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The dual task effect on gait in adults with intellectual disabilities: is it predictive for falls?

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ABSTRACT

Purpose: Falling is an important health issue in adults with intellectual disabilities. Their cognitive and motor limitations may result in difficulties with dual tasking (walking and talking), which increases fall risk. Therefore, we assessed the dual task effect on gait in adults with intellectual disabilities, if this dual task effect is predictive for falls, and if this is more predictive than regular walking.

Method: Gait characteristics of 31 adults with intellectual disabilities without Down syndrome were assessed with the GAITRite at comfortable speed and during dual tasking (conversation). Falls were collected over a three-month follow-up period.

Results: During dual tasking, participants walked slower, with a lower cadence, increased stride time, and shorter stride lengths. They spend less time in swing and single support phase than at comfortable speed. Also swing and single support time became more variable. The dual task effect and walking at comfortable speed were not predictive for falls, although medium effect sizes were found.

Conclusions: Dual tasking affects gait in adults with intellectual disabilities. This is an important finding for safe community participation, and must be considered while interacting with adults with intellectual disabilities during daily activities. Possible negative consequences of distractors should be kept in mind. More research is needed to better understand the predictive value of gait for falls.

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Gait; dual task; falls; intellectual disabilities; adults

➤ IMPLICATIONS FOR REHABILITATION

- Having a conversation while walking affects the gait pattern of adults with intellectual disabilities, possible negative consequences of distractors should be kept in mind.
- The dual task effect on the width of the gait pattern and stride time variability had the largest effect sizes with future falls, this potential relationship should be kept in mind in clinical practice.
- The dual task effect on gait is important to consider with regard to safe community participation.
- Future studies are needed to better understand the predictive value of gait for falls, and for cutoff points to be used in clinical practice.

Introduction

Dual task walking is a common activity in daily life, and therefore highly relevant for safe community participation. While walking, we often perform another task such as talking to someone or paying attention to traffic. Gait is therefore a complex task, requiring both motor and cognitive activity to adapt to the constantly changing environment [1,2]. Performing two concurrent tasks often results in a decline in performance in one or both of the tasks, which reflects limited processing resources in the brain [3,4]. Limited dual task ability results in an increased risk for adverse outcomes such as falls, and is therefore of clinical importance [5–8]. This so called dual task effect is seen in healthy adults, but becomes more pronounced in people with neurological deficits because the increased attentional demand to control motor performance results in less available attentional resources for performance of a secondary task [4,9,10].

In line with this, the dual task effect has been found to be larger in people with impairments in motor and cognitive functioning [4,9]. The dual task effect is also more pronounced at older age [4]. People with intellectual disabilities have lifelong limitations in cognitive and motor functioning. Gait deviations are already evident in this population during walking without a secondary task [11]. The existing cognitive and motor limitations may also result in difficulties performing a secondary task while walking. A few small studies have looked at the dual task effect on gait in people with specific syndromes causing intellectual disabilities, and higher dual task effect was found in adolescents and young adults with Down syndrome and with Williams syndrome compared to matched controls without intellectual disabilities [12,13]. However, research regarding the dual task effect on gait in people with intellectual disabilities is scarce, and little is known about the dual task effect in people with intellectual disabilities without specific syndromes.

The gait deviations and a higher dual task effect in people with intellectual disabilities may be a cause for the high fall incidence seen in this population [14–16]. In the general population gait impairments are predictive for falls [17–19], however little is known about this in people with intellectual disabilities and

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contradicting results have been found. For example, some retrospective studies have found strength and gait impairments to be associated with increased fall risk in people with intellectual disabilities [20–22], but two prospective studies did not find balance, strength and gait speed to be predictive for falls [14,15]. One possible explanation for the finding that these physical components may not be as predictive for falls in people with intellectual disabilities as in the general population is that the cognitive limitations may influence the relationship between physical components and falls due to limited processing resources. Therefore, the dual task effect may add to fall prediction compared to regular walking, because this takes into account the increased attentional demand. It is seen that most falls occur during walking in people with intellectual disabilities [23], which may be because dual task walking is very common in daily life and the limited attentional resources for a secondary task may lead to an increased fall risk.

Because of the high fall incidence and related injuries in people with intellectual disabilities [16,24], the lack of consensus regarding risk factors, and the lack of fall prevention guidelines for people with intellectual disabilities, it is important to better understand which factors increase fall risk in this population. Therefore, we aim to assess if the dual task effect is predictive for falls in adults with intellectual disabilities, and if this is more predictive than regular walking. In order to do so we first assess the dual task effect on gait in adults with intellectual disabilities, without Down syndrome.

Methods

Study design and participants

This cross-sectional study was conducted in a consort of the Chair of Intellectual Disability Medicine of the Erasmus MC, University Medical Center Rotterdam and three care organizations for people with intellectual disabilities in the Netherlands. Thirty-one clients from these care organizations participated in this study. To be eligible for participation clients had to be 20 years and over, have a mild (IQ = 50–69) or moderate (IQ = 35–49) intellectual disability, and be able to walk without a walking aid. Exclusion criteria were a diagnosis of Down syndrome, Parkinson's disease, cerebrovascular accident, dementia, Cerebral palsy, and severe visual impairment (<0.3). Based on these criteria participants were selected by behavioral therapists and medical doctors of the participating care organizations. Data was collected between December 2014 and July 2015.

Medial approval was obtained by the Medical Ethical Committee of the Erasmus MC, University Medical Center Rotterdam (MEC-2014-201), and the study was conducted according to the guidelines of the declaration of Helsinki [25]. Participants or their legal representatives provided written informed consent.

Measurements

Characteristics of the study sample

To describe the study sample we collected the following information: age, sex, genetic syndrome, and the presence of spasticity of the legs, osteoarthritis, epilepsy, visual impairments and polypharmacy (using five or more medications) from the medical files; level of intellectual disability as classified by the behavioral therapists as mild (IQ = 50–69) or moderate (IQ = 35–49) [26]; height (without shoes), weight (without shoes and wearing light clothes), and leg length (with shoes, from greater trochanter to the floor bisecting the lateral malleolus) was measured and BMI calculated.

To describe the physical fitness of the study sample we performed the Short Physical Performance Battery. The Short Physical Performance Battery is widely used in the general population, and is a strong predictor for disability, institutionalization, and mortality in the general population [27–29]. The Short Physical Performance Battery consists of a measure of gait speed, three balance stances (side by side, semi-tandem stand, tandem stand), and the five times chair stand. A summary score was calculated for the three balance stances ranging from 0 to 4 points, with four points being the best performance. A total score was calculated including all tests ranging from 0 to 12 points, with 12 being the best performance. Additionally, we assessed the one leg stand for which participants were asked to hold the stand for 10 s. The best score of both legs was the test result.

Gait measurements

Spatial and temporal gait parameters were measured with the GAITRite Electronic Walkway (CIR Systems, Inc., USA; 5.79 m with 4.88 m active area, 120 Hz scan rate). Reliability and validity of the GAITRite has previously been established [30–33]. In people with Down syndrome and elderly with a mild cognitive impairment, test-retest reliability has also been established [34,35]. Spatial and temporal parameters were measured over multiple steps at comfortable speed and during dual tasking. The variability over these steps was measured as standard deviations.

Falls

We registered the number of falls over a three-month period with monthly registration calendars. Each day participants had to put a sticker on the calendar; a green sticker if they did not fell that day, and a red sticker if they did fell that day. If the participant fell multiple times during that day, the number of falls was written down on the calendar. Participants that were not able to do this themselves were assisted by their professional caregivers. For all the participants, the caregivers checked the calendars for completeness at the end of the week. When complete, the week was checked with a smiley sticker. We collected the fall calendars monthly.

Procedure

Measurements were performed in a large room or a gym at the care organizations, and were carried out by a human movement scientist and physiotherapists with experience with people with intellectual disabilities. All gait measurements were carried out by the same test instructor. According to the guidelines, the GAITRite was placed in the test location with two meter in front of and at the end of it to avoid acceleration and deceleration on the GAITRite [31]. Gait was measured in two conditions: (1) walking at comfortable speed, and (2) walking at comfortable speed while dual tasking. Participants were instructed to walk at the speed they normally walk. The dual task was a conversation with the test instructor. Four walks were performed in each condition, of which the first walk was considered a practice walk. After the gait measurements, height, weight, and leg length was measured.

Statistical analyses

Characteristics of the study sample and gait parameters in both conditions were described. The practice walk was excluded from the analyses, and the mean of both legs across the three remaining walks were taken for all gait parameters.

Normality of the gait parameters and number of experienced falls was checked and considered sufficient for the spatial, temporal and phasic parameters, but not for the variability parameters and falls. Therefore, parametric tests were used for the spatial, temporal and phasic parameters, and nonparametric tests for the variability parameters and falls.

Differences between the gait parameters in the comfortable speed and dual task conditions were analyzed with paired *t* tests and Wilcoxon signed-rank tests. Cohen's *d* effect sizes were calculated, with 0.2, 0.5, and 0.8 as benchmarks for small, medium, and large effects, respectively [36].

To assess the predictive value of a dual task condition for falls we used the dual task effect in which the dual task condition is compared against the comfortable speed condition instead of the measured gait parameters in the dual task condition, because we are interested to see if the changes in gait due to the dual task are predictive for falls. The dual task effect was calculated as the difference between the gait parameters in the comfortable speed condition – dual task condition. To assess if there was an association between dual task effect and level of intellectual disability and age, Pearson's and Spearman's correlation coefficients were calculated. To assess the association between gait during regular walking and falls and the dual task effect and falls, Spearman's correlation coefficients were calculated between the gait parameters and the number of experienced falls. For these analyzes all gait measurements were adjusted for leg length by dividing them by the mean leg length of both legs. *R* values of 0.1, 0.3, and 0.5 were categorized as benchmarks for small, medium, and large effects, respectively [36].

Analyses were performed with the Statistical Package for Social Science (SPSS) version 21 (IBM Corporation, NY, USA) and R (R Foundation, Core Team, Vienna, Austria). We used a Bonferroni correction to correct for multiple testing, and thereby considered *p* values smaller than 0.002 (0.05/27 gait parameters) as statistically significant.

Results

Descriptives of the study population

The study sample consisted of 31 adults with a mean age of 42.77 ± 16.70, of whom 22.6% was female, and 48.4% had a mild intellectual disability (Table 1). From the 20 participants of whom a complete fall calendar was available, seven participants experienced a fall during the three-month follow-up period, with a maximum of seven falls. Other characteristics of the study sample are described in Table 1.

Dual task effect on gait

Gait characteristics at comfortable gait speed and while dual tasking are described in Table 2. During dual tasking, a significant ($p < 0.002$) increase was seen in step time, stride (cycle) time, stance time, swing time, single and double support time, stance and double support time as percentage of the gait cycle, and the standard deviations of swing time and single support time, relative to the comfortable speed condition. A significant decrease was seen in step and stride length, velocity and stride velocity, cadence, and swing time and single support time as a percentage of the gait cycle. All effect sizes were medium, except those for the differences in stance, swing, single support and double support time as a percentage of the gait cycle. Medium effect sizes were also found for increases in the standard deviations of step and stride length, stride time, stance time, and double support time, and a large effect size for the increase in the standard deviation of step time, however these were not significant (or did not remain significant after correcting for multiple testing).

Table 1. Characteristics of the study sample.

	Total study sample ($N = 31$)
Personal characteristics	
Age	
Years, *m* ± *sd*, range	42.77 ± 16.70, 20–68
Sex	
Female, *n* (%)	7 (22.6%)
Male, *n* (%)	24 (77.4%)
Level of ID	
Mild, *n* (%)	15 (48.4%)
Moderate, *n* (%)	16 (51.6%)
BMI	
kg/m^2, *m* ± *sd*	27.24 ± 4.51
Normal, *n* (%)	9 (29.0%)
Overweight, *n* (%)	15 (48.4%)
Obese, *n* (%)	7 (22.6%)
Medical information	
Genetic syndrome	
No genetic syndrome, *n* (%)	9 (29.0%)
PKU, *n* (%)	1 (3.2%)
Mosaic mutation, *n* (%)	1 (3.2%)
Smith–Magenis syndrome, *n* (%)	1 (3.2%)
Williams syndrome, *n* (%)	1 (3.2%)
Perlman syndrome, *n* (%)	1 (3.2%)
No information available on genetic syndrome, *n* (%)	17 (54.8%)
Spasticity legs	
Yes, *n* (%)	1 (3.2%)
Osteoarthritis	
Yes, *n* (%)	4 (12.9%)
Epilepsy	
Yes, *n* (%)	5 (16.1%)
Visual impairments	
Yes, *n* (%)	4 (12.9%)
Polypharmacy	
Yes, *n* (%)	13 (41.9%)
Physical fitness	
Balance one leg	
s	7.1 ± 3.83
Balance SPPB	
Points out of 4	3.38 ± 0.98
SPPB total	
Points out of 12	10.92 ± 1.38
Falls	
Fallers (20 complete calendars)	
Yes, *n* (%)	7 (35.0%)
No, *n* (%)	13 (65.0%)
# of falls, *m* ± *sd, range*	1.86 ± 2.27, 1–7

n: number of participants; *m:* mean; *sd:* standard deviation; ID: intellectual disability; SPPB: short physical performance battery.

No significant associations were found between age and level of intellectual disability and the dual task effect gait parameters, after correction for multiple testing. We did see medium effect sizes for the association between level of intellectual disability and the dual task effect on base of support, and on the standard deviations of step and stride length, stride velocity, swing time, and single and double support time. Large effect sizes were found for the association between age and the dual task effect on step and stride length, and medium effect sizes for velocity, stride velocity, cadence, step time, stride (cycle) time, stance and swing time and single support time.

Associations between gait and falls

Comfortable speed condition

No significant associations were found between the gait parameters at comfortable speed and the number of falls experienced (Table 3). Although the associations were not significant we did see medium effect sizes for the associations between the number of falls and step time, stride (cycle) time, stance time, swing time,

Table 2. Results of the gait parameters while walking at comfortable and while dual tasking, and effect sizes of the comparisons between conditions.

	Comfortable speed condition ($n = 31$)		Dual task condition ($n = 31$)		Dual task effect			
	$m \pm sd$	95% CI	$m \pm sd$	95% CI	$m \pm sd$	95% CI	Test statistic	d
Spatial parameters								
Step length (cm)	65.28 ± 10.14	[61.56, 69.0]	59.13 ± 10.74	[55.19, 63.07]	6.16 ± 4.50	[4.50, 7.81]	7.61[a]	0.59** (medium)
Stride length (cm)	130.88 ± 20.25	[123.45, 138.31]	118.49 ± 21.46	[110.62, 126.36]	12.39 ± 9.25	[8.99, 15.78]	7.45[a]	0.59** (medium)
Base of support (cm)	11.88 ± 3.51	[10.59, 13.17]	12.58 ± 4.04	[11.09, 14.06]	−0.70 ± 1.75	[−1.34, −0.05]	−2.21[a]	−0.18* (small)
Toe in/toe out (degrees)	7.06 ± 7.17	[4.43, 9.69]	7.31 ± 7.64	[4.51, 10.12]	−0.26 ± 2.07	[−1.02, 0.50]	−0.69[a]	−0.03 (small)
Temporal parameters								
Velocity (cm/s)	118.36 ± 23.43	[109.76, 126.95]	100.21 ± 23.14	[91.72, 108.70]	18.15 ± 13.22	[13.30, 23.0]	7.65[a]	0.78** (medium)
Stride velocity (cm/s)	118.98 ± 23.47	[110.37, 127.59]	100.90 ± 22.93	[92.49, 109.32]	18.07 ± 13.42	[13.15, 23.0]	7.50[a]	0.78** (medium)
Cadence (steps/min)	108.36 ± 10.19	[104.62, 112.10]	101.02 ± 10.71	[97.09, 104.95]	7.34 ± 6.63	[4.91, 9.77]	6.17[a]	0.70** (medium)
Step time (s)	0.56 ± 0.05	[0.54, 0.58]	0.60 ± 0.07	[0.58, 0.62]	−0.04 ± 0.04	[−0.06, −0.03]	−5.75[a]	−0.66** (medium)
Stride (cycle) time (s)	1.12 ± 0.11	[1.08, 1.15]	1.20 ± 0.13	[1.15, 1.25]	−0.08 ± 0.08	[−0.11, −0.05]	−5.73[a]	−0.66** (medium)
Stance time (s)	0.66 ± 0.08	[0.63, 0.69]	0.71 ± 0.09	[0.68, 0.75]	−0.06 ± 0.05	[−0.07, −0.04]	−6.30[a]	−0.59** (medium)
Swing time (s)	0.46 ± 0.04	[0.44, 0.47]	0.49 ± 0.05	[0.47, 0.50]	−0.03 ± 0.03	[−0.04, −0.02]	−4.61[a]	−0.66** (medium)
Single support time (s)	0.46 ± 0.04	[0.44, 0.47]	0.49 ± 0.05	[0.47, 0.50]	−0.03 ± 0.03	[−0.04, −0.02]	−4.61[a]	−0.66** (medium)
Double support time (s)	0.20 ± 0.06	[0.18, 0.22]	0.23 ± 0.06	[0.21, 0.26]	−0.03 ± 0.03	[−0.04, −0.02]	−5.92[a]	−0.50** (medium)
Phasic parameters								
Stance, %GC	58.97 ± 1.99	[58.24, 59.70]	59.47 ± 2.02	[58.73, 60.21]	−0.50 ± 0.72	[−0.76, −0.23]	−3.86[a]	−0.25** (small)
Swing, %GC	41.03 ± 1.99	[40.30, 41.76]	40.53 ± 2.01	[39.80, 41.27]	0.49 ± 0.73	[0.22, 0.76]	3.76[a]	0.25** (small)
Single support, %GC	41.03 ± 1.99	[40.30, 41.76]	40.53 ± 2.01	[39.80, 41.27]	0.50 ± 0.73	[0.23, 0.76]	3.80[a]	0.25** (small)
Double support, %GC	18.08 ± 4.08	[16.58, 19.57]	19.31 ± 4.01	[17.84, 20.78]	−1.23 ± 1.81	[−1.89, −0.57]	3.79[a]	−0.30** (small)
Variability parameters								
Step length SD	2.99 ± 0.89	[2.66, 3.32]	4.14 ± 2.26	[3.31, 4.97]	−1.15 ± 2.37	[−1.88, −0.03]	−2.14[b]	−0.67* (medium)
Stride length SD	5.29 ± 1.90	[4.59, 5.99]	7.04 ± 4.08	[5.54, 8.54]	−1.75 ± 4.39	[−3.20, 0.14]	−1.69[b]	−0.55 (medium)
Base of support SD	2.51 ± 1.07	[2.12, 2.91]	2.67 ± 1.00	[2.31, 3.04]	−0.16 ± 0.99	[−0.53, 0.12]	−1.16[b]	−0.15 (small)
Stride velocity SD	7.07 ± 2.84	[6.03, 8.11]	8.57 ± 4.56	[6.89, 10.24]	−1.50 ± 5.35	[−3.55, 0.78]	−1.25[b]	−0.39 (small)
Step time SD	0.02 ± 0.01	[0.02, 0.03]	0.04 ± 0.03	[0.03, 0.05]	−0.01 ± 0.03	[−0.02, −0.003]	−3.07[b]	−0.89* (large)
Stride time SD	0.04 ± 0.02	[0.03, 0.04]	0.06 ± 0.05	[0.04, 0.08]	−0.02 ± 0.05	[−0.03, −0.003]	−2.52[b]	−0.53* (medium)
Stance time SD	0.03 ± 0.01	[0.026, 0.034]	0.05 ± 0.04	[0.03, 0.06]	−0.02 ± 0.04	[−0.02, −0.003]	−2.81[b]	−0.69* (medium)
Swing time SD	0.02 ± 0.01	[0.02, 0.03]	0.03 ± 0.02	[0.02, 0.04]	−0.01 ± 0.01	[−0.01, −0.003]	−3.27[b]	−0.63** (medium)
Single support time SD	0.02 ± 0.01	[0.02, 0.03]	0.03 ± 0.02	[0.02, 0.04]	−0.01 ± 0.01	[−0.01, −0.003]	−3.27[b]	−0.63** (medium)
Double support time SD	0.03 ± 0.02	[0.02, 0.03]	0.04 ± 0.02	[0.03, 0.04]	−0.01 ± 0.02	[−0.02, −0.002]	−2.47[b]	−0.50* (medium)

m: mean; *sd*: standard deviation; CI: confidence interval; dual task effect: gait parameters comfortable speed condition – dual task condition; % GC: percentage of the gait cycle, *d:* Cohen's d as effect size (small (0.2), medium (0.5), large (0.8) effect), a positive effect size means that the mean value in the comfortable speed condition is higher than in the fast or dual task condition.
[a]t value from paired t test, [b]Z value from Wilcoxon signed-rank test.
$^{*}p < 0.05$.
$^{**}p < 0.002$.

single and double support time, stance as a percentage of the gait cycle, and the standard deviations of step and stride length, base of support, stride velocity, step and stride time, stance and swing time, and single support time.

Dual task condition

Although we also did not find significant associations between the dual task effect on the gait parameters and the number of falls experienced (Table 3), we did find medium effect sizes for the associations between the number of falls and base of support, toe in/toe out, and the standard deviation of stride time.

Discussion

This study describes the dual task effect of talking while walking in adults with intellectual disabilities. When performing a dual task while walking at comfortable speed we saw that participants walked slower with a lower cadence, and increased stride time, with shorter stride lengths, and spend less time in the swing and single support phase of the gait cycle. Also swing and single support time became more variable. Although we saw a clear dual task effect on gait in this population, this was not predictive for falls within the three-month follow-up period, although medium effect sizes were found.

Comparing our results to a meta-analysis regarding the dual task effect in the general population and people with neurological disorders, we see similar dual task effects on gait; decreased speed and cadence, decreased stride length, and increased stride time and stride variability [4]. Comparing the magnitude of the dual task effects of a verbal fluency dual task (word association, word generation, articulation, conversation) on gait speed and cadence in this meta-analysis to our dual task effects, we can see that the dual task effects found in our study were more comparable to those found in people with neurological disorders than to those in the general population [4]. However, in this meta-analysis no significant differences were found in dual task effects of a verbal fluency dual task between people with neurological disorders and healthy controls, but a difference was found between these groups with a mental tracking dual task for gait speed. Looking only at the studies that used a conversation as the dual task, we also see that our dual task effects are quite similar to those of people with neurological disorders (Parkinson's disease and post-stroke) [37,38].

Comparing our results to other studies with people with intellectual disabilities with a verbal fluency dual task, we can see that the dual task effects we found for adults with intellectual disabilities without Down syndrome was higher than that seen in a study with young adults with Down syndrome (22.75 ± 3.05 years; dual task was talking on the phone) [12], but lower than the dual task effects in young adults with Down syndrome (24.82 ± 3.0 years) and Williams syndrome (26.22 ± 7.34; dual task was word generation) in the study of Hocking et al. [13], and

Table 3. Correlations between the number of falls experienced and gait during regular walking and the dual task effect.

	r comfortable speed condition – falls	*r* dual task effect – falls
Spatial parameters		
Step length (cm)	0.06, $p = 0.801$ (small)	−0.23, $p = 0.335$ (small)
Stride length (cm)	0.08, $p = 0.726$ (small)	−0.26, $p = 0.265$ (small)
Base of support (cm)	0.29, $p = 0.210$ (small)	0.48, $p = 0.033^*$ (medium)
Toe in/Toe out (degrees)	0.22, $p = 0.351$ (small)	0.34, $p = 0.141$ (medium)
Temporal parameters		
Velocity (cm/s)	0.09, $p = 0.720$ (small)	−0.18, $p = 0.456$ (small)
Stride velocity (cm/s)	0.09, $p = 0.720$ (small)	−0.20, $p = 0.393$ (small)
Cadence (steps/min)	0.05, $p = 0.851$ (small)	−0.11, $p = 0.656$ (small)
Step time (s)	0.36, $p = 0.121$ (medium)	0.15, $p = 0.520$ (small)
Stride (cycle) time (s)	0.38, $p = 0.103$ (medium)	0.15, $p = 0.520$ (small)
Stance time (s)	0.36, $p = 0.121$ (medium)	0.14, $p = 0.550$ (small)
Swing time (s)	0.32, $p = 0.163$ (medium)	0.17, $p = 0.474$ (small)
Single support time (s)	0.32, $p = 0.163$ (medium)	0.17, $p = 0.474$ (small)
Double support time (s)	0.30, $p = 0.194$ (medium)	0.11, $p = 0.651$ (small)
Phasic parameters		
Stance, %GC	0.36, $p = 0.124$ (medium)	−0.01, $p = 0.952$ (small)
Swing, %GC	0.11, $p = 0.651$ (small)	0.06, $p = 0.818$ (small)
Single support, %GC	0.11, $p = 0.651$ (small)	0.08, $p = 0.743$ (small)
Double support, %GC	0.24, $p = 0.316$ (small)	0.18, $p = 0.441$ (small)
Variability parameters		
Step length SD	0.46, $p = 0.044^*$ (medium)	0.12, $p = 0.626$ (small)
Stride length SD	0.38, $p = 0.099$ (medium)	0.14, $p = 0.545$ (small)
Base of support SD	0.52, $p = 0.020^*$ (medium)	−0.05, $p = 0.836$ (small)
Stride velocity SD	0.35, $p = 0.134$ (medium)	0.19, $p = 0.426$ (small)
Step time SD	0.41, $p = 0.071$ (medium)	0.18, $p = 0.441$ (small)
Stride time SD	0.40, $p = 0.081$ (medium)	0.31, $p = 0.186$ (medium)
Stance time SD	0.41, $p = 0.071$ (medium)	0.26, $p = 0.274$ (small)
Swing time SD	0.38, $p = 0.101$ (medium)	0.27, $p = 0.244$ (small)
Single support time SD	0.38, $p = 0.101$ (medium)	0.27, $p = 0.244$ (small)
Double support time SD	0.26, $p = 0.260$ (small)	0.09, $p = 0.710$ (small)

Dual task effect: gait parameters comfortable speed condition – dual task condition; % GC: percentage of the gait cycle; SD: standard deviation; *r:* Spearman correlation coefficient (small (0.1), medium (0.3), and large (0.5)).
$^*p < 0.05$.
$^{**}p < 0.002$.

more in the range of the dual task effects of the healthy controls in that study. However, it is difficult to compare dual task effect results of our study to those found in other studies, because of the wide variety of dual task methodology used, with differences in the kind of dual task used, different instructions with regard to prioritization, and differences in the ability of the participants to perform the dual task [4,10].

In contrary to what we expected and what is seen in the general population, we did not find the dual task effect to be predictive for falls [5–8]. Falling is a multifactorial problem and often results from an interaction between multiple and diverse risk factors [39], therefore a lot of different risk factors may be important for falls in this population. We did see non-significant associations with medium effect sizes between falls and the gait parameters. During regular walking medium effect sizes with falls were mainly seen for the temporal timing parameters, such as stance/swing time and single/double support time, and for the variability parameters. For the dual task effect, medium effect sizes with falls were found for the variables related to the width of the gait pattern (base of support and toe in/toe out) and stride time variability. These associations between the variability parameters and falls are in line with what is seen in the general population. Gait variability, stride-to-stride fluctuations in walking, seems to be the most predictive for falls, more than average gait speed, stride length and stride time [40–42]. Variability in gait may be a reflection of inconsistency in the ability of the central neuromuscular control system to regulate gait and maintain a steady gait pattern [40]. In this way, a more variable gait pattern may be relatively uncontrolled and lead to an increased fall risk. The width of the gait pattern has also been found to be predictive for falls in older adults [43]. We also saw that dual task effect on base of support and toe in/toe out had a medium association with falls, although non-significant. Even though we did not find any significant associations between falls and dual task effect and gait parameters during regular walking, we did find the largest associations with the variables that are most predictive for falls in the general population.

We also did not find the dual task effect to be more predictive for falls than regular walking, since both were not significantly associated with falls. We did expect dual task effect to be a better predictor for falls because dual task effect would be more sensitive for the limited cognitive ability and limited processing resources which may put people with intellectual disabilities at a higher risk for falls.

Even though we did not find clear results regarding the predictive value of the dual task effect for falls, we think it is important for clinical practice to keep this possible association between the dual task effect and falls in mind. The clear dual task effect we saw on gait is important for safe community participation, because distracting stimuli are present all around us in daily life. Also we found the variables that are the strongest predictors for falls in the general population to have the largest effect sizes with falls in our study as well. This may suggest that this association is also present for adults with intellectual disabilities and possible negative consequences of distractors during walking should be kept in mind. However, our rather small and heterogeneous sample and relative few fallers ($n = 7$) may have limited our power to find significant results. The results presented here give a first insight into the dual task effect on gait in adults with intellectual disabilities and its association with falls, and provides a base for further research. Replicating this study with a larger sample size and a longer follow-up period is recommend to get a better understanding of the predictive value of gait parameters for falls in this population. For clinical use, it then would be of value to add discriminative analyses to distinguish cutoff points between fallers and non-fallers.

A strong aspect of this study is that we assessed the dual task effect on a large number of gait parameters in adults with intellectual disabilities by other causes than Down syndrome, a group not often studied. However, this study also had some limitations. Even though this study was one of the largest looking at this topic in people with intellectual disabilities, we still had a fairly small sample size and therefore the effect sizes, which represent the magnitude of the effect, provide more information than the significance levels. In addition, the generalizability of our results to the total population of adults with intellectual disabilities may be limited. We tried to facilitate the interpretation of our results by describing important participant characteristics that may influence gait, and thereby allow comparison with future studies. Finally, we used a conversation as a dual task, which is difficult to standardize. However, to ensure a good conversation with plenty of response from the participant we talked about topics that were of the participants interest. Prior to the measurements we collected these interests from the professional caregivers of the participants.

Summarizing, we showed that having a conversation while walking affects the gait pattern of adults with intellectual disabilities, resulting in walking at a slower speed with a lower cadence and increased stride time, with shorter stride lengths, and spending less time in the swing and single support phase of the gait cycle, which also became more variable. These changes while dual tasking were not predictive for falls, however medium effect sizes were found. More research with larger samples is needed to get a better understanding of the predictive value of gait for falls in this population. The finding that a conversation while walking affected gait in adults with intellectual disabilities is important for safe community participation, and should be considered while interacting with adults with intellectual disabilities in their daily activities and possible negative consequences of distractors should be kept in mind.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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