**Title: Patterns of objectively measured sedentary behaviour in adults with intellectual disabilities**

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**ABSTRACT**

**Background**

The purpose of this study was to investigate the patterns of objectively measured sedentary behaviour in adults with intellectual disabilities.

**Methods**

Baseline accelerometer data were pooled from two randomised controlled trials of lifestyle behaviour change programmes for adults with intellectual disabilities. Patterns of sedentary behaviours were computed including total volume, number, and duration of bouts and breaks.

**Results**

Participants spent > 70% of the day sedentary (eight hours), which was generally accumulated in short sedentary bouts (< 10 minutes). Participants engaged in significantly more sedentary time during the morning, although differences between time of day were small (mean bout duration range: 19.8 – 22.3 minutes).

**Conclusions**

The findings add valuable insight into the patterns of sedentary behaviours among adults with intellectual disabilities. Further research investigating the patterns and context of sedentary behaviour is required to develop targeted interventions to reduce total sedentary time in adults with intellectual disabilities.

## 1 INTRODUCTION

Sedentary behaviour is defined as any waking behaviour with an energy expenditure ≤ 1.5 metabolic equivalent, while in a sitting or reclined position, and is considered a separate construct from physical inactivity (Tremblay et al., 2017). Sedentary behaviour represents a

large component of daily life, with observational studies illustrating that adults in the general population engage in sedentary activities for 60% of waking hours, corresponding to 9-10 hours/ day (Dunstan, Howard, Healy, & Owen, 2012a). Total sedentary time is independently associated with increased risk of chronic diseases, including obesity, type 2 diabetes, and cardiovascular disease (de Rezende, Lopes, Rey-López, Matsudo, & do Carmo Luiz, 2014; Thorp, Owen, Neuhaus, & Dunstan, 2011; Wilmot et al., 2012). In addition to total sedentary time, there is increasing evidence that the patterns in which sedentary time is accumulated influence health outcomes (Diaz et al., 2017; Healy et al., 2008; Healy, Matthews, Dunstan, Winkler, & Owen, 2011; Kim, Welk, Braun, & Kang, 2015). Data from the National Health and Nutrition Examination Survey (NHANES) demonstrated that accumulating sedentary time in bouts of > 10 minutes was associated with an increased risk of all-cause mortality (Diaz et al., 2017).

This is concerning as epidemiological studies have illustrated that adults accumulate sedentary time in prolonged, uninterrupted bouts of sedentary behaviour, spending approximately 50% of their day in sedentary bouts ≥ 30 minutes (Diaz et al., 2016). Moreover, prolonged sedentary behaviour is influenced by demographic characteristics including male gender, older age, and overweight and obesity (Diaz et al., 2016). Therefore, in addition to total sedentary time, understanding the patterns of sedentary behaviour and focusing on interrupting prolonged periods of sedentary time (through higher intensity stationary activities and brief activity bouts) is recognised as a priority research area.

As research focussing on sedentary behaviour has continued to evolve, in particular in relation to health outcomes, research guidance on reporting objectively measured sedentary behaviour has been developed (Byrom, Stratton, McCarthy, & Muehlhausen, 2016). These recommendations include the reporting of total sedentary time, weighted mean sedentary bout duration, scaling parameters of the frequency distribution of bout duration (including the

maximum sedentary bout duration and the proportion of bouts exceeding a defined duration e.g. 30 minutes), and the number of postural transitions (Byrom et al., 2016).

In comparison to the increasing evidence-base in the general population, the investigation of patterns of sedentary behaviour and health effects related to sedentary bouts in adults with intellectual disabilities remains relatively understudied. Although there is a growing body of research investigating total sedentary time in adults with intellectual disabilities, to-date, only two studies have investigated patterns of sedentary behaviour.

Finlayson, Turner, and Granat (2011) reported the sedentary time of adults with intellectual disabilities segmented by the time of day (morning, afternoon, and evening) and by type of day (weekday and weekend). Women were significantly more likely to be sedentary than men, both overall and during weekdays. There was a trend for adults with intellectual disabilities to be more sedentary during the morning, although this was not statistically significant. Furthermore, a recent study by Oviedo, Travier, and Guerra-Balic (2017) reported patterns of sedentary behaviour by type of day (weekday and weekend) and by time of day, categorised as time at a day centre (9:00 am to 5:00 pm) and time outside the centre (5:00 pm to 12:00 am). Findings from this study demonstrated that adults with intellectual disabilities were more sedentary during weekdays and during centre time.

Oviedo et al. (2017) also extended the available evidence on patterns of sedentary behaviour by including measures on the number of sedentary bouts and breaks, the percentage of time spent in different bout durations, and the influence of personal factors (gender, age, and weight status) on sedentary behaviour. Adults with intellectual disabilities accumulated sedentary time predominantly in short bouts (< 10 minutes), and adults who were classified as overweight or having obesity participated in significantly more bouts of sedentary behaviour in comparison to adults classified as normal weight. In addition, adults aged < 45 years interrupted sedentary

behaviour more times than adults aged ≥ 45 years. Although these previous studies provide important initial information on the patterns of sedentary behaviour in adults with intellectual disabilities, they are limited by small sample sizes and have not been conducted in accordance with best practice guidelines.

Providing data on patterns of sedentary behaviour, in line with best practice guidelines, will enable more detailed data relating to the impact of sedentary patterns on health to be generated and will inform the development of targeted interventions to reduce sedentary behaviour. Therefore, to address the limited evidence base, the primary aim of this study was to investigate the patterns of objectively measured sedentary behaviour in adults with intellectual disabilities, in accordance with best practice guidelines. A secondary aim was to conduct exploratory analyses to investigate differences in patterns of sedentary behaviour by time and type of day, and by demographic characteristics.

## 2 METHODS

### 2.1 Study Design

Participant data utilised for these analyses were pooled from baseline data from two single-blind randomised controlled trials (RCTs) of lifestyle behaviour change programmes conducted in adults with intellectual disabilities. One RCT was focused on weight management (n = 50; Harris et al., 2015; Harris et al., 2017) and one on increasing physical activity (n = 102; Mitchell et al., 2013; Melville et al., 2015).

The weight management RCT compared two multi-component interventions. Participants were randomised to TAKE 5 or a comparator weight management programme, Waist Winners Too (WWToo) for a 12-month period; a six-month weight loss period (9-12 sessions) followed by a six-month weight maintenance period (six sessions). The key elements of TAKE 5 included an individualised daily energy deficit diet (600 kcal deficit/ day), support to increase physical

activity, the incorporation of behaviour change techniques (goal setting, self-monitoring, review of goals, and feedback on performance), and social support from carers. In addition to these core elements, the TAKE 5 intervention included additional behaviour change techniques to meet the individual needs of each participant. The main components of WWToo involved a health education approach, relaying information on healthy and unhealthy food groups, advocating the benefits of regular physical activity, and incorporating behaviour change techniques (goal setting and self-monitoring). Both programmes were delivered on a one-to-one basis (with support from carers where applicable) by a dietitian and a health professional. The primary outcome was change in body weight (kg) collected at baseline, six months and 12 months.

The physical activity RCT was conducted over a 12-week period. Participants were randomised to a community-based walking intervention (Walk Well) or a waiting-list control. Walk Well consisted of three physical activity consultations (PAC) with a walking advisor. The PAC method focused on four core behaviour change techniques: goal setting; self-monitoring; developing self-efficacy; and social support. Additional behaviour change techniques were again incorporated to tailor the intervention to the individual participants. In line with current physical activity recommendations (Department of Health, 2004) the walking advisor supported participants to develop a walking programme which aimed to increase walking by 30 minutes on at least five days per week, by week 12. The waiting list control group were advised to continue with their daily activity for 12-weeks, following which they were invited to participate in the Walk Well intervention. Data were collected at baseline, 12 and 24-weeks to assess change in the primary outcome: average steps walked/ day. Secondary outcome measures included in both RCTs were: BMI; waist circumference; time spent in, light physical activity or moderate-vigorous intensity physical activity; measures of subjective wellbeing, and; time spent in sedentary behaviour.

### 2.2 Study population

Participants from the primary studies (n = 152) were recruited in Glasgow, Scotland, between 2013 and 2014. Participants were recruited from day centres, voluntary provider organisations, and intellectual disabilities services. Participants were included if they were adults (≥ 18 years), with any level of intellectual disabilities (mild to profound), and who were independently ambulatory. Full details of these studies have been published previously.

### 2.3 Accelerometer data collection and analysis

Sedentary behaviour was objectively measured using the ActiGraph GT3X+ accelerometer (ActiGraph, LLC, Pensacola, FL, USA). This small, lightweight device (46 × 33 × 15 mm, 19 g) was worn on the right hip at the iliac crest, attached using an elastic belt, for seven days, except when showering, bathing, or swimming. The baseline accelerometer data of participants were used in this study to remove any potential influence of the lifestyle behaviour change programmes. The minimum requirements for valid accelerometer data were six hours of data, on at least three out of seven days. Non-wear time was defined by intervals of at least 60 minutes of zero activity counts (Troiano et al., 2008). Activity counts were recorded over 15-second intervals (epochs) and counts for four consecutive epochs summed to give activity counts per minute (cpm). Sedentary behaviour was defined as < 100 cpm, based on cut points in the general population (Atkin et al., 2012). Based on research recommendations, a sedentary bout was defined as a continuous period of < 100 cpm for greater than 10 minutes (Kim et al., 2015). A sedentary break was defined as one or more consecutive epochs ≥ 100 cpm.

**Insert Table 1. Approximately Here**

### 2.4 Sedentary outcomes

Recommended sedentary behaviour measures and their rationale, based on best practice guidelines, are presented in Table 1. The recommendation on the number of postural transitions

could not be assessed due to limitations with estimating this from cpm data produced by ActiGraph accelerometers (Byrom et al., 2016).

Sedentary behaviour variables measuring the total volume were calculated as averages/ day (defined as ≥ 6 hours of wear time) and averaged across all valid days. The included sedentary outcomes were: 1) total sedentary time (hours/ day); 2) percentage of wear time spent sedentary (%), and; 3) total time in sedentary bouts (minutes/ day).

Sedentary bout and sedentary break data were averaged across all measured bouts and summarised for waking hours only (defined as 6 am to 11:59 pm). Sedentary bout variables were: 1) weighted median bouts duration (minutes); 2) maximum sedentary bouts duration (minutes); 3) number of sedentary bouts, and; 4) duration of sedentary bouts (minutes). The distribution of sedentary bouts (number and duration) were examined using the following thresholds: ≥ 10, ≥ 30, ≥ 60, and ≥ 90 minutes. Sedentary break variables were: 1) number of sedentary breaks, and; 2) duration of sedentary breaks (minutes).

**2.5 Statistical analysis**

Descriptive statistics for all sedentary behaviour variables and demographic data are presented as means ± standard deviations (SD) for normally distributed data and medians (Interquartile range; IQR) for not normally distributed data (Tables 2-3). The primary sedentary behaviour outcomes [total sedentary time (hours/ day); weighted median sedentary bouts duration (minutes); the maximum sedentary bouts duration (minutes), and: the distribution of sedentary bouts, number and duration of bouts, defined as bout thresholds: ≥ 10, ≥ 30, ≥ 60, and ≥ 90 minutes] recommended from best practice guidelines (Byrom et al., 2016) are presented in Table 3.

Mixed linear models (repeated measures and analysed at the participant level) were used to conduct exploratory analyses to examine differences in sedentary behaviour variables (total

volume, bouts, and breaks) according to the type of day (weekday vs weekend) and time of day (number and duration of sedentary bouts only). Time of day was categorised as: early morning (6:00 am to 8:59 am); late morning (9:00 am to 11:59 am); early afternoon (12:00 pm to 2:59 pm); late afternoon (3:00 pm to 5:59 pm); early evening (6:00 pm to 8:59 pm), and; late evening (9:00 pm to 11:59 pm). Mixed linear models were used to account for unbalanced data (e.g. incomplete data between different time periods for weekdays and weekend days; Cnaan, Laird, & Slasor, 2005).

To investigate if sedentary behaviour variables (total volume, bouts, and breaks) were influenced by demographic characteristics, linear models were conducted stratified by age (< 45 years/ ≥ 45 years) using a median split (MacCallum et al., 2002); gender (male/ female); level of intellectual disabilities (mild to moderate/ severe to profound), and; weight status (normal weight to overweight/ obesity to morbid obesity). The outcome variables were assessed for normal distribution. For variables that were not normally distributed (all variables except percentage of wear time spent in sedentary behaviour), analyses were conducted on transformed data (log/ square root transformed). For ease of interpretation, the non-transformed values (estimated marginal mean ± SD) are reported in the results sections 3.4-3.5. All statistical data were analysed using SPSS 24 IBM statistical package (SPSS IBM, New York, NY, USA).

## 3 RESULTS

### 3.1 Participant characteristics

The demographic characteristics of participants with valid accelerometer data (n = 143 from the total recruited sample of 152 participants) are presented in Table 2. Data from nine participants was omitted as they did not meet the wear criteria of at least six hours/ day on three or more days. Participants had a mean body mass index of 35.0 ± 8.4 kg/m$^2$ and a mean age of

45.3 ± 13.6 years. The sample had physical health problems (39.2%), mental health problems (33.6%), and problem behaviours (27.3%). Participants lived either independently (28.7%), with family carers (44.8%), or in residential housing with paid support (26.6%). Sixty-eight percent of participants lived in the most deprived areas in Scotland. The health characteristics and deprivation levels of participants in this study are similar to a large population-based sample of adults with intellectual disabilities from the same geographical location, suggesting that this data can be generalised to the wider population of Scottish adults with intellectual disabilities (Cooper, Smiley, Morrison, Williamson, & Allan, 2007; Cooper et al., 2011).

**Insert Table 2. Approximately Here**

### 3.2 Wear time

Participants wore the accelerometer for 11.3 (8.6 - 13.4) hours/ day. Non-wear time was highest during early morning (44.0%) and late evening (39.0%) and ranged from 2.0 - 13.0% during other time periods across the day.

### 3.3 Total volume of sedentary behaviour

The total volume of sedentary behaviour variables are presented in Table 3. Participants spent a median of 8.1 (6.1 - 10.1) hours/ day sedentary, which is 73.0 ± 10.4 % of wear time. The median total time spent in sedentary bouts ≥ 10 minutes was 169.3 (96.8 - 273.0) minutes/ day, which is equivalent to only 35.6 (23.0 - 50.4) % of total daily sedentary time. There were no significant differences between the total volume of sedentary behaviour variables by type of day (weekday/ weekend; $p > .05$; Supplementary Table S1). Test statistics for all exploratory analyses are presented in the online supporting information (Supplementary Table S1, S2, and S4).

**Insert Table 3. Approximately Here**

### 3.4 Sedentary bouts

Sedentary bout variables are presented in Table 3 and Figures 1 - 2. The weighted median sedentary bouts duration for the total sample was 22.0 minutes (minimum – maximum: 10.0 – 171.0 minutes). The weighted median and maximum sedentary bouts duration are reported solely as descriptive statistics and no formal analyses were conducted on these variables. Moreover, due to the small number of bouts, statistical analyses were conducted only for the total number and duration of sedentary bouts by type of day, and results based on an average day were compared by time of day. Participants engaged in a median of 8.0 (5.0 - 12.0) sedentary bouts/ day lasting ≥ 10 minutes [median duration = 18.9 (15.7 - 23.2) minutes], 2.0 (1.0 - 3.0) bouts/ day lasting ≥ 30 minutes [median duration = 41.5 (34.0 - 56.0) minutes], a median of one bout/ day lasting ≥ 60 minutes [median duration = 74.3 (64.6 - 85.5) minutes], and ≥ 90 minutes [median duration = 100.5 (94.8 - 110.7) minutes]. There were no significant differences between the total number and duration of sedentary bouts by type of day (weekday/ weekend; $p > .05$; Supplementary Table S1).

Figures 1 and 2 illustrate the number and mean duration of bouts by time of day. There was no significant difference between the mean number of bouts by time of day ($p > .05$; Supplementary Table S2). However, there was a significant difference in the mean (estimated marginal means) duration of sedentary bouts between the early morning (22.5 ± 11.6 minutes), in comparison to late morning (19.8 ± 6.9 minutes; $p = .043$), early afternoon (19.7 ± 5.8 minutes; $p = .031$), and late afternoon (19.8 ± 6.1 minutes; $p = .038$). There was a trend for the mean duration of sedentary bouts to be greater in the early evening (21.3 ± 7.0 minutes) than in the early afternoon (19.7 ± 5.8 minutes; $p = .051$), although not statistically significant.

**Insert Figure 1. Approximately Here**

**Insert Figure 2. Approximately Here**

### 3.5 Sedentary breaks

The total number and duration of sedentary breaks for the entire sample are illustrated in Table 3. Participants had a median of 7.0 (4.0 - 11.0) breaks/ day, with a median break duration of 43.2 (27.2 - 73.7) minutes. There was a significant difference in mean (estimated marginal means) sedentary breaks duration between weekday (79.8 ± 151.6 minutes) and weekend days (62.6 ± 55.7 minutes; $p = .021$; Supplementary Table S1). However, there was no significant difference between the mean number of breaks during a weekday and weekend day ($p > .05$).

### 3.6 Factors associated with patterns of sedentary behaviour

In the exploratory bivariate analyses, patterns of sedentary behaviour (total volume, bouts, and breaks) were not significantly different by demographic characteristics (age, gender, level of intellectual disabilities, or weight status; $p > .05$; Supplementary Tables S3-S4).

## 4 DISCUSSION

This study adds to the limited evidence on patterns of objectively measured sedentary behaviour in adults with intellectual disabilities. The principal findings were that adults with intellectual disabilities spent on average eight hours/ day (73.0%) sedentary. This was predominantly accumulated in short bouts of sedentary behaviour (< 10 minutes), with participants not frequently engaging in prolonged sedentary bouts (≥ 30 minutes). Participants were more sedentary during the early morning, although there was a low variance in sedentary bout duration across the day (mean bout duration range: 19.8 – 22.3 minutes). Breaks in sedentary behaviour were significantly longer during weekdays compared to weekend days.

Participants in the present study engaged in high levels of sedentary behaviour, which is consistent with findings in the general population (Dunstan et al., 2012a; Healy et al., 2011). However, sedentary time was accrued in fewer prolonged sedentary bouts (≥ 30 minutes), in

comparison to adults without intellectual disabilities (Diaz et al., 2016). These differences could potentially be explained by the limited cognitive abilities and concentration levels of adults with intellectual disabilities, which may result in difficulty engaging in prolonged sedentary tasks, such as reading or using a computer. Moreover, adults with intellectual disabilities have been shown to have different lifestyles and routines to adults without intellectual disabilities, e.g. lower levels of employment (Health and Social Care Information Centre, 2011) and large amounts of time at community day centres/ voluntary organisations (Oviedo et al., 2017). These organisations typically involve set structured routines with periods of scheduled activities (e.g. bowls, snooker, and aerobics). This is distinct from an office-based environment, which generally requires long periods of seated tasks. Therefore, interventions to reduce sedentary behaviour developed for the general population, e.g. work-based interventions, may not be applicable to the lives of adults with intellectual disabilities.

Excessive sedentary time was prevalent for the entire sample in this study, with demographic variables not influencing sedentary behaviours. Previous studies have demonstrated null associations (Harris, McGarty, Hilgenkamp, Mitchell, & Melville, 2018; Oviedo et al., 2017), and significant associations between sedentary time and gender (Finlayson et al., 2011; Melville et al., 2018), obesity (Melville et al., 2018; Nordstrøm, Hansen, Paus, & Kolset, 2013; Oviedo et al., 2017), and higher levels of intellectual abilities (Melville et al., 2018). Although differences between studies may be explained by the component of sedentary behaviour measured, e.g. screen time and total sedentary time, these inconsistencies are in contrast to the breadth of evidence in the general population, which demonstrates a number of individual factors correlate with sedentary behaviour (e.g. age, gender, body mass index; Diaz et al., 2016; O'Donoghue et al., 2016). Therefore, further research is required to elucidate individual factors that may influence patterns of sedentary behaviour in adults with intellectual disabilities.

Recent evidence illustrated that frequent interruptions to sedentary behaviour are beneficial to health and associated with protective cardio-metabolic health outcomes (Bailey et al., 2016; Dunstan et al., 2012b; Pulsford, Blackwell, Hillsdon, & Kos, 2017). The study findings demonstrate that adults with intellectual disabilities engaged in longer sedentary breaks in comparison to previous research in adults with and without intellectual disabilities (Diaz et al., 2016; Oveido et al., 2017). However, this finding should be interpreted with caution as breaks were only investigated for bouts > 10 minutes (resulting in a smaller dataset; n = 831 bouts from 143 participants). Furthermore, the intensity of activity during sedentary breaks was not investigated, thus participants could have continued to participate in short bouts (< 10 minutes) of sedentary behaviour during these breaks. Breaks in sedentary behaviour were also significantly longer during weekdays in comparison to weekend days, which may be reflective of the more structured routines at day centres. However, unlike sedentary bouts, there is no research recommending the duration and frequency of sedentary time interruptions to reduce the risk incurred by prolonged sedentary bouts. Therefore, further research is required to inform behavioural interventions on the frequency and duration of sedentary breaks required to improve the health of adults with intellectual disabilities.

### 4.1 Strengths and limitations

Key strengths of this study include the objective measurement of total sedentary time and patterns of sedentary behaviour in a relatively large and representative sample of adults with intellectual disabilities. This study complied with best practice guidelines for reporting sedentary behaviour (Byrom et al., 2016) and included clinically relevant bouts of sedentary behaviour (bout duration ≥ 30 minutes; Kim et al., 2015; Peddie et al., 2013).

There are, however, measurement-related issues within this study and research involving adults with intellectual disabilities that need to be considered when interpreting the results. Sedentary behaviour was defined as < 100 cpm. This is a standard cut point based on research in the

general population and may not be valid for adults with intellectual disabilities. Adults with intellectual disabilities have shown to fidget more whilst sedentary (Ohwada, Nakayama, Suzuki, Yokoyama, & Ishimar, 2005) and may require a higher cut point to classify sedentary behaviour, as shown to be required in children with intellectual disabilities (McGarty, Penpraze, & Melville, 2016). Therefore, there is a need for more focussed measurement research in adults with intellectual disabilities to investigate the validity of accelerometer-based devices to measure sedentary time and the validity of existing cut points.

Furthermore, despite the high wear time compliance, the consideration of valid data was set to the minimum six hours/ day on at least three out of seven days and, therefore, may underestimate total sedentary time, particularly in the early morning and late evening where there was a high proportion of participants not wearing their accelerometer. Accelerometers were also unable to capture postural transitions, and therefore information on the type of sedentary behaviour (i.e. sitting or standing) was not provided.

### 4.2 Implications for future research

This study adds to the current evidence-base by providing information on the patterns of sedentary behaviour, which is essential to inform the design of targeted interventions. However, to date, there have been no interventions focussed solely on reducing sedentary behaviour in adults with intellectual disabilities. As sedentary behaviour is accumulated in short bouts, intervention development should focus on promoting the transition from sedentary behaviours to stationary and light intensity activities to reduce total sedentary time.

Sedentary bouts were significantly greater in the morning; however, these differences were small and not clinically meaningful, suggesting that adults with intellectual disabilities have little variation in their sedentary behaviours throughout the day. Therefore, further research is necessary to understand the context in which patterns of sedentary behaviour occur.

Understanding the purpose, location, and social setting of sedentary behaviour would help identify which behaviours are potentially modifiable. Moreover, as adults with intellectual disabilities spend a large proportion of their week at day centres, which inadvertently promote high levels of total sedentary time (Oveido et al., 2017), developing community-based interventions may provide an opportunity to reduce this lifestyle behaviour.

## 5 CONCLUSION

Sedentary behaviour represents a large component of the daily lives of adults with intellectual disabilities. Patterns of sedentary behaviour were primarily accumulated in short sedentary bouts (< 10 minutes). However, further research is required to understand the correlates of different patterns and contexts of sedentary behaviour. This type of focussed research would allow for the development of targeted interventions for reducing sedentary behaviour relevant to the lives of individuals with intellectual disabilities.

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## Tables

**Table 1.** Summary and rationale of measures of sedentary behaviour (Adapted from Byrom et al., 2016).

| **Outcome measure** | **Rationale/ Definition** |
|---|---|
| Total sedentary time (hours/ day) | Interpretable volume estimate shown to relate to chronic disease risk |
| Weighted median sedentary bouts duration (minutes) | The duration of the sedentary bouts corresponding to 50% of the daily accumulated sedentary time. Provides a measure of centrality given the distribution of bout duration with good sensitivity to detect change. |
| Maximum sedentary bouts duration (minutes) | There is evidence that the way sedentary behaviour is accumulated is related to health outcomes and, therefore, is a target for interventions aiming to break up sedentary time. However, it is likely to exhibit high intra-subject variability and may be insensitive to detecting changes. |

| | |
|---|---|
| Distribution of sedentary bouts | Describes the overall pattern of sedentary behaviour. Measures derived include the proportion of bouts exceeding a defined duration (e.g. 30 minutes). For the purpose of this study this was defined as bout thresholds: ≥ 10, ≥ 30, ≥ 60, and ≥ 90 minutes. |
| Number of postural transitions | Describes the changes in sedentary activities (i.e. lying/sitting to standing). |

**Table 2.** Demographic characteristics of participants.

| **Demographic characteristic** | **n (%)** |
|---|---|

| | |
|---|---|
| ***Age*** | |
| 18-24 | 14 (10.0) |
| 25-34 | 22 (15.7) |
| 35-44 | 18 (12.9) |
| 45-54 | 52 (37.1) |
| 55+ | 34 (24.3) |
| *Missing* | 3 |
| ***Gender*** | |
| Male | 69 (48.3) |
| Female | 74 (51.7) |
| *Missing* | 0 |
| ***Marital Status*** | |
| Married/ live-in partner | 5 (3.5) |
| Separated/ divorced | 3 (2.1) |
| Single | 135 (94.4) |
| *Missing* | 0 |
| ***Ethnicity*** | |
| White | 141 (98.6) |
| Asian | 2 (1.4) |
| *Missing* | 0 |
| ***Level of intellectual disabilities*** | |
| Mild | 69 (48.3) |
| Moderate | 51 (35.7) |
| Severe | 18 (12.6) |

| | |
|---|---|
| Profound | 4 (2.8) |
| *Missing* | 1 |
| ***Weight status (kg/m$^2$)*** | |
| Normal (18.5–24.9) | 17 (12.1) |
| Overweight (25–29.9) | 23 (16.3) |
| Obesity (30–39.9) | 68 (48.2) |
| Morbid obesity (>40.0 kg) | 33 (23.4) |
| *Missing* | 2 |

**Table 3.** Summary of sedentary behaviour (total volume, bouts, and breaks).

| **Sedentary Behaviour Variable** | **Average day** | **Weekday** | **Weekend day** |
|---|---|---|---|
| ***Total volume*** | | | |
| **Total time in sedentary behaviour (hours/ day)**[+] | 8.1 (6.1 - 10.1) | 8.2 (6.1 - 10.1) | 8.0 (5.9 - 9.9) |
| **Total time in sedentary behaviour (minutes/ day)**[+] | 491.3 (364.4 - 603.4) | 494.0 (366.0 - 605.7) | 481.0 (353.1 - 592.0) |
| Percentage of wear time spent sedentary (%; mean ± SD)[+] | 73.0 ± 10.4 | 72.8 ± 10.7 | 73.7 ± 9.3 |
| Total time of sedentary bouts (minutes/ day)[+] | 169.3 (96.8 - 273.0) | 170.0 (94.8 - 273.0) | 162.1 (100.3 - 278.3) |
| ***Sedentary bouts*** | | | |
| **Weighted median bouts duration [minutes (minimum – maximum)]**[*] | 22.0 (10.0 - 171.0) | 22.0 (10.0 - 166.8) | 10.8 910.0 - 171.3) |
| **Number of sedentary bouts ≥ 10 minutes (n)**[*] | 8.0 (5.0 - 12.0) | 8.0 (5.0 - 12.0) | 8.0 (5.0 - 12.0) |
| **Duration of sedentary bouts ≥ 10 minutes (minutes)**[*] | 18.9 (15.7 - 23.2) | 18.8 (15.6 - 23.1_ | 19.4 (15.9 - 23.7) |
| **Number of sedentary bouts ≥ 30 minutes (n)**[*] | 2.0 (1.0 - 3.0) | 2.0 (1.0 - 3.0) | 2.0 (1.0 - 3.0) |
| **Duration of sedentary bouts ≥ 30 minutes (minutes)**[*] | 41.5 (34.0 - 56.0) | 41.5 (34.3 - 55.3) | 40.9 (34.0 - 57.3) |

| | | | |
|---|---|---|---|
| **Number of sedentary bouts ≥ 60 minutes (n)*** | 1** | 1** | 1** |
| **Duration of sedentary bouts ≥ 60 minutes (minutes)*** | 74.3 (64.7 - 85.5) | 74.8 (64.8 - 85.4) | 73.0 (63.3 - 86.3) |
| **Number of sedentary bouts ≥ 90 minutes (n)*** | 1** | 1** | 1** |
| **Duration of sedentary bouts ≥ 90 minutes (minutes)*** | 100.5 (94.8 - 110.7) | 102.3 (95.0 - 108.3) | 99.3 (92.8 - 113.8) |
| ***Sedentary breaks*** | | | |
| Number of sedentary breaks (n)* | 7.0 (4.0 - 11.0) | 7.0 (4.0 - 11.0) | 7.0 (4.0 - 11.0) |
| Duration of sedentary breaks (minutes)* | 43.2 (27.2 - 73.7) | 42.4 (26.5 - 72.7) | 44.8 (29.0 - 74.5) |

Note: Unless otherwise stated data are presented as median (IQR). Variables in bold are reported according to best practice guidelines by Byrom et al. (2016).

+ total volume of sedentary data were averaged across all valid days.

* sedentary bout data were averaged across all measured bouts (≥ 10 minutes) and summarised for waking hours only.

**IQR not presented as all data values equal to one bout.

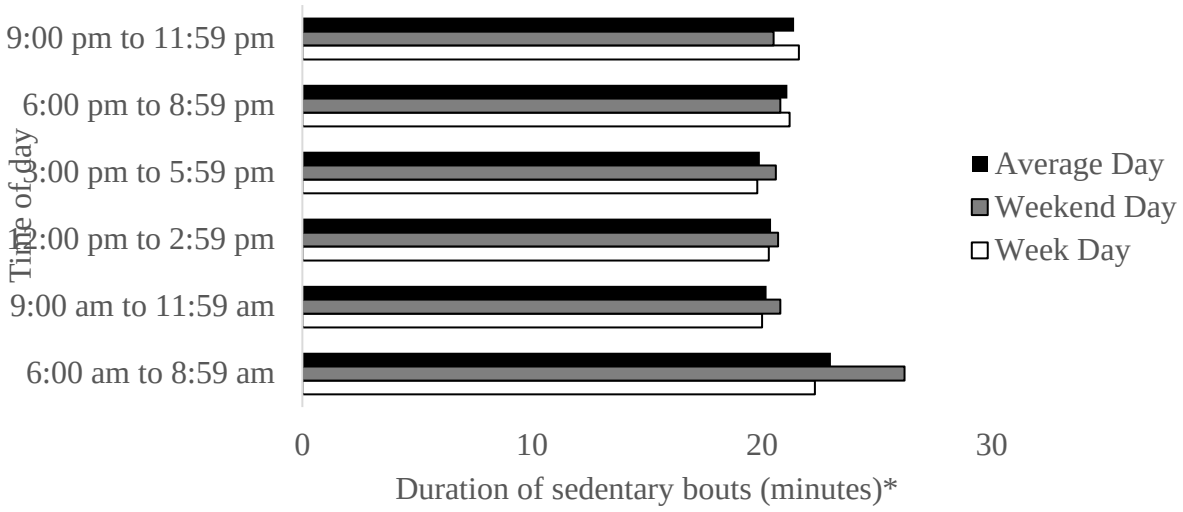
IQR: Interquartile Range; SD: Standard Deviation.

**Figures**

**Figure 1.** Summary of the average number of sedentary bouts at different time intervals throughout the day.


* sedentary bout data were averaged across all measured bouts (≥ 10 minutes) and summarised for waking hours only. Results differ from section 3.4, which reports the estimated marginal means (analysed at the participant level).

**Figure 2.** Summary of the average duration of sedentary bouts at different time intervals throughout the day.




* sedentary bout data were averaged across all measured bouts (≥ 10 minutes) and summarised for waking hours only. Results differ from section 3.4, which reports the estimated marginal means (analysed at the participant level).

**Appendix: Supplementary information**

**Table S1.** Test statistics from linear models (type of day associated with sedentary behaviour variables)

| **Sedentary behaviour variable** | **Numerator df** | **Denominator df** | **F** | **p-value** |
|---|---|---|---|---|
| ***Total volume*** | | | | |
| Total time in sedentary behaviour (hours/ day) | 1 | 184 | 1.5 | 0.219 |
| Percentage of wear time spent sedentary (%) | 1 | 222 | 0.4 | 0.521 |
| Total time of sedentary bouts (minutes/ day) | 1 | 206 | 0.3 | 0.589 |
| ***Sedentary bouts*** | | | | |
| Number of sedentary bouts (n) | 1 | 239 | <0.1 | 0.844 |
| Duration of sedentary bouts (minutes) | 1 | 209 | 1.3 | 0.249 |
| ***Sedentary breaks*** | | | | |
| Number of sedentary breaks (n) | 1 | 237 | 0.6 | 0.449 |
| Duration of sedentary breaks (minutes) | 1 | 223 | 5.4 | 0.021 |

DF: degrees of freedom.

**Table S2.** Test statistics from linear models (time of day associated with sedentary behaviour variables)

| **Sedentary behaviour variable** | **Numerator df** | **Denominator df** | **F** | **p-value** |
|---|---|---|---|---|
| Number of sedentary bouts (n) | 5 | 195 | 1.8 | 0.106 |
| Duration of sedentary bouts (minutes) | 5 | 191 | 2.1 | 0.065 |

DF: degrees of freedom.

**Table S3.** Summary of sedentary behaviour (total volume, bouts and breaks).

| **Demographic characteristic** | **Total time in sedentary behaviour (hours/ day)**[+] | **Percentage of wear time spent sedentary (%; means ± SD)**[+] | **Total time of sedentary bouts (minutes/ day)**[+] | **Number of sedentary bouts (n)**[*] | **Duration of sedentary bouts (minutes)**[*] | **Number of sedentary breaks (n)**[*] | **Duration of sedentary breaks (minutes)**[*] |
|---|---|---|---|---|---|---|---|
| All participants | 8.1 (6.1 - 10.1) | 73.0 ± 10.4 | 169.3 (96.8 - 273.0) | 8.0 (5.0 - 12.0) | 18.9 (15.7 - 23.2) | 7.0 (4.0 - 11.0) | 43.2 (27.2 - 73.7) |
| ***Age*** | | | | | | | |
| < 45 years | 6.7 (5.5 - 8.5) | 70.9 ± 10.6 | 119.9 (71.4 - 204.6) | 7.0 (4.0 - 10.0) | 17.1 (14.4 - 24.6) | 5.0 (3.0 - 8.3) | 45.6 (31.2 - 83.8) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ≥ 45 years | 6.6 (5.4 - 8.8) | 74.1 ± 10.7 | 152.3 (84.3 - 234.3) | 8.0 (5.0 - 12.0) | 18.1 (15.2 - 23.4) | 7.0 (4.0 - 10.0) | 39.1 (24.1 - 74.6) |
| ***Gender*** | | | | | | | |
| Female | 6.5 (5.4 - 8.5) | 71.9 ± 10.7 | 137.9 (74.3 - 201.1) | 7.0 (4.8 - 10.0) | 18.2 (15.3 - 23.5) | 6.0 (4.0 - 9.0) | 42.6 (27.8 - 77.9) |
| Male | 7.3 (5.6 - 8.9) | 73.9 ± 10.8 | 133.8 (84.6 - 254.6) | 8.0 (5.0 - 11.5) | 17.2 (14.6 - 23.5) | 6.0 (4.0 - 10.0) | 43.9 (23.4 - 78.7) |
| ***Level of intellectual disabilities*** | | | | | | | |
| Mild | 6.6 (5.2 - 8.5) | 69.8 ± 10.8 | 113.3 (73.9 - 207.3) | 7.0 (4.0 - 10.0) | 17.3 (14.3 - 23.4) | 6.0 (4.0 - 9.0) | 45.3 (25.7 - 87.3) |
| Moderate | 6.7 (5.3 - 9.0) | 75.4 ± 8.9 | 157.3 (85.0 - 253.8) | 8.0 (5.0 - 12.0) | 18.2 (15.8 - 23.7) | 6.0 (3.0 - 10.0) | 43.4 (26.3 - 74.7) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Severe | 7.9 (5.8 - 8.5) | 77.7 ± 12.5 | 169.4 (112.3 - 303.9) | 9.5 (6.8 - 12.3) | 19.0 (15.5 - 26.0) | 8.0 (5.0 - 11.0) | 41.7 (22.1 - 73.4) |
| Profound | 6.5 (4.7 - 10.3) | 73.0 ± 11.0 | 132.4 (47.9 - 240.3) | 8.0 (2.8 - 12.5) | 15.6 (12.6 - 19.2) | 6.0 (1.5 - 10.5) | 41.6 (30.0 - 68.8) |
| ***Weight status (kg/m$^2$)*** | | | | | | | |
| Normal (18.5–24.9) | 7.8 (5.4 - 10.0) | 74.1 ± 11.8 | 168.0 (65.3 - 320.4) | 8.0 (5.5 - 13.5) | 17.3 (14.7 - 23.0) | 7.0 (2.5 - 12.5) | 57.1 (28.0 - 78.3) |
| Overweight (25–29.9) | 6.1 (5.0 – 7.8) | 69.2 ± 10.0 | 84.3 (48.3 - 170.0) | 5.0 (3.0 - 9.0) | 16.2 (14.2 - 18.3) | 4.0 (3.0 - 9.0) | 51.0 (25.5 - 95.6) |
| Obesity (30–39.9) | 6.6 (5.5 - 8.6) | 73.0 ± 10.7 | 141.1 (85.7 – 211.0) | 8.0 (5.0 - 11.0) | 17.6 (14.8 - 25.0) | 7.0 (4.0 - 9.0) | 36.7 (26.0 - 84.3) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Morbid obesity (>40.0) | 7.1 (6.3 - 8.7) | 74.2 ± 11.0 | 155.5 (98.8 - 254.6) | 7.0 (5.5 - 12.0) | 19.5 (15.7 - 23.2) | 6.0 (3.5 - 10.0) | 42.3 (21.9 - 52.0) |

Note: Unless otherwise stated data are presented medians (IQR). Linear models were conducted stratified by age (< 45 years/ ≥ 45 years); gender (male/ female); level of intellectual disabilities (mild to moderate/ severe to profound), and; weight status (normal weight to overweight/ obesity to morbid obesity).

+data were averaged across all valid days.

* sedentary bout and break data were averaged across all measured bouts/ breaks and summarised for waking hours only.

IQR: Interquartile Range; SD: Standard Deviation.

**Table S4.** Test statistics from linear models (Demographic factors associated with sedentary behaviour variables)

| **Sedentary behaviour variable** | **Numerator df** | **Denominator df** | **F** | **p-value** |
|---|---|---|---|---|
| ***Total time in sedentary behaviour (hours/ day)*** | | | | |
| Age (< 45 years/ ≥ 45 years) | 1 | 138 | 0.4 | 0.526 |
| Gender (male/ female) | 1 | 141 | 1.9 | 0.170 |
| Level of intellectual disabilities (mild to moderate/ severe to profound) | 1 | 140 | 0.9 | 0.345 |
| Weight status (normal weight to overweight/ obesity to morbid obesity) | 1 | 139 | 0.1 | 0.771 |
| ***Percentage of wear time spent sedentary behaviour (%)*** | | | | |
| Age (< 45 years/ ≥ 45 years) | 1 | 138 | 3.0 | 0.086 |
| Gender (male/ female) | 1 | 141 | 1.3 | 0.264 |
| Level of intellectual disabilities (mild to moderate/ severe to profound) | 1 | 140 | 3.5 | 0.063 |
| Weight status (normal weight to overweight/ obesity to morbid obesity) | 1 | 139 | 1.1 | 0.292 |
| ***Total time of sedentary bouts (minutes/ day)*** | | | | |
| Age (< 45 years/ ≥ 45 years) | 1 | 138 | 2.1 | 0.151 |
| Gender (male/ female) | 1 | 141 | 1.4 | 0.238 |
| Level of intellectual disabilities (mild to moderate/ severe to profound) | 1 | 140 | 1.9 | 0.174 |

| | | | | |
|---|---|---|---|---|
| Weight status (normal weight to overweight/ obesity to morbid obesity) | 1 | 139 | 0.8 | 0.364 |
| ***Number of sedentary bouts (n)*** | | | | |
| Age (< 45 years/ ≥ 45 years) | 1 | 138 | 3.0 | 0.086 |
| Gender (male/ female) | 1 | 141 | 1.3 | 0.247 |
| Level of intellectual disabilities (mild to moderate/ severe to profound) | 1 | 140 | 2.1 | 0.151 |
| Weight status (normal weight to overweight/ obesity to morbid obesity) | 1 | 139 | 0.4 | 0.531 |
| ***Duration of sedentary bouts (minutes)*** | | | | |
| Age (< 45 years/ ≥ 45 years) | 1 | 138 | <0.1 | 0.935 |
| Gender (male/ female) | 1 | 141 | <0.1 | 0.937 |
| Level of intellectual disabilities (mild to moderate/ severe to profound) | 1 | 140 | <0.1 | 0.924 |
| Weight status (normal weight to overweight/ obesity to morbid obesity) | 1 | 139 | 1.4 | 0.235 |
| ***Number of sedentary breaks (n)*** | | | | |
| Day of week (weekday/ weekend) | 1 | 237 | 0.6 | 0.449 |
| Age (< 45 years/ ≥ 45 years) | 1 | 138 | 2.7 | 0.102 |
| Gender (male/ female) | 1 | 141 | 0.6 | 0.447 |
| Level of intellectual disabilities (mild to moderate/ severe to profound) | 1 | 140 | 0.9 | 0.345 |
| Weight status (normal weight to overweight/ obesity to morbid obesity) | 1 | 139 | 1.5 | 0.704 |

| | | | | |
|---|---|---|---|---|
| ***Duration of sedentary breaks (minutes)*** | | | | |
| Age (< 45 years/ ≥ 45 years) | 1 | 138 | 2.5 | 0.118 |
| Gender (male/ female) | 1 | 141 | 0.5 | 0.502 |
| Level of intellectual disabilities (mild to moderate/ severe to profound) | 1 | 140 | 1.1 | 0.301 |
| Weight status (normal weight to overweight/ obesity to morbid obesity) | 1 | 139 | 0.9 | 0.355 |

DF: degrees of freedom.