*Article*

# Difference in balance capacity for Special Olympics athletes and non-athletes with intellectual disabilities

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**Abstract:** Fall incidents are a significant health problem for people with intellectual disabilities (ID) and physical activity improves balance capacity and can prevent the risk of falling. The Special Olympics Healthy Athletes® offers health screenings and education to athletes with ID. The aim of this cross-sectional study was to explore whether Special Olympics athletes have better balance capacity than non-athletes with ID. During the Special Olympics Sweden Invitational Games 2020, athletes and non-athletes participated in the Healthy Athletes programme. The results of athletes (n=47) and non-athletes (n=25) for balance tests (i.e. single leg stance, functional reach and timed sit-to stand test) and health markers (i.e. blood pressure and body mass index) were analysed. Athletes showed higher balance capacity, more physical activity at moderate intensity and a lower body mass index and diastolic blood pressure compared to non-athletes. However, the balance capacity of both athletes and non-athletes with ID were low, lower than for people without ID. From this study, Special Olympics athletes showed higher physical activity on moderate intensity and higher balance capacity which can decrease the risk of fall incidents compared to non-athletes. –

**Keywords:** balance tests; intellectual impairment; para sports; physical activity

## Introduction

Falls are a global public health problem and one of the leading reasons for accident injury death in older adults, 65 years or older (Deprey et al., 2017). Injuries from falls include fractures, which can lead to reduced mobility and reduced health-related quality of life (Hsieh et al., 2001). People who experience a fall are most likely to suffer from other lifestyle diseases and therefore also premature death, this is well known in older adults (Liu et al., 2015). For people with intellectual disabilities (ID), fall incidents are a significant health problem for all ages above 18 years old and adults with ID are more likely to experience falls than older adults without ID (Cox et al., 2010). This can be explained by the fact that people with ID can experience signs of ageing as early as their thirties (Connolly, 2006; Strydom et al., 2013). Injuries from falls do not only impact the individual person, they also lead to high healthcare costs (Burns et al., 2016; Florence et al., 2018; Haddad et al., 2019).

Studies have shown that improving balance and functional strength prevents the risk of falling (Enkelaar et al., 2012). Compared with the general population, people with ID have reduced postural balance and muscle strength along with balance problems, and thus have a higher fall risk (Chiba et al., 2009). Due to the early ageing signs and lifestyle habits of individuals with ID, higher blood pressure and hypertension can be observed more often in people with ID, which also leads to a higher risk of falling (Gangavati et al., 2011). Less is known about how the balance capacity differs between people with ID that are physically active and those who are not physically active. Studies have shown that people who are active in a sports club have better health than those who practice leisure training (Guidetti et al., 2010). Research also shows that a lower amount of physical activity is related to a higher risk of falls (Cahill et al., 2014) and people with ID are generally less active than their peers (Hinckson & Curtis, 2013) and never or rarely reach the recommended daily amount of physical activity; 150-300 minutes per week at moderate intensity or 75-150 minutes per week at vigorous intensity (Bull et al., 2020). There is no consensus concerning the balance capacity of athletes with ID compared to non-athletes. Previous studies on postural balance present contradictory results. There is some evidence that people with ID who are active in a sports club have better balance capacity than non-athletes (Jouira et al., 2021). Another study presented no difference between the groups concerning postural balance (Blomqvist et al., 2017). Compared to people without disabilities, people with ID generally have a higher body mass index (BMI) and suffer from obesity which can lead to a sedentary lifestyle. It has been shown for older adults (non-ID population) that regular physical activity including aerobic, anaerobic and proprioceptive components can promote balance and reduce the risk of falling (Thomas et al., 2019). This argues for the hypothesis that athletes with ID have better balance than non-athletes with ID.

Balance capacity is a complex skill and is defined as the ability to achieve, maintain, or restore a state of balance during any posture (Pollock et al., 2000). There are different aspects of balance capacity including static and dynamic balance, weight distribution and body alignment. Physical inactivity rapidly decreases the performance of many bodily functions and thus reduces the balance capacity (Inouye et al., 2007), whereas physical activity enhances balance capacity. According to the International Classification of Functioning, Disability and Health (ICF), balance is considered as one component of body functions and structures (measured by the single leg stance test) or activities (measured by the functional reach test and timed sit-to stand) (Van Duijnhoven et al., 2016).

The Special Olympics (SO) is the world's largest sports organization for people with ID. It was founded in 1968 (Special Olympics, 2020b) and every second year the SO World Games is organized, alternating between summer and winter games. In 1997, the SO launched the Healthy Athletes® programme, which provides free health screenings to athletes with ID (Lloyd et al., 2018). Healthy Athletes® aims to help athletes improve their health and fitness and thus each individual's ability to train and compete in the SO, and also for life in general. There are eight disciplines in the Healthy Athletes program: Opening Eyes (vision), FUNfitness (physical therapy), Healthy Hearing (audiology), Health Promotion (healthy lifestyles), Strong Minds (psychology), Special Smiles (dentistry), Medfest (history and physical exam), and FitFeet (podiatry) (Lloyd et al., 2018).

During the SO Sweden Invitational Games 2020, the Healthy Athletes® screening was provided. Both athletes with ID from all participating countries and non-athletes with ID from Sweden were invited to participate in Healthy Athletes®. The aim of this study was to examine whether people with ID who participate in sports (SO athletes) have better balance capacity compared to non-athletes with ID.

## Materials and Methods

### Study overview

This cross-sectional study examined the results from the Healthy Athletes® screening at the SO Sweden Invitational Games 2020. To explore balance capacity and related factors this study used data from the two disciplines Health Promotion and FUNfitness for athletes with ID who participated in the competitions and for non-athletes (local inhabitants with ID). All participants signed an informed consent form supplied by the SO. The researchers in this study were given approval to access the Health Promotion and FUNfitness data from SO International to analyse the results of the balance and health tests according to the aims above. This study was approved by the Swedish Ethical Review Authority, DNR 2020-021118.

**Participants**

The inclusion criteria were age between 18-50 years old and having participated in the tests in Health Promotion and FUNfitness. The data did not include any other type of disability or the level of ID. For the athletes, there was no information on which sport they participated in. They competed in one or several events in the winter games including floorball, snowshoeing, cross-country skiing, figure skating, alpine skiing, short-track speed skating or snowboarding. Of 127 athletes and 65 non-athletes, 80 and 40 respectively did not meet the inclusion criteria and were excluded from the study.

***Procedures***

Trained clinical professionals performed the Healthy Athletes® screening in the FUNfitness and Health Promotion disciplines. The tests were carried out in accordance with the FUNfitness manual and the Health Promotion manual (Special Olympics, 2020b). The test leaders were provided written information and videos of the tests one month in advance, as well as completed an online course about the SO. When the test leaders arrived at the event, they attended one day of training prior to the test period to ensure reliability. One clinical director was responsible for supervising the test leaders during the event. All test results were documented in an electronic form and stored in a database. Data from the disciplines FUNfitness (data regarding single leg stance (SLST) with open and closed eyes, functional reach (FRT) and timed sit-to-stand (TST) and questions concerning the level of physical activity) and Health Promotion (including height, weight and blood pressure).

To investigate the status of the participants' balance capacity, suitable tests from the Health Promotion and FUNfitness discipline were selected. From the discipline Health Promotion, data on height, weight and blood pressure were included in this study. Height was measured in centimetres without shoes using a stadiometer with a 15 cm or wider headboard. The height was noted to the nearest cm. Weight was measured, also without shoes, with an electronic scale with an accuracy of 0.1 kg. Blood pressure was measured on the right arm, using an oscillometric semiautomatic device. The athletes had to avoid smoking, eating and physical activity 30 minutes prior to the blood pressure reading being taken. They were instructed to sit down and keep their legs uncrossed and their arms were supported at heart level. Their back and feet were supported, and no conversation took place with the athlete while the blood pressure was measured (Special Olympics, 2019). If the right side presented a pressure that was outside the normative values (>120 mmHg or <80 mmHg), a test in the left arm was also required. If the test showed a value within the normal range in the left arm, the participant was asked to rest and redo the test in the right arm. A systolic pressure of >120 mmHg, and a diastolic pressure of <80 mmHg required a medical referral, i.e., a recommendation to contact a healthcare specialist (Special Olympics, 2020a; Special Olympics, 2020b).

The FUNFitness station included tests examining balance, flexibility, functional strength, aerobic condition, and a questionnaire about physical activity habits (Special Olympics, 2020a). From the FUNfitness discipline, data for the SLST, FRT and TST were included in the study to assess the balance capacity. In addition, data from the questions concerning physical activity habits were also included.

The SLST required the participant to stand on one leg, first with their eyes open (EO) and then with their eyes closed (EC), for as long as possible (Frzovic et al., 2000). The tests continued until the participant lost their balance and put their foot on the floor. They were instructed to keep their supporting foot still and not to let the non-supporting foot touch anything else, e.g., the other leg or the wall. The mean value, time in seconds, of right- and left-foot stances were noted. A stand time of less than 20 seconds (EO) and 10 seconds (EC) indicated a need for education, meaning that they received an exercise program with customized exercises (Birmingham, 2000). The SLST is a reliable test in investigating balance capacity for people with ID and previous studies have shown a correlation between low muscle mass and poor postural balance evaluated with the SLST (Blomqvist et al., 2012).

For the FRT (Duncan et al., 1990), a measuring pole was placed at shoulder height along a wall horizontal to the floor. The participant was asked to stand next to the start of the measuring pole, feet hip-width apart and then lift up one arm with a 90° shoulder flexion to determine the starting point; the fingertip position was noted. The test leader instructed the participant to reach forward beyond the length of the starting point as far as possible while maintaining balance. The reach length in cm was noted. A reach length of less than 30 cm indicated a need for education (Special Olympics, 2020a). The FRT is a validated and reliable test and has excellent inter-rater ($r = 0.97$) and intra-rater reliability (intraclass correlation coefficient = 0.92) (Thomas & Lane 2005). The FRT has also been shown to predict fall risk (Duncan et al., 1992; Hale et al., 2007).

The TST required the participants to start in a sitting position on a chair without handles, with their arms crossed over their chest. The test leader instructed the participant to complete ten full stands as quickly as possible keeping their arms crossed. The time in seconds was noted (Boer, 2018; Lord et al., 2002; Terblanche & Boer, 2013). If the participant took longer than 20 seconds to complete ten full stands, or if they were unable to perform ten stands, education was recommended. The test is complex and tests balance, strength, sensation, speed and psychological status (Lord et al., 2002). Although the FUNFitness manual identifies TST as a strength test, it has also been shown to test balance (Lord et al., 2002). TST is a reliable test (Newcomer et al., 1993) and can provide information to predict future falls (Cuesta-Vargas & Gine-Garriga, 2014).

Questions about the participants' physical activity habits were asked. The questionnaire used has been a part of the FUNfitness test battery for over 20 years. Participants were assisted by staff, family or coaches to interpret the questions if needed. There were two questions about physical activity: 1) how many days per week are you physically active at low intensity, and 2) how many days per week are you physically active at moderate intensity. Low intensity physical activity (LPA) was defined as daily exercise, such as walking, without sweating and moderate intensity physical activity (MPA) was defined as having a faster heartbeat and possibly beginning to sweat.

**Statistical analysis**

To assess whether the data were normally distributed, the Shapiro-Wilk test for normality was used (Elliott & Woodward, 2007; Peat & Barton, 2008). The majority of the data was non-normally distributed, which is why the Mann-Whitney U-test was chosen to be used consistently for all tests for continuous variables. Therefore, the median and interquartile range are presented. For categorical variables, the Chi-square test of independence was used. The level of significance was set at $\alpha = 0.05$ and a probability value (p-value) of $p < \alpha$ was interpreted as significant. Effect sizes were computed using Cohen's d and were classified as small ($0.2 \le d < 0.5$), medium ($0.5 \le d < 0.8$) and large ($d \ge 0.8$) (Cohen, 1988, 1992). The Pearson correlation coefficient, r, was used to calculate correlations between balance tests and MPA. The strength of the coefficient was defined as: 0.00–0.25 = little if any correlation; 0.26–0.49 = low correlation; 0.50–0.69 = moderate correlation; 0.70–0.89 = high correlation; and 0.90–1.00 = very high correlation

(Domholdt, 2000). All statistical analyses were performed using IBM SPSS-Statistics for Windows version 25 (IBM Corporation, Armonk, NY, USA).

## Results

### Participant characteristics

There were 72 study participants in total, 47 athletes and 25 non-athletes (demographics are shown in Tables 1). The majority of the athletes were from Sweden (67.3%) the rest from other countries, and the non-athletes were adults living in central Sweden with ID (receiving support and service under the Swedish Act on Support and Service for Persons with Certain Functional Impairments). The median age of the participants in the study was 29 y (IQR=12) and 40% were females. The height was similar both in total and between the females and males. The mean BMI was 26.1 (IQR=7.3), with a lower value for athletes compared to non-athletes ($p < .001$). The higher BMI was most prominent among the men. The systolic blood pressure was similar for both athletes and non-athletes, although slightly elevated for both groups, i.e. >120mmHg. The diastolic blood pressure (DPB) was higher for the non-athletes compared to athletes ($p = .02$) and the median for non-athletes was 81 mmHg. In addition, the DPB was most prominent for the men.

**Table 1**. Descriptive data, age, height, weight, BMI, SBP and DBP, for the two groups (athletes vs nonathletes) and divided by sex in median and interquartile range (IQR).

| All (n=47 vs 25) | Athletes Median | IQR | Non-athletes Median | IQR | U-value | p-value | Effect size (95% CI) | Total Median | IQR |
|---|---|---|---|---|---|---|---|---|---|
| Age (years) | 28 | 13 | 31 | 11 | 465.5 | .13 | 0.4 (0.1-0.8) | 29 | 12 |
| Height (cm) | 172.5 | 11.3 | 169 | 18.4 | 508.5 | .24 | 0.3 (0.2-0.8) | 171 | 15.7 |
| Weight (kg) | 74.1 | 19.2 | 87.9 | 31.4 | 427 | .03 | 0.6 (0.1-1.1) | 76.5 | 24.6 |
| BMI (kg/m2) | 24.6 | 5.1 | 31.7 | 9.7 | 284 | < .001 | 0.9 (0.4-1.5) | 26.1 | 7.3 |
| SBP (mmHg) | 125 | 19 | 125.5 | 16 | 578.5 | .71 | 0.09 (0.4-0.6) | 125 | 18 |
| DBP (mmHg) | 76.5 | 14 | 81 | 15 | 374 | .02 | 0.6 (0.1-1.1) | 78 | 13 |
| Females (n=13 vs 15) | | | | | | | | | |
| Age (years) | 28 | 14 | 30 | 10 | 80.5 | .31 | 0.4 (0.3-1.2) | 20 | 10 |
| Height (cm) | 167.3 | 4.7 | 164.5 | 15 | 90 | .80 | 0.02 (-0.7-0.8) | 166.7 | 11.1 |
| Weight (kg) | 72.4 | 12.5 | 76 | 29 | 76 | .41 | 0.5 (0.3-1.3) | 72.4 | 23.8 |
| BMI (kg/m2) | 23.4 | 4.7 | 28.6 | 11.8 | 53 | .08 | 0.7 (0.1-1.5) | 26.1 | 10.7 |
| SBP (mmHg) | 115 | 22 | 127 | 21 | 74 | .21 | 0.4 (0.3-1.2) | 124 | 20 |
| DBP (mmHg) | 78 | 6 | 79 | 17 | 93 | .86 | 0.3 (-0.5-1.1) | 78.5 | 8 |
| Males (n=34 vs 10) | | | | | | | | | |
| Age (years) | 28 | 14 | 36.5 | 11 | 116.5 | .1 | 0.6 (0.1-1.4) | 29.5 | 15 |
| Height (cm) | 174.8 | 10.9 | 174.4 | 20 | 166 | 1 | 0.008 (-0.7-0.7) | 174.8 | 11.8 |
| Weight (kg) | 76.5 | 20.1 | 95.4 | 25.5 | 69 | .004 | 1.1 (0.3-1.8) | 78.3 | 23 |
| BMI (kg/m2) | 24.7 | 4.9 | 32.4 | 6.9 | 44 | <.001 | 1.4 (0.6-2.2) | 26.1 | 6.2 |
| SBP (mmHg) | 127.5 | 19 | 122.4 | 15 | 159.5 | 1 | 0.002 (-0.7-0.7) | 126 | 17 |
| DBP (mmHg) | 74 | 18 | 85 | 11 | 79 | .01 | 0.8 (0.1-1.6) | 78 | 16 |

Note: BMI = Body mass index. SBP = Systolic blood pressure. DBP=Diastolic blood pressure.

**Comparison of balance performance and physical activity level between athletes and non-athletes**

Better results were observed in all balance tests for the athletes compared to the non-athletes, i.e. higher balance capacity for athletes in the SLST, FRT and TST (Table 2). Athletes performed the SLST with open eyes for 5.8 seconds longer than non-athletes (p=0.04) and with closed eyes for 2.6 seconds longer (p = .02) with a medium effect size of 0.7 and 0.6, respectively. A large effect size was observed in the performance of the FRT (0.89) and the TST (1.18). Similar results were observed for both men and women a better performance in both tests for the athletes.

**Table 2**. Median and IQR of the test performance of participants and stratified by sex.

| All (n=47 vs 25) | Athletes Median | IQR | Non-athletes Median | IQR | U-value | p-value | Effect size (95% CI) | Total Median | IQR |
|---|---|---|---|---|---|---|---|---|---|
| LPA (days/week) | 5 | 4 | 5 | 4 | 541 | .3 | 0.2 (0.3-0.7) | 5 | 4 |
| MPA (days/week) | 3 | 2 | 1 | 2 | 156 | < .001 | 1. (0.9-2) | 2 | 3 |
| Single leg stance EO (s) | 30 | 6.5 | 26.5 | 19.5 | 429.5 | .04 | 0.7 (1.2-1.9) | 30 | 9.5 |
| Single leg stance EC (s) | 9.7 | 7.5 | 5.5 | 9.5 | 346 | .02 | 0.6 (1.1-0.1) | 9 | 7.3 |
| Functional reach (cm) | 55 | 13.6 | 43.5 | 14.5 | 251 | < .001 | 1 (-0.5-1.5) | 51.5 | 17.5 |
| Timed sit-to-stand (s) | 18 | 4 | 25 | 13 | 225.5 | < .001 | 0.8 (0.8-1.8) | 19 | 6 |
| Females (n=13 vs 15) | | | | | | | | | |
| LPA (days/week) | 4 | 4 | 5 | 2 | 89 | .5 | 0.3 (0.5-1) | 5 | 3 |
| MPA (days/week) | 4 | 4 | 1 | 2 | 21 | <.001 | 1.8 (0.9-2.7) | 2.5 | 3 |
| Single leg stance EO (s) | 30 | 5.5 | 29.5 | 6.5 | 77.5 | .3 | 0.7 (0.2-1.4) | 30 | 6 |
| Single leg stance EC (s) | 8.8 | 9.1 | 9 | 9 | 64.5 | .5 | 0.3 (0.5-1.1) | 9 | 7.8 |
| Functional reach (cm) | 52 | 16.6 | 43.3 | 11 | 38.5 | .01 | 1 (0.2-1.8) | 46 | 14 |
| Timed sit-to-stand (s) | 17 | 5 | 29.5 | 14 | 30.5 | .002 | 1.4 (0.5-2.2) | 19 | 13 |
| Males (n= 34 vs 10) | | | | | | | | | |
| LPA (days/week) | 5 | 4 | 6.5 | 3 | 169 | .9 | 0.03 (-0.7-0.7) | 6 | 4 |
| MPA (days/week) | 3 | 2 | 1 | 1 | 24 | <.001 | 1.3 (0.8-2.4) | 2 | 2 |
| Single leg stance EO (s) | 30 | 7.3 | 11 | 24.5 | 79 | .05 | 1.1 (0.3-1.8) | 30 | 7.4 |
| Single leg stance EC (s) | 10 | 4 | 4 | 9 | 101.5 | .01 | 1 (0.3-1.7) | 9 | 14.5 |
| Functional reach (cm) | 57.5 | 10.5 | 46.5 | 19.5 | 93 | .03 | 0.7 (0.02-1.5) | 55 | 15.8 |
| Timed sit-to-stand (s) | 19 | 4 | 24 | 7 | 60 | .003 | 1.4 (0.5-2.1) | 20 | 4 |

Note: LPA = Physical activity at low intensity. MPA = Physical activity at moderate intensity.

In terms of the level of physical activity, athletes were more physically active at moderate intensity (MPA) than non-athletes among both men (p=<.001) and women (p=<.001). No statistically significant difference was observed between athletes and non-athletes concerning physical activity at low intensity (LPA).

Less MPA correlated with lower performance on the TST (i.e. longer time for ten stands for people who reported less exercise on moderate intensity), r = -.38, p < .001 (Table 3). Physical activity at moderate intensity did not correlate with any of the other balance tests. Less LPA also correlated with lower performance on the TST, p=0.006.

**Table 3**. Correlations between the balance tests and MPA, LPA.

| | MPA | | LPA | |
|---|---|---|---|---|
| | Pearson's r | p-value | Pearson's r | p-value |
| Single leg stance EO | .21 | .08 | .001 | .99 |
| Single leg stance EC | .07 | .6 | .06 | .6 |
| Functional reach | .21 | .08 | .21 | .07 |
| Timed sit-to-stand | -.38 | <.001 | -.32 | .006 |

Note: LPA = Physical activity at low intensity. MPA = Physical activity at moderate intensity

## Discussion

The main finding of the present study was that people with ID who participate in sports have better balance capacity compared to non-athletes with ID. This was observed in all balance tests (SLS, FRT and TST), mainly for the male athletes. Furthermore, both BMI and DPB was higher in the non-athlete group for both men and women and these measures are related to increased risk of balance problems. Previous studies have analysed the reasons why people with ID fall more frequently than their peers. As mentioned in the introduction, the reasons seem to be complex and multifactorial. Low motor control, visual defects, medical problems and medication have been observed as a few of the potential reasons (Hale et al., 2007). In the current study, medical problems, such as blood pressure, can be observed and might be a reason behind a lower balance capacity and thus higher risk of falls.

The BMI reported in the study, for athletes and non-athletes, are considered overweight (>25) and obese (>30) respectively, and a BMI of between 20-24.9 is considered normal weight (Nuttall, 2015). Individuals with higher BMI are often less physically active which can influence their balance capacity (Gouveia et al., 2020) and may partially explain why we see this difference in balance capacity between athletes and non-athletes.

When observing the measurements of blood pressure, a significantly higher DPB was observed for non-athletes with a DPB of >80 indicating hypertension stage 1 (Flynn et al., 2017; Whelton et al., 2018) and potentially increasing the risk of falling. Hypertension (i.e. DPB >80) also decreases the chances to improve their balance (Gangavati et al., 2011). For the present study, the participants did not lie down prior to the measurement but sat on a chair without crossing their legs and with their arms resting. Studies have shown that the body position affects blood pressure, with higher values in supine compared to sitting (Wei et al., 2008). Nevertheless, the measurements of blood pressure in the current study were performed in the same way for both athletes and non-athletes therefore the difference would be similar. Both the BMI and blood pressure results reveal information concerning health and well-known predictors of cardiovascular diseases (Bhaumik et al., 2008) that can lead to higher fall risk.

Previous studies have shown that normative values for the SLST in able-bodied adults aged 30-39 years are more than 30.0 s (EO) and 27.8 (5.0) s (EC). The values decrease with age and for older adults aged 70-79 years, the values are mean = 14.2 SD = 9.3 s (EO) and 4.3 (3.0) s (EC), and for people aged 60-69 years, the values are 22.5 (8.6) s (EO) and 10.2 (8.6) s (EC) (Bohannon et al., 1984). By comparing these values with the present cohort, it is evident that athletes have slightly better values, while the non-athletes have similar values to people aged 60-69 years. Given that people with ID can experience signs of ageing as early as in their thirties (Connolly, 2006; Strydom et al., 2013), the results showing that they perform the SLST worse than a person of 70-79 years of age is alarming. The median life expectancy for people with mild ID is 74 years. Considering the observation of low balance capacity even in individuals in their thirties, it prompts the question: how might the balance capacity evolve as physically inactive individuals with ID progress into their forties or fifties? Also, as shown by others (Chiba et al., 2009; Haddad et al., 2019; Liu et al., 2015). decreased balance capacity can lead to increased risk of falls and fractures and thereby also high healthcare costs. For older people (> 60 years of age) a stand time of < 10s on the SLST is considered an independent predictor of falls (Kozinc et al., 2020). To the best of the authors' knowledge, for people with ID there is no cut-off value for the SLST which identifies the risk of falls and therefore no clear conclusion concerning the relation between SLST and fall risk can be made.

For the FRT, in older adults without disabilities, a previous study indicates that there is an 8-fold greater risk of falling if one is unable to reach >15.2 cm. (Duncan et al., 1992). In the present study, the result of the FRT was clearly above these 15 cm for both groups, more promising for athletes and no alarming results for non-athletes were observed. The FRT is a static balance test and the results of the current study are similar to results for people with ID reported by others (Hale et al., 2007). The TST, on the other hand, is a dynamic balance test and the results indicate that the dynamic test appears to be more challenging for non-athletes than the static balance tests, which is consistent with previous studies (Cuesta-Vargas & Gine-Garriga, 2014). The reason for this is unknown but studies have shown that people with ID often require more time to practise balance capacity than their peers without ID, due to their motor challenges (Blomqvist et al., 2014). Consequently, this might explain why the current study identified a correlation between physical activity level and the TST, but no correlation between PA-level and the SLST or FRT. Another explanation could be that TST has muscle strength and power components, more than FRT and SLST, which could also be the reason, aside from being dynamic, why a higher level of PA has a stronger correlation with TST.

In terms of doing more physical activity, athletes were more active than non-athletes, and there was a negative correlation between physical activity level and the TST. This indicates that not doing PA can increase the risk of balance problems for people with ID, or that the poorer results on the TST indicate that individuals are less physically active. The current study observed that non-athletes took longer time to perform ten full stands compared to athletes. In older adults, the TST has also shown that lower limb proprioception, reaction time and postural sway are independent predictors of test performance. Furthermore, the TST can provide information to predict future falls (Cuesta-Vargas & Gine-Garriga, 2014) and previous research indicates that lower amounts of physical activity and decreased physical capacity are related to a higher risk of falls (Cahill et al., 2014). A previous study has shown that physical activity has a positive effect on physical performance, and it can improve postural balance for people with ID aged between 18 and 45 years (Guidetti et al., 2010). Regarding fall risk, a previous study used gait activities as the experimental task and identified intelligence-related difficulties in the learning and performance of motor skills. In comparison to people without ID, walking speed was greater, stride length was shorter and cadence was greater in the group with ID (Sparrow et al., 1998). The observed challenges in motor skills indicates a higher risk of falls and suggests that people with ID possibly need more balance training to avoid falls.

However, the questionnaire included in the study did not ask about the participants' active time per day and therefore the total active time is unknown. In addition, the questions concerning physical activity were self-reported in this study and more studies are thus needed to confirm the indication that low physical activity can contribute to balance problems. Although, a previous study has shown that self-reported questionnaires with assistance are a reliable tool and render similar results to objective measures for people with ID (Johnson et al., 2014).

When observing the balance capacity, previous studies have shown that people with ID lose their balance capacity more with ageing compared to people without ID (Lahtinen et al., 2007), hence it is of great importance that the situation is addressed at an early stage. The fact that individuals with ID require more time to practice balance due to difficulties in processing information from the somatosensory system might also explain why it is harder to reach the same balance capacity to their peers and why they experience a faster decline in balance capacity with ageing (Blomqvist et al., 2014). Positive effects from exercise interventions have been identified (Boer, 2018; Carmeli et al., 2002; Carmeli et al., 2005), however, individuals with poor balance may find it difficult to perform various physical activities, which can, for example, raise the threshold to participation in sports clubs. Therefore, training programs adapted to the target group are highly important.

### Limitations

The sample consisted of non-athletes from Sweden as well as athletes mainly from Sweden. The data did not include any detailed information about the level of ID or type of disability, which affect balance capacity (El Shennawy, 2015; Paillard, 2017). The types of sports in which athletes participated were not described in the data either, this is also a limitation because the type of physical exercise or sport also affects the balance capacity (Guidetti et al., 2010). Therefore, this study mainly reflects the situation for people with ID in Sweden, in Swedish living conditions, with the sports situation for people with ID in Sweden, and may therefore not be generalizable to other countries.

This study does not show evidence of cause and effect. In other words, the study cannot distinguish whether 1) individuals with better balance capacity are more likely to start doing sports and enjoy it and therefore continue to participate, or 2) individuals that participate in sports improve their balance. The study sample is relatively small, especially after dividing the data into the sexes. Future studies with a larger sample size are therefore needed.

## Conclusion

Individuals with ID who participate in sports are more physically active at moderate intensity and have better balance capacity compared to non-athletes with ID. Adapted training programs focusing on balance are highly important for people with ID and a significant factor to consider when further developing sports for people with ID.

## Perspectives

This paper contributes to knowledge on the physical health status of people with intellectual disabilities (ID) who participate in sports, compared with those who do not participate in sports. The study results indicate that individuals with intellectual disabilities (ID) who engage in sports demonstrate better balance capacity compared to those who do not participate in sports. It also shows that athletes are more physically active, which was associated with better dynamic balance.

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