Sedentary behavior levels and patterns in men and women with intellectual disability

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Background: Adults with Intellectual Disability (ID) experience health disparities that may be attributable to high sedentary behavior (SB). The levels and patterns of SB among U.S. adults with ID have received little attention.

Purpose: To examine levels and patterns of SB in adults with ID.

Method: The sample included 52 adults with ID who wore an accelerometer on the hip for 7 days. We determined total sedentary time, percent of wear time spent sedentary, number and duration of sedentary bouts, and breaks in sedentary time. We used t-tests and 2×2 ANOVA to evaluate the effects of sex or age-group and day of the week.

Result: Adults with ID spent about 8-8.5 hours per day in SB and they primarily accumulated sedentary time in bouts 1-30 min in duration.

Conclusion: Apart from small differences in SB, people with ID appear to have near uniform SB levels and patterns throughout the week.
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CHAPTER I
INTRODUCTION

Changes in technology over the past 50 years have led to a progressive increase of sedentary behavior (SB) around the world (Archer et al., 2013; Church et al., 2011; Lewis et al., 2017; Lin et al., 2015; Proper et al., 2011; Rey-López et al., 2010). Diversification in communication, transportation, the workplace, and domestic life have promoted prolonged SB (Brownson et al., 2005). SB is defined as any waking behavior having an oxygen consumption of \( \leq 1.5 \) metabolic equivalents (METs), while in a sitting or lying position (Tremblay et al., 2017). Epidemiological research has demonstrated that adults allocate a high proportion of their day engaging in SB (Colley et al., 2011; Healy, Clark, et al., 2011; Matthews et al., 2008). SB is an independent risk factor for adverse health problems, such as obesity, type 2 diabetes, cardiovascular disease, and mental illness (de Rezende et al., 2014; Thorp et al., 2011a; Wilmot et al., 2012).

Intellectual Disability (ID) is a condition which affects intellectual functioning (abstract thinking, planning, and reasoning) and adaptive behavior, and it originates before the age of 18 years (Schalock et al., 2010). The estimated prevalence of ID around the world is 1% of the population (Pallab K. Maulik et al., 2011), and data from the United States indicate an estimated prevalence of about 1.2% (Maenner et al., 2016). People with ID experience health disparities including higher rates of early mortality, obesity, diabetes, hypertension, cardiovascular disease, cerebrovascular accidents, depression, and anxiety (Altman & Bernstein, 2008; Heslop et al.,
Research data also indicate that most adults with ID do not meet physical activity recommendations (Dairo et al., 2016; Dixon-Ibarra et al., 2013; Phillips & Holland, 2011). Furthermore, adults with ID from around the world have high levels of SB (Harris et al., 2019; C. Melville et al., 2018; Oviedo et al., 2017). The physical activity and SB profiles of adults with ID may be partly responsible for the health problems and health disparities they experience as previously suggested (Chau et al., 2015; de Rezende et al., 2014; Warburton et al., 2006). Understanding the levels and patterns of SB in adults with ID is important for developing interventions for reducing SB and improving their health.

The SB levels and patterns of adults with ID may be different from those of the general adult population because a large proportion of adults with ID live in residential facilities and participate in community-based programs that are designed especially for them (Kelly Hsieh et al., 2017; Stancliffe et al., 2012). The reported data on SB levels of adults with ID are limited, however, data from around the world indicate that adults with ID spend 8-10 hours·day⁻¹ in sedentary activities and they have higher levels of SB than the general population (C. Melville et al., 2018; C. A. Melville et al., 2017; Schuna et al., 2013). High sedentary time has been reported for adults with ID from Spain and the United Kingdom (Harris et al., 2019; Oviedo et al., 2017; Phillips & Holland, 2011). Only one past study has been conducted in the United States and this study found that adults with ID spent 8.5 hours·day⁻¹ in accelerometer-determined SB which was 60-65% of their accelerometer wear time (Dixon-Ibarra et al., 2013). Levels of SB among adults with ID do not seem to differ between sexes and younger and older individuals (Harris et al., 2019; Oviedo et al., 2017; Westrop et al., 2019), but this has not been reported among adults with ID in the United States. Among the general U.S. population, however, sedentary time is
higher in older than younger adults and higher in men than women (Diaz et al., 2016; Evenson et al., 2012). More research among U.S. adults with ID is needed.

Furthermore, limited data exist on patterns of SB among adults with ID and there are no such data available from the United States. The study conducted in Spain mentioned earlier found that adults with ID had higher sedentary time during weekdays than weekend days (Oviedo et al., 2017). And the abovementioned study conducted in the United Kingdom showed that adults with ID primarily engaged in SB of short bouts <10 min in duration; they had long sedentary breaks and the duration of breaks was longer in weekdays than weekend days (Harris et al., 2019). These findings contrast with data on patterns of SB from the general U.S. adult population indicating high levels of SB primarily of prolonged uninterrupted bouts of ≥30 min (Diaz et al., 2016), and no differences in SB variables between days of the week (Evenson et al., 2015; S. Marshall et al., 2015). It is evident that more research is needed to describe the levels and patterns of SB among adults with ID in the United States.

The purpose of this study was to offer accelerometer-determined data on the levels and patterns of SB among adults with ID from the United States. We examined whether sedentary time, bouts, and breaks differ between sexes and age-groups and we also explored differences between week and weekend days.
CHAPTER II
LITERATURE REVIEW

Introduction

Adults with Intellectual Disabilities (ID) have adverse health profiles; they have high rates of obesity, hypertension, cardiovascular disease, diabetes, and stroke (Morin et al., 2012; Reichard et al., 2011). Adults with ID also have high levels of sedentary behavior (SB) (Kelly Hsieh et al., 2017). High levels of SB increase the risk for mortality and morbidity (Biswas et al., 2015; Chau et al., 2013). Recognizing the health impact of SB and identifying factors that may contribute to SB in people with ID may aid in the development of interventions for reducing SB and improving health in this population group. There is a need to review the research base on levels and patterns of SB in people with ID. This literature review will explore issues related to measurement, levels, and patterns of SB in adults with ID. In addition, this review will discuss some interventions for reducing SB in adults with ID.

Intellectual Disability

What is Intellectual Disability?

The American Association on Intellectual and Developmental Disabilities (AAIDD) defines Intellectual Disability (ID) as a condition which affects intellectual functioning and adaptive behavior which developmentally originates before the age of 18 (Schalock et al., 2010). Intellectual functioning refers to normal mental capability of abstract thinking, planning, reasoning. Adaptive behavior consists of a group of skills that people gain through training or
practice which, in turn, help them to perform activities of daily living (Schalock et al., 2010). A research group working on the classification of ID has recommended the term Intellectual Developmental Disorders which can be defined as “a group of developmental conditions characterized by significant impairment of cognitive functions associated with limitations of learning, adaptive behavior and skills” (Carulla et al., 2011).

**Prevalence of ID**

The prevalence of ID differs broadly from country to country and it varies across States of the United States. This variation is probably due to the differences in the definition and etiology of the cases (P. K. Maulik & Harbour, 2010). According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), people with ID compose approximately 1% of the population (American Psychiatric Association, 2013). A meta-analysis conducted among people with ID found that the prevalence of ID is around 10.37 per 1000 population which is also equivalent to 1% (Pallab K. Maulik et al., 2011). This study mentions that the prevalence depends on the gross income of the country, age-group, and study design. According to this research group, the low-income countries have the highest prevalence of people with ID roughly 16.41 per 1000 population. In case of adults with ID, the male female ratio falls between 0.7 to 0.9 (Pallab K. Maulik et al., 2011). A very recent study analyzing prevalence of cerebral palsy, ID, hearing loss, and blindness among children aged between 3-17 years estimated that the prevalence of ID is 11.1 per 1000 children (McGuire et al., 2019). Down syndrome (DS), one form of ID, is one of the most common birth defects in the US with approximately 6,000 births annually, resulting in an estimated birth prevalence of 14 per 10,000 live births (Besser et al., 2007; Canfield et al., 2006; Parker et al., 2010).
Features and complications of ID

Newborn with ID often have structural abnormalities. For example, phenotypic characteristics of DS comprise of short stature, small head, short neck, small ears, muscle hypotonia, ligament laxity (Roizen & Patterson, 2003). During infancy, feeding problems, inadequate response, postural abnormalities occur very frequently in people with ID (Bear, 2004). Between 6-18 months of age, gross motor delay (walking, sitting, crawling), language, and behavioral abnormalities are trivial among this population group (Batshaw et al., 2007). People with ID can have a variety of complications, some of which become more prominent as they get older; for example, endocrine, sensory, orthopedic, and behavioral problems, Alzheimer’s disease, cerebrovascular events (Shapiro & Batshaw, 2013). Some comorbid conditions are highly prevalent among people with ID such as cerebral palsy, seizure disorders, autism spectrum disorder, attention deficit hyperactivity disorder, and hearing and visual impairments which creates a diagnostic dilemma (Fletcher et al., 2007). Moreover, congenital heart disease, faster aging, high obesity, very low fitness, and functional limitations are common among people with DS (Roizen & Patterson, 2003). Life spans have increased dramatically for people with ID. According to existing literature, people with ID can expect to live around 50 to early 70 years, depending on the severity of associated health problems (Heller et al., 2010). As the life expectancy of people with ID is increasing overtime, it is important to determine the extent to which their lifestyle is sedentary.

Sedentary Behavior

What is sedentary behavior and how is it measured?

The Sedentary Behavior Research Network has defined SB as activities having energy expenditure of ≤1.5 metabolic equivalents (METs) while in a sitting or lying position during
waking hours (Barnes et al., 2012), including behaviors such as watching television (TV), playing video games, and using a computer. SB can be measured subjectively with questionnaires or objectively with physiological or motion sensors and direct observation.

The majority of studies using self-reported measures are centered on capturing daily TV viewing as a marker of SB (Bryant et al., 2007; S. J. Marshall & Ramirez, 2011). However, TV viewing time does not appear to be representative of overall SB (S. J. Biddle et al., 2009; Sugiyama et al., 2008). The Sedentary Behavior Questionnaire (SBQ) is a self-report measure of time spent in SB during a typical week (Rosenberg et al., 2010). The SBQ has a strong test-retest reliability (Rosenberg et al., 2010).

Self-reported questionnaires are cost effective and promptly accessible to the majority of the population, and have a comparably small participant burden (Atkin et al., 2012). Self-report can also be used to analyze the form of behavior and the situation in which it arises, information that may be used to notify interventions. A basic constraint of self-reported measures is that they consistently demonstrate poor validity. A major impediment to establishing validity is the lack of an accepted ‘Gold Standard’ antecedent measure of SB (Rennie & Wareham, 1998). The operation of one form of self-report to validate another is unsuitable because of the problem of correlated error. A further obstacle is that they are susceptible to impact by cultural benchmark and recognized social desirability (Atkin et al., 2012). Additional methods for subjective measurement of SB exist; for example, activity diaries and seven-day recall interviews (Atkin et al., 2012; S. J. Marshall & Ramirez, 2011). Those methods may provide additional information on SB that other methods do not provide.

Sedentary time can also be measured using accelerometers. Accelerometers are small lightweight devices that are usually worn on an elastic belt positioned on the hip or lower back
for 7 consecutive days after the health examination (Atkin et al., 2012). Participants usually remove it during water activities. Accelerometers measure the frequency and amplitude of acceleration of the body segment to which they are affixed and often intermingle this information in the disposition of movement counts (K. Y. Chen & Bassett, 2005). Accelerometers can be used to determine the total magnitude of SB and observe brief incidental gaps in sedentary time, which may not be conceivably documented by questionnaires (Healy, Clark, et al., 2011). A fundamental drawback of accelerometers in measuring SB is that they evaluate intensity of movement and thus are less able to differentiate between postures, such as sitting and lying or standing still; therefore, episodes of standing still may be misclassified as sedentary time (Clemes et al., 2012; Hart et al., 2011). Disposable inclinometers that attach to the skin, much like a plaster/band-aid, have also been used to aid in identifying posture (Atkin et al., 2012). Inclinometers can access whether someone is sitting or standing. Therefore, this method reduces the risk of classifying standing as SB.

**Why is sedentary behavior important?**

High levels of SB are associated with adverse health outcomes, in both adolescents and adults (Ekelund et al., 2012). Prolonged period of time spent in SB is an independent risk factor for obesity, type 2 diabetes, cardiovascular disease (de Rezende et al., 2014; Thorp et al., 2011a; Wilmot et al., 2012) and mental ill health (Hamer et al., 2014; Teychenne et al., 2010). Epidemiological studies have shown that adults spend a high proportion of their day engaged in sedentary activities (Colley et al., 2011; Healy, Clark, et al., 2011; Matthews et al., 2008) Adults with intellectual disabilities, including those with DS, have high levels of sedentariness (C. A. Melville et al., 2017) and have been shown to engage in more sedentary time in comparison to the general population (Schuna et al., 2013). Thus, minimizing sedentary time in adults with ID
might improve their health. For minimizing sedentary time in adults with ID, it is important to review the levels and patterns of SB in the general population so that the researchers can make a comparison to people with ID.

**Levels and patterns of sedentary behavior in the general population**

Researchers have found that children and adults in the United States spend the majority of their waking time in SB (Matthews et al., 2008). The most sedentary groups are older adolescents (aged between 16-19 years) and older adults (above 60 years), whereas, the least sedentary groups are children (aged between 6-11 years) and Mexican American males (Matthews et al., 2008). Large-scale epidemiological research from Japan and South-East Asia has also found high levels of SB among adults in these regions (T. Chen et al., 2018; Win et al., 2015). In summary, people from different countries around the world spend significant portions of their waking time in sedentary activities.

Currently, limited information exists on patterns of SB among US adults (e.g., does most SB occur in a few long bouts or in many short bouts? How often are breaks from SB taken and how long do these breaks last?) (Diaz et al., 2016). As physical activity guidelines now advocate for reductions in sedentary time as an adjunct to structured exercise and physical activity programs (Piercy et al., 2018), such data may be helpful to inform specific recommendations regarding how to reduce SB.

An analysis of objective SB data from the Women’s Health Study found that most sedentary time (71%) was accumulated in shorter bouts lasting less than 30 minutes (Shiroma et al., 2013). However, these data were limited to white women and of higher socio-economic status. On the other hand, a study among U.S. middle-aged and older adults revealed that nearly half of total sedentary time was accumulated in prolonged, uninterrupted bouts lasting ≥30 min
(Diaz et al., 2016). Therefore, sedentary lifestyle is highly prevalent in the general population in the United States. The same scenario may also be true for adults with ID. It is, therefore, important to review the levels and patterns of SB in individuals with ID.

**Levels and patterns of sedentary behavior in individuals with ID**

Across the lifespan, people with ID seem to have high SB levels. A Spanish study analyzing patterns of sedentary time of adults with ID found high sedentary time among this population (Oviedo et al., 2017) In addition, there were no differences for SB variables while comparing between sexes and age-groups (Oviedo et al., 2017). While examining different week periods, the same research group noted that participants spent more sedentary time in weekdays than weekend days. Regarding the sedentary time patterns, the participants included in this study invested their 79.4% walking time in sedentary activities (Oviedo et al., 2017). The average sedentary bouts per day was 65 with 6 breaks per sedentary hour lasting approximately 6.7 min. Interestingly, younger adults had more breaks per sedentary hour in comparison to older adults. Overall, the participants spent 1 bout ≥ 30 minute of sedentary time per day constituting 9.4% of sedentary time as well as only 0.3 bouts ≥ 60 minute of sedentary time per day which comprised 4.5% of total sedentary time. In addition, for the same study, the number of breaks per sedentary hour was 6.2 (Oviedo et al., 2017).

Another separate study for adults with ID from United Kingdom investigated total volume of sedentary time, number, and duration of bouts and breaks in sedentary time. This research group obtained that participants used 8.1 hours·day⁻¹ being sedentary while the total volume for the variables of the SB was the same between weekday and weekend day. The duration of sedentary bouts was 22 minutes, and the participants involved themselves in 8 sedentary bouts·day⁻¹ continuing ≥ 10 minutes, 2 bouts·day⁻¹ enduring ≥30 minutes, 1 bout·day⁻¹
persisting $\geq 60$ minutes and $\geq 90$ minutes (Harris et al., 2019). Also, a significant difference in mean duration of sedentary breaks between weekdays and weekend days was noticed. But the number of breaks in sedentary bouts was the same for week and weekend days.

An extensive systematic review and meta-analysis including 8 papers assessing gender differences in SB in adults with ID noticed no constant gender differences in SB (Westrop et al., 2019). Another relevant study appraising physical activity and physical fitness levels of adults with ID residing in group homes in Hong Kong observed that these specific group of adults spent 67% of their time in sedentary activities during weekdays (Chow et al., 2018). According to this research evidence, there were no gender differences in SB levels which is consistent with the findings of the aforementioned study by Westrop, Melville, Muirhead, & McGarty. (2019). A cross sectional study recruiting 109 participants (45 younger adults with ID, 31 older adults with ID, and 33 older adults without ID) conducted in the Pacific Northwest and Northeast United States found that the participants spent approximately 60-65% of their recorded time in sedentary activities (Dixon-Ibarra et al., 2013). Overall, the average sedentary time for younger adults with ID was 6.75 hours per day and it was 7.36 hours per day for older adults with ID in that study.

In an another study among individuals with ID aged 12-64 years, those with DS had higher sedentary time than those without DS and SB was higher among older age-groups compared to younger ones (Phillips & Holland, 2011). Another cross sectional study with 104 participants with DS measured the time spent in sedentary, light, and moderate to vigorous physical activity, and indicated that 14 to 15 years adolescents with DS were the most sedentary (Esposito et al., 2012a). This study also found that SB increases as age increases. An exception was the 10 to 11 years age-group, which engaged in the least amount of SB and were physically active (Esposito et al., 2012a). Based on the existing literature, it is difficult to infer whether SB
of people with ID differs from that of people without disabilities. Because of the different accelerometer output cut-offs, sedentary time was different among different studies which makes a difficulty in statistically comparing SB between adults with ID and adults without disabilities (Agiovlasitis et al., 2019). In addition, limited data are available on SB for adults with ID (Dixon-Ibarra et al., 2013). Therefore, more research data on SB for adults with ID are needed.

**Correlates of sedentary behavior**

The term correlates are used to indicate variables that have a mutual relationship or connection. Factors associated with SB can be understood as correlates or determinants depending on the study design (Bauman et al., 2012). Correlates are factors that have statistical associations in cross sectional studies and determinants are factors with causal relationships with SB often identified in longitudinal studies. Thus, before assessing determinant factors, identifying correlates is essential in order to understand what factors might need to be changed (Izquierdo-Gomez et al., 2017).

**What are the correlates of sedentary behavior in the general population?**

Correlates of SB in the general population can be expressed in terms of a socio-ecological model that encompasses demographic, biological, and environmental factors (Sallis et al., 2015). Existing literature reports the most frequently investigated correlates of SB in the general population are age, sex, body mass index (BMI), physical activity levels, mood, and attitude (Rhodes et al., 2012; Thorp et al., 2011b). Researchers used self or proxy report questionnaires for measuring most of the correlates and assessed obesity via BMI determined objectively from measurements of height and weight. In a study assessing differences in sedentary time between West European and South Asian people revealed that there was a sex difference in physical
activity levels and sedentary behavior between these two groups. The findings of this study was inconsistent. South Asian women were the least sedentary group despite having less moderate-to-vigorous physical activity. On the other hand, West European men were the most sedentary although they were most active having 36 minutes/day of moderate-to-vigorous physical activity and 571 minutes/day of sitting time (G. J. Biddle et al., 2019). Another study examining correlates of sedentary time and self-reported screen time among Canadian children found no sex differences in total sedentary time and screen time (LeBlanc et al., 2015). Nevertheless, boys spent more time in playing video games or using computers.

Limited research data exist on possible interpersonal and environmental factors that may influence sedentariness (Rhodes et al., 2012). Of the environmental correlates, the socio-economic domain is the most common. For instance, some authors reported a low socio economic status (SES) neighborhood to be associated with an increase in TV viewing time (Coogan et al., 2012; Sugiyama et al., 2012) while others found that a high SES neighborhood resulted in increased SB (Kozo et al., 2012; Stamatakis et al., 2012). Therefore, neighborhood deprivation was positively associated with leisure screen time (Stamatakis et al., 2012, 2014). Multiple environmental attributes such as high walkability of neighborhoods, presence of aesthetic features, proximity / access to destination and facilities, traffic safety, residential density, and a safe environment presented numerous inconsistencies in their association with SBs (Ding et al., 2012a; Fields et al., 2013; Lee et al., 2012; Teychenne et al., 2012; Van Dyck et al., 2012a; Van Holle et al., 2014). Further research is necessary to determine the impact on these factors on SB.

The relationship of SB with income, occupation, and education is controversial. Educational levels were negatively correlated with Television and Screen Time (TVSE), whereas
self-reported or objectively measured total sedentary time was positively correlated with it (Clark et al., 2010; Ding et al., 2012a; Stamatakis et al., 2014). The higher the education level the more likely one is employed in more sedentary roles (Clark et al., 2010; Ding et al., 2012b). Therefore, researchers have showed that socioeconomic status is a significant indicator, probably the most consistent factor of all the individual factors identified (Clark et al., 2010; Ding et al., 2012a). In summary, it is still unclear which changes in environments can affect sedentariness. More research is needed to examine how specific environmental variables interact with individual and social factors and how they are interrelated with particular types and purposes of SB.

What are the correlates of sedentary behavior in adults with ID?

Most of the knowledge-base on correlates of SB comes from research in adults with ID. Correlates of SB may be categorized into demographic, biological, and environmental factors (Sallis et al., 2000). Demographic factors include age, gender and level of ID (Harris et al., 2018). Biological factors include physical health problems, mental health problems, problem behaviors, and obesity (Harris et al., 2018). Among all environmental factors, the most significant were accommodation type and neighborhood deprivation (Harris et al., 2018). A study with 152 participants with ID over 18 years of age assessed the correlates of SB and found a correlation between physical and mental health problems and increased sedentariness (Harris et al., 2018). The relationship between demographic factors and SB in individuals with DS is still unclear. Past research findings indicate that weekly sedentary time increases with older age among youth with DS (Esposito et al., 2012b; Izquierdo-Gomez et al., 2014). Among these two studies, one also showed that this applies to weekdays, but not weekend days (Izquierdo-Gomez et al., 2014). On the contrary, another study identified no association with sedentary time and age in youth with DS (Foerste et al., 2016). Two extensive studies conducted among adults with ID
incorporating large number of adults with DS reported that there was no association between age and TV or screen times (K Hsieh et al., 2014; C. Melville et al., 2018). The existing data related to the sex specific differences in SB among people with ID are restricted and disputing. Existing literature found that females were more sedentary than males in adults with DS and other intellectual disabilities (Finlayson et al., 2011; Nordstrom et al., 2013b). On the other hand, another study carried out among youth with DS delineated no remarkable link between sex and sedentary time (Foerste et al., 2016). So, future research is necessary to examine if there is any relationship between gender and SB.

Regarding obesity, the findings have been strikingly inconsistent in studies involving adults with ID. Three studies reported no significant associations between sedentary time and measures of fatness like BMI and total percent body fat (Esposito et al., 2012b; Pitchford et al., 2018). Two studies among adults with ID including some with DS found obesity to be positively associated with TV watching or screen times after controlling other personal and environmental factors (Kelly Hsieh et al., 2017; C. Melville et al., 2018). On the other hand, studies from other researchers did not find a significant positive relationship between weight status and sedentariness (K Hsieh et al., 2014; Mikulovic et al., 2014; Nordstrom et al., 2013a). Further research is necessary regarding this aspect.

Some research highlighted that adults with ID experience the environment differently to the general population. As examples, barriers in accessing transport (Bodde & Seo, 2009a), inaccessibility of fitness centers (Heller et al., 2004), and low rates of employment (Siperstein et al., 2013). A Norwegian study which included individuals with DS, Williams syndrome, and Prader-Willi syndrome, reported no differences in SB between individuals living in community settings and family support (Nordstrom et al., 2013b). A recent study from the United States
among adults with ID where 25% had DS, noted that individuals living in foster or group homes had lower TV viewing time than those living independently while individuals living with family had higher sedentary time compared to those living independently (Kelly Hsieh et al., 2017). However, another study demonstrated no significant associations between environmental correlates and sedentary time among adults with ID including some with DS (Harris et al., 2018). Oppewal et al. (2018) summarized all of these findings in a systematic review inquiring into the correlates of SB in adults with ID (Oppewal et al., 2018).

What can be done to reduce sedentariness in people with ID?

In general, people with ID mainly people with DS display high levels of SB (Agiovlasitis et al., 2018; Ulrich, Burghardt, Lloyd, Tiernan, & Hornyak, 2011). If SB persists over an extended period of time, negative health consequences will occur. Therefore, developing interventions to reduce SB in people with ID is urgent. Researchers have attempted to identify some means of reducing SB in this population group. A study comprising of 72 children with DS aged between 8 to 15 years investigated the physical activity and health related outcomes of teaching children with DS to ride a 2 wheel bicycle (Ulrich et al., 2011). The researchers indicated that most children with DS learned to ride a bicycle which reduced sedentariness and increased physical activity. Therefore, sedentariness is responsive to interventions among youth with DS and the same may be possible in adults with other ID. Regular treadmill program can also provide distinct benefits for elderly adults with DS and can lead to improvements in leg strength, balance, and walking function (Carmeli et al., 2002). Generally, people with ID face complex problems and a vast variety of barriers that prevent them from participating in physical activities. Several authors highlight the difficulties for people with ID to overcome social and environmental barriers and engage in physical activity (Bartlo & Klein, 2011; Johnson, 2009).
The key barriers are lack of money, transportation, access, and support from family and caregivers. Therefore, addressing these barriers is urgent. Interventions that simultaneously impact personal and environmental barriers at different levels may prove effective in reducing SB among adults with ID.

**Conclusion**

In conclusion, adults with ID seem to have higher levels of SB, and multiple factors are responsible for their SB. The study of SB measurement, levels, patterns, correlates of SB in people with ID is still in early stages and requires greater attention from researchers.
CHAPTER III

METHOD

Participants

For this study, we used previously collected data. Participants were recruited through service programs for people with ID within 60 miles from the MSU campus. Inclusion criteria were: (a) having ID affirmed by parent or caregiver; (b) age over 18 years; (c) being ambulatory with or without assistive device; (d) ability to speak; and (e) ability to understand the testing procedures. Potential participants not meeting the above inclusion criteria or using a wheelchair were excluded from the study. We obtained written informed consent or assent from the participants and permission from legally authorized representatives as needed. The Institutional Review Board approved this study.

Study Design and Procedures

This study was cross sectional. A testing session was conducted at a place of convenience to participants. During this session, we measured anthropometrics, and then participants were fitted with an accelerometer for measuring SB over a week.
Measurement

Anthropometrics

Height was measured to the nearest 1 mm with a portable stadiometer (CE 0213; Seca, Chino, CA). Weight (kg) was measured to the nearest 0.1 kg with a portable scale (CE 813; Seca, Chino, CA). We then calculated the body mass index (BMI) as weight·height⁻² (kg·m⁻²) and classified participants as overweight, obese, or of normal weight using BMI categories.

Sedentary behavior

Measurement of SB was done with an accelerometer. We used the wGT3X-BT accelerometer (ActiGraph, Pensacola, FL) which is a small lightweight device (46×33×15 mm; 19 g) and obtained data using the ActiLife 6 Software v.6.13.4. Instructions regarding how to wear the accelerometer throughout the waking hours and placement were given to participants and parents/legal guardians. Participants wore the accelerometer with a waist strap on the dominant hip at the iliac crest for 7 days during waking times. Participants did not wear the accelerometer during sleep and any water activities like bathing, swimming, or showering. The minimum requirement for valid accelerometer data was at least 10 hours/day for 4 days including at least three weekdays and one weekend day (Berlin et al., 2006; Matthews et al., 2008). The sampling frequency for data collection was 60 Hz. Activity counts were recorded in 60s intervals (epochs). We identified non-wear time as intervals of at least 60 min of zero activity counts using an algorithm available in the ActiLife software (Troiano et al., 2008). Based on a cut-point for the general population, we defined sedentary time as time spent below a threshold of < 100 cpm (Atkin et al., 2012). Using the ActiLife software, we obtained the following SB variables:
(a) daily total sedentary time (min·day$^{-1}$); (b) percentage of wear time spent sedentary; (c) number of sedentary bouts·day$^{-1}$ (defined as a period of consecutive min where the accelerometer registers <100 counts per minute); (d) average bout duration in min; (e) number of sedentary breaks·day$^{-1}$ (defined as at least 1 min where the accelerometer registers ≥ 100 counts per minute following a sedentary bout); and (f) average duration of sedentary breaks in min. We derived the number and duration of sedentary bouts with the following thresholds: ≥1, ≥10, ≥30, ≥60 and ≥90 min and sedentary breaks for bouts ≥10 min. In addition, the data from the accelerometer were split into weekdays (Monday-Friday) and weekend days (Saturday and Sunday).

**Statistical Analyses**

Statistical analyses was conducted using SPSS Statistics 25 (IBM Corp., Armonk, NY). The alpha level was 0.05. Two age-groups were generated based on a median split of the distribution for age. We derived descriptive statistics for demographic and anthropometric variables, and we evaluated differences in these variables between sexes and between age-groups with independent samples t-tests. We evaluated differences in SB variables between sexes or age-groups and between weekdays and weekend days using 2×2 mixed-model (sex or age-group by day) Analysis of Variance (ANOVA). The Greenhouse-Geisser adjustment was applied to correct for violations of sphericity based on Mauchly’s test. Significant interactions in ANOVA were further analyzed with: (a) independent samples t-tests for differences between groups; and (b) paired samples t-tests for differences between days within-groups.
CHAPTER IV

RESULTS

Participants

A total of 87 participated in this study; however, 35 participants did not provide accelerometer data meeting the criterion of 10 hours for at least four days, including one weekend day. Therefore, the final sample was 52 adults with ID (25 men and 27 women; age range 20 - 79 years). The median age was 48 years, and we derived two age-groups; one for those 48 years or younger and another for those older than 48 years. Four men and six women had Down syndrome and one man had Cerebral Palsy. Forty-three participants lived in group-homes, eight with their parents, and one independently. Only 11.5% of the sample was of normal BMI; most participants were either overweight (26.9%) or obese (50%). Furthermore, most participants were classified as having either mild or moderate level of ID with only 5.8 % of the sample in the severe ID category. Descriptives of the whole sample and sub-samples by sex and age-group are shown in Table A1.

Sedentary Behavior Variables in the Complete Sample

Among the 52 participants, 37 provided valid data from 7 days, 5 from 6 days, 4 from 5 days, and 1 from 4 days. The average accelerometer wear time of the total sample was $14.4 \pm 2.2$ hours·day$^{-1}$ across all days. There was no difference in wear time between men and women with ID ($p = 0.915$; Table A1). There was also no difference in wear time between younger and older
individuals with ID ($p = 0.847$; Table A1). The number and duration of SB variables across all days among complete sample, men, and women with ID are shown in Table A2.

**Comparisons by sex and days of the week**

The comparisons between men and women with ID for all SB variables are shown in Table A3. Daily total sedentary time did not differ significantly between men and women across all days combined and for weekdays and weekend days separately as indicated by non-significant main effects and interaction in $2 \times 2$ (sex by day) ANOVA ($p > 0.05$); this was the case for sedentary time expressed both in absolute form (min·day$^{-1}$) and as a percent of wear time.

Most variables describing sedentary bouts (number and duration for bouts ≥1, 10, 30, 60, or 90 min) did not differ significantly between sexes or between days of the week ($p > 0.05$), but there were some exceptions. The number of bouts ≥1 min was greater during weekdays than weekend days for both men and women as indicated by a significant main effect of day ($p = 0.045$) and non-significant effect of sex and interaction in sex by day ANOVA. The average duration of bouts ≥1 min was longer for men than women for all days of the week as indicated by a significant independent samples t-test ($p = 0.017$); this was also the case for weekdays and weekend days, and the duration of bouts ≥1 min was longer during weekend days than weekdays for both sexes as indicated by significant main effects of sex and day ($p = 0.027$ and $p = 0.048$ respectively) without interaction. The number of bouts ≥30 min across all days combined was greater for men than women as indicated by a significant t-test ($p = 0.045$). The duration of bouts ≥60 min was longer during weekdays than weekend days in both men and women with ID as indicated by a significant main effect of day ($p = 0.037$) and non-significant effect of sex and interaction in sex by day ANOVA.
The number of sedentary breaks did not differ significantly between men and women or between days of the week. However, the duration of sedentary breaks was longer during weekdays than weekend days in both men and women with ID as indicated by a significant effect of day ($p < 0.001$) and non-significant effect of sex and interaction in sex by day ANOVA.

**Comparisons by age-group and days of the week**

The comparisons between younger and older individuals with ID for all SB variables are shown in Table A4. Daily total sedentary time did not differ significantly between younger and older individuals across all days combined and for weekdays and weekend days separately as indicated by non-significant main effects and interaction in $2 \times 2$ (age-group by day) ANOVA ($p > 0.05$); this was case for sedentary time expressed both in absolute form (min·day$^{-1}$) and as a percent of wear time.

Most variables describing sedentary bouts (number and duration for bouts ≥1, 10, 30, 60, or 90 min) did not differ significantly between age-groups or between days of the week ($p > 0.05$), but there were some exceptions. The number of bouts ≥1 min was greater during weekdays than weekend days for both younger and older individuals with ID as indicated by a significant main effect of day ($p = 0.043$) and non-significant effect of age-group and interaction in age-group by day ANOVA. The duration of bouts ≥60 min showed a significant age-group by day interaction in $2 \times 2$ ANOVA ($p = 0.001$). Follow up t-tests showed that the duration was longer during weekdays than weekend days in older individuals with ID ($p = 0.006$); this was not the case for younger individuals with ID ($p > 0.05$).

The number of sedentary breaks did not differ significantly between younger and older individuals or between days of the week ($p > 0.05$). However, the duration of sedentary breaks was longer during weekdays than weekend days in both younger and older individuals with ID as
demonstrated by a significant effect of day ($p < 0.01$) and non-significant effect of sex and interaction in age-group by day ANOVA.
CHAPTER V
DISCUSSION

This study examined the levels and patterns of SB among U.S. adults with ID and differences in SB variables between sexes, age-groups, and week vs. weekend days. The main findings were that adults with ID spent about 8-8.5 hours per day in SB and they primarily accumulated sedentary time in bouts 1-30 min in duration.

**Levels and Patterns of SB**

The present findings indicate that U.S. adults with ID spend a large portion of their wake time during the week in SB, which is also the case for the general U.S. population (Dunstan, Howard, et al., 2012; Evenson et al., 2015; Healy, Matthews, et al., 2011; Matthews et al., 2008; Yang et al., 2019). The total sedentary time of the present adults with ID across all days and for both sexes combined was 514 min·day\(^{-1}\) or about 8.5 hours per day; this amount of sedentary time is consistent with past research among adults with ID from the United States, the United Kingdom, and Spain (Dixon-Ibarra et al., 2013; Harris et al., 2019; C. A. Melville et al., 2017; Oviedo et al., 2017). Among the general U.S. population, the amount of time spent sedentary ranges between 7.5 and 8.5 hours per day (Dunstan, Howard, et al., 2012; Evenson et al., 2012; Healy, Matthews, et al., 2011; Matthews et al., 2008; Yang et al., 2019); thus, the total sedentary time of the present adults with ID was at the higher end of the range reported for the general U.S. population.
The present U.S. adults with ID accumulated a significant amount of sedentary time in bouts 1-30 min in duration. This observation is unlike past research in the general population from the United States showing that adults accumulate SB primarily in prolonged bouts of ≥ 30 min (Diaz et al., 2016). This difference between adults with ID and the general U.S. population cannot be explained from the present data. It is possible, however, that adults with ID may participate in community-based programs structured in a way that prevents long bouts of SB. Supporting this argument is that many adults with ID live in residential arrangements and participate in community-based programs designed for adults with ID (Kelly Hsieh et al., 2017; Stancliffe et al., 2012), and this was the case for the present participants. Similar findings to ours on bout duration have been reported among adults with ID from Spain and the United Kingdom (Harris et al., 2019; Oviedo et al., 2017). The number and duration of sedentary breaks, however, were higher in our study compared to the aforementioned two studies from Spain and the United Kingdom (Harris et al., 2019; Oviedo et al., 2017). Furthermore, the number of sedentary breaks was higher for the present study compared to older people without ID from the United States and the United Kingdom (Jefferis et al., 2015; Shiroma et al., 2013). The differences from other countries may be due to environmental and cultural factors which are known to influence SB (Owen et al., 2011; Van Dyck et al., 2012b). In summary, the present U.S. adults with ID accumulate sedentary time in relatively short bouts and take many breaks between bouts.

**Comparison of SB Between Weekdays vs. Weekend Days**

The duration of sedentary bouts ≥1 min was longer during the weekends than weekdays for both men and women. The number of sedentary bouts ≥1 min and the duration of bouts ≥60 min was higher during the weekdays than weekends for both men and women. Similarly, the
number of sedentary bouts ≥1 min was higher in weekdays than weekends for both younger and older individuals with ID. Among the older participants with ID, the duration of bouts ≥60 min was longer in weekdays than weekends. It is possible that older participants are not in the active workforce; therefore, they do not have much work-related engagement throughout the weekdays. Overall, these findings may possibly be due to the fact that many adults with ID participate in recreational activities such as Special Olympics (Kelly Hsieh et al., 2015, 2017), which are often held during the weekends, and may lead to lower SB compared to weekdays. In addition, the duration of sedentary breaks was longer in weekdays than weekend days across both sexes and age-groups; this may be due to structured work-related activities that occur during weekdays. Most SB variables, however, did not differ significantly between weekdays and weekend days; this is consistent with the findings in the general population from the U.S. and adults with ID from the United Kingdom (Evenson et al., 2012; Harris et al., 2019; S. Marshall et al., 2015), but it contrasts with data for adults with ID from Spain showing higher sedentary time during weekdays than weekends (Oviedo et al., 2017). Differences in programs and cultural, environmental, and lifestyle factors between adults with ID from Spain and adults from the United States might explain this difference.

Comparison of SB Between Sexes

There were small differences in SB variables between men and women: the duration of sedentary bouts ≥1 min was longer in men than women across all days combined and during both weekdays and weekend days; and the number of sedentary bouts ≥30 min was greater for men than women across all days. Among the general U.S. population, sedentary time is higher in men than women (Diaz et al., 2016; Evenson et al., 2012). Furthermore, the duration of sedentary
bouts 1+, 5+, 10+, 20+, 30+, 40+, 50+, and 60+ min has been found longer in men than women, although the number of sedentary bouts 1+ min was higher in women than men among older adults of the general U.S. population (Bellettiere et al., 2015). This finding indicates that women spend less time in longer sedentary bouts than men and tend to more frequently break up sedentary bouts. However, total sedentary time did not differ significantly between men and women with ID in the present study, which is consistent with the findings of a systematic review for adults with ID (Westrop et al., 2019). These disparate findings across studies between adults with and without ID cannot be presently explained. However, individuals with ID have cognitive impairments, postural, and locomotor abnormalities (Bear, 2004; Shapiro & Batshaw, 2013); therefore, these features may make their SB level different from general population.

Furthermore, it is also possible that differences in physical functioning between men and women make this difference among general population (Bellettiere et al., 2015). Perhaps, women without ID regularly perform domestic or household activities; whereas, men without ID keep themselves engaged in sitting tasks such as watching movies, playing games (Bellettiere et al., 2015). Overall, the present and past findings indicate that sex-related changes in SB variables may vary between adults with and without ID.

**Comparison of SB Between Age-groups**

We did not find significant differences in SB variables between younger and older individuals with ID consistent with past findings among adults with ID (Dixon-Ibarra et al., 2013; Harris et al., 2019; Kelly Hsieh et al., 2017; C. Melville et al., 2018; Oviedo et al., 2017). This could partly be explained by a consistent behavioral pattern of adults with ID with high SB across the lifespan as it has been reported among people with Down syndrome from around the
world (Agiovlasitis et al., 2019). However, sedentary time is higher in older than younger individuals among the general population (Bellettiere et al., 2015; Diaz et al., 2016; Evenson et al., 2012). Individuals with ID may have high SB across the lifespan because of high levels of health conditions and multi-morbidity (Kinnear et al., 2018). Environmental factors such as lack of support from parents or caregivers, transportation problems, inadequate opportunities, absence of clear policies might predispose individuals with ID to high SB levels (Bodde & Seo, 2009b). Collectively, the present and past findings raise the possibility that age-associated changes in SB may differ between adults with ID and the general population.

**Implications**

The present finding that adults with ID spend a large portion of their day in SB may have health implications because SB is independently associated with all-cause mortality, obesity, diabetes, hypertension, cancer, and depression (de Rezende et al., 2014). It is known that breaks in SB of even short bouts can reduce the risk of diabetes, hypertension, and other cardio-metabolic health issues (Bailey et al., 2015; Dunstan, Kingwell, et al., 2012). Therefore, altering SB with low intensity physical activity may be a good strategy for reducing SB among adults with ID. In addition, adults with ID generally have a different lifestyle than the general population such as different residential arrangements (Kelly Hsieh et al., 2017; Stancliffe et al., 2012), absence of motivation, and discrepancy (Temple, 2007). Therefore, interventions within community-based programs may help reduce SB levels in adults with ID.

**Limitations & Strengths**

In evaluating the present results, readers should consider the following limitations and strengths. We determined sedentary time based on accelerometer output with a threshold
developed for the general population that may not be appropriate for adults with ID (Agiovlasitis et al., 2019; C. A. Melville et al., 2017). A higher accelerometer output cut-point has been found for children with than without ID (McGarty et al., 2016), and this could also be the case among adults with ID. We used a convenience sample from the Southern United States that may not be representative of the entire U.S. population of individuals with ID. Finally, age-group comparisons were cross-sectional and may not reflect longitudinal age-associated changes in SB among adults with ID. Although the study was not population based, it had a reasonable sample size with equal numbers of men and women with ID. Another strength was that each participant provided accelerometer data from several days in accordance with best practice guidelines (Byrom et al., 2016). Furthermore, the present study is among few to provide data on SB levels for adults with ID from the United States and the first offering comprehensive data on their SB patterns.

**Future Research**

More research with larger population-based samples is needed to further delineate the SB levels and patterns of adults with ID from the United States. Longitudinal research is also needed for exploring age-associated changes in SB among adults with ID. In addition, the determinants and consequences of SB in adults with ID should be systematically explored. Such knowledge may aid the development of interventions for reducing SB levels in this population. Importantly, health promotion interventions may be more successful if they abide with theoretical frameworks of behavior change (Agiovlasitis et al., 2018).
**Conclusion**

Adults with ID spend significant amount of their wake time in SB primarily of short to medium bouts. There are small differences between sexes, age-groups, and days of the week, indicating near-uniform SB levels and patterns for men and women with ID throughout the week.
REFERENCES


American Psychiatric Association. (2013). Diagnostic and Statistical Manual of Mental Disorders V. *BMC Medicine, 17,* 133–137.


APPENDIX A

TABLES
Table A1

**Mean ± SD or percent of demographics, anthropometrics, and accelerometer wear time of participants with Intellectual Disability by sex and by age-group**

<table>
<thead>
<tr>
<th>Variables</th>
<th>All n=52</th>
<th>By sex</th>
<th>By age-group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Men n=25</td>
<td>Women n=27</td>
</tr>
<tr>
<td><strong>Age (years)</strong></td>
<td>46 ± 14</td>
<td>48 ± 15</td>
<td>44 ± 14</td>
</tr>
<tr>
<td><strong>Weight (kg)</strong></td>
<td>88.2 ± 24.6</td>
<td>89.7 ± 20.8</td>
<td>86.8 ± 28.0</td>
</tr>
<tr>
<td><strong>Height (cm)</strong></td>
<td>161.9 ± 10.5</td>
<td><strong>167.8 ± 8.8</strong></td>
<td>156.4 ± 9.0</td>
</tr>
<tr>
<td><strong>BMI (kg·m⁻²)</strong></td>
<td>33.3 ± 7.3</td>
<td>31.7 ± 6.0</td>
<td>34.6 ± 8.0</td>
</tr>
<tr>
<td><strong>BMI Category</strong></td>
<td></td>
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</tr>
<tr>
<td>Normal BMI (%)</td>
<td>11.5</td>
<td>12.0</td>
<td>11.1</td>
</tr>
<tr>
<td>Overweight (%)</td>
<td>26.9</td>
<td>32.0</td>
<td>22.2</td>
</tr>
<tr>
<td>Obese (%)</td>
<td>50.0</td>
<td>48.0</td>
<td>51.9</td>
</tr>
<tr>
<td>Extremely obese (%)</td>
<td>11.5</td>
<td>8.0</td>
<td>14.8</td>
</tr>
<tr>
<td>Down syndrome (%)</td>
<td>19.2</td>
<td>16.0</td>
<td>22.2</td>
</tr>
<tr>
<td>Cerebral palsy (%)</td>
<td>1.9</td>
<td>4.0</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Residence type</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Group home (%)</td>
<td>82.7</td>
<td>88.0</td>
<td>77.8</td>
</tr>
<tr>
<td>Parents (%)</td>
<td>15.4</td>
<td>12.0</td>
<td>18.5</td>
</tr>
<tr>
<td>Independent (%)</td>
<td>1.9</td>
<td>0.0</td>
<td>3.7</td>
</tr>
<tr>
<td><strong>ID level</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Mild (%)</td>
<td>48.1</td>
<td>56.0</td>
<td>40.7</td>
</tr>
<tr>
<td>Moderate (%)</td>
<td>46.2</td>
<td>36.0</td>
<td>55.6</td>
</tr>
<tr>
<td>Severe (%)</td>
<td>5.8</td>
<td>8.0</td>
<td>3.7</td>
</tr>
<tr>
<td><strong>Wear time (hours·day⁻¹)</strong></td>
<td>14.4 ± 2.2</td>
<td>14.8 ± 1.9</td>
<td>14.1 ± 2.4</td>
</tr>
</tbody>
</table>

Note: †p<0.05 between men and women with ID; ‡p<0.05 between age-groups.
Table A2

Mean ± SD wear time and sedentary behavior variables across all days among men and women with Intellectual Disability

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total Sample</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wear time (hours·day⁻¹)</strong></td>
<td>14.4 ± 2.2</td>
<td>14.8 ± 1.9</td>
<td>14.1 ± 2.4</td>
</tr>
<tr>
<td><strong>Total Sedentary Time</strong></td>
<td></td>
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<tr>
<td>Sedentary time (min·day⁻¹)</td>
<td>513.6 ± 139.0</td>
<td>532.7 ± 138.8</td>
<td>496.1 ± 140.5</td>
</tr>
<tr>
<td>Sedentary time (% wear time)</td>
<td>59.3 ± 11.8</td>
<td>61.0 ± 15.3</td>
<td>58.0 ± 7.3</td>
</tr>
<tr>
<td><strong>Sedentary Bouts</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Number of bouts ≥1 min</td>
<td>90.0 ± 19.5</td>
<td>85.2 ± 20.6</td>
<td>94.5 ± 17.6</td>
</tr>
<tr>
<td>Duration of bouts ≥1 min</td>
<td>6.0 ± 2.1</td>
<td>6.7 ± 2.6</td>
<td>5.3 ± 1.1</td>
</tr>
<tr>
<td>Number of bouts ≥10 min</td>
<td>13.7 ± 4.6</td>
<td>14.6 ± 5.0</td>
<td>13.0 ± 4.1</td>
</tr>
<tr>
<td>Duration of bouts ≥10 min</td>
<td>21.8 ± 3.9</td>
<td>22.7 ± 4.0</td>
<td>21.0 ± 3.7</td>
</tr>
<tr>
<td>Number of bouts ≥30 min</td>
<td>2.8 ± 2.1</td>
<td>3.5 ± 2.2</td>
<td>2.3 ± 1.8</td>
</tr>
<tr>
<td>Duration of bouts ≥30 min</td>
<td>46.2 ± 5.8</td>
<td>47.1 ± 5.5</td>
<td>45.4 ± 6.1</td>
</tr>
<tr>
<td>Number of bouts ≥60 min</td>
<td>0.5 ± 0.6</td>
<td>0.6 ± 0.6</td>
<td>0.4 ± 0.5</td>
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<tr>
<td>Duration of bouts ≥60 min</td>
<td>55.4 ± 36.7</td>
<td>61.0 ± 36.7</td>
<td>50.3 ± 36.7</td>
</tr>
<tr>
<td>Number of bouts ≥90 min</td>
<td>0.1 ± 0.2</td>
<td>0.1 ± 0.2</td>
<td>0.1 ± 0.1</td>
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<tr>
<td>Duration of bouts ≥90 min</td>
<td>46.3 ± 55.6</td>
<td>55.7 ± 60.4</td>
<td>37.6 ± 50.4</td>
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<tr>
<td><strong>Sedentary Breaks</strong></td>
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<tr>
<td>Number of breaks</td>
<td>13.5 ± 4.6</td>
<td>14.4 ± 5.0</td>
<td>13.0 ± 4.1</td>
</tr>
<tr>
<td>Duration of breaks</td>
<td>101.9 ± 61.7</td>
<td>100.7 ± 73.8</td>
<td>103.0 ± 49.4</td>
</tr>
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</table>
Table A3

*Mean ± SD* Sedentary Behavior Variables in Men and Women with Intellectual Disability

<table>
<thead>
<tr>
<th>Variable</th>
<th>Men</th>
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<td>All days</td>
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<td>All days</td>
<td>Weekdays</td>
<td>Weekend</td>
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<td><strong>Total Sedentary Time</strong></td>
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<tr>
<td>Sedentary time (min·day⁻¹)</td>
<td>532.7 ± 138.8</td>
<td>530.1 ± 146.8</td>
<td>508.5 ± 152.5</td>
<td>496.1 ± 140.5</td>
<td>495.9 ± 139.9</td>
<td>483.7 ± 175.5</td>
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<tr>
<td>Sedentary time (% wear time)</td>
<td>61.0 ± 15.3</td>
<td>59.2 ± 16.0</td>
<td>62.8 ± 15.3</td>
<td>58.0 ± 7.3</td>
<td>57.4 ± 7.3</td>
<td>58.4 ± 12.4</td>
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<tr>
<td><strong>Sedentary Bouts</strong></td>
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<tr>
<td>Number of bouts ≥1 min</td>
<td>85.2 ± 20.6</td>
<td>87.4 ± 21.5*</td>
<td>83.2 ± 25.4</td>
<td>94.5 ± 17.6</td>
<td>95.7 ± 18.7*</td>
<td>90.1 ± 21.6</td>
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<td></td>
</tr>
<tr>
<td>Duration of bouts ≥1 min</td>
<td>6.7 ± 2.6†</td>
<td>6.5 ± 2.6†</td>
<td>7.2 ± 3.8</td>
<td>5.3 ± 1.1</td>
<td>5.2 ± 1.1*</td>
<td>5.5 ± 1.8</td>
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<td>Number of bouts ≥10 min</td>
<td>14.6 ± 5.0</td>
<td>15.0 ± 5.2</td>
<td>13.6 ± 6.1</td>
<td>13.0 ± 4.1</td>
<td>13.8 ± 4.3</td>
<td>12.6 ± 5.5</td>
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<tr>
<td>Duration of bouts ≥10 min</td>
<td>22.7 ± 4.0</td>
<td>22.3 ± 4.1</td>
<td>23.8 ± 5.7</td>
<td>21.0 ± 3.7</td>
<td>20.7 ± 3.6</td>
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<td>Duration of bouts ≥30 min</td>
<td>47.1 ± 5.5</td>
<td>44.6 ± 11.0</td>
<td>46.0 ± 17.5</td>
<td>45.4 ± 6.1</td>
<td>44.5 ± 6.6</td>
<td>39.6 ± 20.3</td>
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<td>0.6±0.7</td>
<td>0.6±0.7</td>
<td>0.4 ± 0.5</td>
<td>0.4±0.4</td>
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<td>Duration of bouts ≥60 min</td>
<td>61.0 ±36.7</td>
<td>56.8 ±42.7*</td>
<td>47.1 ±44.5</td>
<td>50.3 ±36.7</td>
<td>44.2 ±37.8*</td>
<td>28.3 ±37.8</td>
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<td>Number of bouts ≥90 min</td>
<td>0.1±0.2</td>
<td>0.1±0.1</td>
<td>0.2±0.4</td>
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<td>Duration of bouts ≥90 min</td>
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<td>50.8 ±59.8</td>
<td>30.8 ±50.8</td>
<td>37.6 ±50.4</td>
<td>23.4 ±45.0</td>
<td>18.0 ±38.2</td>
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<td><strong>Sedentary Breaks</strong></td>
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<td>13.0 ± 6.1</td>
<td>13.0 ± 4.1</td>
<td>12.6 ± 4.3</td>
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<td>Duration of breaks</td>
<td>100.7 ± 73.8</td>
<td>138.0 ±126.4*</td>
<td>81.1 ± 67.8</td>
<td>103.0 ± 49.4</td>
<td>133.2 ± 50.5*</td>
<td>77.6 ± 45.5</td>
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</tbody>
</table>

Note: *p<0.05 between weekdays and weekend days for both sexes combined; †p<0.05 between men and women with ID.
Table A4

*Mean ± SD* sedentary behavior variables in younger (≤48 years) and older (>48 years) adults with Intellectual Disability

<table>
<thead>
<tr>
<th>Variable</th>
<th>48 years or Younger</th>
<th>Older than 48</th>
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<tbody>
<tr>
<td></td>
<td>All days</td>
<td>Weekdays</td>
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<tr>
<td><strong>Total Sedentary Time</strong></td>
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<tr>
<td>Sedentary time (min·day$^{-1}$)</td>
<td>492.1 ± 135.5</td>
<td>491.4 ± 143.6</td>
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<tr>
<td>Sedentary time (% wear time)</td>
<td>56.3 ± 11.3</td>
<td>55.3 ± 11.7</td>
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<td><strong>Sedentary Bouts</strong></td>
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<td></td>
</tr>
<tr>
<td>Number of bouts ≥1 min</td>
<td>92.1 ± 17.2</td>
<td><strong>92.8 ± 18.6</strong>$^{*}$</td>
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<tr>
<td>Duration of bouts ≥1 min</td>
<td>5.5 ± 1.8</td>
<td>5.4 ± 1.8</td>
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<td>Number of bouts ≥10 min</td>
<td>12.8 ± 4.5</td>
<td>13.0 ± 5.0</td>
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<tr>
<td>Duration of bouts ≥10 min</td>
<td>21.2 ± 4.0</td>
<td>20.6 ± 3.9</td>
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<tr>
<td>Number of bouts ≥30 min</td>
<td>2.4 ± 2.0</td>
<td>2.4 ± 1.8</td>
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<tr>
<td>Duration of bouts ≥30 min</td>
<td>46.3 ± 6.4</td>
<td>43.6 ± 11.0</td>
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<tr>
<td>Number of bouts ≥60 min</td>
<td>0.5 ± 0.6</td>
<td>0.5 ± 0.7</td>
</tr>
<tr>
<td>Duration of bouts ≥60 min</td>
<td>51.5 ± 38.9</td>
<td>42.2 ± 40.5</td>
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<tr>
<td>Number of bouts ≥90 min</td>
<td>0.1 ± 0.2</td>
<td>0.9 ± 0.2</td>
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<tr>
<td>Duration of bouts ≥90 min</td>
<td>46.3 ± 55.4</td>
<td>33.4 ± 51.3</td>
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<tr>
<td>Number of breaks</td>
<td>12.8 ± 4.6</td>
<td>12.8 ± 5.0</td>
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<tr>
<td>Duration of breaks</td>
<td>102.8 ± 54.6</td>
<td><strong>140.8 ± 95.0</strong>$^{*}$</td>
</tr>
</tbody>
</table>

Note: $^{*}$p<0.05 between weekdays and weekend days as indicated by main effect of day in day-by-age-group ANOVA or paired-samples t-test following significant day-by-age-group interaction. There were no significant differences between younger and older groups.