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Identification of Falls Risk in Adults with ID

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Background

Falls are a major public health problem among older adults[1] and are becoming an increasing concern for adults with intellectual disabilities (ID). Over the last two decades the life expectancy of individuals with mild ID has increased to 74 years (67.6 years for people with moderate ID) which is approaching that of the general population.[2]

Falls are a major cause of serious injuries and fractures in adults with ID.[3-5] Fractures are estimated to occur 1.7-3.5 times more frequently among people with ID.[5-7] Studies showed the prevalence rate of falls among adults with ID ranging from 12.1%-61%.[5, 8, 9] Our previous RRTC projects noted that 19-37% of adults with ID were reported to have fallen within the past year. Numerous studies in the general population have shown that falls are associated with several risk factors, including having a history of falls in the past year, reduced lower muscle strength, and abnormal gait or balance.[10-12] Some of these risk factors are modifiable such as lower muscle strength, abnormal gait or balance.

People with ID tend to have higher levels of physical inactivity and poor physical fitness [13, 14] and poorer dietary habits (e.g., reduced calcium intake, higher fat consumption)[15] compared to the general population. These risk behaviors may be associated with reduced muscle mass, bone mineral density (i.e., osteopenia or osteoporosis) and increased body fat.[16] However, research in risk factors for falls among adults with ID is limited. The few studies that examined risks for falls among adults with ID found that these risks included older age,[3] ambulatory status,[3] seizure disorder,[3, 8, 17] visual deficits, and abnormal gait.[18] These studies included adults with ID from nursing home settings,[3] and young adults with ID living in the community.[17] One study had a very small sample size.[18] The one published large scale study (N= 511) conducted in Scotland[9] found that incident falls were associated with urinary incontinence and that the presence of Down syndrome was a protector from falls. Other factors associated with falls risk from the general population included being male, older age, taking more than four prescription medications, and fear of falls. These risk factors were not found in studies involving adults with ID.

More large scale studies are needed to identify potential fall risks for adults with ID living in community settings. There is also a need to develop falls prevention programs in the ID community targeting those at the highest risk for falls.

Little attention has been directed at balance and strength assessment and training for adults with ID.[19, 20] While balance and strength assessment tools have been widely used in the general older adult population, they have not been validated for adults with ID. Presently, there is no sufficient empirical evidence to support the use of balance instruments in adults with ID in terms of addressing certain physical and/or cognitive adaptations that have good sensitivity and specifity for this population. Therefore, this research is aimed at developing a battery of strength and balance assessment tools that can be used with adults with ID in assessing and monitoring falls, followed by a randomized controlled trial to reduce falls in adults with ID who are high risk fallers.

Research Objectives

(1) To investigate the prevalence of falls and potential risk factors associated with them.
(2) To develop a set of strength and balance assessment tools appropriate for adults with ID.
(3) To test the efficacy of a falls prevention intervention. This paper describes objectives 1 and 2 only as the intervention for objective 3 is ongoing.

Research Questions for Objective #1

(1) What is the prevalence of falls among adults with ID living in community settings?
(2) Do adults with ID who experienced one or more falls in the past 12 months differ in characteristics, physical function, health conditions, and medication use compared to non-fallers?
(3) What are the potential risk factors associated with falls in adults with ID after adjusting for the characteristic variables (e.g., age and sex)?

Research Questions for Objective #2

(1) How reliable are strength and balance instruments in adults with ID?

(2) How do strength and balance measures of participants with ID compare to the general population?

Methods

Objective #1

Prevalence and risk factors for falls. The LHIDS baseline data (see Rimmer & Hsieh paper) were used to examine prevalence of falls and explore the potential risk for falls in 1000 adults with ID. After excluding missing data on falls, data from 952 participants were included for analyses. We asked informants, "*How many falls has he/she experienced in the past 12 months*?" A fall was defined as "an unexpected event in which the participant comes to rest on the ground, floor, or lower level,"[21] which was adopted from the consensus definition of the Prevention of Falls Network Europe. The responses included (1) "0", (2) "1", (3) "2", (4) "3", and (5) "4 or more." Participants who experienced one or more falls in the past 12 months were grouped as "fallers," and those who did not have a fall were defined as "non-fallers." We performed univariate analyses to compare characteristics, physical function, health conditions, and medication use between the fallers and non-fallers. Logistic regression was also used to identify potential risk factors. The dependent variable was occurrence of falls in the past year. The independent variables included participant characteristics (age, sex, Down syndrome, cerebral palsy, obesity, living arrangement), physical function (assistive device use, difficulty lifting/carrying, climbing stairs, walking), chronic health conditions (seizure disorder/epilepsy, urinary incontinence, dizziness, visual impairment), and use of medications (seizure, hypertension, psychotropic, sleep, taking 4 or more medications).

Objective #2
Participants

We recruited 41 participants for the falls prevention study from three community-based agencies that serve adults with ID. Agency staff were asked to identify their adult clients with ID who had one or more falls in the past year or were at high risk for falls based on poor balance. Participants had to meet the following inclusion criteria: (a) mild or moderate ID; (b) 30 to 60 years of age; (c) physician approval to participate in the strength/balance training or walking program. Exclusion criteria include: (a) currently participating in an organized physical activity program three or more days per week for 30 or more minutes per day; (b) do not receive approval from their physician; and (c) unable to walk long distances due to a mobility impairment or medical condition.

If individuals with ID agreed to participate, they and their legal guardians were consented. Initial assessments included: (a) informant survey (by family caregivers or direct support staff) including other risk factors for falls, health status, medication usage, demographics, and falls history; (b) comprehensive fitness assessment conducted by research staff in the participants' residence.

Measures

Occurrence of falls. Falls was assessed by asking informants the same question that was also used in the LHIDS survey which was described earlier.

Lower Extremity Strength. Lower extremity strength was measured by a handheld dynamometer (Chatillon K-MSC-500, Ametek, Inc., USA) and Timed-Stands test. A handheld dynamometer was used to measure knee flexion, knee extension, and ankle dorsiflexion according to the procedures described by Andrews et al.[22] The Timed-Stand test measures time to complete five full stands from a sitting position. It has been demonstrated to have a highly significant relationship with age and measures of knee flexor and extensor muscle strength.[23]

Balance. Balance was assessed by the Timed Get Up and Go (TGUG) and Four-test balance scale. The TGUG involves rising from a chair, walking 3 m (10 ft.), turning, and returning to the chair.[24] The Four-test balance scale includes four timed static balance tasks (feet together stand, semi-tandem stand, tandem stand, and one leg stand) of increasing difficulty that are completed without assistive devices.[25,26]

Body Mass Index. Body weight and height were measured to calculate Body Mass Index.

Demographics and health. Demographic information included age, gender, race, type of diagnosis, level of ID, and residential setting. We asked informants to complete an informant survey on participants' health information including number and type of health conditions, current medications, and informant-rated health status.

Reliability of Balance and Strength Assessments

We examined inter-rater or inter-observer reliability and test-retest reliability on all balance and strength measures. Inter-rater reliability was used to assess the degree to which different raters give consistent estimates of the same event. Two examiners conducted testing on each strength and balance measure on the same participant at different times of the same day in an alternating order. Test-retest reliability examined the consistency of each balance and strength test within a 2-4 week interval. Subjects performed all strength and balance measures for one examiner on two consecutive visits with an interval of 2-4 weeks. Pearson's correlation coefficients (r) were calculated to assess inter-rater reliability. Intra-class correlation coefficients (ICC) were calculated to assess test-retest reliability.

Findings and Progress to Date

Objective #1: To investigate the prevalence of falls and potential risk factors associated with them.

For the participant demographics information, please refer to the LHIDS paper (Rimmer & Hsieh, conference proceedings).

Prevalence of falls. The prevalence of falls among adults with ID was 25% (20.7% between 18-44 years; 31% 45-64 years; 42.6% 65 years and older). Within the fallers, 41.7% experienced

one fall; almost one-fourth (24%) of the fallers had 4 falls or more; 21% had 2 falls; and 13% had 3 falls. 58% of the fallers experienced recurrent falls in the past 12 months. Twenty percent of the fallers required medical care.

Comparisons between fallers and non-fallers. **Table 1** presents the results of univariate analyses between fallers and non-fallers. Over one-half (50.8%) of fallers were in the 18 to 44 year old age group and 39.5% were in 45 to64 year old group. Significant differences ($p<.05$) were found between groups on the following participant characteristics: sex, obesity, diagnosis of cerebral palsy, level of ID, Special Olympics participation, living arrangement, and employment status. The significant differences ($p<.05$) in physical function, health conditions and medications were in use of an assistive aid, difficulty lifting/carrying greater than 10 lbs, difficulty climbing a flight of stairs, walking 4 blocks, having seizure disorder, urinary incontinence, foot pain, visual impairment, use of seizure and blood pressure medications, and polypharmacy (taking 4 or more medications). The fallers tended to be women (54.8%), obese (mean BMI 30.05±8.22 vs. 28.70± 7.22), have cerebral palsy (19.3% vs. 11.2%), less Special Olympics participation (27.8% vs. 39.3%), severe ID (11.6 % vs. 4.4%), living with host family/foster care (10.8% vs. 6.7%) or living in group home (14.5%), and less likely to be employed (49.25 vs. 64.2%). The fallers were more likely than non-fallers to use an assistive aid (cane, crutches, walker or wheelchair), have physical function limitations (difficulty lifting/carrying greater than 10 lbs, climbing a flight of stairs, or walking 3 blocks), have seizures, urinary incontinence, foot pain, visual impairment, use of seizure and psychotropic medication, and take 4 or more medications (see **Table 2**).

Identification of potential risk factors. **Table 3** shows the multivariate analyses associated with risk factors for falls. The results indicated that use of an assistive aid, (OR=6.30, 95% CI=3.13-12.68), difficulty walking 3 blocks (OR=1.88, 95% CI=1.02-3.05), foot pain (OR=2.44, 95% CI=1.28-4.64), and polypharmacy (OR=1.89, 95% CI=1.10-3.26) were risks for falls. Being a wheelchair user (OR= .33, 95% CI=.16-.68) was a protector for falls. Age, sex, obesity status, condition related to ID, and living arrangement were not significant risk factors.

Objective #2: To develop a set of strength and balance assessment tools appropriate for adults with ID.

Participant Characteristics

Table 4 displays participant characteristics for the falls prevention cohort. All participants came from the Chicago area. Mean age for participants was 45.30 years (SD=7.15), ranging from 34-60 years (73% between 30-49 years, 27% 50 years and older). The number of male and female participants was almost equally distributed (male=45.9%; female=54.1%). The majority of participants were White. Over two-thirds (70.3%) were living in group homes or Community Independent Living Arrangements CILA; 24.3% were living with family; and 5.4% were living on their own. Almost three-quarters of the participants were either overweight or obese. 18.9% had hypertension, followed by 16.7% with seizure disorder, 5.4% osteoporosis, 5.4% diabetes, and 2.7% foot pain. More than 40% were on psychotropic; 27.3% took hypertension medication; and 17.4% were on anti-seizure medication. 29.7% took 4 medications or more. 19% of

participants were reported as having one or more falls in the past year. Over 50% of informants reported that they were concerned about the risk of the participant experiencing a fall.

Table 1. Characteristics of fallers and non-fallers in the past 12 months

	Fallers (N=242)	Non-fallers (N=710)	
	Mean ± S.D. or % (n)		X^2 or t
Average Age (years)	44.15 ± 16.17 (Range=18-86)	38.47 ± 14.14 (Range=18-83)	26.60***
Age Group (years)			20.44***
18-44	50.8(121)	66.0(463)	
45-64	39.5(94)	29.6(208)	
≥65	9.7(23)	4.4(31)	
Sex			9.65**
Male	45.2(109)	56.8(402)	
Female	54.8(132)	43.2(306)	
Race			8.85
White	94.1(223)	90.0(630)	
Black	1.3(3)	6.0(42)	
Hispanic	2.5(6)	2.0(14)	
Asian or Pacific Islander	0.8(2)	0.9(6)	
American Indian or Alaskan Native	1.3(3)	1.1(8)	
BMI	30.05 ± 8.22	28.70 ± 7.22	5.48**
Weight Status			2.51
Underweight (BMI<18.5)	3.5(8)	4.8(32)	
Normal Weight (BMI ≥18.5 & <25)	24.2(55)	28.4(191)	
Overweight (BMI ≥25 & <30)	30.0(68)	28.8(194)	
Obese (BMI ≥30)	42.3(96)	38.0(256)	
Conditions Related to ID			
Intellectual Disability only	52.8(115)	47.6(314)	1.76
Down Syndrome	19.7(43)	25.3(167)	2.80
Cerebral Palsy	19.3(42)	11.2(74)	9.27**
Autism/PDD	6.0(13)	11.2(74)	5.06*
Other	6.0(13)	7.3(48)	0.44
Special Olympics Participation	27.8(67)	39.3(277)	10.25***
Level of Intellectual Disability			16.53**
Borderline	10.7(24)	13.9(92)	
Mild	29.0(65)	32.1(213)	
Moderate	22.3(50)	20.9(139)	
Severe	11.6(26)	4.4(29)	
Profound	3.6(8)	3.5(23)	
Did not report level	22.8(51)	25.3(168)	
Living Arrangement			12.38*
Live on their own	15.8(38)	15.2(107)	
With family member/Relative	39.4(95)	47.5(335)	
Host family/Foster care home	10.8(26)	6.7(47)	
Supportive living	19.1(46)	19.7(139)	
Group home	14.5(35)	9.5(67)	
Large facility	0.4(1)	1.4(10)	
Employment status			9.65**
Yes	49.2(119)	64.2(456)	
No	50.8(123)	35.8(254)	

Note. * p<0.05, ** p<0.01, *** p<0.001.

Table 2. Physical function and health condition by fall status

	Fallers (N=242)	Non-fallers (N=710)	X^2
Assistive Device	% (n)		
Cane, crutches or walker	26.4(63)	4.7(33)	92.18***
Wheelchair	20.8(50)	10.1(71)	18.58***
Physical Function			
Difficulty lifting/carrying > 10 lbs	48.8(117)	23.2(164)	56.26***
Difficulty climbing a flight of stairs	48.1(116)	21.2(150)	64.93***
Difficulty walking three blocks	51.7(124)	21.5(152)	79.20***
Health Condition			
Seizure/epilepsy	30.6(74)	16.2(115)	23.46***
Urinary incontinence	24.8(60)	10.0(71)	33.28***
Foot Pain	13.2(32)	5.1(36)	18.09***
Dizziness/Vertigo	5.0(12)	2.7(19)	2.99
Visual impairment	14.0(34)	8.5(60)	6.36*
Medication			
Anti-Seizure/epilepsy	27.4(65)	14.3(100)	22.85***
Anti-Hypertension	13.1(31)	11.7(82)	2.41
Psychotropics	37.3(87)	29.0(203)	5.61*
Sleep	6.1(14)	3.8(27)	5.19
Taking 4 or more medications	36.8(89)	16.8(119)	42.35***

Note. * p<0.05, ** p<0.01, *** p<0.001.

Table 3. Risk factors for occurrences of falls (n =756)

Risk Variable	Occurrence of falls		
	B	OR	95% CI
Age (years)			
18-44 (Reference)	-	-	-
45-64	0.00	1.00	0.64-1.58
≥65	-0.22	0.80	0.33-1.97
Sex (female)	0.19	1.21	0.83-1.78
Condition related to ID			
Down syndrome	-0.32	0.73	0.44-1.20
Cerebral palsy	0.16	1.20	0.64-2.14
Obesity	0.17	1.18	0.79-1.78
Walking Assistive Device			
Cane, crutches or walker	1.84	6.30	3.13-12.68***
Wheelchair	-1.20	0.33	0.16- 0.68***
Physical Function			
Difficulty lifting/carrying > 10 lbs	0.49	1.63	0.94-2.85
Difficulty climbing a flight of stairs	0.15	1.17	0.63-2.15
Difficulty walking three blocks	0.63	1.88	1.02-3.50*
Chronic Health Condition			
Seizure/epilepsy	-0.47	0.63	0.06-6.08
Urinary incontinence	0.54	1.72	0.97-3.06
Foot pain	0.89	2.44	1.28-4.64**
Dizziness/Vertigo	-0.07	0.93	0.32-2.69
Visual impairment	0.25	1.29	0.71-2.33
Medication			
Anti-Seizure/epilepsy	0.83	2.30	0.23-22.74
Anti-Hypertension	-0.37	0.69	0.36-1.33
Psychotropics	-0.06	0.94	0.59-1.51
Sleep	-0.31	0.74	0.26-2.09
Polypharmacy	0.64	1.89	1.10-3.26*
Living Arrangement			
Live on their own (Reference)	-	-	-
With family member/Relative/Guardian	0.03	1.03	0.56-1.92
Host family/Foster care home	0.23	1.26	0.55-2.89
Supportive living	-0.09	0.91	0.46-1.84
Group home	-0.07	0.93	0.42-2.07

Note. * p<0.05, ** p<0.01, *** p<0.001.

Table 4. Participant Characteristics (N=37)

Demographics	Mean or % (n)
Age (in years) Mean = 45.30 , Range = 34 – 60, SD = 7.15	
Age group (in years)	
30- 49	73.0(27)
≥50	27.0(10)
Sex	
Male	45.9(17)
Female	54.1(20)
Race/Ethnicity	
White/Caucasian	97.8(36)
Hispanic	2.2(1)
Living Situation	
Own their own	5.4(2)
Home with family	24.3(9)
Group home/CILA	70.3(26)
Body weight status[a]	
Normal	26.8(11)
Overweight	29.3(12)
Obesity	43.9(18)
Health Condition	
Osteoporosis	5.4(2)
Hypertension	18.9(7)
Diabetes	5.4(2)
Seizure/epilepsy	16.7(6)
Foot pain	2.7(1)
Dizziness	0.0(0)
Urinary incontinence	0.0(0)
Medication	
Antihypertension	27.3(6)
Anti-seizure	17.4(4)
Psychotropics	40.5(15)
Polypharmacy	29.7(11)
Falls in the past 12 months (Yes)	18.9(7)
Frequency of falls	
1	8.1(3)
≥ 2	10.8(4)
Concerns about falls (Yes)	51.3(19)

[a]N=41

Table 5. Test Retest Reliability

Measure	N	ICC	95% CI
Lower extremity strength			
Knee extension	17	.86***	.67 - .95
Ankle dorsiflexion	16	.63**	.21 - .85
Sit to stand (5x)	19	.78**	.63 - .94
Balance			
Time get up & go	9	.90***	.63 - .98
Four test balance scale	21	.52*	.21 - .87

*p<.05. **p<.01. ***p<.001.

Reliability of instruments. Both strength and balance measures had strong inter-rater reliability with Pearson's correlations ranging from .937 to .998. As shown in **Table 5**, the results indicated fair to strong test retest reliability (ICC ranged from .52-.90). Ankle dorsiflexion and the four test balance scale only had fair test-retest reliability.

Strength and balance measures and general population norms. We compared participants' strength and balance measures with normative values for the general population. As shown in **Table 6**, participants with ID in the 30-39 year old age group had poorer lower extremity strength than norm-referenced data for an older age group (50-59 years), ion while almost two-thirds of our participants were in the age 30-49 years. Mean differences between the norm and participants' knee and ankle strength ranged from 27.61 to 61.86 pounds for males, and 22.02 through 77.27pounds for females. A notable difference was also found for the two dynamic balance measures. Participants required longer to complete the Timed up and Go (11.90 vs. 8.10 seconds). Only one participant (2.4%) could stand on one leg for 10 seconds, and 26.8% could perform the tandem stand for 10 seconds.

Table 6. Mean strength and balance measures compared with normative values for general population

	Male		Female	
Outcome measure	Study	General[c] Population	Study	General[c] Population
Lower extremity strength (lbs)				
Knee flexion[a]	53.7 (n=16)	110.9	44.3 (n=19)	76.1
Knee extension[a]	71.7 (n=16)	199.3	55.8 (n=19)	133.1
Ankle dorsiflexion[a]	67.3 (n=17)	129.2	64.2 (n=19)	86.2
	Study (n=41)		General Population[d]	
Sit to stand (5x)[b]	15.80		11.40	
Balance				
Timed up and go test[b]	11.90		8.10	
Four test balance scale	3.02		3.55[e]	

[a]Both legs in lbs of force. [b] in seconds. [c]age group=50-59 years. Source: Andrews, A. W., Thomas, W. M., & Bohannon, W. R. (1996). Normative values for isometric muscle force measurements obtained with hand-held dynamometers. *Physical Therapy*,76(3),pp.,248-259. [d]age group=60-69 years. Source: Bohannon W. R. (2006). Reference values for the five-repetition sit-to-stand test: A descriptive meta-analysis of data from elders. *Perceptual and Motor Skills*, 103, pp., 215-222.[e]age group=65-97.

Discussion and Implications

The findings from this preliminary work show that adults with ID have a higher rate of falls at younger ages compared to norm-referenced data. One in four adults with ID living in community settings experienced one or more falls in the last year, which is a similar rate as a significantly older population of non-ID adults (there are no norm-referenced data on rate of falls in younger populations). The temporal relation between occurrence of falls and underlying risk factors for adults with ID are still emerging. Our findings indicated that falls were associated with use of an assistive aid (with the exception of using a wheelchair), difficulty walking 3 blocks, having foot pain, and taking 4 or more medications. We suggest an emphasis on individual fall risk assessments, such as, the use of walking aids and adaptations is crucial, in the provision of care/support services to persons with ID at both individual and organizational levels.

Limitation in this study is that we used the retrospective data on falls which might have recall bias and have a higher rate of underreporting. However, given that 20% of falls required medical care, further investigation on the consequences of falls is an important area for future research. Interestingly, adults with ID who use wheelchairs do not fall as often as those who are ambulatory. This is probably related to a much lower risk of slipping. Risk factors for falls that we identified in our data are similar to previous studies are parallel with previous studies.[3, 17] Since polypharmacy is very common in adults with ID, this may have masked or overshadowed the underlying modifiable risk factors. More research is needed to identify these factors to guide the development of strategies to promote more active and healthy lifestyles that lower the risk of falls among younger populations of adults with ID.

In our assessment of lower extremity strength and balance, we found Timed Get Up and Go, knee extension, and five times sit to stand had excellent reliability. Further research is needed to determine to what extend these strength and balance measures predict the occurrence of a fall for adults with ID. Ankle dorsiflexion and four balance measures had fair reliability. We found many participants had a difficult time performing ankle dorsiflexion, which required them to perform an unfamiliar motion, in addition participants demonstrated limited range of motion at both tibiotalar and subtalar joints. They also had a difficult time performing the tandem stand, which involved spatial coordination and stability. Both of these tests may require more practice time before obtaining an accurate measure.

Overall, strength and balance measures in our cohort were much lower than what you would expect to find in an age- and sex-matched sample. While are findings are preliminary due to the small sample size, it does suggest that there are significant health disparities in both strength and balance, two major risk factors for falls, in young adults with ID. Larger and more diverse sample of adults with ID is needed to establish a clearer picture of the characteristics associated with falls risk in this population. When we compared our data on strength and balance with norms for the general older population, a wide gap in both measures were noted, with adults with ID having much poorer measures for both strength and balance. Data from the 2003 Special Olympics Healthy Athletes Screening data found that over 50% of younger athletes (over 75% for age 35 years and older) needed to improve their balance.[27]

Next Steps

The literature on falls risk and falls prevention in adults with ID is almost non-existent. There is an urgent need for more research examining the mediators and moderators associated with falls in adults with ID, followed by falls prevention interventions that show promise in reducing the risk of falls in this population.

Falls in the general older adult population cause catastrophic injury and death in addition to higher health care costs associated with hospitalization and long-term care. The extended lifespan of adults with ID will likely increase their risk and rate of falls in their later years. It is important, therefore, to target falls prevention and increased physical fitness among younger adults with ID to reduce their risk and rate of falls in older adulthood.

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