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Correlates of objectively measured sedentary time in adults with intellectual disabilities.

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Abstract

Sedentary behaviour is an independent risk factor for adverse health conditions. Adults with intellectual disabilities spend a high proportion of their day engaged in sedentary behaviour, however, there is limited evidence on potential correlates of objectively measured sedentary behaviour in this population group. In Glasgow, UK from July to September 2017, a secondary analysis of pooled baseline accelerometer data from two randomised controlled trials of lifestyle behaviour change programmes was conducted. Backwards linear regression was used to investigate the associations between demographic, biological, and environmental correlates and objective measure of sedentary behaviour (percentage of time spent sedentary). One-hundred and forty-three participants provided valid accelerometer data. Mean percentage time spent sedentary (adjusted for wear time) was 72.9% [Standard Deviation (SD) = 8.7] per day. In the final model, physical and mental health problems were significantly ($p < 0.05$) associated with increased percentage time spent sedentary. This is the first study to provide evidence on multi-level, demographic, biological, and environmental correlates of objectively measured sedentary behaviour in adults with intellectual disabilities. To inform the development of interventions to modify sedentary behaviours in adults with intellectual disabilities, further research is required including a wide range of socio-ecological correlates.

CPM: Counts per minute; IQR: Interquartile Range; LHIDS: Longitudinal Health and Intellectual Disabilities Study; SD: Standard Deviation; TV: Television.

Introduction

Prolonged periods of time spent in sedentary behaviour is an independent risk factor for adverse health conditions, such as obesity, type II diabetes, cardiovascular disease (de Rezende et al., 2014; Thorp et al., 2011; Wilmot et al., 2012), and mental-ill health (Hamer et al., 2014; Teychenne et al., 2010). 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 a separate construct from physical inactivity (Tremblay et al., 2017).

Epidemiological studies have shown that adults spend a high proportion of their day engaged in sedentary activities, such as television (TV) viewing, screen time, and sitting for occupation and travel (Matthews et al., 2008; Colley et al., 2011; Healy et al., 2011a). Adults with intellectual disabilities [defined as having impairments in intellectual functioning and adaptive behaviour that are present before the age of 18 (American Association on Intellectual and Developmental Disabilities, 2010)] are consistently regarded as a highly sedentary population (Melville et al., 2017), and have been shown to engage in more sedentary time in comparison to the general population (Schuna et al., 2013). Therefore, reducing sedentary time in adults with intellectual disabilities may improve the health of this population group.

The knowledge base relating to correlates of sedentary behaviour in adults with intellectual disabilities is limited (Melville et al., 2017). Two previous studies have utilised subjective measures of sedentary behaviour. Exploratory bivariate analysis revealed that having obesity was positively correlated with more hours spent watching TV in a large (n = 1450) sample of adults with intellectual disabilities from the USA, using baseline data from the Longitudinal Health and Intellectual Disabilities Study (LHIDS; Hsieh et al., 2014). However, this was not replicated in a study of 570 French adults with intellectual disabilities (Mikulovic et al., 2014). In contrast, exploratory bivariate analysis revealed that mean weekly time spent sedentary (use of TV, computers or video games) was lower in overweight participants in comparison to non-overweight participants, although this was not statistically significant (Mikulovic et al., 2014).

Two studies have examined the correlates of objectively measured sedentary behaviour in adults with intellectual disabilities. In a UK sample of 62 adults with mild-moderate intellectual disabilities, gender was correlated with sedentary behaviours, with women more sedentary than men (Finlayson et al., 2011). A Norwegian study with a sample of 96 individuals with Down syndrome, William syndrome, or Prader Willi syndrome found that body weight was a correlate

of sedentary behaviour, with participants who were underweight or of normal weight more sedentary than individuals who were overweight or obese (Nordstrøm et al., 2013).

Although these initial studies are of interest, they are limited by their focus on individual factors and provide little information on the complex environmental influences on sedentary behaviour. A socio-ecological perspective has been proposed as a useful framework to understand correlates of sedentary behaviour. This multi-level approach includes intrapersonal (biological), interpersonal (social), organisational, environmental, and policy factors (Bronfenbrenner, 1979; Owen et al., 2011). This model has been widely used to investigate how different factors affect sedentary behaviour and activity in typically developing populations (Sallis et al., 2008).

Due to the limited existing research relating to adults with intellectual disabilities, it is important to increase our understanding of multi-level factors which correlate with sedentary behaviour in this population. This can then inform the development of future interventions to decrease the high levels of sedentary behaviours and reduce the health inequalities experienced by this population group (Owen et al, 2011). Furthermore, it is important that the limitations of previous studies measuring sedentary behaviour in adults with intellectual disabilities are addressed and research is conducted with objective measures of sedentary behaviour. Therefore, the aim of this study is to add to the available evidence by investigating correlates of objectively measured sedentary behaviour in adults with intellectual disabilities.

Method

Design

A secondary analysis of pooled baseline data from two randomised controlled trials (RCTs) of lifestyle behaviour change programmes was conducted. One RCT was focused on weight management (n = 50; Harris et al., 2015; Harris et al., 2017) and the second one on increasing physical activity (n = 102; Mitchell et al., 2013; Melville et al., 2015).

Participants

Participants (n = 152) were recruited for the multi-component lifestyle behaviour change programmes, which were conducted in Glasgow, Scotland, between 2013 and 2014. The eligibility criteria for both studies were similar. Participants over 18 years of age with any level of intellectual disabilities and who were independently ambulatory were included. Full details of these studies have been published previously.

Measures

Objective measure of sedentary behaviour

The baseline accelerometer data of participants was used in this study, to remove any potential influence of the lifestyle behaviour change programmes. 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 minimum data requirements for valid accelerometer data was set at six hours of data, on at least three days from seven. 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). Sedentary behaviour is reported as minutes per day and percentage time spent in sedentary behaviour, adjusted for wear time.

Potential correlates of sedentary behaviour

Descriptive data from the primary studies were included as potential correlates of sedentary behaviour, which were categorised into demographic, biological, and environmental factors based on the framework by Sallis et al. (2000).

Demographics

Demographic factors included age (categorised as < 45 years/ ≥ 45 years), gender (male/ female), and level of intellectual disabilities (mild to moderate/ severe to profound). Level of intellectual disabilities was assessed based on questions on ability and development in five key areas of functioning: eating and drinking, intimate care, personal safety, communication, and decision-making (The C21 Health check; https://www.gla.ac.uk/media/media_62785_en.pdf pages 63-64). Total scores assessed by the ability and development questionnaire have shown to be highly associated (Melville et al., 2008) with the Vineland's Adaptive Behaviour Scale a validated assessment of functioning and ability level (Sparrow et al., 1984). Ethnicity (White/ Asian), marital status (married or live-in partner/ separated or divorced/ single) were also measured but due to categories with very low numbers of data points these factors were not included in the analysis.

Biological

Biological factors included were physical and mental health problems, problem behaviours, and obesity. Health was assessed by whether participants had physical health problems (yes/no), mental health problems (yes/no), or problem behaviours (yes/no), using self- or family/paid carer- proxy-reports. Physical health was assessed using an open-ended question where participants listed any physical health problems, e.g. type II diabetes or high blood pressure. Mental health was assessed based on a yes/no response to the following definitions: any mental health needs, emotional problems, psychological problems, dementia, or other psychiatric ill-health. Problem behaviours were defined as any problem behaviours, challenging behaviour, or special needs related to behaviour, for example verbal aggressive behaviour toward other people, physical behaviour that lead to injury to the individual or others, or destruction of property.

Prevalence of obesity (yes/no) was assessed based on objective measurements of weight and height. Measurements were made with the participant wearing light clothes without shoes. All measurements were made in duplicate and the final value calculated as the mean of the two measurements. Weight in kilograms (kg) was measured to the nearest 100 grams (g) using SECA877 scales (SE approval class III; SECA Germany). Height in meters (m) was measured to the nearest 1milimetre (mm) using the SECA Leicester stadiometer (SECA, Germany). BMI (kg/m^2) was calculated as weight (kg)/$height^2$ (m). Obesity was defined as a BMI $\geq$ 30 kg/m^2.

Environmental

Environmental factors included were accommodation type and neighbourhood deprivation.

Accommodation type was assessed based on a self- or family/paid carer- proxy-reported question asking where the participant lives, which had the following nine potential responses:

1) Parents home
2) Other family carers home
3) Lives independently +/- children, without any paid support
4) Lives independently with paid support
5) Supported group living (shared tenancy, with paid support)
6) Supported living - individual (single tenancy, with paid support)
7) Residential care (registered home)
8) Nursing home
9) NHS accommodation.

Based on the answer to the question about where the person lived, accommodation type was categorised as: lives with family support (1-2 from the list above), lives independently (3-5), or lives with paid support (6-9).

Neighbourhood deprivation category was assessed based on the Scottish Index of Multiple Deprivation (SIMD) quintile (http://www.scotland.gov.uk/Topics/Statistics/SIMD), calculated based on a participant's postcode. This is categorised into five quintiles of deprivation (most deprived 0-20% to least deprived 80-100%).

Statistical analysis

Descriptive statistics were used to describe the socio-demographic characteristics of adults with intellectual disabilities and sedentary behaviour (minutes/day). Percentage of time spent sedentary was calculated as the dependent outcome, adjusted for wear time [mean (standard deviation; SD)]. Median and interquartile range (IQR) is reported for non-normally distributed data. Simple linear regression was used to examine the relationship between each correlate and percentage of time spent sedentary. Variables from these exploratory bivariate analyses with $p < .25$ were considered to have a potentially significant relevance to sedentary behaviour and were taken forward to multiple linear regression modelling (Bendel & Afifi, 1977). Multiple linear regression modelling was performed using a backwards linear regression method to remove variables that were non-significant ($p > .05$). The final multivariate model fit was tested using R^2 and the model was assessed to ensure it met the assumptions of linear regression. All statistical data were analysed using SPSS 21 IBM statistical package (SPSS IBM, New York, NY, USA).

Results

Participant characteristics

The socio-demographic characteristics are presented in Table 1. One hundred and forty-three participants provided valid accelerometer data from the total recruited sample of 152 adults with intellectual disabilities. Missing data were due to nine participants not meeting the wear criteria of at least six hours per day on three or more days. The participant health characteristics and deprivation levels in this study are similar to a large population-based sample of adults

with intellectual disabilities from the same geographical location (Cooper et al., 2007; Cooper et al., 2011).

INSERT Table 1. Approximately here

Sedentary behaviour

Levels of objectively measured sedentary behaviour were high. The median time spent sedentary was 467.5 minutes per day (IQR = 411.0 - 542.2). Mean percentage time spent in sedentary behaviour (adjusted for wear time) was 72.9% (SD = 8.7), with a range of 49.2 - 96.4% (Table 1).

Correlates of objectively measured sedentary behaviour

Seven variables from the bivariate analyses had a p-value of < .25 and were included in the initial multivariate model (age, level of intellectual disabilities, physical health problems, mental health problems, behavioural problems, obesity, and accommodation type); full results of the bivariate analyses are presented in Table 2. Final multivariate backwards regression models revealed that only physical and mental health problems were significantly associated with sedentary behaviour. The fit of the final model (Table 3) explained a low proportion of the variance (8.8%), leaving a high proportion still to be accounted for.

INSERT Table 2. and Table 3. Approximately here

Discussion

This is the first study to investigate a wide range of demographic, biological, and environmental correlates of objectively measured sedentary behaviour in adults with intellectual disabilities. The principal findings of this study illustrate that physical and mental health problems are significantly associated with increased sedentary behaviour in adults with intellectual disabilities.

Understanding the relationship between health and sedentary behaviour is of paramount importance for adults with intellectual disabilities due to the increased health inequalities experienced by this population group (Emerson & Bains, 2011; Krahn et al., 2006). There is accumulating evidence in the general population illustrating the negative health effects of sedentary behaviour (de Rezende et al., 2014; Hammer et al., 2014; Teychenne et al., 2010;

Thorp et al., 2011; Wilmot et al., 2012). However, due to the paucity of research involving adults with intellectual disabilities the effect of sedentary behaviour on health in this population is unknown. Based on the results of this study it is not possible to assess cause and effect i.e. whether physical and/or mental health problems cause increased sedentary behaviour or whether sedentary behaviour causes physical and/or mental health problems. This is a consistent limitation with cross-sectional sedentary behaviour research (Byun et al., 2011).

The mechanisms of the effect of sedentary behaviour on health have not been fully elucidated, however, evidence in the general population demonstrated potential explanations include both physiological and psychological factors. Sedentary behaviour has shown to elicit a reduction in metabolic activity which leads to increased cardiovascular risk factors, including high levels of circulating blood glucose and triglycerides (Hamilton et al., 2007; Healy et al., 2008). Metabolic risk factors have also shown to be associated with psychological factors and therefore this may also provide an explanation for mental-ill health (Matthews et al., 2002). Moreover, it is reported that sedentary activities such as TV/computer viewing may also evoke a psychological response due to a lack of social interaction and thus hindering the development of social networks (Kraut et al., 1998; Kubey & Csikszetmihalyi, 1990). This may be applicable to adults with intellectual disabilities who engage in less social/civic activities in comparison to individuals without intellectual disabilities (Emerson et al., 2016), and spend extended periods of time in their household environment (Verdonschot et al., 2009).

Research on sedentary behaviour in adults with intellectual disabilities is in its infancy and, therefore, there is little evidence to compare with the findings of this study. It is surprising that none of the demographic characteristics were significantly associated with sedentary behaviour, as evidence in adults without intellectual disabilities has demonstrated a number of individual factors correlated with sedentary behaviour (e.g. age, gender, body mass index; O'Donoghue et al., 2016). However, the relationship between individual factors and sedentary behaviour in adults with intellectual disabilities has shown to be unclear, with inconsistent findings reported. Finlayson et al. (2011) found that females were more sedentary than males with mild to moderate intellectual disabilities. Whereas, Nordstrøm et al. (2013) reported no gender difference in objectively measured sedentary behaviour in individuals with Down syndrome, Williams syndrome and Prader Willi syndrome. Therefore, future research is necessary to elucidate the relationship between gender and sedentary behaviour in adults with intellectual disabilities.

In the present study, obesity was not significantly correlated with sedentary behaviour in the final model. Studies involving adults with intellectual disabilities have reported contrasting findings. Nordstrøm et al. (2013) reported weight to be a correlate of objectively measured sedentary time. In contrast, Hsieh et al., (2014) and Mikulovic et al. (2014) did not find a significant relationship between weight status and screen time as a proxy for sedentary behaviour at the multivariate level. However, as screen time only represents a small portion of sedentary time, differences between the present study and previous research could be due to differing sedentary-related outcomes (Tremblay et al., 2017). Further research involving multivariate analysis is required to investigate these socio-demographic characteristics and sedentary behaviour in adults with intellectual disabilities.

The results of this study demonstrate no significant associations between environmental correlates (accommodation type and level of deprivation) and percentage time sedentary. This was an unexpected finding as previous research has highlighted that adults with intellectual disabilities experience their environment differently to the general population; for example, facing barriers to accessing transport (Bodde & Seo, 2009), inaccessibility of fitness centers (Heller et al., 2002), and low rates of employment (Siperstein et al., 2013). Given the important role that environmental factors have in understanding and changing sedentary behaviours (O'Donoghue et al., 2016), it is important that future research investigates a wider range of environmental correlates. This is also important from a theoretical perspective as, in the general population, an ecological model has been widely proposed to categorize sedentary behaviour and inform the development of interventions (Owen et al., 2011). However, this model focuses on sedentary behaviour across four domains: leisure time, transport, household, and occupation, yet the applicability of these domains to the lives of adults with intellectual disabilities is unknown. Therefore, understanding environmental correlates of sedentary behaviour specific to adults with intellectual disabilities, and the development of population-specific theoretical frameworks, is essential to inform evidence- and theory-based interventions for this population group.

Strengths and limitations

This study adds to the limited knowledge base on correlates of objectively measured sedentary behaviour in adults with intellectual disabilities. Objectively measured sedentary behaviour has

shown to provide a more valid and reliable measure of sedentary time by reducing the risk of recall bias (Healy et al., 2011b). Furthermore, this study also included a more representative sample of adults with intellectual disabilities by including adults with all levels of intellectual disabilities.

A limitation of this study was the multiple correlates included in the analysis were restricted to those collected during baseline data collection of two multi-component behaviour change interventions (Harris et al., 2017; Melville et al., 2015). As a result, a wider investigation into additional interpersonal, social, and organizational factors was not possible. The cross-sectional design of this study precludes any causality. Furthermore, the direction of the association between physical and mental health problems and sedentary behaviour remains unclear. Therefore, further experimental research is needed to distinguish between cause and effect.

Implications for future research

The results of this study highlight that the factors influencing sedentary behaviour in this population group are complex. The included variables in this study explained a relatively small proportion of the variance in sedentary behaviour. Additional factors which were not included in this study may be influential in affecting sedentary behaviour. To implement significant changes in behaviour, there is a need for studies to move away from addressing individual level factors in isolation, and incorporate a broad range of environmental, social and organisational factors (Sallis et al., 2008). Patterns of sedentary time have been shown to be different during weekdays and weekends in the general population (McVeigh et al., 2016) and therefore may have different influencing factors. It is important that further research examines correlates of patterns of sedentary behaviour (i.e. during weekdays/weekends and time of day), and different types of sedentary behaviour, which may have different influences on the lives of adults with intellectual disabilities. Finally, research involving longitudinal studies is required to distinguish the relationship between correlates and determinants of sedentary behaviour to inform the development of evidence-based interventions tailored to the needs of adults with intellectual disabilities.

The results of the present study should, however, be interpreted with caution as it is not possible to assess cause and effect, i.e. whether physical and/or mental health problems cause increased sedentary behaviour or whether sedentary behaviour causes physical and/or mental health

problems. Future research involving longitudinal studies to distinguish the relationship between correlates and determinants of sedentary behaviour in adults with intellectual disabilities, and subsequent experimental research, is therefore necessary.

Conclusion

This is the first study to provide evidence on multi-level, demographic, biological, and environmental correlates of objectively measured sedentary behaviour in adults with intellectual disabilities. Physical and mental health problems were identified as significantly associated with increased sedentary behaviour. These health problems are considered potentially modifiable. Therefore, knowledge of these correlates may be influential in designing interventions to improve the health of this population group and concurrently reduce sedentary behaviour. Further studies are required to examine the effect of additional intrapersonal, interpersonal, environmental, and organizational factors which may affect sedentary behaviour in adults with intellectual disabilities.

Conflict of interest

None of the authors have any conflicts of interest to declare.

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List of Tables

Table 1. Socio-demographic characteristics of adults with intellectual disabilities in Glasgow, UK from July to September 2017.

Table 2. Bivariate analysis of correlates associated with percentage time spent sedentary Glasgow, UK from July to September 2017.

Table 3. Final multivariate analysis of correlates associated with percentage time spent sedentary Glasgow, UK from July to September 2017.

Table 1. Socio-demographic characteristics of adults with intellectual disabilities in Glasgow, UK from July to September 2017.

Demographic	**N**	**N (%)**
Age	140	
<45 years		54 (38.6)
≥ 45 years		86 (61.4)
Gender	143	
Male		69 (48.3)
Female		74 (51.7)
Marital Status	143	
Married/live-in partner		5 (3.5)
Separated/divorced		3 (2.1)
Single		135 (94.4)
Ethnicity		
White		141 (98.6)
Asian		2 (1.4)
Level of intellectual disabilities	142	
Mild		69 (48.3)
Moderate		51 (35.7)
Severe		18 (12.6)
Profound		4 (2.8)
Biological		
Physical health problems (Yes)	142	56 (39.2)
Mental health problems (Yes)	128	48 (33.6)
Problem behaviours (Yes)	133	39 (27.3)
Obesity	141	
Normal (18.5–24.9 kg/m^2)		17 (12.1)
Overweight (25–29.9 kg/m^2)		23 (16.3)
Obesity (30–39.9 kg/m^2)		68 (48.2)
Morbid obesity (>40.0 kg/m^2)		33 (23.4)
Environmental		
Type of accommodation	143	
Lives independent		41 (28.7)
Family carers		64 (44.8)
Paid carers		38 (26.6)
SIMD	138	
0–20 % most deprived		68 (49.3)
20–40 %		28 (20.3)
40–60 %		29 (21.0)
60–80 %		9 (6.5)
80–100 % least deprived		4 (2.9)
Sedentary behaviour	143	
Time spent sedentary (minutes/day) Median (IQR)		467.5 (411.0 - 542.2)
Percentage of time spent sedentary (%) Mean (SD)		72.9 (8.7)

Physical activity	143	
Time spent in light intensity physical activity (minutes/day) Median (IQR)		141.9 (114.5 -173.7)
Percentage of time spent in light intensity physical activity (%) Mean (SD)		22.6 (6.8)
Time spent in MVPA intensity (minutes/day) Median (IQR)		26.0 (15.9 - 38.1)
Percentage of time spent in MVPA (%) Median (IQR)		3.8 (2.4 - 6.1)

SIMD: Scottish Index of Multiple Deprivation; IQR: Interquartile Range; SD: Standard Deviation; MVPA: Moderate to Vigorous Physical Activity

Table 2. Bivariate analysis of correlates associated with percentage time spent sedentary Glasgow, UK from July to September 2017.

	N	**B (SE)**	**β**	**p-value**
Demographic				
Age	140			
<45 years vs ≥ 45 years		2.46 (1.48)	0.14	0.098
Gender Female	143	0.39 (1.46)	0.02	0.789
Level of intellectual disabilities	142			
Mild/Moderate vs Severe/Profound		2.73 (2.01)	0.11	0.176
Health				
Physical health problems	142	3.03 (1.48)	0.17	0.042
Mental health problems	128	3.74 (1.57)	0.21	0.019
Problem behaviours	133	1.95 1.64)	0.10	0.238
Obesity	141			
No vs Yes		3.48 (1.60)	0.18	0.032
Accommodation Type	143			
Independent vs Family		-2.22 (1.45)	-0.13	0.129
Independent vs Paid		2.05 (1.64)	0.10	0.214
Environmental				
SIMD	138			
Most (0-20) vs 20-40		-0.94 (1.85)	-0.04	0.612
Most (0-20) vs 40-60		-0.11 (1.83)	-0.01	0.951
Most (0-20) vs 60-80		0.02 (3.01)	<0.001	0.996
Most (0-20) vs Least (80-100)		3.79 (4.42)	0.07	0.393

SIMD: Scottish Index of Multiple Deprivation; SE: Standard Error

Table 3. Final multivariate analysis of correlates associated with percentage time spent sedentary Glasgow, UK from July to September 2017.

	B (SE)	**β**	**p-value**
Physical health problems	3.59 (1.58)	0.20	0.025
Mental health problems	3.68 (1.61)	0.20	0.024
R^2/Adjusted R^2	0.09/0.07		

SE: Standard Error

Highlights

Adults with intellectual disabilities spent 72.9% of the day sedentary
Poor physical and mental health significantly correlated with sedentary behaviour
Individual or environmental factors did not correlate with sedentary behaviour