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Physical Activity and Sedentary Behavior in Older Adults With Intellectual Disabilities: A Comparative Study

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The purpose of this study was to examine the physical activity patterns of older adults with intellectual disabilities (ID) in comparison with younger adults with ID and older adults without ID. A sample of 109 participants was included in the study. Sophisticated data reduction, time stamped technology, and multiple objective measures (i.e., pedometers and accelerometers) were used to determine physical activity intensities and walking patterns of participants. Results indicate that older adults with ID are performing less physical activity than comparison groups. A small proportion of older adults with ID (6%) met national physical activity recommendations of 150 min of moderate or 75 min of vigorous physical activity in bouts greater than ten minutes across the week (USDHHS, 2008). Sedentary behavior was also an observable factor in this study. These findings demonstrate the need for health promotion efforts for adults with ID across the lifespan.

Keywords: health promotion, pedometer, accelerometer, Down syndrome, aging

Understanding the health behaviors of older adults with intellectual disabilities (ID) is an area where little is known. With increases in life expectancy over the past decade, adults with ID are going to be a visible part of the aging community. Although today's older population with ID still have a shorter life span to the general population (approximately 65 years), the current younger generation of adults with ID are expected to have comparable longevity to the general population (76.9 years; Bigby, 2007; Fisher & Kettl, 2005; Torr & Davis, 2007). With increases in life expectancy, adults aging with ID are developing chronic conditions such as cardiovascular disease, diabetes, heart disease, and cancer at similar rates to the general population (Bigby, 2007; Bittles et al., 2002; Fisher & Kettl, 2005).

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The World Health Organization's (2000) report on *Aging and Intellectual Disabilities: Improving Longevity and Promoting Healthy Aging* describes aging for those with ID as a lifelong process with no generally accepted age to define being old; however, for reporting aging in this population, those in their 50s are more likely to experience age-related changes (WHO, 2000). This is consistent with Bigby's (2007) article, which states that persons with ID in their 40s and 50s are often the oldest service users in the ID population. Furthermore, aging in adults with ID is a complex phenomenon. Similar to the general population, older adults are a diverse rather than a homogenous group. The combination of lifestyle, genetics, experiences, and health earlier in life shape how individuals age (Bigby, 2007). For instance, early onset of aging in this population can be linked to various biological and social conditions (i.e., associated conditions related to more profound disability, certain etiologies of ID, poor health status related to lifestyle factors, and living conditions; WHO, 2000). Health promotion efforts should emphasize preventable factors negatively influencing aging to increase longevity in this population.

Physical activity is a health behavior influencing the onset of chronic conditions and poor health status in persons aging with ID. There is a scarcity of studies that have explored physical activity patterns of older adults with ID and the factors affecting this behavior. For instance, an evaluation of objectively measured physical activity for those with ID did not find any studies focused on physical activity patterns of this older population (Temple, 2010). Stanish, Temple, and Frey's (2006) review of the literature commented that age is an unexplored factor in physical activity literature for those with ID and seems to be negatively associated with physical activity. Furthermore, passive lifestyles present health risks. Sedentary behaviors lead to physical deconditioning and secondary conditions like obesity, coronary artery disease, hypertension, and diabetes (WHO, 2000). For adults with ID, targeting physical activity and reducing sedentary behavior may result in gains in longevity, older-age quality of life, and increased functional capacity (WHO, 2000).

As the majority of our society ages, it is important to evaluate lifestyle factors (e.g., physical activity behaviors) affecting health outcomes. This is especially true for persons with disabilities, who tend to experience a "thinner margin of health" (Pitetti & Campbell, 1991), which requires frequent access to care to maintain good health. Accumulating knowledge to create appropriate health promotion programs is critical to prevent long term dependency on healthcare services. The medical and nonmedical lifetime costs associated with the diagnoses of ID (e.g., physician visits, inpatient hospital stays, etc.) are estimated over one million dollars per person (Honeycutt, Dunlap, Chen, & Homsi, 2004). These costs are substantially higher than those associated with the diagnosis of other disabilities (e.g., cerebral palsy, vision, and hearing impairments) and could potentially be reduced with lifestyle modifications.

Before creating health promotion programs for older adults with ID, we need to understand the physical activity patterns of this aging population. According to the Centers for Disease Control and Prevention's (CDC) *2008 Physical Activity Guidelines*, adults should be accumulating at least 150 min of moderate physical activity or 75 min of vigorous physical activity in bouts greater than 10 min across the week. Examining physical activity within the public health guidelines is a useful procedure for two reasons: (a) to directly assess if participants are meeting expert determined recommendations to improve health and (b) to compare standard recommendations across population groups. In the creation of the *2008 Physical*

Activity Guidelines, a committee of physical activity experts reviewed existing scientific research to develop guidelines for optimal health outcomes (USDHHS, 2008). Bouts of moderate to vigorous physical activity (MVPA) are a specified target of the guidelines. Although the use of MVPA bouts shorter than ten minutes may still be effective for improving health, this is not promoted in the public health guidelines due to limited evidence (USDHHS, 2008).

Furthermore, there is much to be learned about sedentary behaviors and its effect on health. Recent research has demonstrated that sitting too much is a risk factor for chronic disease, especially for increased risk of type II diabetes and cardiovascular disease (Owen, Healy, Matthews, & Dunstan, 2010). Despite meeting recommended guidelines of 150 min of moderate or 75 min of vigorous intensity activity per week, there are still independent side effects from prolonged sitting (Healy et al., 2007). In addition, time spent in low energy activities has been linked to increased risk of higher glucose levels, obesity, adverse metabolic profile, and type II diabetes (Healy et al., 2007; Matthews et al., 2008). The described consequences of sedentary behavior are documented secondary conditions for those with ID (Haveman et al., 2010). This demonstrates a potential link between the observable poor health of many with ID and sedentary activity.

Thus, the first primary aim of this cross-sectional study is to describe the physical activity patterns of older adults with ID in comparison with younger adults with ID and older adults without ID in accordance with the CDC *2008 Physical Activity Guidelines*. An additional primary aim of this study is to compare sedentary behavior across groups. Secondary aims include (a) comparing the amount of light physical activity across groups and (b) examining the differences in pedometer steps across the week.

Method

Study Design

This study is a cross-sectional design comparing the physical activity and sedentary behaviors of older adults with ID with two comparative groups.

Participants

A sample of 109 participants including younger adults with ID (n = 45), older adults with ID (n = 31), and older adults without ID (n = 33) participated in the study (see Table 1, for demographics).

Participants with ID were a purposive sample recruited from the Pacific Northwest and Northeast United States. The researchers used their knowledge about the population to recruit from organizations and groups that would best represent those with intellectual disabilities. The recruitment sites were group home agencies, supported living, foster care, vocational programs, community access programs, and Special Olympics events. The researchers spoke at events, posted flyers, and sent recruitment e-mails to local agencies and programs. Due to the nature of recruitment, we were unable to keep accurate records of the amount of participants that were approached to participate in the study. Overall, there were 12 participants with ID from the Northeast United States recruited from a vocational program. The remaining participants with ID were from the Pacific Northwest.

The sampling frame for older adults without ID was the *LIFE registry* out of the *Center for Healthy Aging Research* at Oregon State University. From the list of eligible participants, the researcher conducted systematic sampling which selects every k^{th} participant after a random start.

Older adults with ID were over the age of 50, which is the set point determined in literature to be the onset of aging within this population (Grant, 2001; Hatzidimitriadou & Milne, 2005). Older adults without ID were over the age of 65, which is considered "young old" for aging without a disability (Spirduso, Francis, & MacRae, 2005). Younger adults with ID were between 18–49 years of age. Participants were ineligible for the study if they had severe ID or used an assistive device for walking. Adults were identified as having mild to moderate ID by the agency in which they received services (e.g., supported living, foster care, and occupational services). This was done by describing the study requirements (i.e., wearing the devices for seven days and answering demographic questions) to a proxy. The proxy then made the decision whether the participant could complete the study. The proxy was available throughout the study process for those with ID to assist with the consent process, demographic information, and device adherence. The proxy was an individual who had regular contact with the participant with ID. This included parents, caregivers, and support staff. The inclusion criteria for proxies was working or assisting the participant for at least eight hours a week and knowing the participant for at least three months. Furthermore, all participants were verbal, ambulatory, and could recite what they had to do for the study as the IRB requested. The participants signed an informed consent approved by the university's Institutional Review Board for the protection of human subjects.

Instruments

Both pedometers and accelerometers were used to assess the quality and quantity of movement of the participants.

Accelerometer. GT1M Actigraph accelerometers (Flordia, USA) were used to determine physical activity intensity of the participants in relation to sedentary, light, and MVPA. The accelerometer detects movement in multiple planes but is most sensitive to movements conducted in vertical accelerations. Data output is represented in activity "counts." The counts provide information related to the magnitude of accelerated movement. The device can collect data continuously for several weeks (Berlin, Storti, & Brach, 2006).

Motion detectors provide strong, objective measures of physical activity frequency, duration, and intensity, especially for those in free-living environments. The accelerometer is a suggested instrument to use for those with ID, because there is no recall demand and other studies have effectively used motion sensors with participants with ID (Stanish, Temple, & Frey, 2006). Accelerometer validity has been determined for older adults, children, individuals who are obese, individuals with physical disabilities, and individuals with slow gait speeds (Berlin et al., 2006). Temple and Walkley (2003) conducted a study with individuals with mild to moderate ID ($n = 37$) demonstrating concurrent validity of energy expenditure from accelerometers with proxy reported physical activity. Results demonstrated a significant positive relationship between the two energy expenditure estimates (intraclass correlation = .78, $p < .001$). From our knowledge, there have been few attempts to validate accelerometer activity cut points for those with ID. We hypothesize that for those without underlying gait or altered autonomic function, the accelerometer would accurately depict activity intensity. Due to these assumptions, activity cut-points for certain etiologies of ID (i.e., Down syndrome [DS]) have been contested. An attempt has been made to validate accelerometer intensity cut points in this specific population of ID (Agiovlasitis et al., 2011).

Pedometer. Omron HJ 720ITC Pedometer (Omron Health, Japan) was used to measure physical activity walking behavior. The pedometer monitors physical activity patterns in steps taken across weekdays, weekends, and hours of the day using time-stamped technology. It contains a piezoelectric accelerometer mechanism that responds to accelerations at the hip and has a memory storage capacity of 42 days at one hour epochs (Tudor-Locke, Bassett, Shipe, & McClain, 2011).

Data from previous studies indicate that pedometers are accurate and a reliable measurement for assessing walking activity in adults with ID. Pedometer counts for those with ID were highly consistent with actual step counts during normal and fast paced walking on two ground surfaces with intraclass correlation coefficients above .95 (Stanish, 2004). The Omron HJ720 pedometer has been validated for use in slower walking populations (i.e., older adults and adults with Down syndrome), on various walking surfaces (i.e., flat sidewalk, stairs, and mixed surfaces), and in various wearing locations (i.e., waist, backpack, shirt pocket, and jacket; Lee, Zhu, Yang, Bendis, & Hernandez, 2007; Pitchford & Yun, 2010; Zhu & Lee, 2010).

Demographic and General Health Information

Additional information about age, sex, employment status, income, marital status, racial/ethnic group, living arrangement, height, and weight were collected. All demographic information was acquired through a brief survey.

Procedures

Trained student researchers completed the informed consent process with participants. Participants' demographic information was obtained with assistance from the lead researcher and proxy for those with ID.

Study participants were provided instruction for wearing the activity monitors including placement (i.e., on the waistline with a device over each hip), wear time (i.e., morning to bedtime), and when to return the devices (i.e., 7 days). The pedometer display was covered during the assessment period to reduce reactivity. Both devices were worn concurrently for one week.

Body composition and demographic information was also collected during the initial meeting. Body weight was directly measured at the assessment site. The participants were advised to wear loose fitting clothing to the initial meeting. If participants did not have a scale, the researcher brought the Health-O-Meter 500KL Professional Fitness Scale for measurements. Height was obtained from participants and/or proxies. Nominal compensation was provided at the completion of the 7-day period.

Data Treatment

The pedometer data were downloaded to the OMRON Health Management software and imported in Microsoft Excel for data reduction before analysis. Accelerometer data were downloaded with the ActiLife5 software and imported into a Microsoft

Excel macro program. The macro is designed to accurately reduce data into intensity categories of sedentary, light, moderate, vigorous, and bouts of moderate to vigorous activity. Data were recorded in 1-min epoch lengths for the assessment period (i.e., one week).

The intensity cut points were replicated from the National Health and Nutritional Examination Survey (NHANES) for adults over 18 years of age (Troiano et al., 2008). These intensity thresholds are a weighted average of four threshold criteria used in the literature. The intensity thresholds are as followed: 100 counts for light intensity, 2020 counts for moderate intensity (equivalent to three METs), and 5999 counts for vigorous intensity. Time in moderate to vigorous intensity activity was determined by summing the minutes over the moderate intensity threshold. Modified bouts of MVPA were determined with an algorithm with a specified 2-minute interruption interval. This allowed activity that fell below the moderate intensity threshold for two minutes to be included in the bout of MVPA. This interruption interval takes into account free-living situations of MVPA (e.g., waiting at a stop light, stopping to get a drink of water, catching a breath, etc).

Nonwear time was defined by a string of 60 consecutive minutes of zero counts with an allowance for 1–2 min of counts between 1 and 100. The zero bout ends when the program encounters a count larger than 100, three consecutive epochs with counts between 1 and 100, or the last epoch of the day. The macro calculates the amount of minutes participants do not wear the device based on the criteria described above. The calculated nonwear time is removed from minutes of sedentary activity. Without the macro algorithm, nonwear time would be included in sedentary behavior, which would overestimate sedentary behavior. Monitoring time (i.e., wear time) was estimated by subtracting nonwear time from total observation time for the day (i.e., 24 hr).

The number of days necessary to assess habitual physical activity was determined through the literature. Three days of pedometer wear time can accurately predict weekly steps for persons with ID (Temple & Stanish, 2009), and 4 days of accelerometer wear time is necessary to estimate weekly physical activity behavior (Berlin et al., 2006). Thus, participants who wore devices for at least four days, with one weekend day, were included in analysis. The data were further reviewed for daily wear time. Ten hours of daily wear time is considered a valid day for analysis (Troiano et al., 2008). The demographic information was numerically coded for descriptive analysis.

Data Analysis

The following steps were taken to conduct data analysis: (a) dependent variables were assessed for normalcy using histograms and skewness estimates; (b) descriptive statistics were calculated for each group (i.e., means, standard deviations, and frequencies); (c) chi-squared analysis was conducted to determine differences among groups for demographic variables; (d) one-way ANCOVA analyses were conducted to examine the differences in physical activity levels (i.e., sedentary, light, moderate-to-vigorous, and pedometer steps) while controlling for BMI and income. When statistical significance between groups was found, one-way ANCOVAs were applied to learn the impact of the covariate variables on physical activity levels. Moreover, the covariates were chosen based on their frequent use in physical activity studies; (e) one-way ANOVAs were employed for secondary analyses examining differences across weekday, weekend, and time periods (i.e., morning, afternoon, and evening) between groups; and (f) post hoc Bonferroni techniques determined differences between groups. Three *t* tests were used to make post hoc comparisons, thus the Bonferroni *p*-value adjustment was set at .017 ($p = .05/3 = .017$).

Further analysis included paired *t* tests to analyze differences in physical activity walking across the day (i.e., morning, afternoon, and evening time blocks) and weekday versus weekend walking within each group. Independent *t* tests between persons with DS and those with ID on the following variables (i.e., sedentary, light, MVPA, and pedometer steps) were explored. Analyses were conducted with Stata/IC 11.2 statistical program.

Results

The dependent variables, except for MVPA, had "good" skewness within the desired range of 1 to –1. The following results were derived: sedentary activity (skewness = –.59), light activity (skewness = .28), and pedometer steps (skewness = .58). Moderate to vigorous activity had an acceptable value for skewness (skewness = 1.45). Skewness of 2 to –2 is considered an acceptable range to conduct an ANOVA analysis (Morgan, Leech, Gloeckner, & Barrett, 2007).

Demographics

Approximately 26% of the adults with ID had Down syndrome ($n = 20$), other etiologies of ID were associated with the rest of the sample. Chi-squared analyses determined significant differences between those with ID and the older adults without ID in the following demographic variables: living arrangement $\chi^2(4) = 50.25$, ($p < .001$); income $\chi^2(18) = 101.68$, $p < .001$; working status $\chi^2(2) = 45.76$, $p < .001$; and marital status $\chi^2(8) = 96.02$, $p < .001$ (see Table 1, for demographics).

Physical Activity Wear Time

Younger and older adults with ID had an average daily wear time of 11 hr. Older adults without ID averaged 13 hr of daily wear time. The percentages of participants in each group who wore devices over 10 hr include younger adults with ID 83.7% ($n = 36$), older adults with ID 85.2% ($n = 23$), and older adults without ID 97% ($n = 32$). Since each group had a daily average greater than 10 hr, participants were not excluded from analysis if they had eight to nine hours of wear time. Participants were excluded if they had less than four days of eight to nine hours of wear time.

Sedentary activity. There were significant differences in sedentary activity between groups, $F(2, 90) = 7.61$, $p < .001$, after adjusting for income and BMI . Post hoc comparisons indicated that older adults without ID had significantly more sedentary time than younger adults with ID (see Table 2, for physical activity intensity). All participants in the study spent 60–65% of their monitoring time in sedentary activity.

Light physical activity. There were no significant differences in light physical activity between the groups after adjusting for income and BMI. All three groups performed approximately four hours of light activity across the day (see Table 2 for physical activity intensity).

Table 1 Participant Demographics

Characteristic		Adults w/ ID (n = 45)	Older Adults w/ ID (n = 31)	Older Adults (n = 33)	*p*
Age	Range	20–49	50–77	65–89	***
	Mean (SD)	32.34 (8.43)	57.87 (6.88)	73.18 (5.92)	
Gender (n, %)					
	Male	26 (52%)	22 (63%)	16 (47%)	
	Female	23 (46%)	13 (37%)	18 (53%)	
Down syndrome (n,%)		13 (28.9%)	7 (22.6%)	(0%)	**
BMI (n, %)[b]					
	Underweight	2 (5%)	(0%)	(0%)	
	Normal	12 (29%)	11 (37%)	16 (49%)	
	Overweight	14 (34%)	12 (40%)	12 (36%)	
	Obese	13 (32%)	7 (23%)	5 (15%)	
Ethnicity (n, %)					
	Caucasian	44 (97.8%)	28 (90.3%)	33 (100%)	
	African American	(0%)	2 (6.5%)	(0%)	
	Asian	(0%)	1 (3.2%)	(0%)	
	Aboriginal	1 (2.0%)	(0%)	(0%)	
Living Arrangement (n,%)					***
	Independent	8 (17.8%)	9(29.0%)	28(84.8%)	
	Group /foster home	28 (62.2%)	22 (70.9%)	(0%)	
	Home w/ family	9 (20%)	(0%)	5(15.2%)	
Income (n,%)					***
	< 10,000	25 (55.6%)	17 (48.6%)	(0%)	
	$10,000-$19,999	3 (6.7%)	11 (31.4%)	(0%)	
	$20,000-$74,999	2 (4.4%)	1 (2.9%)	19 (57.6%)	
	$75,000- $100,000	(0%)	(0%)	10 (30.3%)	
	Rather not say	19 (42.2%)	6 (17.1%)	5 (15.2%)	
Marital Status (n,%)					***
	Single	43 (95.6%)	27 (87.1%)	(0%)	
	Married	(0%)	2 (6.4%)	30 (90.9%)	
	Divorced	1 (2.2%)	1 (3.2%)	1 (3.0%)	
	Separated	1 (2.2%)	(0%)	(0%)	
	Widowed	(0%)	1 (3.2%)	2 (6.1%)	
Working (n,%)					***
	Workers	40 (88.9%)	15 (48.4%)	4 (12.1%)	
	Nonworkers [a]	5 (11.1%)	16 (51.6%)	29 (87.8%)	

Note. ID = intellectual disability.

[a]Nonworkers include students, retired, and unemployed

[b]Underweight = < 18.5 kg/m2; Normal weight = 18.5–24.9 kg/m2

Overweight =25–29.9 kg/m2; Obese = > 30 kg/m2

$^{**}p < .01$. $^{***}p < .001$

Table 2 Comparison of Physical Activity Intensity

	Adults w/ID (n = 40)		Older Adults w/ID (n = 28)		Older Adults (n = 24)	
	Mean	SD	Mean	SD	Mean	SD
Avg sedentary***	6.75	1.94	7.36	1.77	8.59	1.41
Avg light[a]	3.84	1.20	3.75	1.42	4.43	1.02
MVPA[b]	21.0	18.6	10.2	13.8	21.6	13.8

Note. ID= intellectual disability; Avg= average; MVPA =moderate to vigorous physical activity

[a]Displayed in average hours per day

[b]Displayed in average minutes per day

***$p < .001$.

Moderate to vigorous physical activity. All three groups spent less than 30 min per day in MVPA across the seven day period (see Table 2, for physical activity intensity). After adjusting for income and BMI, the groups were approaching significant differences for MVPA $F(2, 90) = 2.87$, $p = .06$.

The amount of MVPA in bouts greater than 10 min was also assessed to determine the proportion of participants meeting the promoted *Centers for Disease Control and Prevention 2008 Guidelines for Physical Activity* (USDHHS, 2008). Only 6% ($n = 2$) of the current sample of older adults with ID had at least 150 min of moderate physical activity or 75 min of vigorous physical activity in bouts greater than 10 min across the week. Younger adults with ID had 13% ($n = 6$) and older adults without ID had 33% ($n = 11$) meeting recommended physical activity guidelines.

Pedometer steps. The differences in pedometer steps between groups did not meet the Bonferroni significance requirement, $F(2, 99) = 3.32$, $p < .05$., after adjusting for income and BMI. Younger adults with ID and older adults without ID accumulated approximately 2,000 more steps across the day, compared with older adults with ID (see Table 3, for pedometer steps).

According to the literature, individuals who reach 10,000 steps per day are more likely to meet physical activity guidelines (Le Masurier, Sidman, & Corbin, 2003). In the current sample, only 4% ($n = 1$) of older adults with ID averaged 10,000 steps per day. Ten percent ($n = 4$) of younger adults with ID and 3% ($n = 1$) of older adults without ID reached the guideline. Figure 1 summarizes the percentage of participants in each category of walking steps. In the sample of older adults with ID, 58% of the participants were averaging less than 5,000 steps per day, compared with 42% of younger adults with ID and 33% of older adults without ID.

Weekday and weekend steps are compared in Figure 2. Results were approaching statistical significance between groups, after Bonferroni adjustment, for weekday steps, $F(2, 99) = 3.43$, $p < .05$ and weekend steps, $F(2, 88) = 4.99$, $p < .01$. Post hoc comparisons revealed that older adults with ID had less steps on the weekend compared with older adults without ID ($p < .01$), and older adults with ID had fewer steps during the week than younger adults with ID ($p < .05$).

Table 3 Comparison of Pedometer Steps[a,b]

	Adults w/ID (*n* = 42)		Older Adults w/ID (*n* = 27)		Older Adults (*n* = 32)	
	Mean	*SD*	Mean	*SD*	Mean	*SD*
Steps	6031	2929	4552	3176	5935	2908
Weekday steps	6831	3221	4596	3052	6238	3123
Weekend steps	4530	2337	3504	2239	5744	3225
Morning	2514	1674	1554	1121	2618	1770
Afternoon	2596	1671	1715	1192	2059	1322
Evening	1165	924	821	943	989	690

Note. ID = intellectual disability

[a] steps are average steps per day during the week.

[b] morning, afternoon, and evening are 5-hr time blocks (Monday-Friday).

Morning = 7:00–11:59 a.m.; Afternoon = 12:00–4:59 p.m.; Evening = 5:00–9:59 p.m.

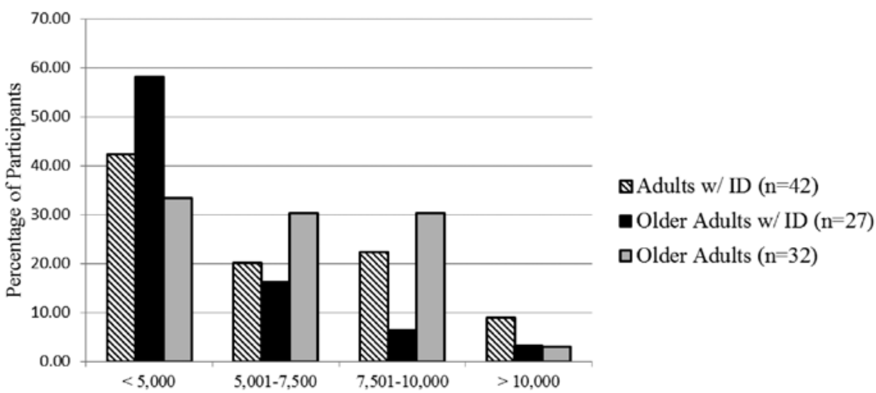

Figure 1 — Percentage of groups within step categories.

Paired *t* tests indicate that younger and older adults with ID had significantly less steps on average across the weekend (i.e., Saturday and Sunday) compared with weekdays. Older adults without ID had no significant differences between weekday and weekend steps (see Figure 2 for weekday/weekend physical activity).

Means and standard deviations for steps across the weekday are displayed in Table 3. Time blocks for analyses were morning (7:00 a.m.–11:59 a.m.), afternoon (12:00 p.m.– 4:59 p.m.), and evening (5:00 p.m.–9:59 p.m.). After Bonferroni adjustments, morning pedometer steps, $F(2, 99) = 3.93$, $p < .05$, and afternoon steps, $F(2, 99) = 3.20$, $p < .05$ were approaching significance. The patterns of weekday steps for the groups are displayed graphically in Figure 3. Steps are displayed by

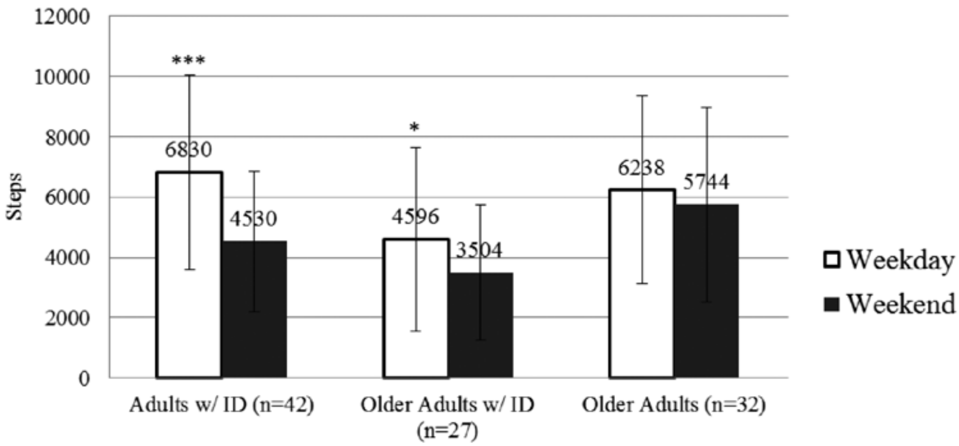

Figure 2 — Mean differences between weekend and weekday steps within groups. **p* < .05. ****p* < .001

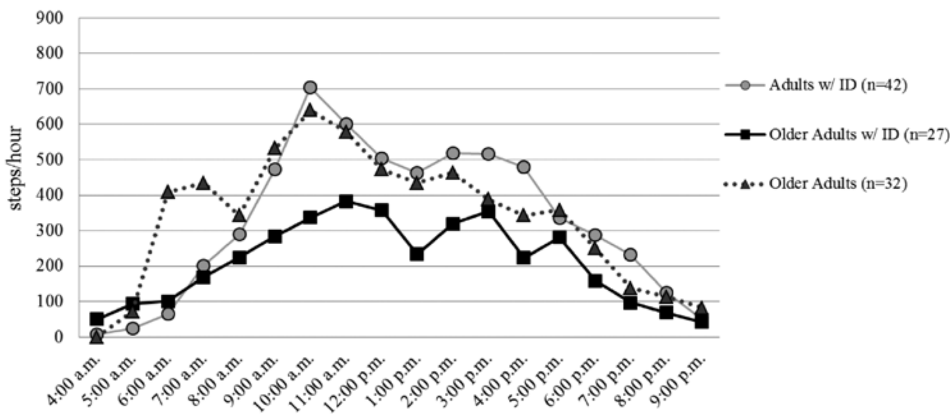

Figure 3 — Patterns of physical activity across the weekday displayed in average steps per hour.

hour to optimize detail. A paired *t* test was conducted across time periods for each group. All three groups had significantly less steps in the evening compared with morning and afternoon time blocks ($p < .001$). There were no significant differences between morning and afternoon time blocks within the groups.

Further analysis was conducted to assess the differences in physical activity and sedentary behavior outcomes between those with DS and those with ID. Results indicate insignificant differences between groups (see Table 4, for comparison of physical activity and sedentary behavior).

Table 4 Comparison of Physical Activity & Sedentary Behavior in Adults With ID & DS

	Adults w/ID (n = 50)		Adults w/DS (n = 18)	
	Mean	*SD*	Mean	*SD*
Avg sedentary [a]	7.38	1.94	6.53	3.03
Avg light[a]	4.02	1.25	3.20	1.74
MVPA[b]	18.6	18.6	12.0	10.8
Steps [c]	5723	2990	4635	2574

Note. ID= intellectual disability; DS= Down syndrome Avg= average; MVPA =moderate to vigorous physical activity

[a]Displayed in average hours per day

[b]Displayed in average minutes per day

[c] Steps are average steps per day during the week

Discussion

This cross-sectional study described the physical activity patterns and sedentary behaviors of older adults with ID in comparison with younger adults with ID and older adults without ID. As the primary purpose of this study, we examined the activity patterns according to the *Centers for Disease Control and Prevention 2008 Physical Activity Guidelines* (USDHHS, 2008) by comparing MVPA in accumulated activity and bouts of ten minutes. As an additional aim, we used advanced accelerometer reduction techniques to examine the amount of sedentary time across the groups. Light physical activity and pedometer walking steps provided additional insight to the activity levels of adults aging with ID in contrast to the comparison groups. Overall, high amounts of sedentary behavior and insufficient MVPA across the groups was evident.

Primary Aim 1: Moderate to Vigorous Physical Activity

No attempts have been made to examine modified bouts of MVPA for those with ID given a user interruption interval of two minutes. The results are alarming that only 6% of the current sample of older adults with ID meet the CDC recommendation of 150 min of moderate or 75 min of vigorous physical activity in bouts greater than 10 min across the week.

The average amount of MVPA per day is consistent with previous research (Frey, 2004). In Frey's study, participants with ID (n = 22) had similar minutes of MVPA across the day (M = 19.7, *SD* = 17.6) compared with the young adults with ID in the current study (M = 21 min, *SD* = 18.6). Temple and Walkley's (2003) study included 37 adults with mild to moderate ID, ages 19–60 years. Data from accelerometers were collected for three days. The results showed that 32% of the participants in the study met the recommended 30 min of moderate intensity physical activity per day (Temple & Walkley, 2003). Frey's (2004) study found similar results, with 28% of participants achieving 30 min of MVPA per day (Frey, 2004). We assume that the discrepancy in the proportion of persons with ID meeting recommended guidelines is due to the data reduction algorithm used in the current study. Unlike other studies, we examined MVPA in bouts greater than 10 min. This specification in our data reduction algorithm would likely account for the difference in the proportions of adults with ID meeting guidelines. Although we emphasize the importance of MVPA in bouts greater than 10 min, these intensity and bout thresholds have not be validated for persons with intellectual disabilities. Future studies are needed to reexamine current physical activity guidelines specifically for this population.

An additional finding in this study is the high amounts of sedentary behavior and insufficient MVPA of younger adults with ID. Despite an almost 40 year mean age difference, younger adults with ID had comparable physical activity to older adults without ID. It is evident that additional health promotion programs are needed for adults with ID across the lifespan.

Primary Aim 2: Sedentary Behavior

Although older adults without ID had more sedentary behavior than older adults with ID, the proportion of sedentary behavior across the day (i.e., the percentage of monitoring time in sedentary pursuits) was the same across groups. Results demonstrate that the difference in sedentary behavior between the groups is potentially due to wear time. The findings for older adults are consistent with 2003–2006 NHANES analysis for adults 60 years and older, who also demonstrated 8.5 hr of sedentary activity on average per day with 60% of monitoring time in sedentary pursuits (Evenson, Buchner, & Morland, 2012; Matthews et al., 2008). However, younger adults with ID are engaged in more sedentary activities compared with NHANES younger adult population without ID. NHANES adult population spent 55% of their waking time in sedentary activity compared with 61% for younger adults with ID in the current study sample (Matthews et al., 2008). The amount of time adults with ID are inactive is problematic, especially if participants were pursuing sedentary activity during nonwear time.

Fortunately for sedentary and low activity populations, reductions in mortality risk begin to accumulate with the first increase in physical activity beyond baseline (Powell, Paluch, & Blair, 2011). Powell et al. suggest that it is an inaccurate assumption that a threshold of physical activity is needed to receive benefits. In fact, the rate of risk reduction is the highest for the lowest activity levels, especially moving from sedentary to light physical activity. This demonstrates that even small increases in activity could provide substantial health benefits (Powell et al., 2011). Therefore, health promotion programs for adults with ID should focus on purposefully decreasing sedentary activity.

Exploring the determinants for low physical activity in older adults with ID is beyond the scope of this study. The literature presumes, however, that older adults may have higher amounts of sedentary behavior due to increased time for leisure activities (e.g., retirement, development of comorbid health conditions limiting activity, etc; Matthews et al., 2008). Beyond additional opportunities for leisure activity, older adults with ID are faced with challenges in their social environment.. For many with ID, the dependence on supports for routine activities of daily living can influence physical activity and other healthy behaviors (Krahn et al., 2006). In a review of social and environmental barriers to physical activity by Bodde and Seo (2009), they determined that personal barriers faced by those with ID are similar to the general population such as age, lack of self-efficacy, lack of interest, and preference for sedentary behaviors; however, these barriers are often elevated for those with ID, due to their reliance on social supports and restrictive environments (Bodde & Seo, 2009). Thus, we suggest that without proper education and supports, persons aging with ID may participate in excessive sedentary activities when more leisure time is available.

Secondary Aim: Pedometer Steps

As suggested in previous research (Peterson, Janz, & Lowe, 2008), the observed walking patterns of those with ID may reflect the use of walking as a mode of transportation and use for employment. For instance, walking peaks for those with ID during morning and afternoon periods potentially displaying walking to and from work (see Figure 3, for patterns of weekday steps/hour). These peaks are exaggerated for younger adults with ID, where 89% of these individuals were employed. In addition, steps for younger adults with ID were significantly higher during the week compared with weekends, potentially due to weekday employment. Based on the time-stamped hourly data, we hypothesize that adults with ID are performing physical activity out of the necessity of employment or structured activities with leisure-time physical activity being low. This is evident by the low bouts of walking during early morning and evening time periods (see Figure 3 for patterns of weekday steps/hour). Similar patterns of walking and conclusions were observed in a study by Peterson et al. (2008) that also used time-stamped pedometer data to assess physical activity in adults with mild to moderate ID. It is noted that the direct contribution of occupation to physical activity was not assessed in this study. Further exploration of this contribution should be examined in future physical activity research in this population.

The current study demonstrates a need for continued efforts to promote physical activity for adults with ID across the lifespan. Based on previous literature and the current study's findings, health promotion efforts could address the social environment (Bodde & Seo, 2009; Krahn et al., 2006; Rimmer & Rowland, 2008), opportunities in the community (particularly in the evening and weekend time periods), sedentary behavior, and productive activities (e.g., work, volunteer engagement, etc.) to maintain or increase physical activity for adults aging with ID.

Limitations

There was a relatively small sample size and participants with ID were not randomly selected to be in the study. Aging was categorized solely by chronological age, biological, physiological, and cognitive markers were not considered in the inclusion criteria. Furthermore, the results cannot be generalized to the entire population of individuals with ID, because those with severe and profound ID were not included in the sample. It is suggested that by excluding persons with more severe ID, we are overestimating activity of this population (Temple, 2010). Having more severe ID is associated with "what seems to be premature aging and shortened life expectancy" (WHO, 2000, p.5).

Another potential limitation is the inclusion of those with Down syndrome in the study sample. We believe the physical activity patterns of those aging with Down syndrome are important to assess in our study sample. The rationale for including this population is based on a validation study conducted by Temple and Stanish (2009). They determined that although those with DS have overall lower physical activity, the patterns of PA throughout the week is similar. Based on these findings, we believe including this segment of the population with ID was acceptable. Moreover, those with DS are an inclusive part of this aging community with similar environment factors influencing physical activity, thus excluding this group did not seem fit. However, the diagnosis of Down syndrome is associated with other medical and neurological conditions which may result in higher energy expenditure. We suggest that future studies examine these underlying differences and its effects on physical activity in comparison with other etiologies of ID.

Furthermore, the accuracy of accelerometer intensity cut points for certain etiologies of ID (i.e., Down syndrome) has been challenged. Persons with Down syndrome have reduced gait stability and altered cardiac autonomic function, which contributes to lower levels of aerobic fitness (Fernhall et al., 2009; Fernhall et al., 1996). These factors could increase metabolic rate during lighter physical activity (i.e., walking). A recent article demonstrated that persons with DS have less predictability of metabolic rate than those without DS during walking trials (Agiovlasitis et al., 2011). Agiovlasitis et al. calculated the first accelerometer intensity cut points for those with DS (i.e., 396 and 1,702 counts per 30 s, respectively, for moderate and vigorous physical activity intensity). We compared the differences in physical activity intensity in the current sample of adults with DS using Agiovlasitis et al.'s documented cut points and NHANES estimates (see Table 5 for cut point comparisons for adults with DS). It is noted that the established cut points have not been validated in a large sample of persons with DS and are limited to locomotion (Agiovlasitis, et al., 2011). The comparison is to demonstrate the potential differences in MVPA, based on cut points, for those with DS. Future validation studies are needed to determine the accuracy of the specified cut points across various activities. These limitations in objective measures of physical activity, as well as, the inability to capture nonambulatory activity (i.e., swimming, biking, rowing, ect) should be taken into account when interpreting the results of this study.

Conclusion

To our knowledge, this is the first study that specifically examines physical activity behavior of older adults with ID (Temple, 2010). The comparison groups in this study provide a logical way to contrast the amount of physical activity performed by this aging population. Furthermore, the evaluation of sedentary behavior is a critical component of this study. Sedentary behavior has independent effects on health (Healy et al., 2007; Owen et al., 2010). Examining sedentary behavior for those with ID is needed due to its potential link to the evident poor health of this population. A primary concern is the lack of health promotion interventions targeted for those aging with a disability. This lack of programming needs to be addressed to increase healthy behaviors, reduce secondary conditions, increase functioning, and improve the quality of life for those aging with ID.

Table 5 Accelerometer Cut Point Comparison for Adults With Down Syndrome

		Adults With DS (n = 11)			Older Adults With DS (n = 6)			Adults With DS (n = 17)		
		Sedentary[a]	Light[a]	MVPA[b]	Sedentary[a]	Light[a]	MVPA[b]	Sedentary[a]	Light[a]	MVPA[b]
NHANES cut points	Mean	6.14	3.27	13.8	7.27	3.06	9.0	6.53	3.20	12.0
	SD	3.23	1.92	10.8	2.69	1.48	10.2	3.03	1.74	10.8
Agiovlasitis et al. (2011)	Mean	6.14	2.42	65.4	7.21	2.62	34.2	6.51	2.49	54.0
	SD	3.23	1.31	51.0	2.67	1.22	28.8	3.02	1.25	46.2

Note. DS = Down syndrome

[a]Displayed in average hours per day

[b]Displayed in average minutes per day

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