results are comparable in terms of significance to other studies including: (a) locomotor and ball skills (Alesi et al., 2018; Capio et al., 2018; Hartman et al., 2010; Schott et al., 2014; Zikl et al., 2013) and (b) balance skills (Craig et al., 2018; Golubovic et al., 2012; Lejčarová, 2009).

The FMS proficiency gap between the groups is quite significant for locomotor, ball skills, and balance, demonstrated by the effect sizes (see Table 1). These effect sizes are comparable to a recent meta-analysis which assessed the motor skill proficiency of 1,232 CwID and 2,293 TDC for all three of the FMS subcomponents and total FMS proficiency (Kavanagh et al.). This study provided convincing quantitative evidence to give a precise estimate of the magnitude of difference in FMS proficiencies between these two groups (Kavanagh et al., 2023). In the same study, similar effect sizes were found by Kavanagh et al. (2023) for locomotor skills (1.14 vs. 1.61 TDC) and ball skills (1.21 vs. 1.1). The effect sizes for balance in both studies were the largest of all the effect sizes found. However, the biggest magnitude of difference can be seen in this study with an effect size for balance of 3.6 compared with 1.26 found by Kavanagh et al.

Researchers (Enkelaar et al., 2012; Maïano et al., 2018) have proposed two mechanisms to determine a cause of the balance deficit among youth with ID: (a) cognitive development delays which impact motor skill proficiency and (b) increased level of physical inactivity leading to less time reinforcing the FMS. This balance deficit exhibited by CwID is a cause for concern as this group gets older, particularly as balance proficiency is an important indicator for risk of falls (Enkelaar et al., 2012; Maïano et al., 2018; Patikas, 2015). Compared with typically developing youth, the incidence rate of falls among young people with ID is higher, often resulting in injury (e.g., fractured bones; Maïano et al., 2018; Sherrard, 2001). In addition, improving the balance proficiency of CwID is a critical issue, as it also improves overall FMS proficiency, encouraging CwID to participate in lifelong sport and physical activity (Maïano et al., 2018).

While the results are not entirely surprising, they are important for establishing a baseline of FMS proficiency among Young Athletes within the Special Olympics Ireland program. It is widely recognized that FMS are the "building blocks" required for sport and physical activity participation (Barnett et al., 2016), and they

are the gateway to more advanced movement skills needed for games and sports (Logan et al., 2018). These findings will enable the National Governing Body of Sport for people with ID to work alongside coaches to implement a structured and developmentally appropriate motor skills program (Goodway & Branta, 2003; Robinson & Goodway, 2009; Valentini & Rudisill, 2004), which will improve athletes' FMS proficiency levels and impact the trajectory of their pathway to developing sport-specific skills. In turn, the long-term aim is to keep people with ID participating in sport and physical activity for life, as the health, social, and cognitive benefits are well documented (Holfelder & Schott, 2014; Hulteen et al., 2018; Lubans et al., 2010; Piek et al., 2008). The positive impact that sport can have on the lives of people with ID is internationally recognized (Robertson & Emerson, 2010). In particular, the benefits that participation in Special Olympics has include improved social competence, with time spent participating in the program correlating with participation in more recreational activities, household work, jobs, and friendships (Dykens & Cohen, 1996), and enhanced psychological well-being (Crawford et al., 2015), in addition to feelings of social approval, opportunity to learn new skills, and having fun (Farrell et al., 2004).

Age and Gender

Participant group and age/gender were examined to determine their role on locomotor, ball skills, and balance scores. The results demonstrated that for TDC, FMS proficiency was significantly impacted by age with the higher scores favoring the older children (Figure 1). Previous research (Behan et al., 2019; Bolger et al., 2018; Jeong et al., 2017) also confirms this finding that age positively influences FMS proficiency due to biological maturation, increased duration of practice, and receiving feedback (Charlesworth, 2016). However, the results did not demonstrate this pattern among CwID. The gap in proficiency increases as the participant's age increases (Figure 1). This result can be viewed through the lens of the developmental skill-learning gap hypothesis proposed by Wall (2004). This hypothesis indicates that as children who experience motor skill deficiencies get older, the skill-learning gap between them and TDC who have better skill proficiency continues to grow (Wall, 2004). This proficiency gap becomes evident across a range of settings including physical education class, sports practice, and competition (Wall, 2004). The potential impact of this skill-learning gap is that TDC continue to participate in sports and physical activity which means they continue to increase their FMS proficiency levels, while CwID may withdraw from sports activities, thus limiting their opportunities for further FMS proficiency development (Bremer & Cairney, 2016). CwID self-perception of their physical competence could also be negatively impacted if they continue to perceive themselves as not being as proficient as their peers (Bremer & Cairney, 2016). With that said, future longitudinal research would be required to get more specific insight into this to comprehend the nature of motor skill delays between CwID and TDC and provide insight into appropriate method of intervention approaches and provision (Staples & Reid, 2009).

The only interaction effect of participant group and gender on FMS was detected with balance, with girls in the CwID group demonstrating significantly greater proficiency compared with boys in the CwID group. No gender differences existed between the genders within the TDC group (Figure 2). Typically, research

shows that among school-aged children, girls outperform boys in balance skills, particularly in the single-leg stand skill (Mickle et al., 2011, Rodríguez-Negro et al., 2019). This gender difference can be explained by the type of activities in which boys and girls participate, as this can often be determined by factors such as their peers, family, and the physical environment (Booth et al., 1999; Hardy et al., 2010). More often than not, girls tend to participate in activities in which the focus is predominantly on locomotor and balance skills (e.g., gymnastics and dance) while boys participate in activities that predominantly involve ball skills (e.g., ball sports like football; Booth et al., 1999; Bardid et al., 2016; Peral-Suárez et al., 2020).

Mastery/Near Mastery

On an individual skill level, the highest mastery/near mastery for both groups was seen in the run, the catch, and the kick (see Table 2). For TDC, these relatively high levels of performance are to be expected, as Gallahue and Ozmun (2006) established that all of the basic FMS should be mastered by 8 years of age. As CwID have been shown to experience motor skill delays of 5–6.5 years behind TDC (Rintala & Loovis, 2013), it is positive to see that there are similarities in the skills in which both groups of children score the highest levels of proficiency. These results also align with studies from Rintala and Loovis (2013) and Behan et al. (2019) who demonstrated that CwID and TDC had relatively high mastery/near mastery for the run and catch, respectively.

The three skills in which both CwID and TDC demonstrated the poorest performance included the one-hand strike (10.5% vs. 41.7%), overhand throw (6% vs. 38.6%), and hop (16.7% vs. 37.5%), comparable with findings from Behan et al. (2019) among TDC. Rintala and Loovis (2013) presented findings that mastery at its highest level was only achieved by 20% of the CwID compared with 59% in this study. In addition to this, mastery was not achieved in five skills, in which CwID scored 0%, for the hop, leap, horizontal jump, striking a stationary ball, and underhand roll (Rintala & Loovis, 2013) compared with the current sample who achieved 16.7% in hop, 27.1% in horizontal jump, and 21.9% in underhand throw. The differences may be due to the small sample size in Rintala's study, which was indicated as a limitation as it influences results' generalizability and reduces statistical power.

For CwID, the balance subtest demonstrated the biggest challenge, with 0% of the group mastering the skills compared with 75% of the TDC cohort. Wang and Ju (2002) found similar results when investigating balance using a subtest of the BOT with children with DS. Participants with DS scored 0.47 ± 0.69 on the beam balance and 2 ± 1.94 on walking heel-to-toe on the line compared with TDC who scored 4.71 ± 3.2 and 5.9 ± 0.30, respectively. CwID, in particular, those with DS, experience muscular hypotonia and joint ligament laxity which have been attributed to poorer balance performance (Ma et al., 2019; Wang & Ju, 2002). In a systematic review by Maïano et al. (2019) exploring the effects of motor skill interventions on FMS performance of CwID, balance was the subtest most investigated in the paper. They found that motor skill interventions were effective in significantly improving balance skills of CwID. These findings and the dearth of proficiency in balance of CwID in this paper indicate an immediate need for motor skill interventions to incorporate balance training.

Limitations

There were several limitations within this study. First, all participants in the CwID group take part in the Special Olympics Ireland Young Athletes program. Going forward, it would be ideal to have access to a control group of CwID to gain further indication of the role and impact of the Special Olympics Ireland Young Athletes program. In addition, due to the time constraints presented to the researchers during data collection, the full battery of the TGMD-3 was not administered. Researchers omitted three skills as a result (gallop and slide from the locomotor subtest and two hand strike from the ball skills subtest). Furthermore, while the interaction effect of age indicated that the gap in FMS proficiency levels between CwID and TDC widened as participants get older, further longitudinal research would be beneficial to confirm these findings. A final limitation important to note is that the FMS data collected from the TCD group were gathered pre-COVID in 2017 while data from the CwID group were collected during/post-COVID in 2021/2022. Therefore, there is a potential that the discrepancies in FMS proficiency between the two groups are greater given the lack of opportunities to be physically active during COVID and the overall declines in physical activity and health outcomes that people experienced during this time period.

Conclusions and Implications for Future Research

The results of this study highlight the fundamental movement skill (FMS) proficiency gap that exists between children with intellectual disabilities (CwID) and typically developing children (TDC), contributing to the wider body of knowledge on the differences in FMS proficiency that exist for these groups. This study further supports the hypothesis that CwID exhibit low levels of FMS mastery, particularly in balance skills. The results presented will help to establish a baseline of FMS proficiency for CwID in the Special Olympics Young Athletes programs in Ireland and further afield. Future research should seek to analyze FMS at a behavioral component level in order to provide coaches and teachers of CwID tangible and practical areas in which to improve children's FMS. This will enable researchers to see similar patterns in prevalence of failure or mastery for behavioral components across multiple skills. This information can then be utilized to develop and implement interventions targeting the poorest performing skills, to try to decrease the proficiency gap that currently exists between CwID and TDC.

References

Alesi, M., Battaglia, G., Pepi, A., Bianco, A., & Palma, A. (2018). Gross motor proficiency and intellectual functioning. *Medicine, 97*(41), Article 12737. https://doi.org/10.1097/md.0000000000012737

Baharudin, N.S., Harun, D., & Kadar, M. (2020). An assessment of the movement and function of children with specific learning disabilities: A review of five standardised assessment tools. *The Malaysian Journal of Medical Sciences, 27*(2), 21–36. https://doi.org/10.21315/mjms2020.27.2.3

Bardid, F., Huyben, F., Lenoir, M., Seghers, J., De Martelaer, K., Goodway, J.D., & Deconinck, F.J.A. (2016). Assessing fundamental motor skills in Belgian children aged 3–8 years highlights differences to US reference sample. *Acta Paediatrica, 105*(6), e281–e290. https://doi.org/10.1111/apa.13380

Barnett, L.M., Stodden, D., Cohen, K.E., Smith, J.J., Lubans, D.R., Lenoir, M., Iivonen, S., Miller, A.D., Laukkanen, A., Dudley, D., Lander, N.J., Brown, H., & Morgan, P.J. (2016). Fundamental movement skills: An important focus. *Journal of Teaching in Physical Education, 35*(3), 219–225. https://doi.org/10.1123/jtpe.2014-0209

Barnett, L.M., van Beurden, E., Morgan, P.J., Brooks, L.O., & Beard, J.R. (2010). Gender differences in motor skill proficiency from childhood to adolescence: A longitudinal study. *Research Quarterly for Exercise and Sport, 81*(2), 162–170. https://doi.org/10.1080/02701367.2010.10599663

Behan, S., Belton, S., Peers, C., O'Connor, N.E., & Issartel, J. (2019). Moving Well-Being Well: Investigating the maturation of fundamental movement skill proficiency across sex in Irish children aged five to twelve. *Journal of Sports Sciences, 37*(22), 2604–2612. https://doi.org/10.1080/02640414.2019.1651144

Boat, T.F., Wu, J.T., Committee to Evaluate the Supplemental Security Income Disability Program for Children with Mental Disorders; Board on the Health of Select Populations; Board on Children, Youth, and Families; Institute of Medicine; Division of Behavioral and Social Sciences and Education. (2015). Clinical characteristics of intellectual disabilities. In T.F. Boat & J.T. Wu (Eds.), *Mental disorders and disabilities among low-income children*. National Academies Press. https://www.ncbi.nlm.nih.gov/books/NBK332877/

Bolger, L.E., Bolger, L.A., O' Neill, C., Coughlan, E., O'Brien, W., Lacey, S., & Burns, C. (2018). Age and sex differences in fundamental movement skills among a cohort of Irish school children. *Journal of Motor Learning and Development, 6*(1), 81–100. https://doi.org/10.1123/jmld.2017-0003

Booth, M.L., Okely, T., McLellan, L., Phongsavan, P., Macaskill, P., Patterson, J., Wright, J., & Holland, B. (1999). Mastery of fundamental motor skills among New South Wales school students: Prevalence and sociodemographic distribution. *Journal of Science and Medicine in Sport, 2*(2), 93–105. https://doi.org/10.1016/S1440-2440(99)80189-3

Bremer, E., & Cairney, J. (2016). Fundamental movement skills and health-related outcomes: A narrative review of longitudinal and intervention studies targeting typically developing children. *American Journal of Lifestyle Medicine, 12*(2), 148–159. https://doi.org/10.1177/1559827616640196

Bruininks, R.H., & Bruininks, B.D. (2005). *Bruininks-Oseretsky test of motor proficiency* (2nd ed.). PsycTESTS Dataset.

Capio, C.M., & Eguia, K.F. (2021). Object control skills training for children with intellectual disability: An implementation case study. *SAGE Open, 11*(3), Article 603. https://doi.org/10.1177/21582440211030603

Capio, C.M., Mak, T.C.T., Tse, M.A., & Masters, R.S.W. (2018). Fundamental movement skills and balance of children with Down syndrome. *Journal of Intellectual Disability Research, 62*(3), 225–236. https://doi.org/10.1111/jir.12458

Cavanaugh, L.K. (2017) Intellectual disabilities. In J.P. Winnick & D.L. Porretta (Eds.), *Adapted physical education and sport* (pp. 153–174). Human Kinetics.

Charlesworth, R. (2016). *Understanding child development* (10th ed.). Cengage Learning.

Clark, J.E. (1994). Motor development. In V.S. Ramachandran (Ed.), *Encyclopedia of human behavior* (3rd ed., pp. 245–255). Academic Press.

Clark, J.E. (2005). From the beginning: A developmental perspective on movement and mobility. *Quest, 57*(1), 37–45. https://doi.org/10.1080/00336297.2005.10491841

Cohen, J. (1992). Statistical power analysis. *Current Directions in Psychological Science, 1*(3), 98–101. https://doi.org/10.1111/1467-8721.ep10768783

Craig, F., Lorenzo, A., Lucarelli, E., Russo, L., Fanizza, I., & Trabacca, A. (2018). Motor competency and social communication skills in preschool children with autism spectrum disorder. *Autism Research, 11*(6), 893–902. https://doi.org/10.1002/aur.1939

Cramér, H. (1946). The two-dimensional case. In H. Cramér, *Mathematical methods of statistics* (pp. 260–290). Princeton University Press.

Crawford, C., Burns, J., & Fernie, B.A. (2015). Psychosocial impact of involvement in the Special Olympics. *Research in Developmental Disabilities, 45–46,* 93–102. https://doi.org/10.1016/j.ridd.2015.07.009

Downs, S.J., Boddy, L.M., McGrane, B., Rudd, J.R., Melville, C.A., & Foweather, L. (2020). Motor competence assessments for children with intellectual disabilities and/or autism: A systematic review. *BMJ Open Sport & Exercise Medicine, 6*(1), Article e000902. https://bmjopensem.bmj.com/content/bmjosem/6/1/e000902.full.pdf

Dykens, E.M., & Cohen, D.J. (1996). Effects of special Olympics international on social competence in persons with mental retardation. *Journal of the American Academy of Child & Adolescent Psychiatry, 35*(2), 223–229. https://doi.org/10.1097/00004583-199602000-00016

Eguia, K.F., Capio, C.M., & Simons, J. (2015). Object control skills influence the physical activity of children with intellectual disability in a developing country: The Philippines. *Journal of Intellectual and Developmental Disability, 40*(3), 265–274. https://doi.org/10.3109/13668250.2015.1041466

Enkelaar, L., Smulders, E., van Schrojenstein Lantman-de Valk, H., Geurts, A.C.H., & 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.2011.08.028

Farrell, R.J., Crocker, P.R.E., McDonough, M.H., & Sedgwick, W.A. (2004). The driving force: Motivation in special Olympians. *Adapted Physical Activity Quarterly, 21*(2), 153–166. https://doi.org/10.1123/apaq.21.2.153

Favazza, P.C., Siperstein, G.N., Zeisel, S.A., Odom, S.L., Sideris, J.H., & Moskowitz, A.L. (2013). Young athletes program: Impact on motor development. *Adapted Physical Activity Quarterly, 30*(3), 235–253. https://doi.org/10.1123/apaq.30.3.235

Gallahue, D., & Ozmun, J. (2006). *Understanding motor development: Infants, children, adolescents, adults* (6th ed.). McGraw-Hill. Retrieved March 24, 2022, from https://www.scirp.org/(S(lz5mqp453edsnp55rrgjct55.))/reference/referencespapers.aspx?referenceid=1396040

Gkotzia, E., et al. (2017). Motor proficiency of children with autism spectrum disorders and intellectual disabilities: A review. *European Psychomotricity Journal, 9*(1), 46–69.

Golubović, Š., Maksimović, J., Golubović, B., & Glumbić, N. (2012). Effects of exercise on physical fitness in children with intellectual disability. *Research in Developmental Disabilities, 33*(2), 608–614. https://doi.org/10.1016/j.ridd.2011.11.003

Goodway, J.D., & Branta, C.F. (2003). Influence of a motor skill intervention on fundamental motor skill development of disadvantaged preschool children. *Research Quarterly for Exercise and Sport, 74*(1), 36–46. https://doi.org/10.1080/02701367.2003.10609062

Hardy, L.L., King, L., Farrell, L., Macniven, R., & Howlett, S. (2010). Fundamental movement skills among Australian preschool children. *Journal of Science and Medicine in Sport, 13*(5), 503–508. https://doi.org/10.1016/j.jsams.2009.05.010

Hartman, E., Houwen, S., Scherder, E., & Visscher, C. (2010). On the relationship between motor performance and executive functioning in children with intellectual disabilities. *Journal of Intellectual Disability Research, 54*(5), 468–477. https://doi.org/10.1111/j.1365-2788.2010.01284.x

Ho, D.E., Imai, K., King, G., & Stuart, E.A. (2007). Matching as nonparametric preprocessing for reducing model dependence in parametric causal inference. *Political Analysis, 15*(3), 199–236. https://doi.org/10.1093/pan/mpl013

Ho, D., Kosuke, I.King, G., & Stuart, E. (2011). *MatchIt: Nonparametric preprocessing inference* [software documentation]. http://gking.harvard.edu/matchit

Holfelder, B., & Schott, N. (2014). Relationship of fundamental movement skills and physical activity in children and adolescents: A systematic review. *Psychology of Sport and Exercise, 15,* 382–391.

Hulteen, R.M., Morgan, P.J., Barnett, L.M., Stodden, D.F., & Lubans, D.R. (2018). Development of foundational movement skills: A conceptual model for physical activity across the lifespan. *Sports Medicine, 48*(7), 1533–1540. https://doi.org/10.1007/s40279-018-0892-6

IBM Corp. (2022). *IBM SPSS Statistics for Windows, version 27.0.*

Jeong, J.H., Choi, Y.S., Yoo, S., & Jeoung, B.J. (2017). The fundamental movement skill of male students with intellectual disabilities in Korea. *The European Journal of Educational Sciences, 4*(1), Article 62. https://doi.org/10.19044/ejes.v4no1a62

Jeoung, B. (2018). Motor proficiency differences among students with intellectual disabilities, autism, and developmental disability. *Journal of Exercise Rehabilitation, 14*(2), 275–281. https://doi.org/10.12965/jer.1836046.023

Jeoung, B.J. (2013). Objective control skills among students with intellectual disability at special school in Korea. *Journal of Exercise Rehabilitation, 9*(5), 477–480. https://doi.org/10.12965/jer.130068

Kavanagh, H., Manninen, M., & Issartel, J. (2023). Comparing the fundamental movement skill proficiency of children with intellectual disabilities and typically developing children: A systematic review and meta-analysis. *Journal of Intellectual Disability Research*. Advance online publication. https://doi.org/10.1111/jir.13012

Lejčarová, A. (2009). Coordination skills in 9 to 11 years old pupils at practical elementary schools in relationship to their degree of intellectual disability. *Medicine, 39*(4), 53–62.

Logan, S.W., Ross, S.M., Chee, K., Stodden, D.F., & Robinson, L.E. (2018). Fundamental motor skills: A systematic review of terminology. *Journal of Sports Sciences, 36*(7), 781–796. https://doi.org/10.1080/02640414.2017.1340660

Lubans, D.R., Morgan, P.J., Cliff, D.P., Barnett, L.M., & Okely, A.D. (2010). Fundamental movement skills in children and adolescents. *Sports Medicine, 40*(12), 1019–1035. https://doi.org/10.2165/11536850-000000000-00000

Ma, Y., Wang, L., Li, M., & Wang, T. (2019). Meta-analysis of the effects of exercise programs in improving the balance ability of children with intellectual disabilities. *Journal of Intellectual & Developmental Disability, 45*(2), Article 40. https://doi.org/10.3109/13668250.2019.1632040

Magistro, D., Piumatti, G., Carlevaro, F., Sherar, L.B., Esliger, D.W., Bardaglio, G., Magno, F., Zecca, M., & Musella, G. (2018). Measurement invariance of TGMD-3 in children with and without mental and behavioral disorders. *Psychological Assessment, 30,* 1421–1429. https://doi.org/10.1037/pas0000587

Maïano, C., Hue, O., & April, J. (2019). Effects of motor skill interventions on fundamental movement skills in children and adolescents with intellectual disabilities: A systematic review. *Journal of Intellectual Disability Research, 63*(9), 1163–1179. https://doi.org/10.1111/jir.12618

Maïano, C., Hue, O., Morin, A.J.S., Lepage, G., Tracey, D., & Moullec, G. (2018). Exercise interventions to improve balance for young people with intellectual disabilities: A systematic review and meta-analysis. *Developmental Medicine & Child Neurology, 61*(4), 406–418. https://doi.org/10.1111/dmcn.14023

Mickle, K.J., Munro, B.J., & Steele, J.R. (2011). Gender and age affect balance performance in primary school-aged children. *Journal of Science and Medicine in Sport, 14*(3), 243–248. https://doi.org/10.1016/j.jsams.2010.11.002

Nocera, V.G., Wood, A.P., Wozencroft, A.J., & Coe, D.P. (2021). The test-retest reliability of the Bruininks-Oseretsky Test of Motor Proficiency-short form in youth with down

syndrome—A pilot study. *International Journal of Environmental Research and Public Health, 18*(10), 5367. https://doi.org/10.3390/ijerph18105367

Okely, A., & Booth, M. (2004). Mastery of fundamental movement skills among children in New South Wales: Prevalence and sociodemographic distribution. *Journal of Science and Medicine in Sport, 7*(3), 358–372. https://doi.org/10.1016/s1440-2440(04)80031-8

Okely, A.D., Booth, M.L., & Chey, T. (2004). Relationships between body composition and fundamental movement skills among children and adolescents. *Research Quarterly for Exercise and Sport, 75*(3), 238–247. https://doi.org/10.1080/02701367.2004.10609157

Ommundsen, Y., Gundersen, K.A., & Mjaavatn, P.E. (2010). Fourth graders' social standing with peers: A prospective study on the role of first grade physical activity, weight status, and motor proficiency. *Scandinavian Journal of Educational Research, 54*(4), 377–394.

Patikas, D. (2015). Gait and balance. In J.L. Matson & M.L. Matson (Eds.), *Comorbid conditions in individuals with intellectual disabilities* (pp. 317–349). Springer.

Peral-Suárez, Á., Cuadrado-Soto, E., Perea, J.M., Navia, B., López-Sobaler, A.M., & Ortega, R.M. (2020). Physical activity practice and sports preferences in a group of Spanish schoolchildren depending on sex and parental care: A gender perspective. *BMC Pediatrics, 20,* 337. https://doi.org/10.1186/s12887-020-02229-z

Piek, J.P., Dawson, L., Smith, L.M., & Gasson, N. (2008). The role of early fine and gross motor development on later motor and cognitive ability. *Human Movement Science, 27*(5), 668–681. https://doi.org/10.1016/j.humov.2007.11.002

Pitchford, E.A., & Webster, E.K. (2021). Clinical validity of the test of gross motor development-3 in children with disabilities from the U.S. National normative sample. *Adapted Physical Activity Quarterly, 38*(1), 62–78. https://doi.org/10.1123/apaq.2020-0023

R Core Team. (2022). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. https://www.R-project.org/

Rey, E., Carballo-Fazanes, A., Varela-Casal, C., Abelairas-Gómez, C., & ALFA-MOV Project Collaborators. (2020). Reliability of the Test of Gross Motor Development: A systematic review. *PLoS One, 15*(7), Article e0236070. https://doi.org/10.1371/journal.pone.0236070

Rintala, P., & Loovis, E.M. (2013). Measuring motor skills in Finnish children with intellectual disabilities. *Perceptual and Motor Skills, 116*(1), 294–303. https://doi.org/10.2466/25.10.pms.116.1.294-303

Robertson, J., & Emerson, E. (2010). Participation in sports by people with intellectual disabilities in England: A brief report. *Journal of Applied Research in Intellectual Disabilities, 23*(6), 616–622. https://doi.org/10.1111/j.1468-3148.2009.00540.x

Robinson, L.E., & Goodway, J.D. (2009). Instructional climates in preschool children who are at-risk. Part I. *Research Quarterly for Exercise and Sport, 80*(3), 533–542. https://doi.org/10.1080/02701367.2009.10599591

Rodríguez-Negro, J., Falese, L., & Yanci, J. (2019). Effects of different balance interventions for primary school students. *Journal of Educational Research, 112*(6), 656–662. https://doi.org/10.1080/00220671.2019.1669522

Rudd, J.R., Barnett, L.M., Butson, M.L., Farrow, D., Berry, J., & Polman, R.C. (2015). Fundamental movement skills are more than run, throw and catch: The role of stability skills. *PLoS One, 10*(10), Article e0140224.

Schalock, R.L., Borthwick-Duffy, S.A., Bradley, V.J., Buntinx, W.H.E., Coulter, D.L., Craig, E.M., Gomez, S.C., Lachapelle, Y., Luckasson, R., Reeve, A., Shogren, K.A., Snell, M.E., Spreat, S., Tasse, M.J., Thompson, J.R., Verdugo-Alonso, M.A., Wehmeyer, M.L., & Yeager, M.H. (2010). *Intellectual disability: Definition, classification, and systems of supports* (11th ed.). American Association on Intellectual and Developmental Disabilities.

Schalock, R.L., Luckasson, R., & Tassé, M.J. (2021). *Intellectual disability: Definition, diagnosis, classification, and systems of supports* (12th ed.). American Association on Intellectual and Developmental Disabilities.

Schott, N., Holfelder, B., & Mousouli, O. (2014). Motor skill assessment in children with Down syndrome: Relationship between performance-based and teacher-report measures. *Research in Developmental Disabilities, 35*(12), 3299–3312. https://doi.org/10.1016/j.ridd.2014.08.001

Sherrard, J. (2001). Injury in young people with intellectual disability: Descriptive epidemiology. *Injury Prevention, 7*(1), 56–61. https://doi.org/10.1136/ip.7.1.56

Skinner, R.A., & Piek, J.P. (2001). Psychosocial implications of poor motor coordination in children and adolescents. *Human Movement Science, 20*(1–2), 73–94. https://doi.org/10.1016/s0167-9457(01)00029-x

Sretenović, I., Nedović, G., & Đorđević, S. (2019). Assessment of balance in younger school age children with intellectual disability. *Facta Universitatis, Series: Physical Education and Sport, 16,* 687–696.

Staples, K.L., Pitchford, E.A., & Ulrich, D.A. (2021). The instructional sensitivity of the test of gross motor development-3 to detect changes in performance for young children with and without down syndrome. *Adapted Physical Activity Quarterly, 38*(1), 95–108. https://doi.org/10.1123/apaq.2020-0047

Staples, K.L., Reid, G. (2009). Fundamental movement skills and autism spectrum disorders. *Journal of Autism and Developmental Disorders, 40,* 209–217. https://doi.org/10.1007/s10803-009-0854-9

Tassé, M.J., Schalock, R.L., Balboni, G., Bersani, H., Borthwick-Duffy, S.A., Spreat, S., Thissen, D., Widaman, K.F., & Zhang, D. (2012). The construct of adaptive behavior: Its conceptualization, measurement, and use in the field of intellectual disability. *American Journal on Intellectual and Developmental Disabilities, 117*(4), 291–303. https://doi.org/10.1352/1944-7558-117.4.291

Temple, V.A., & Foley, J.T. (2017). A peek at the developmental validity of the test of gross motor development–3. *Journal of Motor Learning and Development, 5*(1), 5–14. https://doi.org/10.1123/jmld.2016-0005

Ulrich, D.A. (2013). The Test of Gross Motor Development-3 (TGMD-3): Administration, scoring, and international norms. *Spor Bilimleri Dergisi, 24*(2), 27–33.

Ulrich, D.A. (2019). *Test of gross motor development* (3rd ed.). Pro-Ed.

Valentini, N.C., & Rudisill, M.E. (2004). An inclusive mastery climate intervention and the motor skill development of children with and without disabilities. *Adapted Physical Activity Quarterly, 21*(4), 330–347. https://doi.org/10.1123/apaq.21.4.330

van Beurden, E., Zask, A., Barnett, L., & Dietrich, U. (2002). Fundamental movement skills—How do primary school children perform? The "move it groove it" program in rural Australia. *Journal of Science and Medicine in Sport, 5*(3), 244–252. https://doi.org/10.1016/s1440-2440(02)80010-x

Wall, A.E.T. (2004). The developmental skill-learning gap hypothesis: Implications for children with movement difficulties. *Adapted Physical Activity Quarterly, 21*(3), 197–218. https://doi.org/10.1123/apaq.21.3.197

Wang, W.-Y., & Ju, Y.-H. (2002). Promoting balance and jumping skills in children with down syndrome. *Perceptual and Motor Skills, 94*(2), 443–448. https://doi.org/10.2466/pms.2002.94.2.443

Westendorp, M., Houwen, S., Hartman, E., & Visscher, C. (2011). Are gross motor skills and sports participation related in children with intellectual disabilities? *Research in Developmental Disabilities, 32*(3), 1147–1153. https://doi.org/10.1016/j.ridd.2011.01.009

Zikl, P., et al. (2013). Gross motor skills of children with mild intellectual disabilities. *International Journal of Business, Human and Social Sciences, 7*(10), Article 7.