Sedentary behaviours and physical activity in UK and Thai adults with intellectual disabilities

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Abstract

Background. Adults with intellectual disabilities face numerous health inequalities. Lifestyles, such as high sedentary behaviours and low physical activity levels may contribute to the inequalities. Hence, reducing sedentary behaviour and increasing physical activity could have a role. The research on these behaviours in adults with intellectual disabilities that is conducted in Western countries is limited and requires further research. However, no studies were identified that investigated sedentary behaviours and physical activity in Thai adults with intellectual disabilities. Therefore, this thesis is aimed to add to the knowledge-base on sedentary behaviour and physical activity of adults with intellectual disabilities in UK and Thailand.

Study 1. A secondary analysis of data from The UK Household Longitudinal Study was conducted to explore Individual, interpersonal, and environmental correlates of sedentary behaviours (TV hours) in adults with intellectual disabilities. Analysis showed that adults with intellectual disabilities living in good and poor neighbourhoods had different correlates. In good neighbourhoods, having children and being employed had significant effects to lower the odds of high TV time. In poor neighbourhoods, it was better quality leisure services that lower odds of high TV time.

Study 2. The aim of this study was to evaluate the feasibility of using accelerometers in measuring sedentary behaviours in Thai adults with intellectual disabilities. The protocol was tested on 10 Thai adults with intellectual disabilities. Most of the participants (90%) were able to adhere to the protocol. It is feasible to apply accelerometer as method of measurement to Thai adults with intellectual disabilities.

Study 3. This study was to evaluate levels and patterns of sedentary behaviours in Thai adults with intellectual disabilities (N = 38). The average daily sedentary time was 403 min/day. The sedentary time was accumulated in bouts lasting less than 10 minutes. Women were more sedentary than men. Evening was the most sedentary time. Gender, level of intellectual disabilities, BMI, and BMI Asian cut points were predictors of sedentary behaviour.

Study 4. This study was to examine levels and patterns of physical activity in Thai adults with intellectual disabilities (N = 38). Thai adults with intellectual disabilities had an average of 119 minutes per week of MVPA, 229 minutes per day of LPA and 4,899 steps per day. Thirty-two percent of participants met the goal of 150 minutes of MVPA per week. The most active and least active time were early morning and late evening, respectively. MVPA levels were significantly higher during weekdays compared to weekend days. Women were less active than men. Age, level of intellectual disabilities, and BMI Asian cut points were predictors of physical activity.

Conclusion. Thai adults with intellectual disabilities had high levels of sedentary behaviours and low levels of physical activity. Thai women with intellectual disabilities were more sedentary and less active than men. There was evidence of importance of environmental factors on sedentary behaviour proxy (TV time), however more research is required. Exploration into in sedentary behaviours and physical activity provides an understanding of the lifestyles of adults with intellectual disabilities and opens opportunities to reduce health inequalities in the future.

Table of Contents

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List of Tables

List of Figures

List of Appendices

Publications arising from this thesis.

Articles

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Author's Declaration

"I hereby declare that I am the sole author of this thesis, except where the assistance of others has been acknowledged. It has not been submitted in any form for another degree or professional qualification."

Khemapa Chusamer
December 2022

Abbreviations

BAME - Black Asian and Minority Ethnic

BMA - Bangkok Metropolitan Administration

COVID-19 – Novel coronavirus identified in 2019

CPM – Counts per minute

LPA – Light physical activity

METs – Metabolic equivalent tasks

MVPA – Moderate to vigorous physical activity

NHS – National health service (in the UK)

IQ – Intelligence quotient

PA – Physical activity

PCA – Principal components analysis

PM2.5 – Particulate matter with a diameter of 2.5 microns or less

SB – Sedentary behaviour

SD – Standard deviation

WHO – World Health Organisation

Chapter 1 Thesis introduction

1.1 Overview of this chapter

This chapter introduces the topic of intellectual disabilities, the health inequalities experienced by adults with intellectual disabilities in western and Asian ethnicity, and the important roles of sedentary behaviours and physical activity in adults with intellectual disabilities. This chapter introduces the extant literature to form a rationale for this thesis.

1.2 Intellectual disabilities

The American Association on Intellectual and Developmental Disabilities (AAIDD) defined intellectual disabilities as a condition characterized by significant limitations in both intellectual functioning and adaptive behaviour that originates during the developmental period (Schalock et al., 2021). There are three elements in diagnosing intellectual disabilities, including two limitations (intellectual functioning and adaptive behaviour) and age of onset, as it is a developmental disorder. The end point for developmental period was extended from 18 years old in the previous editions (American Psychiatric Association APA, 2013; Schalock et al., 2010) to 22 years old in the latest definition, based on contemporary research knowledge that brain development continues into a person’s 20's (Schalock et al., 2021). Firstly, intellectual functioning, also called intelligence, refers to general mental capacity, such as learning, reasoning, planning, problem solving, abstract thinking, memorising, etc. (APA, 2013; Schalock et al., 2021). Secondly, adaptive behaviour is the collection of skills that are required in everyday life, including conceptual, social, and practical skills. Conceptual skills involve understanding of basic concepts such as language, money, time, numeracy, and self-direction. Social skills involve communication, interpersonal skills, social responsibility, following rules, and avoiding victimization. Practical skills relate to personal care, occupational skills, transportation, routines, safety, and use of money. Adaptive behaviours are different from intelligence as they are learned behaviours that reflect an individual's competence to face the challenges of daily living (Schalock et al., 2021).

Standardised tests of intellectual and adaptive functioning are used to identify people that have intellectual disabilities. While the standard test for intelligence is the intelligence quotient (IQ) test, there are several tests assessing adaptive functioning, such as The Vineland Adaptive Behavior Scales (Vineland-3) (Saulnier, 2016)and Diagnostic Adaptive Behavior Scale (DABS)(Tassé, 2017). Scores approximately two standard deviations (SD) below the population mean are used, which is equal to less than 70 for IQ test(Schalock et al., 2021). The severity of intellectual disabilities can range from mild, where a person can still live independently with intermittent support, to profound, where a person requires 24-hour care for every daily activity. Table 1.1 shows the approximate IQ scores for mild to profound intellectual disabilities with associated general characteristics (Boat et al., 2015).

Table 1.1 Level of intellectual disabilities, associated IQ range, and general characteristics

Level	IQ range	General characteristics
Mild	50–69	Can live independently with minimum levels of support needed intermittently
Moderate	36–49	Independent living may be achieved with moderate levels of daily support, such as living in group homes
Severe	20–35	Requires extensive support with most self-care activities
Profound	<20	Requires 24-hour care for every aspect of daily routines

There are criticisms over the use of IQ score less than 70 as cut-off, because this number has no particular scientific background other than being the statistical convention of two standard deviations below the population mean of 100 (Burack et al., 2021). People with borderline intellectual functioning (BIF) have IQ scores above this threshold (IQ 70 to 85) but could still experience significant limitations and hardships in life (Peltopuro et al., 2014). The latest definition of intellectual disabilities in the AAIDD is more flexible on IQ score that indicating intellectual impairments, as around 70 or as high as 75 (Schalock et al., 2021).

There are different terms used to describe intellectual disabilities. "Mental retardation" was previously used in the International Classification of Diseases, 10th edition (ICD-10)(WHO, 2004). This term has been replaced by "disorders of intellectual development" in the ICD-11(WHO, 2019). This transition in terminology happened because the term "intellectual disabilities" was considered less offensive to people with disabilities (Schalock et al., 2007). In addition, the United Kingdom (UK) is the only country that uses the term "learning disability" and "intellectual disability" interchangeably, while in other countries, including the USA, the two terms have separate different meanings (Emerson & Heslop, 2010). Internationally, the term "learning disability" refers to people with specific learning difficulties such as dyslexia or dysgraphia, without intellectual capabilities being affected. Therefore, in this thesis, the term "intellectual disabilities" will be used. The term "general population" will be used to describe people who do not have intellectual disabilities.

1.3 Health inequalities experienced by adults with intellectual disabilities

Health experiences by different individuals or groups can vary widely in a population. However, the different health outcomes that occur systemically are unjust and need to be rectified. The comprehensive proposed definition of health inequalities is "the systematic, avoidable, and unfair differences in health outcomes that can be observed between populations, between social groups within the same population, or as a gradient across a population ranked by social position" (McCartney et al., 2019, p. 28).

Adults with intellectual disabilities experience numerous health inequalities, including reduced life expectancy, increased risk of non-communicable diseases (NCDs), and increased risk of having unhealthy weight (Emerson & Hatton, 2014; Ranjan et al., 2018). In Scotland, a total population study found significantly poorer health among adults with intellectual disabilities compared to adults without intellectual disabilities (Hughes-McCormack et al., 2018). In this study, a stark difference was revealed as only 13% of people with intellectual disabilities reported no limitations to their daily activities caused by long-term health problems, versus 81% of people without intellectual disabilities (Hughes-McCormack et al., 2018). A systematic review of death and causes of death of people with intellectual disabilities reported that people with intellectual disabilities die 20 years earlier compared to people without intellectual disabilities (O'Leary et al., 2018). The main causes of death were respiratory and circulatory diseases, which may be contributed to high prevalence of sedentary lifestyles in people with intellectual disabilities (O'Leary et al., 2018).

These results are supported by a population based confidential inquiry into premature deaths in England (Heslop et al., 2014). The findings showed that people with intellectual disabilities had more avoidable deaths from causes amenable to good quality healthcare (37%) than in people without intellectual disabilities (13%; Heslop et al., 2014). Circulatory and respiratory disorders were also in the leading causes of death among people with intellectual disabilities (Heslop et al., 2014). Furthermore, during the COVID-19 pandemic, people with intellectual disabilities had the highest rise in standardised mortality ratios in comparison to people with other psychiatric conditions (Das-Munshi et al., 2021). Among these numerous health inequalities experienced by adults with intellectual disabilities, they also have been reported with high prevalence of sedentary behaviours and low level of physical activity (Hsieh et al., 2017; Lynch, 2021; Melville, Oppewal, Schäfer Elinder, et al., 2017). The mechanisms behind the unhealthy lifestyles are multifactorial and have not been fully understood. It could be because of the lack of places and opportunities to be physically active (Oviedo et al., 2017), the lack of social support due to fear of health conditions (Bossink et al., 2017), and simply the autonomy and freedom of choice of adults with intellectual disabilities (Umb Carlsson, 2021). As everyone has the right to health (Kroll & Mannan, 2022), including people with intellectual disabilities, therefore, to prevent adverse health outcomes and premature deaths, we need meaningful changes on multiple facets to maximise their capabilities and enable them to heathy lifestyles, such as increased physical activity and reduced sedentary behaviours, despite their limitations. For these changes to be most effective, we need a systems approach that see the ecosystem and the interplay between public policy on environmental, social, and individual factors, such as public universal design to improve access to healthcare and community space that could also promote social participation and physical activity of people with intellectual disabilities.

1.3.1 Health inequalities experienced by Asian adults with intellectual disabilities

In addition to people experiencing health inequalities because of having intellectual disabilities, health inequalities are also present in relation to race and ethnicity. In UK, people with intellectual disabilities from Black Asian and Minority Ethnic (BAME) group were bearing more severe illness and consequently dying at higher rates than their white counterparts (Hassiotis, 2020). This aligns with "intersectionality", which argues that inequality is determined by multiple interacting sources of disadvantage, such as race, disability status, class, and gender (Collins & Bilge, 2016). In 2018, the annual report of the English Learning Disabilities Mortality Review (LeDeR) programme, regarding mortality in people with intellectual disabilities, revealed that children and young people (aged 4-24 years) from Black, Asian, and Minority Ethnic (BAME) groups accounted for 68% of all deaths in their age category (NHS, 2019). In addition, the median age of death in the BAME group of adults with intellectual disabilities is much lower than white adults with intellectual disabilities (35 versus 61 years, respectively; NHS, 2019). Furthermore, the 2020 LeDeR report showed that the likelihood of dying between the ages of 18-49 years was 9.2 times greater for adults with intellectual disabilities who were of Asian/Asian British ethnicity, compared to people with intellectual disabilities who were white British (NHS, 2021). The stark differences between BAME and White British could lie within the differences in quality of care received, as the in-depth reviews of deaths revealed several issues specific to the BAME group, such as clarity about care plans, delay in seeking medical treatment, and higher proportion of inadequate care that resulted in significant health impact (NHS, 2019). Therefore, this highlights that BAME adults with intellectual disabilities not only experience health inequalities compared to adults without intellectual disabilities, but that they also experience greater health inequalities compared to white adults with intellectual disabilities.

1.4 Sedentary behaviours, physical activity, and health inequalities

The previous sections of this Chapter have highlighted that globally people with intellectual disabilities experience health inequalities and, in particular, BAME adults with intellectual disabilities. Therefore, effective ways to reduce these inequalities need to be identified. One area deserving of additional focus is changing lifestyle behaviours, specifically sedentary behaviours and physical activity. However, although this is a well-researched field relating to the general population, research and policy on sedentary behaviour and physical activity in adults with intellectual disabilities is limited in comparison.

The current sedentary behaviours and physical activity recommendations available for people with disabilities are generalised and not centred on specific disabilities(Carty et al., 2021). It is recommended that all adults living with disabilities should undertake regular physical activity at least 150–300 min of MVPA per week and muscle-strengthening activities that involve major muscle groups on 2 or more days a week(Carty et al., 2021). However, the experiences and facilitators /barriers that people with intellectual disabilities face in relation to reducing sedentary time and increasing physical activity may differ from people with other disabilities, such as schizophrenia or Parkinson’s disease, thus raising questions on the suitability of these guidelines.

Adults with intellectual disabilities can experience the same health improvements from increased physical activity as any other adult. For example, studies have shown that increasing physical activity among adults with intellectual disabilities leads to significant improvements in mental health (Bondár et al., 2020), cardiovascular fitness (St John et al., 2020) and muscular strength (Obrusnikova et al., 2022). However, adults with intellectual disabilities experience many barriers to increasing their levels of physical activity (Bossink et al., 2017).

The very low baseline levels of physical activity of many adults with intellectual disabilities can be a significant barrier to participation in physical activity programmes that are based on existing physical activity guidelines (Carty et al., 2021). For example, a population-based study of physical activity levels reported that only 34% of adults with intellectual disabilities ever participated in physical activity of at least moderate intensity (Finlayson et al., 2011) and a meta-analysis of studies found that only 9% of adults with intellectual disabilities meet the guideline recommending participation in a minimum of 150 minutes of MVPA per week (Dairo et al., 2016). In contrast, public health initiatives such as exercise referral schemes are often geared towards adults who are already moderately active and so will not be accessible to most adults with intellectual disabilities (Rowley et al., 2020). These findings suggest that adults with intellectual disabilities require physical activity programmes that are personalised to the very low baselines levels of physical activity (Rana et al., 2024) and allow a progressive increase towards increasing participation in MVPA.

To achieve the recommended level of physical activity regularly, it requires a behavioural change, creating a new physically active habit. To change behaviours in individuals with intellectual disabilities, social support from family members and professional caregivers is essential. However, unlike people with other disabilities, family members and professional caregivers of individuals with intellectual disabilities were the group that perceive the most barriers to physical activity, not the individuals with intellectual disabilities themselves (Jacinto et al., 2021). Therefore, there should be recommendations developed that specifically reflect the experiences of people with intellectual disabilities relating to sedentary behaviour and physical activity. However, this is not possible without more research investigating sedentary behaviours and physical activity in adults with intellectual disabilities.

There is growing interest on understanding sedentary behaviours as independent factors on poor health outcomes in adults with intellectual disabilities. There is one systematic review that explored the prevalence of sedentary behaviours in adults with intellectual disabilities (Melville, Oppewal, Schäfer Elinder, et al., 2017). Sedentary behaviours within this review came in specific modes, such as watching TV, as a proxy measure of sedentary behaviours, or total sedentary time. The review reported high level of sedentary behaviours that ranged between 522 to 642 minutes/day. However, it was reported that most of the included studies had small sample sizes. Additionally, this review highlighted that many studies inaccurately defined low levels of physical activity as sedentary behaviours. This suggests that there is limited awareness regarding sedentary behaviours among the research community and that investigating sedentary behaviours should become a priority research area for adults with intellectual disabilities (Melville, Oppewal, Schäfer Elinder, et al., 2017).

There is a systematic review that investigated the physical activity levels of adults with intellectual disabilities (Dairo et al., 2016). The systematic review and meta-analysis used recommended physical activity guidelines for people without disabilities to quantify levels of physical activity. All 15 included studies were from Western high-income countries. Sample sizes ranged from 17 to 1,542. The review included both objective and subjective measurements. The small number of studies showed considerable variability in design and quality. Across the studies, between 0 and 46% of adults achieved 150 minutes of MVPA/week, while 7 to 45 % took more than 10,000 steps/day with an average of 6,795 steps/day. This was below both the recommended 10,000 steps/day, and the 7,000 steps/day threshold indicating 150 minutes of MVPA/week (Tudor-Locke et al., 2011). However, these steps/day targets were based on research for adults without intellectual disabilities and may not be suitable for adults with intellectual disabilities. The focus on physical activity guidelines in this review prevents a wider understanding and quantification of the physical activity levels of adults with intellectual disabilities. Nevertheless, the physical activity of adults with intellectual disabilities were low. This is concerning as low physical activity may contribute to the health inequalities experienced by adults with intellectual disabilities. It is therefore necessary for more research to explore physical activity in adults with intellectual disabilities.

In Thailand, physical activity was one of the target behaviours identified by the Thai Health Promotion Foundation as part of a 2007 nationwide campaign entitled “Just Moving is Equal to Exercising.” (ThaiHealth, 2021). However, one of the problems with promoting physical activity in this context is that the Thai common word for physical activity (ok-kam-lang-kai) does not distinct the nuances between physical activity and exercise. And the new term specific for physical activity (kit-ja-kam-tang-kai) is not widely known, only limited to the research community, and often used interchangeably in publications with the previous ambiguous term. This led to failure in social conceptualization as Thai people may assume getting physically active can only involve exercising, such as in a gym or running, rather than walking to the store or doing house chores. This gap also led to policymakers’ negligence to link the lack of adequate infrastructure for active lifestyles/transport and population adverse health outcomes from physical inactivity. Educational and academic institutions, such as medical schools and academic research groups, share health-related information to the general public in Thailand via television and social media. However, none of this information is a format that is accessible for most people with intellectual disabilities.

Although sedentary behaviours and physical activity are important lifestyle behaviours, they are still overlooked by intellectual disabilities research in Thailand, especially on sedentary behaviours. At the time of developing this thesis, the concept of physical activity in adults with intellectual disabilities research in Thailand is focussed on exercise and physical fitness, and not daily lifestyle behaviours. This can be evidenced by the fact that the structured search conducted for this Chapter identified no studies investigating physical activity and sedentary behaviours in Thai adults with intellectual disabilities. While the concept of sedentary behaviours is almost unheard of in the Thai research community. There is a need for a kick-start in research that focus on these behaviours in Thai adults with intellectual disabilities, so that eventually an understanding of how to effectively target sedentary behaviours and physical activity to improve health outcomes in this population can be achieved in the future.

1.4.1 Health impacts of sedentary behaviour and physical activity

Both sedentary behaviours and physical activity have been linked to mental and physical health outcomes in the people with intellectual disabilities. A secondary data analysis study of correlates of sedentary time of adults with intellectual disabilities reported that mental health problems was associated with higher sedentary time (Harris et al., 2018). However, a systematic review of correlates of sedentary behaviours, published prior to the study by Harris et al. (2018), indicated that the association between mental health and sedentary behaviours is inconsistent (Oppewal et al., 2018). For physical activity, low levels of physical activity are associated with having depression (Hsieh et al., 2017). Although the evidence base is limited compared to the literature in the general population, the findings show an association between mental health and the lifestyle behaviours. Both sedentary behaviours and physical activity could be vital health behaviours that affect mental wellbeing and deserve much more research.

High levels of sedentary behaviours and low levels of physical activity of adults with intellectual disabilities have been associated with poor physical health outcomes. Both of these lifestyle behaviours are potentially linked to obesity in adults with intellectual disabilities (Hsieh et al., 2017; Melville et al., 2018; Oviedo et al., 2017). Although systematic reviews relating to the outcomes of overweight and obesity have identified low levels of physical activity as a potential risk factor for adults with intellectual disabilities (Ranjan et al., 2018), systematic reviews of correlates of sedentary behaviours have reported inconsistent findings for an association with obesity (Oppewal et al., 2018).

In addition to obesity, low levels of physical activity have been linked to other physical health outcomes. Cardiorespiratory fitness of people with intellectual disabilities is low and decreases with age, with a potential contributing factor being low levels of physical activity (Oppewal et al., 2013). In addition, low levels of physical activity were reported to have a tendency to predict poor perceived health (Olsen et al., 2021). However, there are mobility issues in some adults with intellectual disabilities and these issues are associated with low physical activity and high sedentary behaviours (Hsieh et al., 2017; Melville et al., 2018), with poor physical health an additional barrier to physical activity (Bossink et al., 2017). This suggests that although high sedentary behaviours and low physical activity contribute to poor health, existing health issues relating to having intellectual disabilities can also further lessen a person’s ability to change lifestyle behaviours. A recent literature review on the effects of sedentary behaviour on the physical health of adults with intellectual disabilities reported that there was a prevalence of obesity, multimorbidity and metabolic syndrome coexisting with high levels of sedentary behaviours, suggesting sedentary behaviours could be a contributor to the poor health in this group of population. However, the limited body of evidence, which is primary cross-sectional studies, does not confirm a cause-and-effect relationship (Lynch et al., 2022). Therefore, it is crucial to address and further explore both sedentary behaviours and physical activity when considering the health inequalities that adults with intellectual disabilities experience.

1.5 Measurement of sedentary behaviour and physical activity

There are several measurement methods developed to assess physical activity and sedentary behaviours, for many aspects such as intensity, step count, self-reported type of behaviours. These methods can be divided into two broad categories: objective and subjective measurements. Objective measurements include wearable devices that directly or indirectly monitor one or more parameters related to sedentary behaviour and physical activity, such as acceleration or step count. While subjective measurements, both self- and proxy-reported, rely on physical activity or sedentary behaviours being either recorded as they occur or past behaviours recalled (Strath et al., 2013).

Objective measurements used in research involving adults with intellectual disabilities research for measuring physical activity include accelerometers and pedometers (Dairo et al., 2016; Pitchford et al., 2018) and for sedentary behaviours accelerometers and inclinometers are used (Melville, Oppewal, Schafer Elinder, et al., 2017). Accelerometers are feasible and with improved validity compared to other devices like pedometers, which only capture one behaviour (walking) (Esliger & Tremblay, 2007). Accelerometers, such as ActiGraph (Actigraph, Pensacola, FL, USA) and Actical (Phillips Respironics, Bend, OR, USA), are typically small and light weight devices that collect activity data on dimensions of intensity, duration, and frequency, enabling the exploration of physical activity intensities and sedentary behaviours. The mechanism of accelerometers is that it gathers raw acceleration data and converts it into activity counts that are converted into data on intensity by using cut points, such as <100 counts per minute for sedentary behaviours (Atkin et al., 2012). The general consensus is that accelerometers deliver an accurate assessment of physical activity, but less accurate for energy expenditure; in particular free-living conditions (Feito, 2010).

Another objective behaviour monitoring device is inclinometers. This type of devices differs from accelerometers in that, rather than gathering data based on activity counts, inclinometers collect data relating to elevation and slope. An example of inclinometers is activPAL (PAL Technologies, Glasgow, UK). The activPAL is thigh-worn and uses accelerometer-derived information to detect thigh position and activity, so it can differentiate between upright and seated or lying activities (Edwardson et al., 2017). This feature has a significance in indicating sedentary behaviours. Further, physical activity intensity is also quantified through data on cadence or stepping rates of upright activities (PALtechnologies, 2022). From this rationale, ActiGraph also have got incorporated inclinometers in the third generation to collect data on posture (Clemes et al., 2012).

Pedometers are activity monitoring devices that collect step counts over a specified period (for example, steps per day). Unlike accelerometers and inclinometers, pedometers are designed to measure only ambulatory activity by detecting changes in vertical accelerations and provides one user-friendly output, step counts (Feito, 2010). In general, pedometers cannot provide data about intensity or sedentary behaviours. Pedometers offer lower validity compared to accelerometers (Esliger & Tremblay, 2007).

Subjective measurements are relatively more feasible than objective measurements (Esliger & Tremblay, 2007). Subjective measurements cost less in both money and time. These methods do not need the measurement of physical activity and sedentary behaviours to be over several days, which increases feasibility and cost-effectiveness. The subjective measurement methods include self and proxy (for example, carer) completed questionnaires, semi-structured interviews, and activity diaries (Dairo et al., 2016; Melville, Oppewal, Schafer Elinder, et al., 2017; Pitchford et al., 2018). These subjective measurements can be administered at a larger scale, suitable for studies with large samples, such as these two studies with samples of more than 1,000 adults with intellectual disabilities (Emerson, 2005; Hsieh et al., 2014).

However, there is limited agreement between objective and subjective measures (Matthews et al., 2011; Moss & Czyz, 2018). The validity and reliability of subjective methods for physical activity and sedentary behaviours are not without concerns. Especially when used with adults with intellectual disabilities, issues about the dependency on recall and the abstract nature of subjective methods could have serious impacts (Melville, Oppewal, Schafer Elinder, et al., 2017; Pitchford et al., 2018). This further lessens the accuracy of only using subjective measures in intellectual disabilities research; However subjective measures can be used in conjunction with objective measures to capture more contextual data (Melville, Oppewal, Schäfer Elinder, et al., 2017).

Although objective measurements give higher validity, there are still methodological issues in their use with adults with intellectual disabilities. For example, there have been difficulties reported when using pedometers with adults with intellectual disabilities, such as trouble reading and recording the daily step counts (Matthews et al., 2016; Mitchell et al., 2018; Ptomey et al., 2017). Furthermore, adults with intellectual disabilities have been reported to have poor adherence to accelerometer protocols (Ptomey et al., 2017). In addition, a systematic review of accelerometers used in research in individuals with intellectual disabilities reported a lack of uniform standardised accelerometers protocol which hinders understanding of physical activity or sedentary behaviours (Leung et al., 2017). For instance, there were differences in the cut points used and the amount of time the accelerometers needed to be worn per day (Leung et al., 2017). In terms of severity of intellectual disabilities, accelerometers are also mainly used with adults with mild to moderate levels and the knowledge of their use with adults with severe to profound levels of intellectual disabilities is limited (Leung et al., 2017). There are many remaining uncertainties in using accelerometers with individuals with intellectual disabilities, such as in recruitment, acceptability, protocol adherence, retention, and other pragmatic issues. Therefore, it is important to reduce these key uncertainties with a feasibility study before conducting a full-scale study (Skivington et al., 2021).

1.6 Justification for this thesis

Adults with intellectual disabilities face numerous health inequalities which reduces overall life expectancy. Furthermore, these inequalities are more apparent in BAME adults with intellectual disabilities. Therefore, there is an urgent need for research to identify effective methods to reduce these inequalities, with an additional focus on BAME adults with intellectual disabilities required. Reducing sedentary behaviour and increasing physical activity are potentially effective ways to help reduce these inequalities. The research on these behaviours in adults with intellectual disabilities that is conducted in Western countries is limited and requires further research.

However, no studies were identified that investigated sedentary behaviour and physical activity in Thai adults with intellectual disabilities, with the support and policy around these behaviours being limited in comparison to Western countries. Therefore, it is essential to not only add to the research on sedentary behaviour and physical activity in Western countries, but to begin to develop a knowledge-base on this topic in Asian countries, such as Thailand.

1.7 Outline of thesis

This thesis provides the results of an initial exploration into levels, patterns, and factors of sedentary behaviours and physical activity of adults with intellectual disabilities living in UK and Thailand. The thesis is formed of individual studies conducted sequentially. The research questions in each study are as following:

Chapter Two: Individual, interpersonal, and environmental correlates of sedentary behaviours in adults with intellectual disabilities.
What individual, interpersonal, and environmental variables are associated with sedentary behaviours in UK adults with intellectual disabilities?

Chapter Three: Feasibility of the objective measurement of sedentary behaviours in Thai adults with intellectual disabilities.
Is it feasible to recruit and retain Thai adults with intellectual disabilities from the community-based setting during the COVID-19 pandemic to an accelerometer study?

Chapter Four: Sedentary behaviours levels and patterns of Thai adults with intellectual disabilities.
What are the sedentary behaviour levels, patterns (bouts, type of day, and time of day), and correlates of Thai adults with intellectual disabilities?

Chapter Five: Physical activity levels and patterns of Thai adults with intellectual disabilities.
What are the physical activity levels [MVPA, light physical activity (LPA),

and steps], patterns (time of day and type of day), and correlates of Thai adults with intellectual disabilities?

Chapter Six: General discussion.

Synthesis and discussion of the thesis findings with reflection on past literature.

Chapter 2 Individual, interpersonal, and environmental correlates of sedentary behaviours in adults with intellectual disabilities

2.1 Abstract

Background: Sedentary behaviours have adverse health outcomes and adults with intellectual disabilities are at a higher risk of unhealthy lifestyle behaviours. The lack of knowledge relating to sedentary behaviours in adults with intellectual disabilities has impeded the development of effective interventions. This study aimed to investigate individual, interpersonal, and environmental correlates that are associated with sedentary behaviours in adults with intellectual disabilities.

Method: A secondary analysis of data from The UK Household Longitudinal Study *(Understanding Society*; collected 2011 - 2013) was conducted. Twenty-two predictor variables were included in a stepwise logistic regression, with TV hours during weekdays (≤3 and >3 hours/day) used as a proxy for sedentary behaviours. A sample of 266 adults, with mean age of 37.9 and range from 18 to 49 years old, with intellectual disabilities were identified. Since 63.9% were female, 62.4% had children and 28.2% were employed, the sample is likely to be most representative of more able adults with intellectual disabilities.

Results: A significant interaction term between having children and neighbourhood status was found in the initial model so separate models for good and poor-quality neighbourhoods are reported. Having children only had a significant effect to lower the odds of high TV time amongst participants living in good quality neighbourhoods (OR 0.10, 95% CI 0.03, 0.25). However, for people living in poor quality neighbourhoods it was better quality leisure services that was associated with lower odds of high TV time (OR 0.48, 95% CI 0.23, 0.90). Being employed only significantly reduced the odds of high TV time in the good quality neighbourhood model (OR 0.35, 95% CI 0.12, 0.78). These effects highlight the importance of environmental effects on lifestyle behaviours of adults with intellectual disabilities.

Conclusions: Future research should aim to expand our understanding of environmental effects on the sedentary behaviours and other lifestyle behaviours of adults with intellectual disabilities.

2.2 Introduction

Sedentary behaviours are defined as any waking behaviour that expends energy of no more than 1.5 metabolic equivalents (METs), while in a sitting, reclining, or lying position (Tremblay, 2012; Tremblay et al., 2017). Proxy measures are often used to capture components of different sedentary behaviours. For example, TV or screen time is often used as a proxy measure of sedentary behaviours in large, population-based studies. Throughout this paper, the term sedentary behaviours is used to describe the broad construct (Tremblay, 2012; Tremblay et al., 2017) and TV time is used when referring to the proxy measure of sedentary behaviours that was collected in the *Understanding Society* cohort study. Sedentary behaviour is a different construct from physical inactivity, which refers to low levels of physical activity (Leitzmann et al., 2018). An individual can therefore be both sedentary and physically active and these behaviours have independent impacts on health (Biswas et al., 2015).

Sedentary behaviours are an emerging major global health issue and research supports the link between sedentary behaviours and non-communicable diseases (NCDs; (Biswas et al., 2015; Hamburg et al., 2007; Wilmot et al., 2012) and mortality (Chau et al., 2013; Diaz et al., 2017; Dunstan et al., 2010; Veerman et al., 2012). Systematic reviews show associations between sedentary behaviours and an increased risk of diabetes and cardiovascular disease (Biswas et al., 2015; Wilmot et al., 2012). A meta-analysis of sedentary behaviours and cancer risk showed increased relative risks for colon, endometrial, and lung cancer (Schmid & Leitzmann, 2014). Sedentary behaviours were also found to be associated with increased all-cause mortality (Chau et al., 2013; Diaz et al., 2017; Dunstan et al., 2010) and reduced life expectancy (Veerman et al., 2012). Encouragingly, sedentary behaviours are modifiable; therefore, it is one of the key targets for reducing the burden of NCDs.

Sedentary behaviours are an area of high concern among adults with intellectual disabilities. A systematic review by Melville et al. (2017) reported that adults with intellectual disabilities spend approximately 522-643 min/day sedentary, which is more than adults without intellectual disabilities. This is concerning as being sedentary for more than 240 minutes a day is linked to an increased risk of mortality, putting adults with intellectual disabilities at high risk of the negative health outcomes associated with sedentary behaviour (Chau et al., 2015). Since the prevalence of sedentary behaviours is higher in adults with intellectual disabilities than the general population, it is important to combat this with well-designed interventions.

According to the epidemiological framework (Sallis et al., 2000), identifying factors that influence the target behaviour, i.e., sedentary behaviours, is one of the first phases in developing interventions. The goal is to identify high-risk groups and provide targets for interventions. Each phase of this framework is based on the previous phases. Therefore, the current lack of successful interventions to reduce sedentary behaviours in adults with intellectual disabilities emphasises that the limited existing knowledge relating to correlates of, and barriers to changing, sedentary behaviours is preventing effective interventions being designed (Melville et al., 2015). Therefore, it is essential to develop a knowledge base on factors related to sedentary behaviours in adults with intellectual disabilities that can inform evidence-based intervention development.

Investigating corelates within the socio-ecological model is beneficial for designing interventions as it puts individuals within an ecosystem that recognises personal behaviour also depends on the dynamic interactions with other determinants at interpersonal, environmental, social and political levels (O'Donoghue et al., 2016). A systematic review investigating correlates of sedentary behaviours categorized using the ecological model for adults with intellectual disabilities (Oppewal et al., 2018). Most factors in these studies were individual factors, with limited evidence on interpersonal and environmental factors. The results showed only a few, inconsistent intrapersonal correlates. Having epilepsy was associated with lower levels of sedentary behaviours. However, the results were inconsistent for the other correlates identified, e.g., sex, weight status, physical and mental health, level of intellectual disabilities, and genetic syndromes. Data relating to interpersonal and environmental correlates was sparse and therefore results were inconsistent. This results in the absence of confirmative findings regarding the influence of these wider ecological factors. In addition, it should not be assumed that the correlates of sedentary behaviours in adults without intellectual disabilities are the same as those without intellectual disabilities. In the general population, identified correlates of lower sedentary behaviours include being in full-time employment, higher income/socioeconomic status, being physical activity, and having children (O'Donoghue et al., 2016; Prince et al., 2017). However, as adults with intellectual disabilities often lead different lifestyles to the general population, e.g., lower levels of employment, these correlates cannot be generalised (Ellenkamp et al., 2016). Therefore, there is a lack of conclusive evidence which prevents the design of evidence-informed interventions to reduce sedentary behaviours in adults with intellectual disabilities.

The evidence above suggests that, compared to adults in the general population, less is known about interpersonal and environmental correlates of sedentary behaviours in adults with intellectual disabilities. Improving our understanding of correlates of sedentary behaviours will inform the design of effective lifestyle behaviour interventions for adults with intellectual disabilities. This study aims to fill the knowledge gap by examining the individual, interpersonal, and environmental correlates of sedentary behaviours in adults with intellectual disabilities. Specifically, the research question to be investigated is: which individual, interpersonal, and environmental variables are associated with sedentary behaviours in adults with intellectual disabilities?

2.3 Methods

2.3.1 Design

This study was a secondary analysis of data from The UK Household Longitudinal Study *(Understanding Society;(The UK Household Longitudinal Study))*. This longitudinal study is an annual household panel survey covering a wide range of social, economic, and behavioural factors of the UK population. The survey includes approximately 40,000 households. The information was collected from everyone in the household, which enables investigation into the interpersonal domain within the family.

The data were from wave 3, which was collected through interviews between 2011-2013. The total number of respondents at this wave was 25,008. Data were downloaded from the UK Data Archive (http://www.dataarchive.ac.uk/). The index screening for possible variables was done in four groups: individual variables, interpersonal variables, environmental variables, and sedentary variables. Variables were selected based on previous research and factors that require further investigation based on gaps in the existing literature (Melville et al., 2018).

2.3.2 Study population

Adults with intellectual disabilities were identified based on cognitive tests and educational attainment using methods developed in previous research (Emerson et al., 2014; Hatton et al., 2017). To get a representation of the general cognitive ability of the sample, principal component analysis was used on the available cognitive tests to reduce the intellectual information into one set of overall intelligence (Jones & Schoon, 2008). There were three cognitive functioning tests done at wave 3: Number Series, Numerical Ability and Verbal Fluency (McFall, 2013). The scores from these tests were standardized. Linear regression was used to impute missing standardised test scores from obtained scores of the three cognitive functioning tests. There was no other variable in the imputation process. The percentage of imputed scores for Number Series, Numerical Ability, and Verbal Fluency were 4.9%, 0.6%, and 0.6% of the sample, respectively. Principal components analysis was used to extract the first component (accounted for 63% of the variance) as an estimate of general intelligence (Emerson et al., 2014). The inclusion criteria for intellectual disabilities were scoring lower than two standard deviations (SD) below the mean in the extracted component of cognitive results and reporting no educational attainment (Totsika et al., 2014). The total number of identified adults with intellectual disabilities in this study was 266 participants (accounting for 1.1% of the total sample).

2.3.3 Outcome variable

The number of hours of television (TV) watching per weekday was used as the proxy measure of sedentary behaviours in this study. The interview question include in *Understanding Society* was:

How many hours do you spend watching television on a normal weekday, that is, Monday to Friday?

As this study is an initial exploratory study, the data was dichotomised to simplify the analysis and subsequent interpretation of results, despite the limitations to the method, such as information lost and reduced statistical power (Altman & Royston, 2006). For sedentary behaviours, there are no established cut points or recommendations for hours/day of sedentary behaviours, like for physical activity. Therefore, specific cut point could not be chosen from existing literature. A median split was chosen as it has been used in previous similar research and creates the relevant cut point for the sample and ensures a relatively equal split of data points in each category. The number of TV hours was transformed into binary format with a median split, resulting in low TV time (≤3 hours per weekday) and high TV time (>3 hours per weekday). Low TV time was used as reference group in the logistic regression analysis. Throughout this paper, sedentary behaviour is used to describe the broad construct (Tremblay, 2012; Tremblay et al., 2017) but TV time is used when referring to the proxy measure of sedentary behaviours from this study.

2.3.4 Predictor variables

All the relevant predictors were screened by the lead investigator (KC) and then excluded if the missing data in that variable was greater than 50%. The final decision of variables to include was made by discussion and consensus among authors. Twenty-two variables related to individual, interpersonal and environmental factors were included in this study, as described below. All scale variables were transformed into binary format using a median split. Categorical variables that had more than two categories were recoded into favourable or unfavourable value. The decision for binary format is to simplify the data into just two values, making it manageable and easier to understand and report. This method indeed lost information, but as this study was an initial exploration, losing some information was preferred to cutting off some variables.

2.3.4.1 Individual variables

The five individual variables were age (18-40 years/ 41-49 years), sex (male/ female), financial status (financially comfortable/ not financially comfortable), frequency of internet use (less than everyday/ everyday), and paid employment status (employed/ unemployed), which did not distinguish between those who were and were not in the labour force.

2.3.4.2 Interpersonal variables

The six included interpersonal variables were living with at least one parent (yes/ no), living with sibling(s) (yes/ no), partner status (having a partner/ not having a partner), child status (having children/ no children), number of close friends (more than two/ two or less), goes out socially (yes/ no).

2.3.4.3 Environmental variables

There were 11 environmental variables included: number of screen devices in the household (more than seven/ seven or less), belonging to a social website (yes/ no), urban or rural area (rural/ urban), number of cars owed by household (more than one/ one or none), perceived pollution in local area from traffic or industry (yes/ no), like the present neighbourhood (yes/ no), perceived neighbourhood quality (poor/ good), worry about being affected by crime (yes/ no), feel safe walking alone at night (yes/ no), standard of public transport (poor to fair/ good to excellent), standard of local leisure services (poor/ good).

2.3.5 Statistical Analysis

All statistical data were analysed using SPSS 27 statistical package (SPSS IBM, New York, NY, USA) using complete case analysis. Descriptive statistics were used to describe characteristics of the participants. To investigate the relationships between TV time and predictor variables, logistic regression was conducted following method of purposeful selection of variables (Hosmer et al., 2013). This method was chosen as this approach has been shown to be effective at retaining significant risk factors and confounding variables (Bursac et al., 2008). There are 6 steps in this method. Step 1; the exploratory bivariate analyses, all variables with $P < 0.25$ were considered to be potentially relevant to TV time and were taken forward to the next step (Hosmer et al., 2013). Step 2; multivariate logistic regression, variables were entered into the model using backward stepwise regression with statistical significance set at $P < 0.05$. Backward stepwise regression was used because it started with all the potential variables then removed one-by-one from the least significant variable, so no variable was excluded at the beginning and joint predictive ability can be tested. Step 3; the smaller model was compared to the larger model from the backwards stepwise regression by the change in parameter estimates (beta). If there was a change exceeding ±20%, this indicated that one or more of the excluded variables were potentially significant and needed to be entered back to the model. Step 4; the variables excluded from step 1 were then added back into the model to check if they showed dependent contribution. Step 5; to check the possibility of having the estimate of the log-odds of one independent variable change or modify by the other independent variable, interactions among variables in the main effects model were assessed and any significant interaction terms were included in the preliminary final model. Included potential interactions were: child status*employment status, child status*local leisure service, child status*neighbourhood quality, employment status*local leisure service, employment status*neighbourhood quality, and local leisure service*neighbourhood quality. Step 6; the overall fit of the final model was checked with the Hosmer–Lesmeshow goodness of fit statistic, with a small test statistic and a large P value ($P > 0.10$) considered a good fit model. Information on missing data is presented in Table 1. Stepwise regression is not without limitations and is criticized for its faulty selection based on only statistical significance. Some independent variables that have proven effects on the dependent variable may happen to be not statistically significant and excluded, while nuisance variables may be coincidentally significant and mistakenly included (Smith, 2018). This flaw is highly exacerbated on big data with 100 or 1000 potential variables, however the data in this study is deemed within the capacity of the method.

2.4 Results

2.4.1 Participant characteristics

Characteristics of the participants are reported in Table 2.1. The majority of participants were female, with children, not financially comfortable, unemployed, living in urban area, and using internet less than every day. The mean (SD) of TV time in this study was 3.69 (2.73) hours per day. The mean age was 37.9 years old, range from 18 to 49 years old.

2.4.2 Bivariate relationships with TV time

Out of 22 variables, 11 bivariate associations between individual, interpersonal and environmental variables and TV time were statistically significant at $P < 0.25$ (Table 2.1) and so were taken forward to the multivariate analysis- sex, partner status, child status, financial status, employment status, like the present neighbourhood, number of close friends, belonging to a social website, neighbourhood quality, standard of public transport, and quality of local leisure services.

2.4.3 Final multivariate model

Of the eleven variables with a P value of < 0.25 carried forward from the bivariate analyses, only four retained statistical significance ($P<0.05$)- child status, employment status, neighbourhood quality, and standard of local leisure services. The percentage change in the parameter estimates between the smaller and larger models was not greater than 20%, indicating no missing significant contributing variables.

One interaction term, child status* neighbourhood quality, was significant (OR 4.408 95%CI 2.001, 9.711; $P < 0.01$). Table 2.2 provides the raw numbers and percentages, to illustrate the direction of the interaction between child status and neighbourhood quality. This shows that the interaction term is driven by individuals with children, who live in good quality neighbourhoods, and have a lower risk of being in the high sedentary behaviour group.

Since the interaction term between having children and neighbourhood quality is significant, separate models are provided for good- and poor-quality neighbourhood status in Table 2.3 and Table 2.4. In these models, low TV time is used as the reference category, so the odds ratios provided represent the odds of being in the high TV time group- with an odds ratio less than one representing a lower odds of being in the high TV time. Table 2.3 shows that for individuals living in good quality neighbourhoods, individuals with children (OR 0.10, 95% CI 0.03, 0.25) and in employment (OR 0.35, 95% CI 0.12, 0.7) are at a lower odds of being in the high TV time. However, the standard of local leisure services is no longer significant in the good-quality neighbourhood model. This contrasts with the poor-quality neighbourhood model (Table 2.4), where individuals reporting a better standard of local leisure service have a lower odds of being in the high TV time (OR 0.48, 95% CI 0.23, 0.99). Given the small sample sizes for the results reported in Table 2.2, these results need to be interpreted with caution. However, the potential implications of these results will be interpreted further in the discussion because this is one of the first studies to examine individual, interpersonal and environmental variables associated with sedentary behaviours of adults with intellectual disabilities.

2.5 Discussion

2.5.1 Principal findings

This is the first study to investigate the relationship between sedentary behaviours and individual, interpersonal and environmental variables, based on the socio-ecological model, in a population-based sample of adults with intellectual disabilities. The interaction between child status and perceived neighbourhood quality was statistically significant and examining separate models for good and poor-quality neighbourhoods highlighted some important findings relevant to an ecological model of sedentary behaviours.

2.5.2 Comparisons with previous studies

For time spent watching TV, the data in this study has a median value of three hours per day, which is similar to the 21.8 hours per week of TV time reported in a sample living in French institutions (Mikulovic et al., 2014). However, in a UK population-based community sample, Melville et al. (2018) reported median total screen time (TV, DVDs, videos and computers) of 4-5 hours per day. These differences are probably caused by the different measures used for sedentary behaviours i.e., TV time versus total screen time. Since the widespread availability of laptops, tablets and other digital media has diversified opportunities to spend sedentary time looking at screens beyond just TV, it is important that future studies should include questions that capture total screen time.

In the bivariate analysis of interpersonal and environmental correlates age was found to have no association with TV time, consistent with a previous systematic review (Oppewal et al., 2018). Sex was not significantly associated with TV time in bivariate analysis. Two studies reported men were more sedentary than women (Hsieh et al., 2017; Melville et al., 2018), one reported women were more sedentary than men(Finlayson et al., 2011), while two more studies reported no significant difference in sedentary behaviour between men and women with intellectual disabilities (Nordstrøm et al., 2013; Oviedo et al., 2017). This inconsistency could be attributed to different methods used to measure sedentary behaviour, as subjective (Hsieh et al., 2017; Melville et al., 2018) and objective (Finlayson et al., 2011; Nordstrøm et al., 2013; Oviedo et al., 2017) methods have been used. The inconsistency in sex differences relating to sedentary behaviour levels was also reported in a recent systematic review in adults with intellectual disabilities (Westrop et al., 2019) and the inconsistencies are not specific to people with intellectual disabilities, it has also been reported for the general population (O'Donoghue et al., 2016).

In the final model, there was a significant interaction between child status and neighbourhood quality. When separate models for good- and poor-quality neighbourhoods were examined, having children and being employed were retained as significantly reducing the odds of being in the high TV time group for people living in good-quality neighbourhoods. However, in the poor-quality neighbourhood model, only having better standard local leisure services was significantly associated with a reduced odds of being in the high TV time group. No previous studies have examined the effect of having children on the sedentary behaviours of adults with intellectual disabilities. However, our finding is similar to studies reporting that adults with children, who do not have intellectual disabilities, engage in less sedentary behaviours (Müller et al., 2020; O'Donoghue et al., 2016). What is most interesting in the results reported in the present study is that this association is only observed amongst individuals living in good quality neighbourhoods. This suggests that the effect on sedentary behaviours in people with children is likely to be dependent on there being places for people with intellectual disabilities with children to visit in their local neighbourhood, such as parks and accessible indoor spaces. In contrast, it seems individuals with children who live in a poor-quality neighbourhood are only able to replace sedentary behaviours with more active behaviours if there are better quality local leisure services available. It could be that people with children want to be more active with their children but do not feel safe in poor quality neighbourhoods so visit local leisure services instead.

The effects of neighbourhood quality and the standard of local leisure services on TV time reported here could be simply explained through behavioural economics theory (Biddle, 2011) as better experiences outside the home are associated with more reward for the individual. Therefore, having good quality neighbourhoods and local leisure services motivates people to use these facilities and hence spend less time engaged in sedentary behaviours. These findings need to be replicated in bigger samples but highlight the relevance of neighbourhood and built environment effects on the sedentary behaviours of adults with intellectual disabilities. This is particularly important because previous research has suggested that the participation of adults with intellectual disabilities in physical activity is very likely to be impeded by accessibility barriers in the local environment (Bodde & Seo, 2009; Bossink et al., 2017). Research on the importance of environmental variables to sedentary behaviours and physical activity patterns of older adults is well established but there is almost no previous research exploring this in the lives of adults with intellectual disabilities. Our findings suggests that researchers should look beyond individual variables when trying to understand the correlates and determinants of sedentary behaviours of adults with intellectual disabilities (Oppewal et al., 2018).

Our finding that being employed lowered the odds of being in the high TV hours group is consistent with one previous study that investigated interpersonal and environmental correlates (Hsieh et al., 2017). What is unique to our study is that this effect was only reported in individuals living in good quality neighbourhoods. Again, this finding needs to be replicated in a larger-scale study but understanding this effect may inform policies and interventions to improve the employment levels and health of adults with intellectual disabilities. A recent systematic review of systematic reviews on secondary health conditions and employment in people with intellectual disabilities (Iwanaga et al., 2021) found three systematic reviews on employment and health (Dean et al., 2018; Jahoda et al., 2008; Robertson et al., 2019). These studies all concluded that employment has a positive association with quality of life and better health, but none reported specifically on employment and sedentary behaviours. Therefore, we believe that future research on the links between employment status and health of adults with intellectual disabilities should explore the impact of environmental variables, such as neighbourhood quality.

2.5.3 Strengths and limitations

This study is the first that aims to fill the gap of knowledge on individual, interpersonal, and environmental influences on sedentary behaviour in adults with intellectual disabilities. This study used a population-based sample of adults with intellectual disabilities, which could include more participants from hard-to-reach groups than the convenience sampling (Emerson, 2011).

This study’s limitations are consistent with those in previous research involving adults with intellectual disabilities and the Understanding Society survey (Emerson et al., 2016; Emerson et al., 2014; Hatton et al., 2017). The identification of intellectual disabilities was based on tests of cognitive ability combined with indirect evidence based on an assumption that the lack of educational attainment implies early in life impairments. Adults with severe/profound intellectual disabilities may be excluded due to residency in institutional settings, outside the sampling framework of general households. Moreover, in the interview process, they could be further excluded due to the inability to give informed consent. Furthermore, compared to most population-based samples of adults with intellectual disabilities, the study sample reported here included a significantly higher number of females than males, a higher proportion of adults with children, and a higher proportion of people in employment. Therefore, we believe the study sample is most likely to be representative of more able adults with intellectual disabilities. The lack of representativeness of the sample constrains the generalisability of results. In addition, since the same interview questions were used for all respondents in Understanding Society and there were no adjustments made for individuals with cognitive and communication difficulties, the participants with intellectual disabilities may have experienced difficulties understanding some of the interview questions.

The final sample size of individuals with intellectual disabilities in the *Understanding Society* cohort is smaller than we expected (n=266). As a consequence, there is a risk that including 22 variables in the multivariate analyses threatens the validity of the findings, particularly with the addition of several interaction terms into the model. Therefore, the findings presented here should be interpreted with caution and require replication. More broadly, this issue flags up the need for ways to be found to improve the data relevant to the lives of disabled people in population cohorts to examine the complex contributions that neighbourhood and environmental factors can have on health (Abualghaib et al., 2019).

Finally, studies in both people with intellectual disabilities and without intellectual disabilities have found that different sub-domains of sedentary behaviours showed different associated influencers (Chastin et al., 2015; Oppewal et al., 2018). This study focussed on TV time in weekdays as a proxy for sedentary behaviours; therefore, the reported associations may not be fully generalisable to sedentary behaviours.

2.5.4 Implications for future research

Unlike physical activity, there is no consensus on the maximum amount of time per day or week that a person should spend engaged in sedentary behaviours. As a result, previous studies have used different cut points to define low/high sedentary behaviour time, which limits comparability. The gathering of more background pathophysiology and synthesis of standard cut points are required. Additionally, the neighbourhood quality and local leisure service variables used in this study included many facets of facilities (malls, parks, museums, gyms, etc.). The reported link with sedentary behaviours cannot be attributed to one type of facility and therefore future studies should investigate which aspects of the neighbourhood and local services are most associated with reduced sedentary behaviours to help inform intervention development.

2.5.5 Conclusion

This study investigated individual, interpersonal, and environmental variables that are associated with sedentary behaviours in adults with intellectual disabilities. The interaction term between child status and neighbourhood quality highlighted the potential complexity of ecological models of sedentary behaviours. However, we have shown the importance and relevance of environmental variables to modelling lifestyle behaviours, which we hope future researchers will build upon to inform the design of future interventions to reduce the sedentary behaviours of adults with intellectual disabilities.

Table 2.1 Characteristics of participants with intellectual and analysis of factors associated with TV time

Variables	Number (n; Total n=266)	n (%)	TV time		Odds Ratio (95% CI)	*P* value
			≤ 3 hours n (%)	> 3 hours n (%)		
Age	266					
18-40 years		139 (52.3)	74 (53.2%)	65 (46.8%)	REF	
41-49 years		127 (47.7)	70 (55.1%)	57 (44.9%)	0.927 (0.572, 1.503)	0.758
Missing	*0*					
Sex	266					
Male		96 (36.1)	45 (46.9%)	51 (53.1%)	REF	
Female		170 (63.9)	99 (58.2%)	71 (41.8%)	0.633 (0.382, 1.047)	0.075
Missing	*0*					
Financial status	265					
Financially comfortable		90 (33.8)	90 (51.4%)	85 (48.6%)	REF	
Not financially comfortable		175 (65.8)	53 (58.9%)	37 (41.1%)	0.739 (0.442, 1.236)	0.249
Missing	*1*					
Employment status	266					
Unemployed		191 (71.8)	95 (49.7%)	96 (50.3%)	REF	

Employed		75 (28.2)	49 (65.3%)	26 (34.7%)	0.525 (0.302, 0.913)	0.023
Missing	*0*					
Frequency of internet use	266					
Everyday		67 (25.2)	34 (50.7%)	33 (49.3%)	REF	
Less than everyday		199 (74.8)	110 (55.3%)	89 (44.7%)	0.834 (0.479, 1.451)	0.520
Missing	*0*					
Interpersonal variables	Total n	n (%)				
Living with parent	266					
No		226 (85.0)	124 (54.9%)	102 (45.1%)	REF	
Yes		40 (15.0)	20 (50.0%)	20 (50.0%)	1.216 (0.620, 2.383)	0.569
Missing	*0*					
Living with sibling	266					
No		235 (88.3)	127 (54.0%)	108 (46.0%)	REF	
Yes		31 (11.7)	17 (54.8%)	14 (45.2%)	0.968 (0.456, 2.055)	0.933
Missing	*0*					
Number of close friends	254					
More than 2		101 (38.0)	61 (60.4%)	40 (39.6%)	REF	

Two or less		153 (57.5)	78 (51.0%)	75 (49.0%)	1.466 (0.881, 2.440)	0.141
Missing	*12*					
Goes out socially	266					
No		69 (25.9)	37 (53.6%)	32 (46.4%)	REF	
Yes		197 (74.1)	107 (54.3%)	90 (45.7%)	0.973 (0.561, 1.686)	0.921
Missing	*0*					
Partner status	266					
No partner		117 (44.0)	58 (49.6%)	59 (50.4%)	REF	
Having partner		149 (56.0)	86 (57.7%)	63 (42.3%)	0.720 (0.443, 1.172)	0.186
Missing	*0*					
Child status	266					
No children		100 (37.6)	39 (39.0%)	61 (61.0%)	REF	
Has Children		166 (62.4)	105 (63.3%)	61 (36.7%)	0.371 (0.223, 0.619)	<0.001
Missing	*0*					
Environmental variables						
Belong to social website	266					

No		209 (78.6)	117 (56.0%)	92 (44.0%)	REF	
Yes		57 (21.4)	27 (47.4%)	30 (52.6%)	1.413 (0.785, 2.542)	0.249
Missing	*0*					
Urban or rural area	266					
Urban		235 (88.3)	129 (54.9%)	106 (45.1%)	REF	
Rural		31 (11.7)	15 (48.4%)	16 (51.6%)	1.298 (0.613, 2.748)	0.495
Missing	*0*					
Number of cars owed by household	265					
More than 1		28 (10.5)	19 (67.9%)	9 (32.1%)	REF	
One or none		237 (89.1)	124 (52.3%)	113 (47.7%)	1.924 (0.836, 4.425)	0.421
Missing	*1*					
Pollution	265					
No		232 (87.2)	124 (53.4%)	108 (46.6%)	REF	
Yes		33 (12.4)	19 (57.6%)	14 (42.4%)	0.846 (0.405, 1.768)	0.656
Missing	*1*					
Like the present neighbourhood	265					

No		25 (9.4)	9 (36.0%)	16 (64.0%)	REF	
Yes		240 (90.2)	134 (55.8%)	106 (44.2%)	0.445 (0.189, 1.047)	0.064
Missing	*1*					
Neighbourhood quality	255					
Good		111 (41.7)	70 (63.1%)	41 (36.9%)	REF	
Poor		144 (54.1)	68 (47.2%)	76 (52.8%)	1.908 (1.151, 3.164)	0.012
Missing	*11*					
Worry about being affected by crime	265					
No		184 (69.2)	103 (56.0%)	81 (44.0%)	REF	
Yes		81 (30.5)	41 (50.6%)	40 (49.4%)	1.241 (0.735, 2.095)	0.420
Missing	*1*					
Feel safe walking alone at night	266					
No		109 (41.0)	58 (53.2%)	51 (46.8%)	REF	
Yes		157 (59.0)	86 (54.8%)	71 (45.2%)	0.939 (0.575, 1.533)	0.801
Missing	*0*					
Standard of public transport	264					

Good to excellent		163 (61.3)	97 (59.5%)	66 (40.5%)	REF	
Poor to fair		101 (38.0)	45 (44.6%)	56 (55.4%)	1.829 (1.107, 3.021)	0.018
Missing	*2*					
Standard of local leisure services	244					
Good		138 (51.9)	88 (63.8%)	50 (36.2%)	REF	
Poor		106 (39.8)	46 (43.4%)	60 (56.6%)	2.296 (1.368, 3.852)	0.002
Missing	*22*					
Number of screen devices in the household	266					
More than seven		71 (26.7)	41 (57.7%)	30 (42.3%)	REF	
Seven or less		195 (73.3)	103 (52.8%)	92 (47.2%)	1.221 (0.705, 2.113)	0.476
Missing	*0*					

Table 2.2 Modification of the effect of having children on sedentary behaviour by neighbourhood quality

	Has children		No children	
	Low/ high TV time (N)	High TV hours (%)	Low/ high TV hours (N)	High TV hours (%)
Poor neighbourhood quality	47/45	49%	21/ 31	59%
Good neighbourhood quality	55/13	19%	15/28	65%

Table 2.3 Final logistic regression model for high TV time for adults with intellectual disabilities living in good quality neighbourhood

Variables	**B**	**SE**	**Odds Ratio (95% CI)**	***P* value**
Children status				
No children	REF	REF	REF	REF
Has children	-2.40	0.52	0.10 (0.03, 0.25)	<0.001
Employment status				
Unemployed	REF	REF	REF	REF
Employed	1.04	0.54	0.35 (0.12, 0.7)	0.050
Standard of local leisure services				
Poor	REF	REF	REF	REF
Good	-0.65	0.50	0.52 (0.20, 1.37)	0.187

REF denotes reference category; SE: Standard Error; CI: Confidence Interval.

Nagelkerke's R^2 = 0.356; Hosmer-Lemeshow goodness of fit statistic *P* = 0.33

Table 2.4 Final logistic regression model for high TV time for adults with intellectual disabilities living in poor quality neighbourhood

Variables	B	SE	Odds Ratio (95% CI)	*P* value
Children status				
No children	REF	REF	REF	REF
Has children	-2.65	0.39	0.77 (0.36, 1.63)	0.491
Employment status				
Unemployed	REF	REF	REF	REF
Employed	0.68	0.43	1.96 (0.85, 4.55)	0.115
Standard of local leisure services				
Poor	REF	REF	REF	REF
Good	-0.74	0.37	0.48 (0.23, 0.99)	0.047

REF denotes reference category; SE: Standard Error; CI: Confidence Interval.

Nagelkerke's R^2 = 0.081; Hosmer-Lemeshow goodness of fit statistic *P* = 0.98

Chapter 3 Feasibility of the objective measurement of sedentary behaviours in Thai adults with intellectual disabilities

3.1 Abstract

Background: Measurement of sedentary behaviours by accelerometers in Thai adults with intellectual disabilities had never been done before. The aim of this study was to evaluate the feasibility of using accelerometers in measuring sedentary behaviours in Thai adults with intellectual disabilities.

Method: Ten Thai adults with intellectual disabilities were recruited from participants attending prevocational programme. The protocol was to wear accelerometer for 7 days on all waking hours and to fill the timestamp on diary. The minimum wear time was 6 hours of at least 3 days. The outcomes were the percentage of participant that completed the protocol and report of any adverse effects.

Results: The first 10 individuals invited, consented to take part in the study. 50% of the participants had mild and 50% had moderate intellectual disabilities. All 10 participants achieved the minimum wear time and adhered to the measurement protocol, with 90% of participants completing the activity diary. None of the participants reported any negative effects from participation nor from wearing the accelerometer.

Conclusion: The evidence from this study demonstrates that it is feasible for Thai adults with intellectual disabilities to participate in a physical activity measurement protocol using accelerometers. These findings support the use of accelerometers to measure physical activity in a larger representative sample of Thai adults with intellectual disabilities.

3.2 Introduction

Sedentary behaviours have been shown to have adverse outcomes on health and reducing prolonged sedentary time has been identified as one of the targets to mitigate health risks by the World Health Organization (Bull et al., 2020). Adults with intellectual disabilities are at a higher risk of the negative outcomes of sedentary behaviours as they have longer daily sedentary time than adults without intellectual disabilities (Melville, Oppewal, Schäfer Elinder, et al., 2017). Therefore, as highlighted in Chapter 2, there is a need to better understand sedentary behaviour in adults with intellectual disabilities. In addition, it is important that research is collected in various countries and populations to ensure an in-depth understanding of sedentary behaviour in adults with intellectual disabilities. In Thailand, there are very few studies on sedentary behaviours in people without intellectual disabilities (Liangruenrom et al., 2018) and there are no studies investigating sedentary behaviours in Thai adults with intellectual disabilities. Therefore, measuring and understanding sedentary behaviours in Thai adults with intellectual disabilities is an important gap in the literature that must be addressed.

However, measuring sedentary behaviours in adults with intellectual disabilities is complex, with various measurement tools and protocols available. Furthermore, measuring total sedentary time can be challenging and burdensome for participants and, therefore, proxy measures of total sedentary behaviour, such as time spent watching television, are used (Melville et al., 2017). Although using a proxy measure of sedentary is more feasible, it reduces the accuracy of the data collected. As a result, the measurement of sedentary behaviour can be viewed as a trade-off between the feasibility of the measurement method and the validity of the measurement method, i.e. as feasibility increases, validity decreases, and vice versa (Esliger & Tremblay, 2007) .

In adults without intellectual disabilities, sedentary behaviour is commonly measured using self-report subjective measures, e.g. questionnaires or diaries (Healy, Clark, et al., 2011). An important advantage of subjective measures is that contextual data can be collected, e.g. types of sedentary behaviours conducted, such as TV viewing or using sedentary modes of transport (Atkin et al., 2012) . Although subjective measures provide feasible ways to collect varied data on sedentary behaviours, these measures are reliant on memory and recall abilities and, therefore, are prone to reporting and recall bias. Due to these cognitive requirements, subjective measures, e.g., self-report questionnaires, have limited reliability and validity in adults with intellectual disabilities (Melville et al., 2017). However, subjective measures could be used in addition to objective measures to provide additional data that cannot be collected by objective measures (Healy et al., 2011).

Objective measures of sedentary behaviour may be more appropriate for use in adults with intellectual disabilities. This is because objective measures, such as accelerometers and inclinometers, are not reliant on cognitive or recall abilities. Instead, objective methods measure various biomechanical parameters, such as postural positions or steps, and can be used as proxy measures of physiological outcomes, such as intensity of physical activity or energy expenditure. Therefore, objective methods have a higher level of reliability and validity; however, due to variations in measurement protocols and data processing, validity and reliability can vary in a real-world setting (Atkin et al., 2012). The use of accelerometers in a free-living (i.e., real-word) environment relies on various use decisions that can impact the data collected. For example, measurement protocols often require participants to wear an accelerometer for seven days during waking hours. In addition, for data processing, to ensure reliability, participants are often required to wear the device for a certain number of days and hours per day to be included in the analysis.

However, due to the limited use of objective measures in adults with intellectual disabilities, there is limited evidence on the most effective protocols and the feasibility of seven-day measurements. In addition, as there is no existing research investigating objectively measured sedentary behaviour in Thai adults with intellectual disabilities, we do not know anything about the feasibility of data collection using accelerometers in this population. Furthermore, given the on-going COVID-19 pandemic, there is evidence of its impact on significant reduction in the recruitment (Mitchell et al., 2020; Upadhaya et al., 2020). Online survey reported that UK patients were less willing to participate in research if they need to be physically present during data collection (Mirza et al., 2022). A study interviewed outpatients further revealed that their concerns about safety and risks from exposure to public transport and hospital environment were the limiting factors on participating in research (Abdulhussein et al., 2022). It is not possible to determine if organisations would be willing to support recruitment and whether Thai people would be interested to take part in a research study in this current context. There are several uncertainties in the research plan, from acceptability to collection, and advancing to full-scale research without addressing these issues beforehand would be wasteful and unethical to the participants.

Therefore, prior to conducting a full-scale study investigating levels and patterns of sedentary behaviours in Thai adults with intellectual disabilities, it is necessary to ensure the feasibility of recruitment and the measurement protocol. This is an important stage in the development of research to ensure that participants are not overburdened by a protocol that is not feasible and or effective at producing the required data. This feasibility study aims to answer the following research questions:

1. Is it feasible to recruit and retain Thai adults with intellectual disabilities to a study investigating accelerometer-measured sedentary behaviour?

2. Is it feasible to recruit Thai adults with intellectual disabilities from a community-based setting?

3. Is it feasible to recruit Thai adults with intellectual disabilities during the COVID-19 pandemic?

4. Is it feasible for Thai adults with intellectual disabilities to adhere to the measurement protocol?

5. Is it feasible for Thai adults with intellectual disabilities to complete the measurement wear diary?

6. Are any negative effects reported in relation to recruitment or the protocol?

3.3 Methods

3.3.1 Design

This study was a feasibility study that will inform the methods used for a larger cross-sectional study investigating patterns of sedentary behaviour in adults with intellectual disabilities in Thailand.

3.3.2 Ethical Considerations

This study was approved by ethical committees in the College of Medical, Veterinary and Life Sciences, University of Glasgow and Rajanukul Institute, Bangkok, Thailand. Written informed consent was obtained from participants along with permission from caregiver/guardian prior to participation.

3.3.3 Participants

3.3.3.1 Recruitment

As sample size for a pilot study should be based on considerations in practical issues like participant flow and budget (NCCIH, 2017), the aim of this feasibility study was to recruit 10 adults with intellectual disabilities. Because it is justified to use the minimum number of participants needed to meet the objectives (Billingham et al., 2013), this sample size was chosen as it was reasonably sufficient to evaluate the feasibility goal in first research question as recruitment and retention rates. Participants were recruited through the Prevocational Programme Service conducted by Rajanukul Institute in Bangkok, Thailand between September 2020 and October 2020. The Institute is a Thai Governmental agency under the Department of Mental Health specialising in intellectual and developmental disabilities. The Prevocational Programme is aimed to assist people with intellectual disabilities aged 15 years and over, who left the education system, to have basic work skills and prepare them for employment. The activities in the programme include packaging, office messenger, car wash, kitchen work, agricultural work, and handicraft. The primary aim of the Programme is to get the service recipients accustomed to a work environment. The screening for recruitment was done by the staff working within the Programme who identified adults with intellectual disabilities who they believed met the inclusion criteria. The lead investigator (KC) approached potentially eligible people, discussed the study, answered any questions, and recruited people who wished to participate.

3.3.3.2 Inclusion and exclusion criteria

The inclusion and exclusion criteria were developed so that a suitable sample was recruited to answer the research questions and to ensure those who participated could safely take part in this research.

The inclusion criteria for participants were:

- Aged 18 years or over
- Independently ambulatory
- Have mild to moderate level of intellectual disabilities

The exclusion criteria were:

- Participants or carers revoke the participation
- The equipment cannot fit the participant by any reasons, for example, waist circumference larger than the length of the belt (48 inches).

3.3.4 Procedure

This study involved a 7-day sedentary behaviour measurement period, with demographic data collection to this. Data relating to demographics were collected prior to this measurement period and data relating to adverse effects (RQ 6) was collected after the 7-day measurement period. After the 7-day measurement period, participants received a postcard showing a beautiful view of University of Glasgow as a token of appreciation.

3.3.4.1 Precautions due to COVID-19

This study was conducted during the COVID-19 global pandemic. Extra safety and prevention procedures were performed during all face-to-face interactions between the lead researcher (KC) and participants, as follows:

- The time and people on both visits (demonstration and returning) were minimized as much as possible. However, to ensure participants were comfortable and received any required assistance, support staff / parents were allowed to be present.

- Cloth or surgical masks were worn at all times by both the researcher and participants.

- Hand sanitizer was used by the researcher and participants before and after each visit.

- The equipment was thoroughly cleansed between participants. The ActiGraph was cleaned by disinfecting wipes. The belt and buckle were washed with strong detergent.

3.3.4.2 Demographic Data

Demographic data including age, level of intellectual disabilities, cause of intellectual disabilities, underlying diseases, and living arrangement were collected using a researcher-administered questionnaire to give basic characteristics of the sample. Anthropometric measurements were taken from participants, in accordance with the International Standards for Anthropometric Assessment (Stewart, Marfell-Jones, Olds, & de Ridder, 2011). Weight and height were measured using digital scales and a stadiometer, respectively, and body mass index was calculated [weight/height2 (kg/m2)]. The WHO BMI categories (underweight: <18.5, normal weight: 18.5 – 24.9, overweight: 25 – 29.9, obese: ≥30) were used to classify participants' body type (WHO, 2004).

3.3.4.3 Sedentary behaviour measurement

Sedentary behaviour was objectively measured for seven days using the ActiGraph wGT3X+ accelerometer (Actigraph LLC, Pensacola, FL). The ActiGraph wGT3X+ is a small, lightweight device that measures acceleration on up to three axes of the body. This device is one of the most commonly and increasingly used accelerometer in people with intellectual disabilities, which increases the impact and applicability of the findings of this study(Melville, Oppewal, Schafer Elinder, et al., 2017; Westrop et al., 2019). ActiGraph was chosen over another device, ActivPAL, because practical knowledge from previous study in the research group indicated that participants with intellectual disabilities felt ActivPAL to be too invasive as it attached directly onto the skin. However, although there is a growing evidence-base relating to the feasibility of the device in adults with intellectual disabilities, there is still no feasibility evidence for Thai adults with ID. There are still unknown uncertainties, for example, whether or not Thai participants and carers feel intruded and spied on by the new “hi-tech” device in their personal space, therefore this feasibility study is required. Participants were asked to wear the accelerometer around their waist, using an elastic belt that had been adjusted to fit, during all waking hours (except when showering, bathing, or swimming) for 7 days. Participants did not wear the accelerometer 24 hours, only the waking hours. Prior to data collection, how to use the accelerometer was demonstrated and participants had time to practice until they were confident and comfortable with wearing the device. In addition, to increase compliance, participants received a brief single-paged information sheet that contained information relating to the protocol, e.g., when to wear the device, how to correctly wear the accelerometer (using pictures) and contact information for the lead investigator (KC) if any issues arose. Furthermore, to ensure activity was accurately captured, participants (or their carer) were asked to fill a diary to record the times that the accelerometer was put on and removed each day. The lead investigator (KC) put in the first timestamp as an example. Data from this wear dairy was used help identify wear time data to include in the analysis.

3.3.5 Analysis

Descriptive data were calculated in Excel and statistical analysis was conducted in GraphPad. To answer research question one, recruitment rates were calculated as a percentage based on the total number of eligible people approach to participate versus the target number of 10 participants. Retention was calculated as a percentage of the number who started data collection and the number who completed data collection. Research question two and three were assessed by observation and feedback from participants, programme staff, and carers. Research question four was assessed using percentage of participants meeting the minimum wear time (6h/day for at least 3 days)(Harris et al., 2018). The amount of time an accelerometer is worn by a participant is called wear time. It is an important parameter to separate a sitting participant from a sitting accelerometer left on a shelf. Wear time was calculated by removing non-wear time, which was classified as 60 minutes of continues zero counts. Research question five was assessed by calculating the percentage of completed diaries. Information on the person who completed the diary (participant or carer) was also collected. Comparison between the time in the diary and accelerometer data (based on count data and estimating when the device was put on) was conducted to assess the accuracy of the diaries. Unpaired t-test was used to evaluate the difference between average time difference that recorded by participants or carers from the accelerometer data (statistical significance was set as a p-value < 0.05). Research question six, relating to negative impacts of wearing the accelerometer, was evaluated by asking both participants and carers when they returned the device and then noting on descriptive excel file.

3.4 Results

3.4.1 Sample characteristics

The characteristics of the participants are reported in Table 3.1. Of the 10 participants, six were female and four were male. The mean age was 21 years (range 18 – 33 years). The average BMI was 24.9 kg/m^2 (range from 18.6 to 46.2 kg/m^2). Based on BMI cut points, five participants were normal weight, one was underweight, two were overweight, and two were obese. Only three participants were employed. Five participants (50%) were diagnosed with mild levels of intellectual disabilities, the other 50% had moderate levels of intellectual disabilities. For living circumstances, all participants reported living with family.

3.4.2 Research question 1: Recruitment and retainment feasibility

A researcher (KC) attended the centre every weekday for 3 weeks. During the visit, KC was able to contact directly to the programme attendees and carers. From ten people approached, no one declined to participate in the study, therefore the recruitment rate is 100% [10/10*100 = 100%]. In addition, no participants withdrew from data collection and, therefore, the retainment rate is also 100%.

3.4.3 Research question 2: Effect of community-based setting

The community-based setting was positive to the recruitment. The programme organisers and staff were interested and supportive of the study, which was important to enable recruitment. This was achieved through multiple meetings and being flexible to ensure that the recruitment and data collection fitted with the programme schedule and did not interfere with the running of the programme. Individuals were more motivated to join the study when they knew their friends were also taking part. The participants also felt proud to help the scientific community. The postcards as appreciation gift also were great motivation and very rewarding for most of the participants. For example, one participant mentioned the postcard to the caregiver every day of the data collection week [translated: “Am I getting it (the postcard) today?”].

3.4.4 Research question 3: Effect of COVID19

The COVID-19 outbreak and subsequent lockdown within Bangkok delayed the start of recruitment for 7 months. But when restrictions eased, the goal of recruiting 10 participants was achieved within two weeks. All participants and carers were supportive of, and adhered to, the safety procedures in place. No negative effects were reported in relation to the pandemic impacting people’s willingness to participate.

3.4.5 Research question 4: Protocol adherence

All ten participants met the minimum wear time criteria, but one participant wore it day and night for 5 days because she liked it, and the carer did not want to deny her. The average wear time was 11 hours, 15 minutes per day (range from 8 hours, 7 minutes to 15 hours, 54 minutes).

3.4.6 Research question 5: Diary adherence

The wear diary was completed for nine participants [9/10 *100 = 90%]. Four participants completed the diary by themselves. Five were completed by carers. One did not fill it in due to the participant's dislike of writing and the carer did not have time. Table 3.2 shows each participant's seven-day average time difference in minutes between the accelerometer and the diary. There was a trend (p-value = 0.067) that diaries completed by the participants had a higher agreement to the accelerometer data than the diaries completed by carers.

3.4.7 Research question 6: Side effect and feedback

No significant side effects were reported that impacted participation. No sweat rash or any form of skin irritation reported in relation to wearing the accelerometer. Two participants noted mild discomfort when wearing the accelerometer, such as a feeling of tightness around the body. One carer observed that the participant was more irritable on the first few days of the measurement week. However, as all of these effects can be resolved, these are not deemed to impact feasibility.

3.5 Discussion

This study demonstrated that it was feasible to recruit Thai adults with intellectual disabilities from the community-based setting during the COVID-19 pandemic to an accelerometer study. It was also possible to retain participants for the duration of the protocol. All participants were able to achieve the minimum wear time and adhered to the measurement protocol. Most of the participants (90%) completed the diary. There was no major negative effect from participation nor from wearing the accelerometer.

The recruitment and retention rate in this study was 100%. This level was high, compared to the previously reported difficulties with recruiting people with intellectual disabilities to research (Nicholson et al., 2013). This could be because the adults with intellectual disabilities who are involved in the prevocational programme were had very little challenging behaviours and less severe levels of intellectual disabilities. People involved in this programme were keen to socialise, learn to work, and all aspired to get a job in the future. The atmosphere of this Programme could also have a major role, as it was very friendly and supportive. The attendees as a group were excited by the study, specifically the new accelerometer belt, the new task, the new responsibility to the research and the rewarding gift. Furthermore, the group were keen to take part in a study that their friends and peers were also involved in, suggesting this group recruitment from the one community programme assisted with recruitment. Another possible explanation is that one of the barriers of recruitment people with intellectual disabilities was the demands of carers (Lennox et al., 2005). As these participants were relatively healthy young adults with low support needs from carers, this could lessen this effect and increase the willingness from participants and carers to join the research.

The adherence to the protocol in this study was also high. This could in part be because the protocol was not too difficult or complex, and participants and carers did not perceive the commitment as a heavy burden. The protocol was designed to be as simple as possible and it was ensured that all participants and carers received a sufficient and accessible level of information prior to data collection that explained the procedures. In addition, it was made clear to all participants and their carers that participation and adherence to the protocol was optional, for example the participants were able to choose not to wear the device on any day or any time that they did not want to wear it, with no negative implications nor punishment. The emphasis was deemed necessary because verbal or physical punishment as a discipline method was common in Thai families and it was important to ensure that all participants were involved in this study because they wanted to be (Bhasavanich, 1993). The positive view toward the protocol could be the key to the successful adherence. Because there is very limited data on sedentary behaviours of adults with severe level of intellectual disabilities, the high level of success in recruitment and adherence with no significant reported side effect in the feasible study, we saw a possibility to include severe level of intellectual disabilities in the full-scale study.

Although there was a high completion rate for the wear diary, the data highlighted wide variations in the recorded start time between the diary and the accelerometer. Therefore, as this data is not comparable, the additional burden of the dairy may outweigh the benefits of the data collected from it. Therefore, for a future full-scale study, it is recommended that the wear diary is not completed, and that wear time is identified from the accelerometer using a wear time algorithm (Troiano et al., 2008). Finally, this study was done during the COVID-19 pandemic. Thailand was the first country to report a positive case outside China, on 13th January 2020 (Wetchapanpesat et al., 2021). The COVID-19 first outbreak and subsequent lockdown and curfew delayed the start of recruitment for months. No recruitment was performed during any lockdown due to safety concerns. Interestingly, no individual declined to participate due to COVID-19 as a reason.

3.5.1 Strengths and Limitation

This was the first study that has aimed to address the lack of research on sedentary behaviour in Thai adults with intellectual disabilities. To ensure the suitability of the recruitment plan and measurement procedures, this study was designed to ensure feasibility prior to progressing to a full-scale study. Therefore, the findings from this study can be used to inform the design of a full-scale study. Not without limitation, as recruitment was only conducted in one community setting, this limits the understanding of feasibility for other community-based organisations. In addition, as this setting primarily included adults with milder levels of intellectual disabilities, it limits generalizability to people with more severe levels of intellectual disabilities. Finally, due to the pandemic, a follow-up qualitative study to investigate the participants' experience and barriers to lifestyle behaviours was cancelled, therefore, there is still this knowledge gap in Thai adults with intellectual disabilities that can be explored in the future studies.

3.6 Conclusion

In conclusion, all research questions within this study were deemed to be feasible with no major negative effects reported. Therefore, the decision is made to progress to a full-scale study investigating sedentary behaviour in Thai adults with intellectual disabilities with the current protocol.

Table 3.1 participants characteristics

No.	Gender	Age (year)	Height (cm)	Weight (kg)	BMI	BMI category	Employment	ID level	Diagnosis
1	Female	19	153	57	24.3	Normal	No	Mild	Unknown
2	Female	20	167	53	19.0	Normal	No	Mild	Unknown
3	Male	24	167	88	31.6	Obese	Yes	Mild	ASD, G6PD, MDD
4	Female	20	160	65	25.4	Overweight	No	Moderate	Unknown
5	Female	18	164	50	18.6	Normal	No	Moderate	Epilepsy
6	Female	19	142	40	19.8	Normal	No	Moderate	DS
7	Female	21	155	111	46.2	Obese	Yes	Moderate	Unknown
8	Male	18	182	55	16.6	Underweight	No	Mild	ASD, ADHD
9	Male	32	157	72	29.2	Overweight	Yes	Moderate	DS
10	Male	20	172	55	18.6	Normal	No	Mild	ASD, CKD

ASD: Autism spectrum disorder, G6PD: Glucose-6-phosphate dehydrogenase deficiency,
MDD: Major depressive disorder, DS: Down syndrome, ADHD: Attention deficit hyperactivity disorder,
CKD: Chronic kidney disease

Table 3.2 average daily time difference in minutes between the accelerometer and the diary timestamp

ID		Day 1		Day 2		Day 3		Day 4		Day 5		Day 6		Day 7		Day average	Record by
		On	Off	On	Off	On	Off	On	Off	On	Off	On	Off	On	Off		
1	Accelerometer	10:00	0:45	19:21	5:14	19:20	5:54	19:20	5:29	19:26	5:57	19:22	5:08	9:56	21:45		
	Diary	10:00	0:00	19:23	5:12	19:21	5:53	19:22	5:28	19:27	5:42	19:23	5:05	9:57	21:40		
	Time difference	0	45	2	2	1	1	2	1	1	15	1	3	1	5	11.43	Self
2	Accelerometer	10:00	16:41	8:45	20:52	9:34	20:19	9:06	21:31	9:04	22:38	9:23	23:14	10:17	18:41		
	Diary	10:00	17:30	8:50	20:30	9:30	20:20	9:06	20:30	9:09	22:30	9:28	22:30	9:30	22:43		
	Time difference	0	49	5	22	4	1	0	61	5	8	5	44	47	242	70.43	Carer
3	Accelerometer	10:00	0:39	12:41	23:46	13:01	0:41	13:08	0:12	13:11	23:51	12:44	0:09	13:12	0:53		
	Diary	10:00	0:37	12:43	23:44	13:00	0:39	13:08	0:00	13:12	23:50	12:44	0:08	13:11	0:52		
	Time difference	0	2	2	2	1	2	0	12	1	1	0	1	1	1	3.71	Self
4	Accelerometer	11:00	20:00	11:18	19:06	5:23	22:14	7:51	21:17	7:27	19:02	9:44	19:03	6:22	19:43		
	Diary	11:00	20:00	11:20	19:00	6:04	21:40	7:53	20:28	7:33	19:00	9:49	19:00	7:20	19:00		
	Time difference	0	0	2	6	41	34	2	49	6	2	5	3	58	43	35.86	Carer
5	Accelerometer	10:30	18:42	6:00	20:31	5:41	18:57	5:16	18:41	7:26	18:57	6:45	16:43	7:56	16:46		
	Diary	10:30	18:14	6:30	19:30	7:00	19:00	8:30	18:30	8:10	18:00	8:00	17:00	8:00	17:30		
	Time difference	0	30	30	61	79	3	194	11	44	57	75	17	4	44	92.71	Carer
7	Accelerometer	10:00	18:04	7:05	16:01	8:37	15:02	9:06	16:28	7:06	16:29	6:34	16:02	6:32	17:00		
	Diary	10:00	17:00	9:00	16:30	8:00	17:30	9:30	18:00	8:00	16:45	8:00	17:00	7:30	N/A		
	Time difference	0	64	115	29	37	148	24	92	54	16	86	58	58		111.57	Carer

8	Accelerometer	13:21	22:39	5:28	22:42	8:17	22:21	9:00	22:13	5:13	21:54	5:33	21:23	5:43	21:58		
	Diary	13:21	22:17	5:53	22:37	9:10	20:10	9:00	20:15	5:14	21:16	5:36	21:08	5:47	21:54		
	Time difference	0	22	25	5	53	131	0	122	1	38	3	15	4	4	60.43	Self
9	Accelerometer	13:00	19:31	6:32	20:07	7:15	19:47	6:25	19:48	6:42	19:51	6:06	19:56	6:18	19:54		
	Diary	13:00	19:45	6:30	19:30	7:15	19:20	6:45	19:45	6:40	19:40	6:15	19:45	6:50	19:40		
	Time difference	0	14	2	37	0	27	20	3	2	11	9	11	32	14	26.00	Carer
10	Accelerometer	11:00	20:10	7:49	20:06	7:53	19:24	7:18	20:17	9:15	19:49	7:00	20:32	8:56	19:47		
	Diary	11:00	20:08	7:49	20:05	7:52	19:23	7:18	20:15	9:16	19:48	7:01	20:31	8:56	19:46		
	Time difference	0	2	0	1	1	1	0	2	1	1	1	1	0	1	1.71	Self

Noted No.6 did not provide diary timestamp.

Chapter 4 Levels and patterns of sedentary behaviours in Thai adults with intellectual disabilities

4.1 Abstract

Background: There were no data on the levels and patterns of sedentary behaviour among Thai adults with intellectual disabilities. The objective of this study was to examine levels and patterns of sedentary behaviours in Thai adults with intellectual disabilities.

Methods: Thirty-eight free-living adults with intellectual disabilities (24 men; age 23 ± 4.59 years) were recruited. The protocol was to wear an accelerometer during the waking hours for 7 days. Sedentary behaviours parameters were including total sedentary time, percent of wear time sedentary, number and duration of sedentary bouts ≥1, ≥10, ≥30, ≥60, and ≥90 min, and sedentary breaks. Predictors of sedentary parameters were also explored.

Results: Total mean sedentary time was 6 hours 43 minutes per day (mean ± SD = 403 ± 124 min/day), equivalent to 62.5% of wear time (Table 4.2). Most sedentary bouts were shorter than 10 minutes. Women were more sedentary than men and maximum sedentary bouts were 147 minutes for women and 86 minutes for men. Gender (B 77.40, 95% CI 30.73, 124.08) and BMI (B -4.91, 95% CI -8.35, -1.48) were significant predictors of total sedentary time. For percentage of time sedentary, gender (B 8.50, 95% CI 3.38, 13.63), BMI using Asian cut-offs (B -4.24, 95% CI -6.45, -2.03) and severe level of intellectual disabilities (B 5.11, 95% CI 0.67, 9.56) were significant predictors. However, only gender (B 1.17, 95% CI 1.03, 1.33) was a significant predictor of greater duration of maximum sedentary bout duration.

Conclusion: Thai adults with intellectual disabilities are more sedentary than Thai adults without intellectual disabilities. This effect is pronounced for females with intellectual disabilities. Future research should explore the potential socio-ecological factors that contribute to the high sedentary levels of adults with intellectual disabilities.

4.2 Introduction

Sedentary behaviour, from the Latin *sedere*, "to sit" (Tremblay et al., 2010), is defined as any waking activity that expends very low energy of no more than 1.5 metabolic equivalents (METs), while in a sitting, reclining or lying position (Tremblay et al., 2017). There are several everyday activities that are considered sedentary behaviours, such as sitting during commuting to work, working desk jobs, or sitting watching television. It is also important to clarify that sedentary behaviour is not the same as physical inactivity, which indicates inadequate levels of physical activity (Leitzmann et al., 2018). These two constructs can occur independently and have separate health impacts (Biswas et al., 2015).

Prolonged sedentary time has adverse impacts on overall health, with the need to reduce high sedentary time recognised by the World Health Organization (Bull et al., 2020). Sedentary behaviour has been linked to numerous negative health outcomes, such as non-communicable diseases (NCD; (Biswas et al., 2015; Hamburg et al., 2007; Schmid & Leitzmann, 2014; Wilmot et al., 2012) and mortality (Chau et al., 2013; Diaz et al., 2017; Dunstan et al., 2010; Veerman et al., 2012). Systematic reviews have also shown that sedentary time is associated with an increased risk of type 2 diabetes and cardiovascular disease (Biswas et al., 2015; Wilmot et al., 2012). Furthermore, a meta-analysis by Schmid & Leitzmann (2014) found that sedentary time was reported to increase relative risks for colon, endometrial, and lung cancer. Moreover, sedentary time was found to increase all-cause mortality (Chau et al., 2013; Diaz et al., 2017; Dunstan et al., 2010) and reduce life expectancy (Veerman et al., 2012).

Despite these negative health outcomes, sedentary behaviour is modifiable and, therefore, it has become one of the key target behaviours for reducing NCDs. Based on this existing research, several countries putting sedentary behaviours advice in their national health guidelines, including UK, Germany, Norway, Canada, Australia, New Zealand (Stamatakis et al., 2019), and Thailand (Hongchayangkool et al., 2018), as well as the WHO (Bull et al., 2020). These guidelines recommend that adults reduce sedentary time and break up periods of prolonged sedentary time with physical activity. Furthermore, the 2020 guidelines published by the WHO (Bull et al., 2020) were the first guidelines to make recommendations for people living with disabilities, including intellectual disabilities. Similar to the guidelines for people without disabilities, it was recommended that people with disabilities reduce sedentary time and replace sedentary behaviours with physical activity, as much as possible. The development of these guidelines highlights the emerging evidence on the importance of reducing sedentary behaviours in people with intellectual disabilities (Carty et al., 2021). However, as with the general population, there is insufficient evidence to make recommendations on what constitutes high and low sedentary time; therefore, it is important that further research is conducted to better understand sedentary behaviours in adults with intellectual disabilities (Carty et al, 2021).

Previous research has highlighted that adults with intellectual disabilities, in general, spend a high proportion of their day sedentary. A systematic review reported that adults with intellectual disabilities have an objectively-measured sedentary time of approximately 522-643 min/day, which is more than adults without intellectual disabilities (Melville, Oppewal, Schäfer Elinder, et al., 2017). Another comparative study showed that adults with intellectual disabilities had significantly higher sedentary time than adults without intellectual disabilities (Oviedo et al., 2019). This is concerning as sedentary time of more than 240 min/day is associated to an increased mortality rate, putting adults with intellectual disabilities at high risk of the damaging health outcomes from sedentary behaviours (Chau et al., 2015). Since the prevalence of sedentary behaviour is higher in adults with intellectual disabilities, it is important to study sedentary behaviours to support the development of interventions to reduce sedentary time. There is also limited international research on the sedentary behaviours of adults with intellectual disabilities and, therefore, understanding these behaviours in different countries is a priority area (Carty et al., 2021). It is crucial to study sedentary behaviours patterns as there is increasing evidence that, in addition to total sedentary time, the pattern of sedentary behaviours, such as prolonged bouts, also have negative effects on health (Diaz et al., 2017; Healy et al., 2008; Healy, Matthews, et al., 2011; Kim et al., 2015).

There is an increasing number of studies investigating sedentary behaviours in the Thai general population (Banks et al., 2011; Konharn, 2012; Liangruenrom et al., 2019; Liangruenrom et al., 2018; Liangruenrom et al., 2017; Tanlamai et al., 2022). However, these studies all have several limitations. Almost all of the studies (95.6%) were by questionnaire or activity diary and very few (3.5%) were reported sedentary time based on objective device-based measurement (Liangruenrom et al., 2018). In addition, many studies misclassified physical inactivity as sedentary behaviour, which raises questions on the validity of these data. The two studies with the largest sample size did not report sedentary time based on the standard min/day, but in percentage of participants with high level of sedentary time (Liangruenrom et al., 2017; Peltzer & Pengpid, 2016). Not using the standard approach to report sedentary time, limits comparison of Thai sedentary behaviours prevalence to other populations. The limitations described above highlight that research into sedentary behaviours in the Thai population is in the early stages and additional high-quality research is required.

The Department of Empowerment of Persons with Disabilities of Thailand estimated that there are more than 140,000 individuals with intellectual disabilities in Thailand (*Annual report of the disabled people in Thailand 2020*). However, no studies have investigated sedentary behaviour in adults with intellectual disabilities in Thailand. This is a significant gap and the literature that needs to be addressed. Furthermore, it is important to consider the limitations of sedentary behaviour research in the general Thai population and ensure research includes objective measurement and accurate classification of sedentary behaviours. In addition, several inconsistent associations were reported on correlates of sedentary behaviour in adults with intellectual disabilities (Oppewal et al., 2018), hence the need to investigate this gap in Thai adults with intellectual disabilities. Therefore, the aim of this study is to fill this gap in knowledge about levels and patterns of sedentary behaviours in Thai adults with intellectual disabilities.

Research questions

1. What are the levels of sedentary behaviour in Thai adults with intellectual disabilities?

2. What are the patterns (bouts, type of day, and time of day) of sedentary behaviour in Thai adults with intellectual disabilities?

3. What factors are associated with patterns of sedentary behaviour in Thai adults with intellectual disabilities?

4.3 Methods

4.3.1 Ethical considerations

This study was approved by the Medical, Veterinary, and Life Sciences College Ethics Committee, University of Glasgow and Rajanukul Institute, Bangkok, Thailand. Written informed consent was required from participants and legal guardians prior to participation. Participants and carers were able to revoke consent to participate at any point of the study.

4.3.2 Participants

4.3.2.1 Recruitment

This study aimed to recruit 40 adults with intellectual disabilities to participate. This sample size was empirical chosen to potentially afford normal distributed data and was feasible given the study resources. Participants were recruited through Rajanukul Institute’s prevocational programmes for people with intellectual disabilities located in Bangkok and Pathum Thani, Thailand, between September 2020 and March 2021. The two centres in Bangkok and Pathum Thani provided different training programmes. The Bangkok centre activities were mostly indoor work, except for car wash (only assigned to male attendees), while the Pathum Thani centre assignments were outdoor in the agriculture field and large greenhouse. People with intellectual disabilities who are older than 15 years old were eligible to sign up. The programme was from 8.00 to 15.00 on Monday to Friday. The attendees were able to choose to come every weekday or every other day and the course was three months long.

4.3.2.2 Recruitment specifics

The teachers in the prevocational programmes facilitated the researcher (KC) to meet the groups. During the recruitment period, the researcher (KC) attended the morning sessions on a daily basis. The teachers were the gatekeepers and made first introductions between the researcher and people who were interested in taking part. Information sheets were handed out at the beginning to the participants and carers; participant information sheets were in an easy read format. The accelerometer was shown and demonstrated to facilitate understanding of the study procedures. The participants and carers were free to ask any questions and practice wearing and taking off the accelerometer until they felt comfortable with it. Forty-five information sheets were handed out.

4.3.2.3 Inclusion criteria

The inclusion criteria for participants were: (i) aged 18 years or over, (ii) being independently ambulatory, and (iii) having mild to severe intellectual disabilities.

4.3.3 Measurements

4.3.3.1 Descriptive characteristics

Age, gender, employment status, level of intellectual disabilities, diagnosis, and living arrangement were obtained by either self-report from participants or proxy report from a carer or teacher. Weight and height were measured using digital scales and a stadiometer, respectively. Body mass index was be calculated [weight/height^2 (kg/m^2)] and categorised by both global and Asian-specific BMI classification (WHO, 2004).

4.3.3.2 Sedentary behaviours

The ActiGraph wGT3X+ (ActiGraph LLC, Pensacola, FL) device was used to measure sedentary behaviour. Prior to data collection, each device was initialised according to manufacturer’s specifications. Throughout data collection, participants wore the device around their waist, positioned on the hip (above the iliac crest), and attached using an elastic belt. Participants were asked to wear the device for seven days and remove it when showering or swimming. Due to COVID19 breakout and lockdown, the distribution and return of the accelerometers was more flexible to support the participants. Participants could return the device via mail or return it to the day centre where it could be collected. Additionally, the total number of ActiGraph in the study was 5.

4.3.3.3 Management of data

Accelerometer measures movement by converting raw acceleration data into counts, which are arbitrary unit that proportionate to the acceleration per epoch of time. The converted counts were interpreted by cut points into activity intensity. Accelerometer data were sampled at a rate of 30 Hz and post-processed using ActiLife 6 software and reduced to 60-second epochs of data. The required wear time for the device was three out of the seven measurement days for at least six hours per day and non-wear was classified as 60 minutes of continues zero counts. Sedentary behaviour was classified as 0-99 counts per minute, with this cut point applied to all eligible data using ActiLife 6 software. This cut points was chosen as it has been validation in the general population and no population-specific cut points for adults with intellectual disabilities were available (Atkin et al., 2012).

The primary sedentary behaviour parameters were adapted from best practice guidelines (Byrom et al., 2016). Sedentary parameters can be categorised into three groups including sedentary outcomes, sedentary bouts, and sedentary breaks. Sedentary outcomes were as follows: (a) total sedentary time (presenting in both hours and minutes for easier comparison); (b) percentage of time spent sedentary; (c) and total time in sedentary bouts.

Sedentary bout variables were as follows: (a) weighted median bouts duration (minutes); (b) maximum sedentary bouts duration (minutes); (c) number of sedentary bouts; and (d) duration of sedentary bouts (minutes). Previous research has shown that sedentary behaviour in adults with intellectual disabilities was mostly accumulated in short sedentary bouts of less than 10 minutes (Oviedo et al., 2017). Therefore, in the present study, sedentary bouts (number and duration), were investigated with the following thresholds: ≥1, ≥10, ≥30, ≥60, ≥90 minutes.

Sedentary breaks were calculated as at least 1 epoch where the accelerometer registers ≥ 100 cpm following a sedentary bout (Ghosh et al., 2021; Harris et al., 2019). Sedentary breaks were as follows: (a) number of sedentary breaks and (b) duration of sedentary breaks (min).

To further investigate patterns, all sedentary behaviour outcomes were calculated as averages per day (defined as at least 6 hours of wear time) and averaged across all valid days. Furthermore, time of day was categorized as follows: Early morning (6:00 a.m. to 8:59 a.m.); Late morning (9:00 a.m. to 11:59 a.m.); Early afternoon (12:00 p.m. to 2:59 p.m.); Late afternoon (3:00 p.m. to 5:59 p.m.); Early evening (6:00 p.m. to 8:59 p.m.); Late evening (9:00 p.m. to 11:59 p.m.).

4.3.4 Statistical analysis

All statistical data were analysed using SPSS 28 IBM statistical package (SPSS IBM). Prior to analysis, all data were checked for missing values. There was no missing data in descriptive data or daily and hourly sedentary outcomes.

4.3.4.1 Descriptive statistics

To answer research question 1, descriptive statistics for all sedentary behaviour variables and demographic data are presented as mean (M) ± standard deviations (SD) or number (percentage). Independent t-tests were used to investigate any differences in means between men and women.

4.3.4.2 Level and pattern of sedentary behaviours

To answer research question 2, sedentary behaviours were quantified using daily outcomes (total sedentary time, percentage of wear time spent sedentary, weighted median bouts duration, maximum sedentary bouts, number and duration of sedentary bouts (≥1, ≥10, ≥30, ≥60, ≥90), number and duration of sedentary breaks). Patterns of physical activity changes through time of day were investigated on hourly outcomes (sedentary time, bout duration, and bout number). Line graphs were used to illustrate trends. To detect differences between each time of day and type of day, linear mixed models were performed. This statistical model was chosen for its ability to handle missing data in each time category. A fixed effect was the parameter with expected effect on the outcome, which is the time variable in this study. While random effect was the difference between subjects. Time variable was categorical. No predicted score. The SPSS details are in appendix 6.

4.3.4.3 Predictors of sedentary behaviour

To answer research question 3, predictors of sedentary behaviour outcomes were investigated. Firstly, normality of the outcomes was checked by plotting histograms, Kolmogorov-Smirnov, and Shapiro-Wilk tests. The normally distributed outcomes were analysed with stepwise multiple linear regression. The positively skewed decimal outcomes (average bout duration and average break duration) were log transformed and analysed with multiple linear regression. The positively skewed count outcome (maximum bout) was analysed with Poisson or negative binomial regression. Preliminary Poisson test showed overdispersion (variance above mean) in the data indicated by both values of deviance and Pearson Chi-square divided by degree of freedom exceeding 1.2, therefore negative binomial regression was selected. The model with estimate value of dispersion parameter gave the least goodness of fit indicators; Akaike's Information Criterion (AIC) and Bayesian Information Criterion (BIC), and therefore was selected. Mixed linear models 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). Variables tested for predictability were age, gender, BMI, standard BMI classification (overweight 25-29.9 kg/m^2, obesity ≥30 kg/m^2), Asian BMI classification (overweight 23-27.5 kg/m^2, obesity >27.5 kg/m^2, (WHO2004)), level of intellectual disabilities, employment status, job assignment at day centre (mostly desk work or mostly physical work), gender of family member in the house.

4.4 Results

4.4.1 Participants

Forty-one adults with intellectual disabilities participated in this study. Two participants did not meet the minimum wear time criteria of 6 hours of at least 3 days and therefore were not included in the analysis. One participant withdrew from the study because he fiddled with the ActiGraph until the lid covering charging/data port was broken. The carer was the one who returned the device and decided to withdraw. Therefore, N=38 participants were included in the analysis. Table 4.1 shows demographic characteristics of the sample. Men were more prevalent than women (24 *vs.* 14). Age ranged from 18 to 35 years. Twelve participants, who were all men, also had a diagnosis of autism. Nine participants had intellectual disabilities associated with Down syndrome. Most participants were male, in their early twenties, normal weight, with moderate intellectual disability, unemployed, and living with family. In addition, there was a significant difference in job assignment ($p<0.001$) between men and women as women were less likely to be employed in physical work.

4.4.2 Wear time

Participants wore the accelerometer for an average of 10.81±2.81 hours/day (Table 4.1). There was no difference in wear time between men and women. Among the 38 participants, 27 provided a complete week of valid data, while N=2 participants provided 6 days of data, N=4 provided 5 days, N=4 provided 4 days, and N=1 provided 3 days. Non-wear time was highest during late evening.

4.4.3 Levels of sedentary behaviours

Total mean sedentary time was 6 hours 43 minutes per day (mean ± SD = 403 ± 124 min/day), equivalent to 62.5% of wear time (Table 4.2). Most sedentary bouts were shorter than 10 minutes. Maximum sedentary bouts were 147 minutes for women and 86 minutes for men. The average maximum bout duration for women and men were 74.86 and 57.33 minutes, respectively. Sedentary bouts in 30-59 minutes, ≥60 and ≥90 minutes were limited. Women were more sedentary than men in total time, percentage of time, and maximum bout duration (P <

0.05) (Figure 4-2). There was a trend (p=0.068) that men had a longer duration of sedentary breaks. There was no significant difference between men and women for weekend and weekday outcomes.

4.4.4 Patterns of sedentary behaviours

For time of day, the duration of sedentary bouts was significantly higher in the early evening and late evening compared to late morning, with greater difference in late evening (Figure 4-1). The only effect of day of the week (weekday vs weekend) was on sedentary bout duration in the late evening (Figure 4-3), where bouts were M=3.72 minutes longer at the weekend (P<0.001, 95% CI 1.54, 5.91). Sedentary time (minute/hour) was similar in weekday and weekend (Figure 4-5).

There were significant changes in the number of sedentary bouts throughout the day (time of day: Figure 4-4). There were significantly less sedentary bouts in the early morning in comparison to late morning, early afternoon, and late afternoon (P<0.001). The number of sedentary bouts also significantly declined in early and late evening compared to late morning.

4.4.5 Predictors of sedentary behaviours

Results for significant (P<0.05) predictors of sedentary outcomes are presented in Table 4.3. For total sedentary time, gender (B 77.40, 95% CI 30.73, 124.08) and BMI (B -4.91, 95% CI -8.35, -1.48) were significant predictors. Being female was associated with increased sedentary time, while increasing BMI was associated with decreased sedentary time. For percentage of time sedentary, gender (B 8.50, 95% CI 3.38, 13.63) and BMI Asian cut points (B -4.24, 95% CI -6.45, -2.03) were significant predictors, with the same direction of association as those in sedentary time. More severe level of intellectual disabilities (B 5.11, 95% CI 0.67, 9.56) was associated with increased percentage of sedentary time. For maximum bout of sedentary time, only gender (B 1.17, 95% CI 1.03, 1.33) was significant with the same direction of association, being women predicted having greater duration of max sedentary bout.

4.5 Discussion

This is the first study to report on levels and patterns of objectively measured sedentary behaviour in Thai adults with intellectual disabilities. The key findings were that Thai adults with intellectual disabilities had an average sedentary time of 6.7 hours per day (403 min/day, accounting to 62.5% of wear time). In general, this daily sedentary time was accumulated in bouts lasting less than 10 minutes, with participants engaging in minimal sedentary bouts lasting longer than 30 or 60 minutes. Participants were more sedentary during evening time, in particular the late evening during the weekend. Gender, level of intellectual disabilities, BMI, and BMI Asian cut points were predictors of sedentary behaviour.

The level of sedentary behaviours in this study was lower than previous objectively measured studies in Europe and America (Ghosh et al., 2021; Harris et al., 2019; Oviedo et al., 2017). A UK study reported a mean sedentary time491.3 min/day (Harris et al., 2019). Two studies in Spain reported 612.9 min/day (Oviedo et al., 2017) and 615.04 min/day (Oviedo et al., 2019). The most recently published study in the US reported average sedentary time of 514 min/day (Ghosh et al., 2021). One potential explanation for this difference is that the studies in Europe and America is the older participants than in the Thai sample The European and US studies reported mean ages of 45.3 (Harris et al., 2019), 44 (Oviedo et al., 2017), 46 (Oviedo et al., 2019), and 46 years old (Ghosh et al., 2021), compared to the much younger mean age of 23 years old in this study.

There were very few comparable objectively measured sedentary behaviours studies in Thai or Asian adults with intellectual disabilities. There were two studies in Asian adults with intellectual disabilities; reporting sedentary time of 495.4 ± 87.1 min/day in Hong Kong (Chow et al., 2018) and 517.69 ± 103.19 min/day in Taiwan (Hsu et al., 2021). The mean age of participants in these two studies was around 40 years old. The lower level of total sedentary time in the present study could be in part attributed to the assigned day activities in the prevocational programme or the younger age of the participants. Overall, due to the lack of existing research on sedentary behaviours in Asian samples with intellectual disabilities, the scope for comparison with previous literature is limited.

In relation to patterns of sedentary behaviours, sedentary time in this study was highest in late evening. This was in contrast with two previous studies in adults with intellectual disabilities that reported more sedentary time in the morning (Harris et al., 2019) and more sedentary time during daytime than the evening time (Oviedo et al., 2017). A similar recruitment strategy was used in Oviedo et al. (2017), as participants were recruited from an occupational day centre. Therefore, the difference in sedentary time with time of day could be due to different activities or work assignments occurring in the centre programme. This suggests it might be possible to reduce sedentary time through day centre daily activity programmes.

The difference between weekday and weekend days was detected in sedentary bout duration in late evening time, in which weekend bouts were longer. This result was also in contrast with Oviedo et al. (2017), which reported participants spent more time sedentary during the weekday than during weekend days. A previous study involving adults with intellectual disabilities living in the United States reported that the number of bouts was significantly greater during the weekday than weekend (Ghosh et al., 2021). While another study in UK reported no significant difference between total sedentary parameters in weekday and weekend (Harris et al., 2019). This inconsistency could also possibly be the difference in activities in the centres, as instructors would be more confident to assign younger people physical jobs than older participants in previous research. The sedentary time accumulation in short bouts was consistent with previous intellectual disability studies (Ghosh et al., 2021; Harris et al., 2019; Oviedo et al., 2017).

The result that women were more sedentary than men is in contrast to a systematic review on correlates of sedentary behaviours in the Thai population that reported evidence suggesting that male adults were more sedentary than females (Liangruenrom et al., 2019). Therefore, this provides initial evidence that the behaviours of Thai adults with intellectual disabilities differs from Thai adults without intellectual disabilities. Contrastingly, a recent systematic review on sedentary behaviours of adults with intellectual disabilities reported that finding that women were more sedentary than men from objectively measured sedentary time studies , although an analysis by the weighted average found no gender differences, and the meta-analysis found an insignificant overall effect of gender (Westrop et al., 2019).

The present study finding that women were more sedentary than men could be due to the allocation of work within the prevocational programme along gender norms. For example, women received desk or indoor jobs like food preparation or package labelling, whereas men did more manual labour jobs. This could be due to Thai culture tending to be overprotective on women, and especially more on vulnerable disabled women (Bualar, 2014; Lundberg, 2000). Furthermore, in recent years, Thailand has passed a law promoting disability employment (*Empowerment of Persons with Disabilities Act, B.E. 2550 (2007)*), but still, employers hire more men, resulting in an employment rate of men with disabilities that is double the rate of employment for women with disabilities (Cheausuwantavee & Keeratiphanthawong, 2021). Another barrier to employment was that family members were more concerned with safety in the working environment of women (Bualar, 2014). This makes it more challenging for women with intellectual disabilities to be able to work and live independently in Thailand.

Four predictors of sedentary behaviours were identified in this study: gender, level of intellectual disabilities, BMI and BMI Asian cut points. A systematic review on correlates of sedentary behaviour in adults with intellectual disabilities found inconsistent results for sex, genetic syndromes, weight status, physical health, mobility, level of intellectual disabilities, and mental health (Oppewal et al., 2018). Focusing on BMI, the finding in this study that BMI and BMI Asian cut points have negative association with sedentary outcomes is consistent with previous research in individuals with Down syndrome, Williams syndrome and Prader–Willi syndrome (Nordstrøm et al., 2013), but contrast with three studies (Hsieh et al., 2017; Melville et al., 2018; Oviedo et al., 2017). This different finding could be explained by the difference in age of the sample. Mean age in this study and Nordstrøm study were 23 and 28.5, respectively, while the other three studies were 37.67 (Hsieh et al., 2017), 43.6 (Melville et al., 2018), and 44 (Oviedo et al., 2017). This could mean that age might play a role as a modifier for BMI on sedentary outcomes. However, the lack of conclusive findings highlights complexity of the problem and the need for further research into predictors of sedentary behaviours in people with intellectual disabilities, in particular studies including Asian samples. In addition, Asian people are with increased risk of NCDs at lower BMIs than the standard overweight cut-off point at ≥25 kg/m^2 (WHO, 2004). The result that BMI Asian classification was a significant predictor on sedentary behaviours supports the implement of Asian-specific BMI classification.

4.5.1 Strengths and limitations

This is the first study to investigate levels, patterns, and predictors of sedentary behaviours in Thai adults with intellectual disabilities. This study used objective measurement of sedentary behaviours to enable an exploration of various parameters of sedentary behaviours.

As participants were recruited from a prevocational programme provided by a special education service, a sampling bias may be present which could have impacted on the results. People who attended the prevocational programme were, mor likely to be urban middle class with family support and mild to moderate levels of intellectual disabilities. Therefore, adults with intellectual disabilities who were not in the health system or who lived in rural or higher deprivation areas were not represented. The sample size is small. Consequently, there is a risk that including multiple variables threatens the validity of the findings. Therefore, the findings should be interpreted with caution and require replication in the future. In addition, this sampling method resulted in the recruitment of younger adults, therefore a comparison between young and older age groups was not possible in this study.

4.5.2 Future research recommendations

This study is the first to fill the gap relating to the sedentary behaviours of Thai adults with intellectual disabilities. However, several future research needs have been identified. To add to the body of knowledge, there should be continuing investigation relating to factors that have influences on sedentary behaviours in adults living in Thailand. Barriers and facilitators to sedentary behaviours should also be investigated. It is also important to acknowledge that this study was conducted during the COVID-19 pandemic, which could have impacted the levels of sedentary behaviour reported in this study. Therefore, future research should aim to test if these findings are replicated as the impacts of the pandemic lessen on everyday life.

4.6 Conclusion

The results of this study suggested that Thai adults with intellectual disabilities spent an average of 6.7 hours per day sedentary, which is accumulated in short bouts. The highest levels of sedentary time were during the evenings on weekends. Gender, level of intellectual disabilities, BMI, and BMI Asian cut points were potential predictors of sedentary behaviours. This exploratory study provides essential preliminary data to address the gap in the literature on the sedentary behaviours of Asian, specifically Thai, adults with intellectual disabilities. As cultural and gender norms, as well the opportunities given to people with disabilities, can vary between countries and continents, it is essential that research aims to understand potential impacts on lifestyle factors, including sedentary behaviour within Thai and Asian countries. As the majority of previous research in this field is from European and North American countries, it is not yet possible to determine how generalizable this previous research is to Asian countries. Therefore, it is essential that future research builds upon this study to help develop the knowledge-base on the sedentary behaviours of Thai and Asian adults with intellectual disabilities.

Table 4.1 Demographic characteristics of participants presented in mean ± SD or n (%)

Variables	All n = 38	By sex	
		Men n = 24 (63.16)	Women n = 14 (36.84)
Age (years)	23.00 ± 4.59	24.00 ± 4.05	21.29 ± 5.08
18-24	26 (68.42)	14 (36.84)	12 (31.58)
25-29	8 (21.05)	8 (21.05)	0 (0.00)
30-35	4 (10.53)	2 (5.26)	2 (5.26)
Weight (kg)	66.38 ± 20.52	72.74 ± 19.29*	55.48 ± 18.39
Height (cm)	162.82 ± 11.65	167.92 ± 10.11*	154.07 ± 8.66
BMI (kg/m^2)	24.91 ± 6.64	25.70 ± 5.70	23.54 ± 8.03
BMI category			
Underweight	6 (15.79)	3 (7.89)	3 (7.89)
Normal	15 (39.47)	9 (23.68)	6 (15.79)
Overweight	9 (23.68)	6 (15.79)	3 (7.89)
Obese	8 (21.05)	6 (15.79)	2 (5.26)
ID level			
Mild	14 (36.84)	7 (18.42)	7 (18.42)
Moderate	22 (57.89)	15 (39.47)	7 (18.42)
Severe	2 (5.26)	2 (5.26)	0 (0.00)
Down syndrome	9 (23.68)	6 (15.79)	3 (7.89)
Autism spectrum disorder	12 (31.58)	12 (31.58) *	0 (0.00)
Nonspecific	13 (34.21)	4 (10.53)	9 (23.68)
Epilepsy	3 (7.89)	2 (5.26)	1 (2.63)
Organic brain syndrome	1 (2.63)	0 (0.00)	1 (2.63)
Employment status			
Employed	6 (15.79)	5 (13.16)	1 (2.63)
Unemployed	32 (84.21)	19 (50.00)	13 (34.21)
Living arrangement			
Family	36 (94.74)	23 (60.53)	13 (34.21)
Paid carer	1 (2.63)	0 (0.00)	1 (2.63)
Private boarding school	1 (2.63)	1 (2.63)	0 (0.00)
Wear time (hours/day)	10.81±2.81	10.63±2.56	11.12±3.18
Wear time (min/day)	648.58±168.81	637.51±153.89	667.00±190.53

Note. * $p < 0.05$ between men and women with intellectual disabilities

Table 4.2 Sedentary analysis

Variables	Average day M(SD)			Weekday			Weekend		
	All n = 38	Men n = 24 (63.16)	Women n = 14 (36.84)	All n = 38	Men n = 24 (63.16)	Women n = 14 (36.84)	All n = 38	Men n = 24 (63.16)	Women n = 14 (36.84)
Total volume									
Total sedentary time (hr/day)	6.71 (2.07)	6.16 (1.64)*	7.62 (2.36)	6.73 (2.09)	6.21 (1.66)	7.61 (2.43)	6.65 (2.02)	6.00 (1.60)	7.67 (2.22)
Total sedentary time (min/day)	402.54 (123.97)	369.52 (98.58)*	457.46 (141.75)	403.77 (125.21)	372.76 (99.64)	456.52 (145.85)	399.06 (121.30)	360.03 (96.04)	459.96 (132.96)
Percentage of wear time spent sedentary (%)	62.48%	58.76%*	68.66%	62.46%	58.84%	68.63%	62.53%	58.55%	68.75%
Sedentary bout									
Weighted median bouts duration (minutes)	2	2	3	2	2	3	2	2	3
Maximum sedentary bouts duration (minutes)	147	86*	147	147	69	147	89	86	89
Number of sedentary bouts	74.72	75.01	74.24	74.09	74.34	73.66	76.50	76.95	75.80
Number of bouts ≥1 min	74.70	74.99	74.21	74.07	74.33	73.61	76.48	76.92	75.8
Duration of bouts ≥1 min (min)	5.39 (8.03)	4.93 (7.22)	6.16 (9.19)	5.45 (8.11)	5.01 (7.33)	6.19 (9.26)	5.23 (7.80)	4.68 (6.88)	6.09 (9.01)
Number of bouts ≥10 min	11.13	9.84	13.27	11.18	9.96	13.25	10.97	9.46	13.32
Duration of bouts	20.28	19.48	21.27	20.37	19.67	21.28	32.05	18.91	21.25

≥10 min (min)									
Number of bouts ≥30 min	1.95	1.61	2.52	1.97	1.68	2.45	1.91	1.38	2.72
Duration of bouts ≥30 min (min)	42.10	40.72	43.60	42.20	40.67	43.98	41.83	40.91	42.56
Number of bouts ≥60 min	0.08	0.03	0.15	0.08	0.03	0.16	0.08	0.05	0.12
Duration of bouts ≥60 min (min)	76.84	71	78.93	77.50	65.67	80.73	75.00	79.00	72.33
Number of bouts ≥90 min	0.01	0.00	0.03	0.02	0.00	0.04	0.00	0.00	0.00
Duration of bouts ≥90 min (min)	110.33	0.00	110.33	110.33	0.00	110.33	0.00	0.00	0.00
Sedentary Breaks									
Number of breaks	11.05	9.75	13.24	11.10	9.85	13.24	10.92	9.44	13.24
Duration of breaks (min)	100.96	118.31	79.58	97.21	113.32	76.62	111.81	133.66	87.52

Note. * $p < 0.05$ between men and women with intellectual disabilities

Table 4.3 Significant predictors on daily sedentary outcomes

Outcomes	Predictors	p-value	B	95%CI
Total sedentary time	Gender	0.002	77.404	30.730, 124.079
	BMI	0.006	-4.913	-8.350, -1.475
Percentage of time in sedentary	Gender	0.002	8.501	3.376, 13.626
	BMI Asian cut points	< 0.001	-4.242	-6.450, -2.033
	ID level	0.025	5.111	0.667, 9.555
Max bout	Gender	0.018	1.169	1.028, 1.329

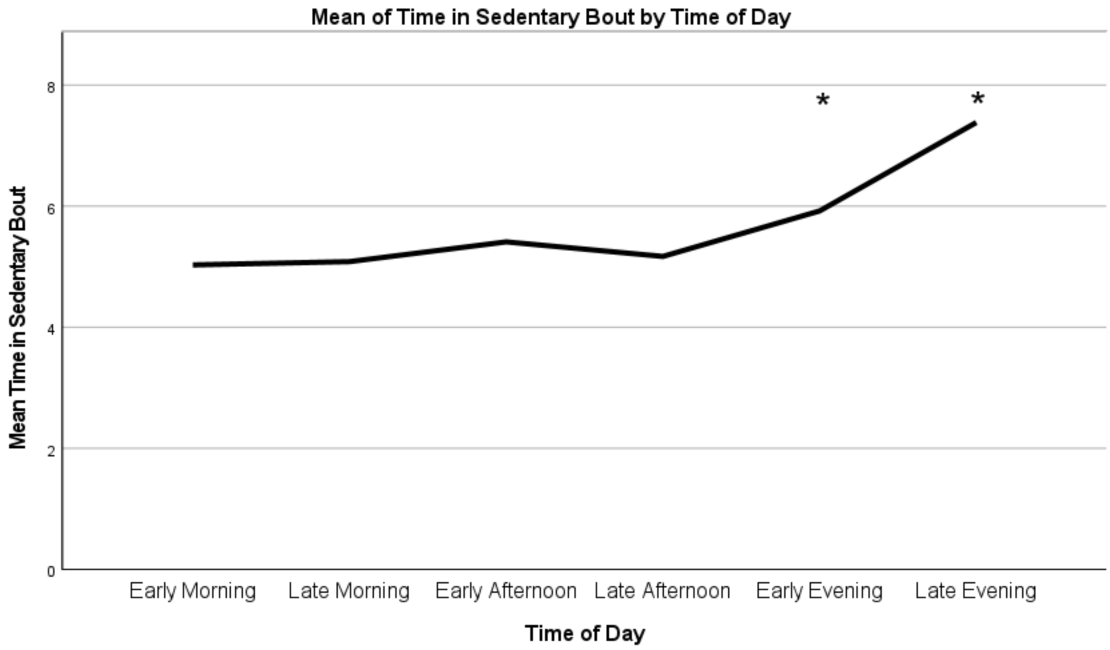

Figure 4-1 Line graph show sedentary bout duration in different time of day. Early and late evening had significantly longer time in sedentary bouts (* marks statistically significant difference).

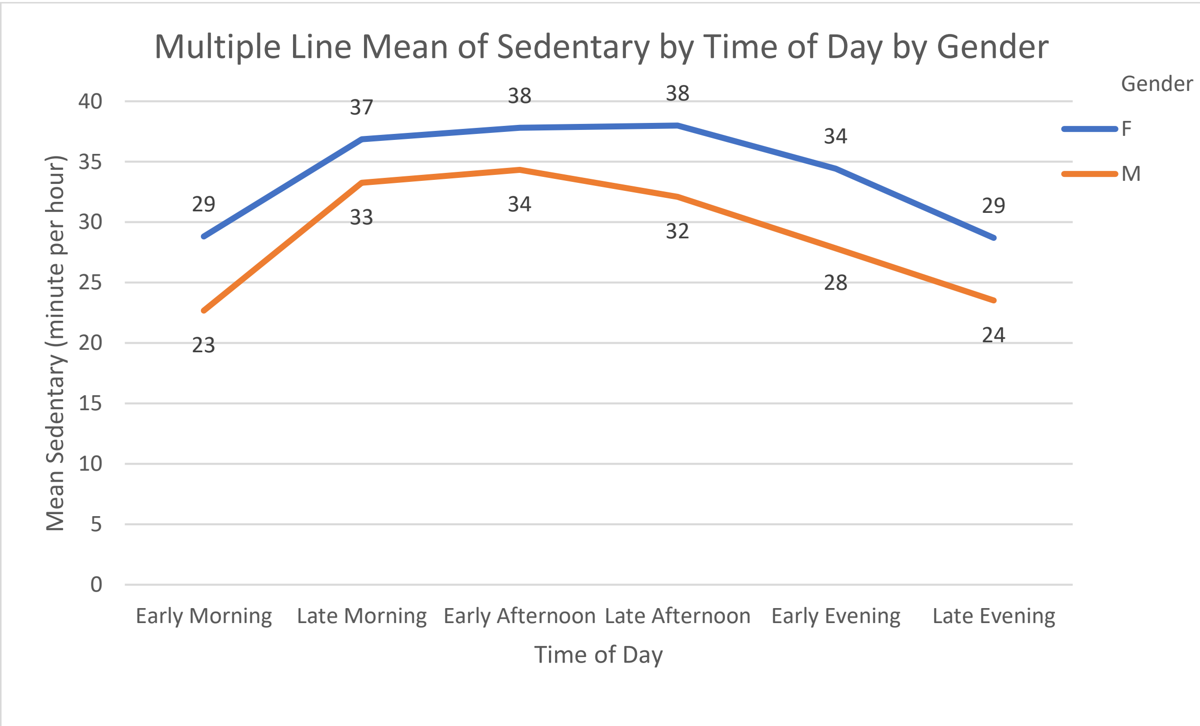

Figure 4-2 Line graph show sedentary time (minute/hour) of women and men in different time of day.

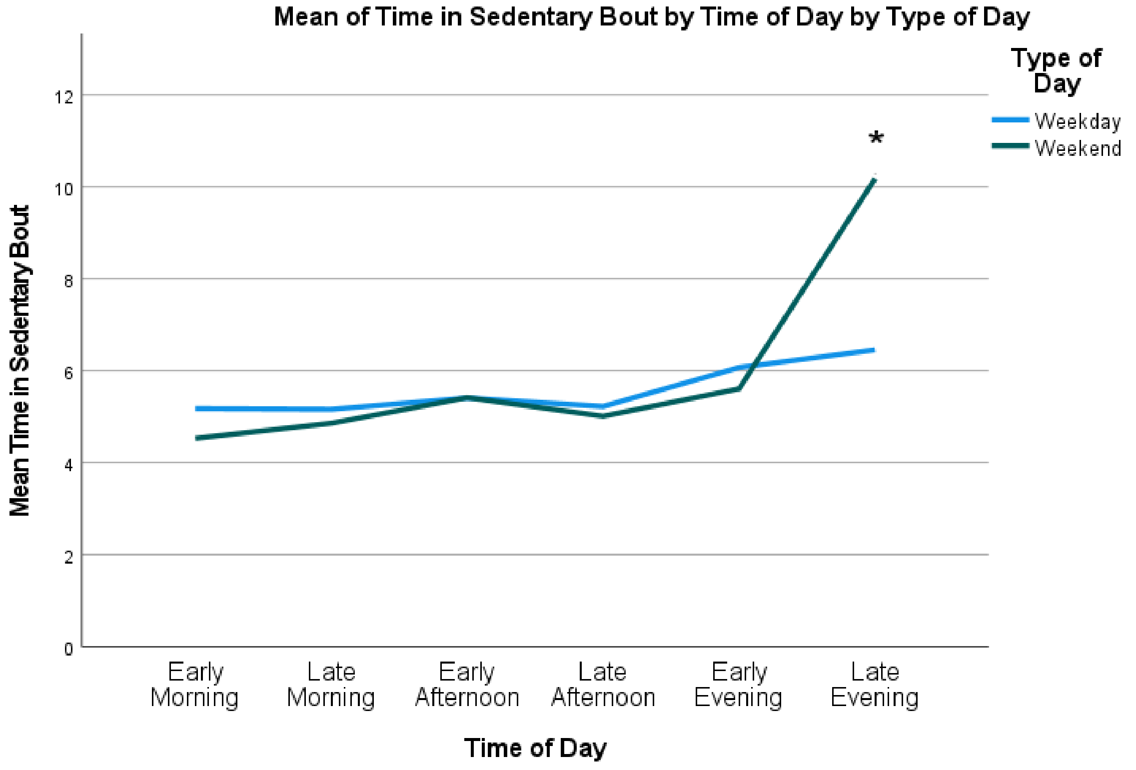

Figure 4-3 Line graph comparing means of sedentary bout duration of different time of day in weekend and weekday.
(* marks statistically significant difference between weekend and weekday)

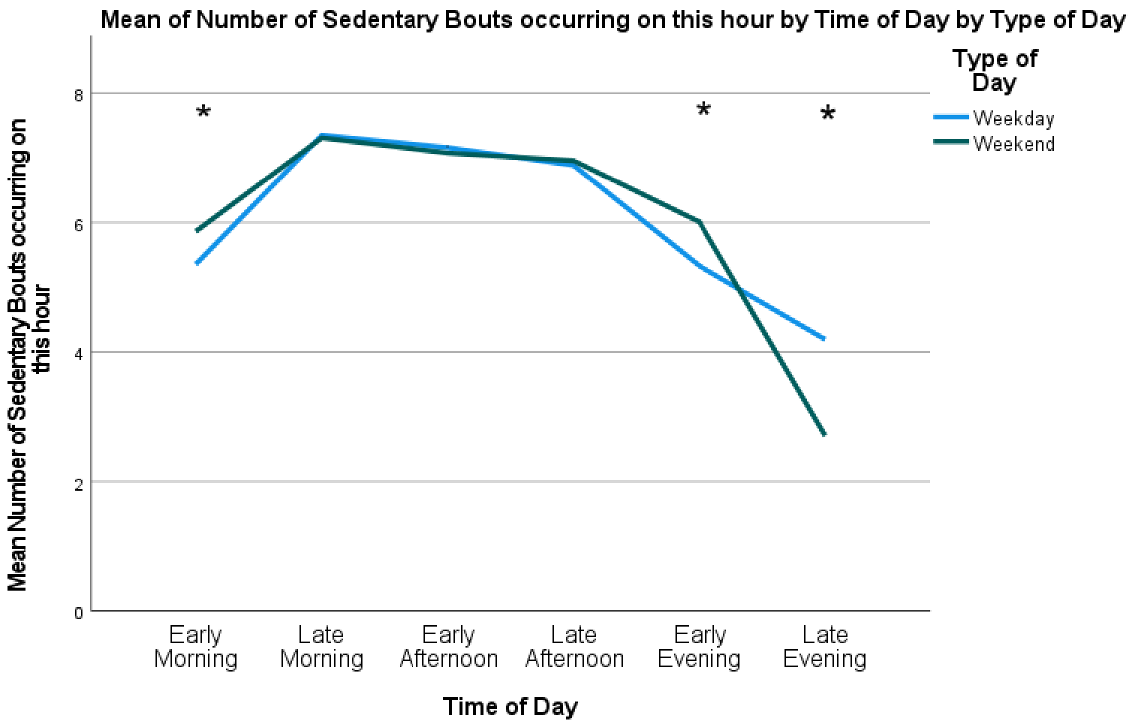

Figure 4-4 Changes in bout number through time of day in weekday and weekend.
(* marks statistically significant difference between time of day)

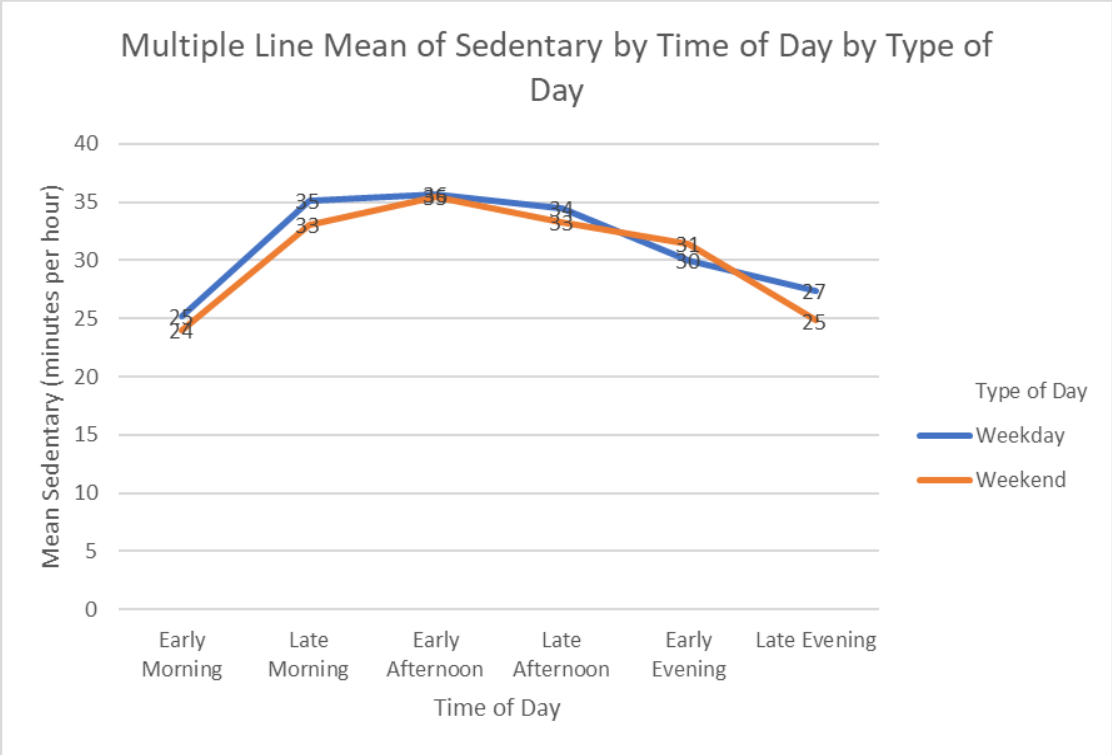

Figure 4-5 Line graph show sedentary time (minute/hour) in weekday and weekend in different time of day.

Chapter 5 Physical activity levels and patterns of Thai adults with intellectual disabilities

5.1 Abstract

Background: There were no data on the levels and patterns of physical activity of Thai adults with intellectual disabilities. The objective of this study was to examine levels and patterns of physical activity in Thai adults with intellectual disabilities.

Methods: Thirty-eight free-living adults with intellectual disabilities (24 men; age 23 ± 4.59 years) were recruited. The measurement protocol was to wear an accelerometer during the waking hours for 7 days. Physical activity outcomes were including MVPA, LPA, and steps. Predictors of physical activity were also explored.

Results: Thai adults with intellectual disabilities took part in an average of 119 minutes per week of MVPA, 229 minutes per day of LPA and 4,899 steps per day. Thirty-two percent of participants met the goal of 150 minutes of MVPA per week. MVPA levels were significantly higher during weekdays compared to weekend days. Men had higher total PA time and had statistically higher levels of total MVPA (20.51 minutes per day) than women (10.78 minutes per day). Step counts of men (5474 steps per day) were significantly higher than women (3935 steps per day). Age, level of intellectual disabilities, and BMI Asian cut points were predictors of physical activity levels.

Conclusion: Thai adults with intellectual disabilities have lower levels of physical activity than adults without intellectual disabilities in Thailand. Gender specific health improvement programmes may be needed to address the gendered patterning of lifestyle behaviours of Thai adults with intellectual disabilities.

5.2 Introduction

Physical activity, which refers to any bodily movement produced by skeletal muscles that results in energy expenditure (Caspersen et al., 1985), is one of the key behaviours that can reduce the risk of noncommunicable diseases (WHO, 2018). Being physically active is linked with lower risk and increased survival for several cancers (McTiernan et al., 2019), cardiovascular disease, type-2 diabetes (Warburton et al., 2006), and dementia (Livingston et al., 2017), as well as improving mental health (Schuch et al., 2016). The health benefits of physical activity for adults with disabilities are comparable to the benefits identified for adults without disabilities (Smith et al., 2018). Low levels of physical activity are one of the key behavioural factors to negatively impact health and increase the risk of NCDs in people with intellectual disabilities (Bergström et al., 2013). People with intellectual disabilities face numerous barriers to physical activity, such as poor physical fitness (Hsieh et al., 2017), being overweight, limited accessibility and social support (Bossink et al., 2017). The seemingly vicious cycle makes them more susceptible to adverse health outcomes.

From an evolutionary perspective, humans are designed to be physically active with survival of our ancestors dependant on physical fitness (Eaton, 2003). Our genome interlinks on that caloric balance between consumption, as food energy, and expenditure, as physical activity, with an imbalance being one cause of obesity. Although the basics of human physiology have not changed from early humans, current living circumstances are greatly different and physical activity has become somewhat unnecessary for daily life. This mismatch between genetic makeup and contemporary inactive lifestyle contributes to many noncommunicable diseases, for example, past exposure to famine may promote saving-calorie gene variants for survival, but subsequently may contribute to obesity in current calorie-excess conditions (Benton et al., 2021). Physical inactivity has been attributed to 6% of the burden of disease from coronary heart disease, 7% of type 2 diabetes, 10% of breast cancer, 10% of colon cancer, and 9% of premature mortality (Lee et al., 2012). In addition, apart from the disease burden, there is also economic burden of physical inactivity. Globally, the estimated cost in health-care systems directly from physical inactivity was 54 billion international dollars in 2013 (Ding et al., 2016).

To gain health benefits from physical activity, adults aged 18 years and over without disability should complete 150–300 minutes per week of moderate-intensity aerobic physical activity; or at least 75–150 minutes of vigorous-intensity aerobic physical activity; or an equivalent combination, with 2 or more days on some muscle-strengthening activities on major muscle groups (UK Department of Health and Social Care2019; WHO, 2020). There is an emphasis on some physical activity is better than none. In addition, the recent version of these guidelines has been the first to include specific guidelines for adults with disabilities. These disability-specific guidelines are the same as those for adults without disabilities with an additional safety aspect noting that appropriate physical activity is not a risk for disabled adults. Even though, these guidelines are not specific for adults with intellectual disabilities, but it included evidence from intellectual disabilities research in the process of the update of the physical activity guideline (Smith et al., 2018). However, despite the inclusion of intellectual disabilities research into the process, almost all of the studies are from Europe and northern America. No studies included populations from Asia, which could be due to the low-quality research in the area, thus highlighting the need for high quality research quantifying the physical activity levels of Asian adults with intellectual disabilities.

Previous research has demonstrated that less than one out of ten adults with intellectual disabilities met the physical activity guideline (Dairo et al., 2016) compared to more than 70% of adults without intellectual disabilities (Guthold et al., 2018). The average step count in adults with intellectual disabilities was 6,795 steps per day (Dairo et al., 2016), well below the recommended 10,000 steps/day, and the 7,000 steps/day threshold that is equivalent to 150 minutes per week of MVPA (Tudor-Locke et al., 2011). In Asia, specifically in Hong Kong, studies have reported adults with intellectual disabilities had 10 min/day of MVPA (Chow et al., 2018) and 5,000-7,499 steps/day (Chan, 2014), based on objective measurements of physical activity. These results display the same trend of low levels of physical activity in Asian adults with intellectual disabilities, compared to studies based in North America and Europe. However, data from Asia is still limited and therefore definitive conclusions cannot yet be made. This vast difference in physical activity levels highlights the need to find ways to increase the activity levels of adults with intellectual disabilities.

From the most recent estimation, Thailand has 143,368 people with intellectual disabilities (*Annual report of the disabled people in Thailand 2020*). However, no studies have been conducted in Thai adults with intellectual disabilities with the aim of quantifying or understanding the physical activity behaviours in adults with intellectual disabilities. Previous studies involving Thai adults with intellectual disabilities were focusing on evaluating physical fitness (Chaiwanichsiri et al., 2000; Chomyounk, 1995), cardiovascular risk factors (Chalwanichsiri D et al., 2000), and exercise interventions (Jarutwanitpong, 2016; Jeerapong, 2011; Laohapakdee, 2012; Waree, 2021). Furthermore, this research is primarily based on unpublished theses in sport science field written in Thai, or papers published in domestic journal with limited scientific community reach, or summary reports for bureaucratic quality assessment without any peer-reviewed process.

These limitations in the previous research highlight the need to investigate the physical activity levels of adults with intellectual disabilities in Thailand. This will provide a better understanding of whether the trend of adults with intellectual disabilities having low levels of physical activity is also present within a Thai population. Furthermore, as there is no existing data on Thai adults with intellectual disabilities, it is important to explore various parameters of physical activity. Physical activity can be categorised in various ways, such as outcomes related to energy expenditure, e.g., intensity, usually light, moderate, vigorous, and MVPA. It can also be categorised in relation to behavioural aspects, such as frequency, duration, and bouts. In addition, physical activity should be measured using objective measures, due to limitations with subjective measures, including when used with people with intellectual disabilities (Esliger & Tremblay, 2007; Pitchford et al., 2018). Therefore, an understanding of objectively physical activity levels and patterns, based on the categories described above, is essential to begin to address the present gap in the literature relating to the physical activity behaviours of Thai adults with intellectual disabilities.

Therefore, the present exploratory study aimed to measure levels and patterns of physical activity in Thai adults with intellectual disabilities to answer the following research questions:

1. What are the physical activity levels [MVPA, light physical activity (LPA), and steps] of Thai adults with intellectual disabilities?

2. What are the patterns (time of day and type of day) of physical activity in Thai adults with intellectual disabilities?

3. What are the predictors of physical activity in Thai adults with intellectual disabilities?

5.3 Methods

5.3.1 Study Design

A cross-sectional study evaluating the levels and patterns of objectively measured physical activity in Thai adults with intellectual disabilities.

5.3.2 Ethical considerations

This study was approved by the Medical, Veterinary, and Life Sciences College Ethics Committee, University of Glasgow and Rajanukul Institute, Bangkok, Thailand. Written informed consent was required from participants and legal guardians prior to participation. Participants or carers were free to withdraw from participating at any point of the study.

5.3.3 Recruitment

Participants were recruited in Thailand, between September 2020 and March 2021. Participants were recruited while attending a prevocational programme that was run by Rajanukul Institute intellectual disabilities services, located in Bangkok and Pathum Thani, Thailand. The programme is optional for people with intellectual disabilities who are aged 15 years and older and aims to introduce people to a work environment. The programme provided training in various job assignments ranging from product labelling, office messenger, ingredient preparation, cooking, car wash, and greenhouse agriculture work. In general, male attendees are assigned outdoor/labour intense jobs, whereas female programme attendees take part in indoor/desk jobs.

The teachers in the prevocational programmes facilitated recruitment by enabling the researcher to meet the groups. The researcher handed out information sheets to people who were interested in taking part. The study was described in easy read language along with pictures in the information sheet.

5.3.4 Inclusion criteria

The inclusion criteria for participation were: (i) aged 18 years or over, (ii) being independently ambulatory, and (iii) having mild to severe intellectual disabilities.

5.3.5 Measures

5.3.5.1 Physical activity

Physical activity was objectively measured using the ActiGraph wGT3X+ accelerometer (ActiGraph, LLC, Pensacola, FL, USA). The device was hip worn on all waking hour except when showering, bathing, or swimming for one week. Prior to data collection, the accelerometer was shown and demonstrated; participants and carers were free to ask any questions and practice until they felt comfortable with the accelerometer.

The minimum wear time was at least 6 hours per day for at least 3 days. Days with below minimum wear time of at least 6 hours were removed. Because of this removal, the weekly MVPA was calculated from average daily MVPA. Activity counts were recorded over 60-second intervals (epochs). Intervals of at least 60 minutes of zero activity counts was defined as non-wear time (Troiano, 2008). The cut points developed by (Troiano et al., 2008) were used to categorise accelerometer count data into intensity levels. No cut points have been developed specifically for adults with intellectual disabilities, therefore these cut points were selected because they were derived from a large sample and free-living physical activity. Cut points were applied using Actilife software and then intensity and step count data were exported into Excel.

Data were categorized into physical activity levels per hour and physical activity levels per day. Time of day was categorized as follows: Early morning (5:00 a.m. to 8:59 a.m.); Late morning (9:00 a.m. to 11:59 a.m.); Early afternoon (12:00 p.m. to 2:59 p.m.); Late afternoon (3:00 p.m. to 5:59 p.m.); Early evening (6:00 p.m. to 8:59 p.m.); Late evening (9:00 p.m. to 11:59 p.m.). Night-time data (after midnight to 4.59 a.m.) were removed and not included in any analysis. The hourly data were used to understand the patterns of physical activity through time of day and type of day (research questions 1 and 2). The daily average data were used to explore predictors of physical activity (research question 3).

5.3.5.2 Demographic data

Demographic data including age, level of intellectual disabilities, cause of intellectual disabilities, underlying diseases, and living arrangement were collected using a researcher-administered questionnaire to give basic characteristics of the sample. Weight and height were measured using digital scales and a stadiometer, respectively, and body mass index was calculated [weight/height^2 (kg/m^2)]. The WHO body mass index (BMI; kg/m^2) categories (underweight: <18.5, normal weight: 18.5 – 24.9, overweight: 25 – 29.9, obese: ≥30) and Asian-specific BMI categories (underweight: <18.5, normal weight: 18.5 – 22.9, overweight: 23 – 27.4, obese: ≥27.5) were used to classify participants' body type (WHO, 2004).

5.3.6 Statistical Analysis

Statistical analysis was done using SPSS (IBM, SPSS Statistics version 28). Prior to any statistical analysis, data were checked for normality using histograms, Kolmogorov-Smirnov, and Shapiro-Wilk tests. Hourly MVPA and steps were square root transformed because they were positively skewed contained zero value.

To answer research question 1, levels of physical activity were quantified by calculating means and SD of daily physical activity outcomes (MVPA, LPA, MPA, VPA, and steps) for whole sample. The data will be presented as mean ± SD. To answer research question 2, patterns of physical activity changes through time of day were investigated on means of hourly physical activity outcomes (MVPA, LPA, and steps). The hourly VPA were mostly at zero minute, so it was excluded from pattern analysis separately. Line graphs were used to illustrate trends. Independent t-tests were used to investigate differences between men / women and weekend / weekday. To detect differences between each time-of-day category, a linear mixed model was performed by configurating time of day as fixed effect and subject as random effect.

To answer research question 3, multiple linear regression was used to explore potential predictors for the outcomes of hourly and daily MVPA, LPA, and step counts. Variables tested for predictability were age, gender, standard BMI classification (overweight 25-29.9 kg/m^2, obesity ≥30 kg/m^2), Asian BMI classification (overweight 23-27.5 kg/m^2, obesity >27.5 kg/m^2, WHO, 2004), ID level, employment status, job assignment, gender of family member in the house. Normal distribution was assessed on the outcome variables. For variables that were not normally distributed and not whole number (daily average MVPA, step counts), analyses were performed on log transformed data.

5.4 Results

5.4.1 Participants

Participants were n=38 adults with mild to severe intellectual disabilities aged from 18 to 35 years (mean age 23 ± 4.59 years). There were more men (n=24) than women (n=14) I the study sample. Briefly, participants were mainly male, in their early twenties, normal weight, with moderate intellectual disabilities, not in paid employment (unrelated to the prevocational programme) and living with family. Full details of descriptive statistics are presented in Table 5.1.

5.4.2 Levels of physical activity

Table 5.2 shows daily levels of physical activity of all participants and men and women separately. MVPA of the whole group ranged from 4 to 595 minutes per week. Participants achieved a mean of 17 minutes per day of MVPA and a mean of 119 minutes per week of MVPA. Twelve participants (10 men and 2 women) achieved the physical activity recommendation, accounting for 32% of all participants. The mean step count was 4,899 steps per day and ranged from 250 to 20,924 steps per day. There was a greater range of daily step counts for men (305 to 20,924 steps per day) than women (250 to 10,481 steps per day). The difference in daily step count between men and women was statistically significant (5474.54 and 3935.27 steps per day, respectively). Women were statistically less active than men in all intensities (Table 5.2).

5.4.3 Patterns of physical activity

Levels of MVPA per hour were small, within the range of zero to three minutes, but a change in patterns through time of day was identified. For time-of-day, MVPA was highest in the early morning then decreased throughout the day and was lowest in the late evening, with statistical significance between early morning and late evening ($P < 0.001$) (Figure 5-1). The range of minutes of MVPA conducted was more distinct in men than women (Figure 5-2). Comparing between weekday and weekend, the similarity was that MVPA was higher in the early morning than late evening (Figure 5-3), but MVPA was statistically higher ($P < 0.001$) in during weekday than the weekend.

For LPA, in the time-of-day pattern, LPA per hour was lowest in late evening compared to every other time of day ($P < 0.001$), with no difference between morning and afternoon (Figure 5-4). Comparing between men and women, both genders had the trend of LPA reducing in the evening, but women's highest levels were in late morning to early afternoon, while men's were in late morning (Figure 5-5), with significantly ($P < 0.001$) more LPA in men. Comparing between weekday and weekend, the change in LPA across the week was small (Figure 5-6).

For step count, in the time-of-day pattern, the highest step count was in the early morning and the lowest steps count was in late evening (Figure 5-7). Comparing between men and women, both genders had the least steps in late evening, but the most steps were in the early morning in men, while women's was in the late morning, with significantly ($P < 0.001$) more steps in men (Figure 5-8). Comparing between weekday and weekend, steps had the same lowest-in-the-end-of-day pattern, with statistically significant ($P < 0.001$) more step on weekdays (Figure 5-9).

5.4.4 Predictors of physical activity

Results for significant predictors of MVPA, LPA, and steps are presented in Table 3. For MVPA, only BMI Asian cut points was a significant predictor with a positive association. For LPA, only age is a significant predictor with a positive association. For steps, BMI Asian cut points and ID level were significant. There is a trend between age and hourly MVPA (Figure 5-10); participants younger than 30 had multiple incidences of MVPA bouts longer than 15 minutes, but those older than 30 had zero bouts longer than 15 minutes.

5.5 Discussion

This is the first study to report evidence on levels, patterns, and predictors of objectively measured physical activity in Thai adults with intellectual disabilities. The principal findings were that Thai adults with intellectual disabilities had an average of 119 minutes per week of MVPA, 229 minutes per day of LPA and 4,899 steps per day. Thirty-two percent of participants achieved the physical activity guideline of 150 minutes of moderate intensity activity per week. Participants were most physically active during the early morning and least active during the late evening. MVPA levels were significantly higher during weekdays compared to weekend days. Men were more active than women. Age, level of intellectual disabilities, and BMI Asian cut points were predictors of physical activity. In addition, steps pattern by time of day was similar to MVPA, decreasing in the evening and on the weekend.

Compared to previous evidence on the PA levels of adults with intellectual disabilities, participants in the present study were more active. Thirty-two percent of participants achieved the equivalent of 150 minutes of MVPA compared to 9% average across studies from a systematic review investigating the physical activity levels of adults with intellectual disabilities (Dairo et al., 2016). There were only two studies that had a higher percentage of PA than reported for the Thai sample, 45% (Stanish, 2004) and 46% (McKeon et al., 2013). The higher percentage in this study could be due to the training programme activity and younger age of participants in this study. Oviedo et al. (2017) reported MVPA 30.8 and LPA 128.3 min/day, Chow et al. (2018) reported MVPA 9.9 and LPA 229.9 min/day, while Hsu et al. (2021) reported MVPA 16.67 and LPA 275.25 min/day. The current results of MVPA 16.87 and LPA 229.16 min/day were closer to the two studies in Asia; Hsu et al. (2021), which was in Taiwan, and Chow et al. (2018), which was in Hong Kong. MVPA and LPA min/day in this study were almost exactly the same (16.87 and 16.67, 229.16 and 229.9) as in the studies by Hsu et al. (2021) and Chow et al. (2018), respectively. Both studies used higher criteria of minimum wear time (10 hour/day). This suggests that the lower minimum wear time of 6 hour/day could be sufficient to gain reliable measurements of physical activity.

Compared to previous objectively measured research in adults with intellectual disabilities, the present study had a lower average daily step count. This study's mean step counts of 4,899 step per day was low compared to studies in Hongkong (5,000-7,499 step per day)(Chan, 2014), Taiwan (6,486 step per day)(Hsu et al., 2021), and Spain (6,192 steps/day)(Oviedo et al., 2017). Oviedo et al. (2017) and Hsu et al. (2021) both used ActiGraph GT3X accelerometers to measure steps, as did the present study, which gives a higher level of comparability, whereas Chan (2014) used pedometers. One of the potential reasons explaining this lower step count in Thai adults could be the walkability of the cities where participants lived. Streets in Bangkok, Thailand, were mostly developed for car traffic, and less attention was paid to pedestrians (Vichiensan & Nakamura, 2021). This leads to narrow and low-quality pavements, and conflicts between pedestrians and vehicles, especially motorcycles (Pongprasert & Kubota, 2017). Hence, pedestrians in Bangkok mostly find the present walking environment unsafe (Vichiensan & Nakamura, 2021). Therefore, it is important to investigate walking in Thai adults with intellectual disabilities who live in more rural or suburb areas to better understand the potential effects of the poor urban walking infrastructure.

The finding from the present study that men were more active than women is consistent with a systematic review and meta-analysis evaluating gender differences in physical activity in adults with intellectual disabilities (Westrop et al., 2019). Women with intellectual disabilities were least active, measured both with step count and MVPA, with a significant overall effect of gender identified (Westrop et al., 2019). Another comparable accelerometer-based study in 186 Thai adolescents without intellectual disabilities, aged 13-18 years old, also showed consistent results that MVPA levels were significantly higher in boys than girls (Konharn, 2012). The same gender difference, boys more active than girls, was reported in pedometer-based study in Thai children (Wannasuntad, 2007). The difference in level of MVPA between men and women suggests that interventions to increase physical activity need to be gender specific. Furthermore, this consistent finding could mean than low physical activity levels in Thailand could be addressed in similar ways to other countries. However, the participants in this study were recruited from the attendees of a prevocational programme, which mostly allocated more active jobs to men than women as culturally deem appropriate, therefore, the impact of gender role on measured physical activity was unavoidably present here on some degree. Lastly, despite the rise in physical activity research in Thailand in the last two decades (Liangruenrom et al., 2018), including at least 15 objectively-measured studies, but there is no report of any means of physical activity levels in Thai adults with or without intellectual disabilities in publicly available domain.

In relation to patterns of physical activity, MVPA levels were highest in morning and lowest in the evening, which is comparable to previous research. Oviedo et al. (2017) compared physical activity between 9am - 5pm and after 5pm - 11:59pm, while Helsel et al. (2022) compared physical activity before 12, 12-3pm, and 3-7pm. Levels of MVPA were lowest during the 5pm-11:59pm evening period, which is similar to the current study. Contrastingly, Helsel et al. (2022) reported the lowest levels of MVPA was during in 12-3 pm afternoon period. This pattern could inform an intervention design that focusses on increasing physical activity at home in the evening could be most beneficial as this is the least active time.

The higher levels of MVPA on weekdays than weekend days were also reported in previous studies (Helsel et al., 2022; Konharn, 2012; Oviedo et al., 2017). The higher MVPA levels in the weekdays in the present study could be partially due to the training activities in the prevocational programme that occurred only on the weekdays. Therefore, as all participants in the present study were recruited through this programme, this may reduce the generalizability of these results to the wider population of Thai adults with intellectual disabilities. Contrastingly, a study on physical activity behaviours among adults with intellectual disabilities in Hong Kong reported that on weekdays adults with intellectual disabilities had more step counts in non-working time compared with that at working time (Chan, 2014). The step count was measured by pedometer by Chan (2014), which could limit comparability to the present study. This different levels between weekend and weekdays could mean that a potential design of intervention might be targeted on increasing activity on the weekend.

Three predictors of physical activity were identified in this study: age, level of intellectual disabilities, and BMI Asian cut points. A systematic review on physical activity levels in adults with intellectual disabilities reported that severity of intellectual disabilities and age were found to be correlated with the number of participants reaching physical activity guidelines, with severity of intellectual disabilities being the strongest predictor (Dairo et al., 2016). The same trend of MVPA lessening with age was reported in a physical activity study in Thai adolescents (Konharn, 2012). This could inform the prioritisation of intervention design for older people with more severe level of intellectual disabilities. In addition, the proportion of Asian people with a high risk of NCDs is substantial at lower BMIs than the WHO cut-off point for overweight (≥25 kg/m^2)(WHO, 2004). The result that only BMI Asian classification was a significant physical activity predictor supports the implementation of Asian-specific BMI classification on Asian people.

5.5.1 Strengths and limitations

The primary strength of this study is that it is the first to address the gap in the literature relating to the physical activity behaviours of Thai adults with intellectual disabilities. Furthermore, another strength of this study is that numerous parameters of physical activity were measured, e.g., various intensities and steps, which gives a more in-depth understanding of various behaviours. Physical activity was also objectively measured using accelerometery. However, limitations of this study should be noted. First, potential sampling bias was present as recruitment was not random sampling, instead a convenience sample were recruited from a prevocational programme. This could introduce bias into the results in relation to the representativeness of the sample and the effect that the work roles associated with the programme had on the physical activity levels measured. Lastly, there were ActiGraph accelerometers' limitations as mentioned in previous research, including underestimation of physical activity from upper-body movements of water activities, and cut points that were not specific to adults with intellectual disabilities (Oviedo et al., 2017).

5.5.2 Future research recommendations

This exploratory study is the first to address the gap in knowledge relating to the physical activity behaviours of Thai adults with intellectual disabilities. However, this study has also identified numerous future research needs. Future research should continue to investigate the physical activity behaviours of Thai adults with intellectual disabilities. This is essential to add to the knowledgebase and to better understand any influences relating to Thai social, culture, and environmental factors have on physical activity levels, patterns, and predictors. Barriers and facilitators to physical activity should also be investigated in Thai adults with intellectual disabilities. To ensure the accurate measurement of physical activity, accelerometer cut points, or another relevant data interoperation method, should be validated for adults with intellectual disabilities.

5.6 Conclusions

This study provides valuable data on physical activity levels and patterns in Thai adults with intellectual disabilities. It shows that the physical activity levels of Thai adults with intellectual disabilities are low and, in general, insufficient to gain clinically meaningful health benefits. The results on patterns and predictors provide several potential points on designing interventions to increase physical activity in adults with intellectual disabilities. This similarity in Thai sample to previous research in other population could mean that implementation in Thailand might not need specific modification and could readily apply the success intervention in the future. However, prior to intervention development, it is first necessary for additional research to build on the present study and to increase the knowledgebase relating to the physical activity behaviours of Thai adults with intellectual disabilities.

Table 5.1 Demographic characteristics of participants presented in mean ± SD or n (%)

Variables	All n = 38	By sex Men n = 24 (63.16)	 Women n = 14 (36.84)
Age (years)	23.00 ± 4.59	24.00 ± 4.05	21.29 ± 5.08
18-24	26 (68.42)	14 (36.84)	12 (31.58)
25-29	8 (21.05)	8 (21.05)	0 (0.00)
30-35	4 (10.53)	2 (5.26)	2 (5.26)
Weight (kg)	66.38 ± 20.52	72.74 ± 19.29*	55.48 ± 18.39
Height (cm)	162.82 ± 11.65	167.92 ± 10.11*	154.07 ± 8.66
BMI (kg/m^2)	24.91 ± 6.64	25.70 ± 5.70	23.54 ± 8.03
BMI category			
Underweight	6 (15.79)	3 (7.89)	3 (7.89)
Normal	15 (39.47)	9 (23.68)	6 (15.79)
Overweight	9 (23.68)	6 (15.79)	3 (7.89)
Obese	8 (21.05)	6 (15.79)	2 (5.26)
ID level			
Mild	14 (36.84)	7 (18.42)	7 (18.42)
Moderate	22 (57.89)	15 (39.47)	7 (18.42)
Severe	2 (5.26)	2 (5.26)	0 (0.00)
Down syndrome	9 (23.68)	6 (15.79)	3 (7.89)
Autism spectrum disorder	12 (31.58)	12 (31.58) *	0 (0.00)
Nonspecific	13 (34.21)	4 (10.53)	9 (23.68)
Epilepsy	3 (7.89)	2 (5.26)	1 (2.63)
Organic brain syndrome	1 (2.63)	0 (0.00)	1 (2.63)
Employment status			
Employed	6 (15.79)	5 (13.16)	1 (2.63)
Unemployed	32 (84.21)	19 (50.00)	13 (34.21)
Living arrangement			
Family	36 (94.74)	23 (60.53)	13 (34.21)
Paid carer	1 (2.63)	0 (0.00)	1 (2.63)
Private boarding school	1 (2.63)	1 (2.63)	0 (0.00)
Wear time (hours/day)	10.81±2.81	10.63±2.56	11.12±3.18
Wear time (min/day)	648.58±168.81	637.51±153.89	667.00±190.53

Note. * $p < 0.05$ between men and women with intellectual disabilities

Table 5.2 Average physical activity levels per day.

	All	Men	Women
Total wear time (min)	647.43	635.75	667.00
Light [min (%)]	229.16 (34.97%)	247.3 (38.19%) *	198.8 (29.56%)
Moderate [min (%)]	16.52 (2.61%)	19.98 (3.12%) *	10.73 (1.77%)
Vigorous [min (%)]	0.35 (0.06%)	0.53 (0.09%) †	0.05 (0.01%)
Total MVPA [min (%)]	16.87 (2.67%)	20.51 (3.21%) *	10.78 (1.78%)
Steps counts	4898.88	5474.54 *	3935.27

T-test men vs women
* P value < 0.001 between men and women
† P value < 0.05 between men and women

Table 5.3 Significant predictors on daily physical activity outcomes

Outcomes	Predictors	p-value	B	95%CI
MVPA	BMI Asian cut points	0.017	0.161	0.030, 0.291
Light PA	Age	0.016	2.539	1.214, 10.854
Step counts	BMI Asian cut points	0.019	0.090	0.016, 0.163
	ID level	0.044	-0.151	-0.299, -0.004

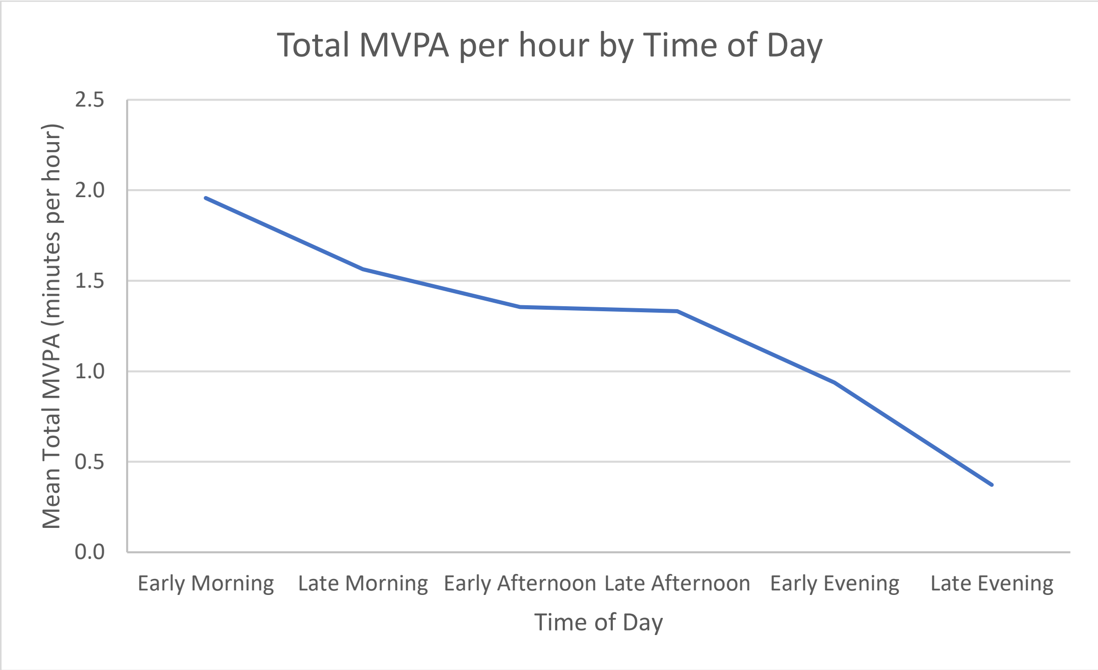

Figure 5-1 Pattern of MVPA in minutes per hour through time of day

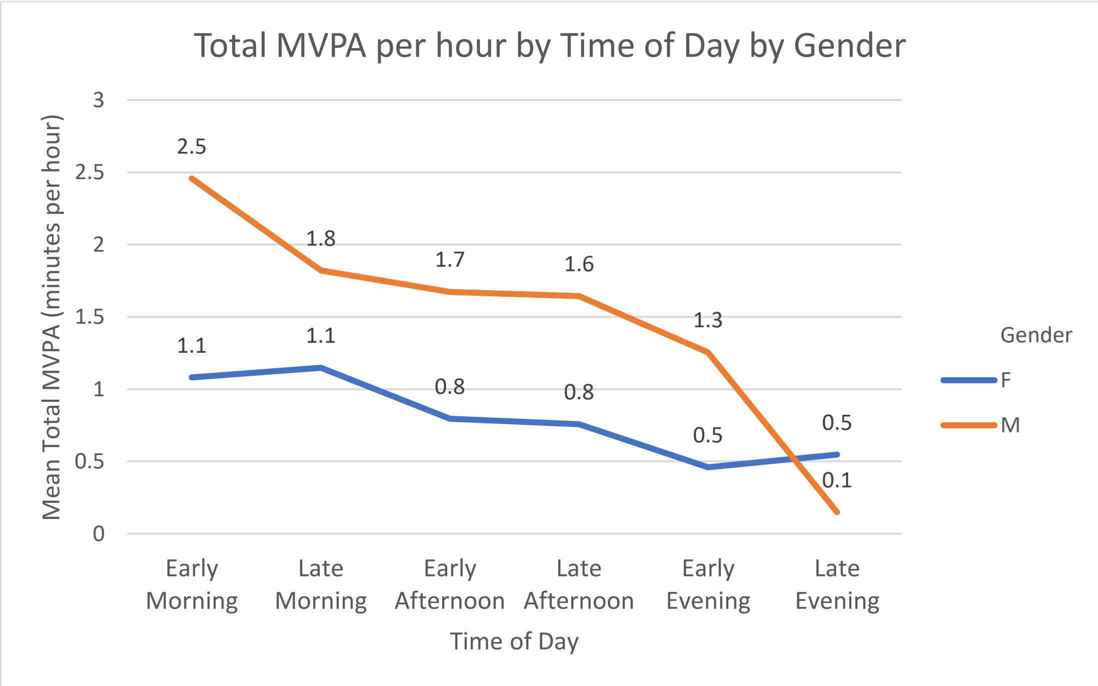

Figure 5-2 Pattern of MVPA in minutes per hour through time of day by gender

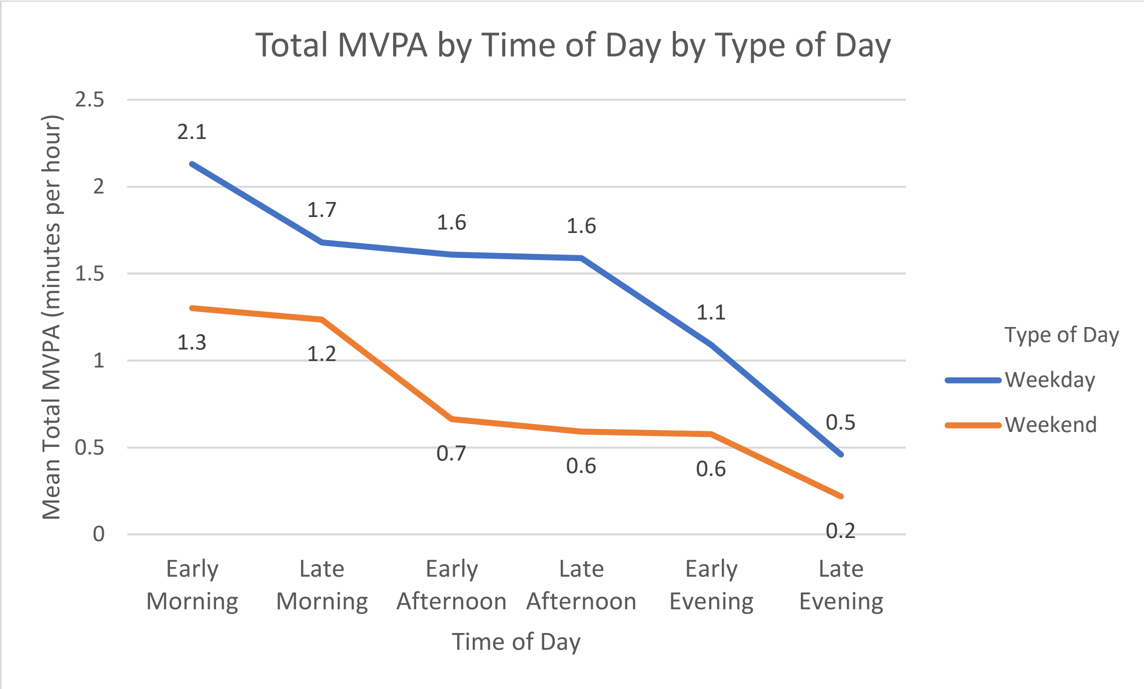

Figure 5-3 Pattern of MVPA in minutes per hour through time of day by type of day

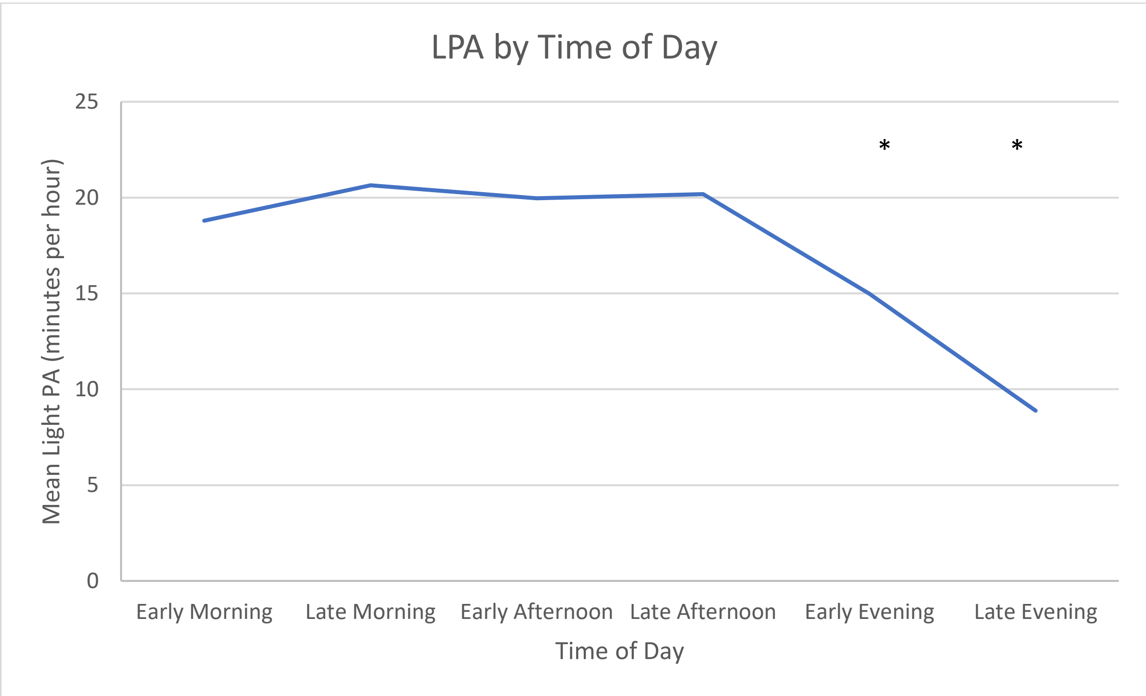

Figure 5-4 Pattern of LPA in minutes per hour through time of day.
(* indicates statistically significant difference comparing to late morning)

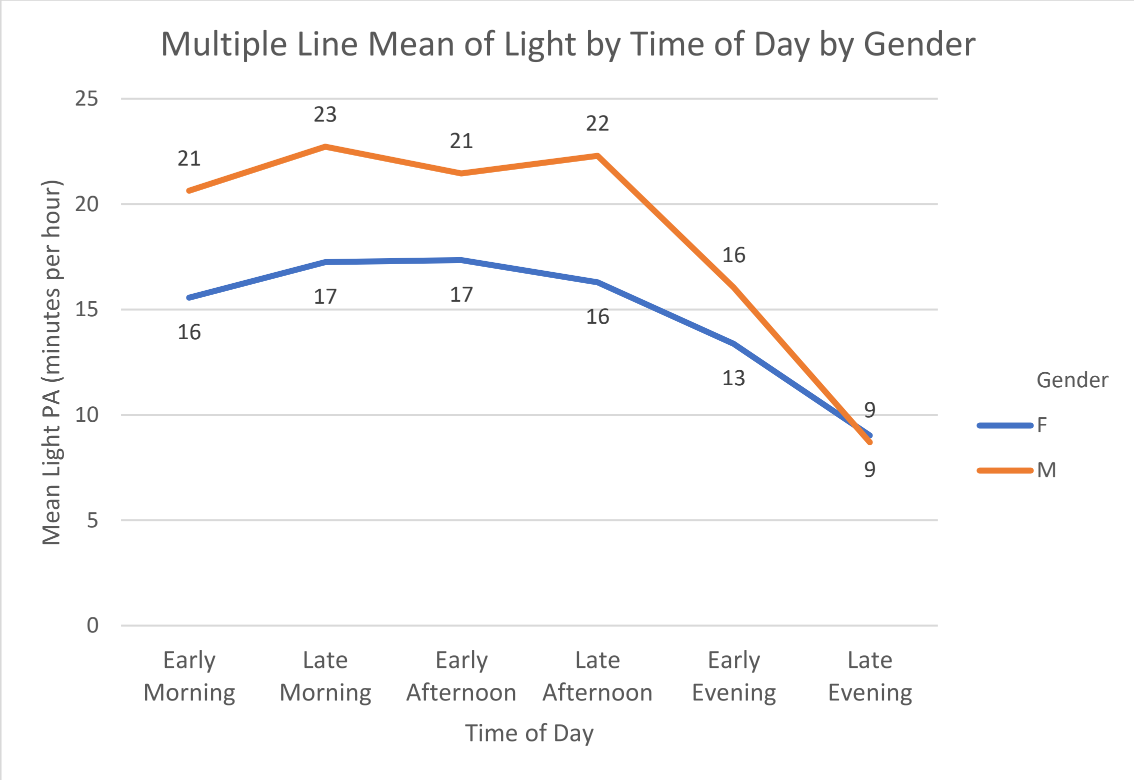

Figure 5-5 Pattern of LPA in minutes per hour through time of day by gender

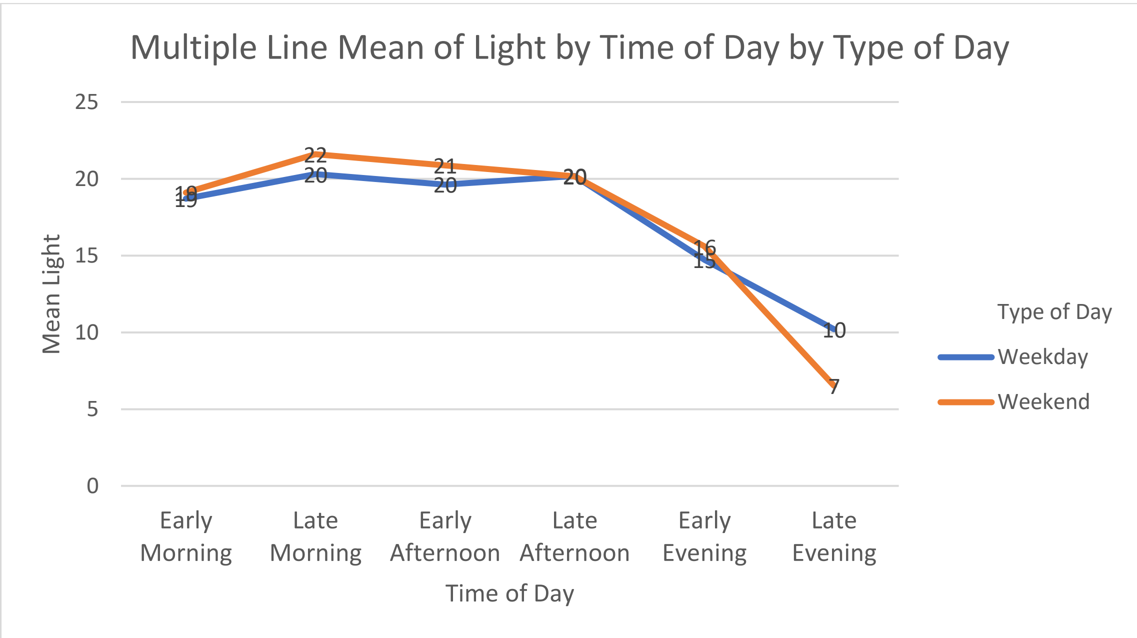

Figure 5-6 Pattern of LPA in minutes per hour through time of day by type of day

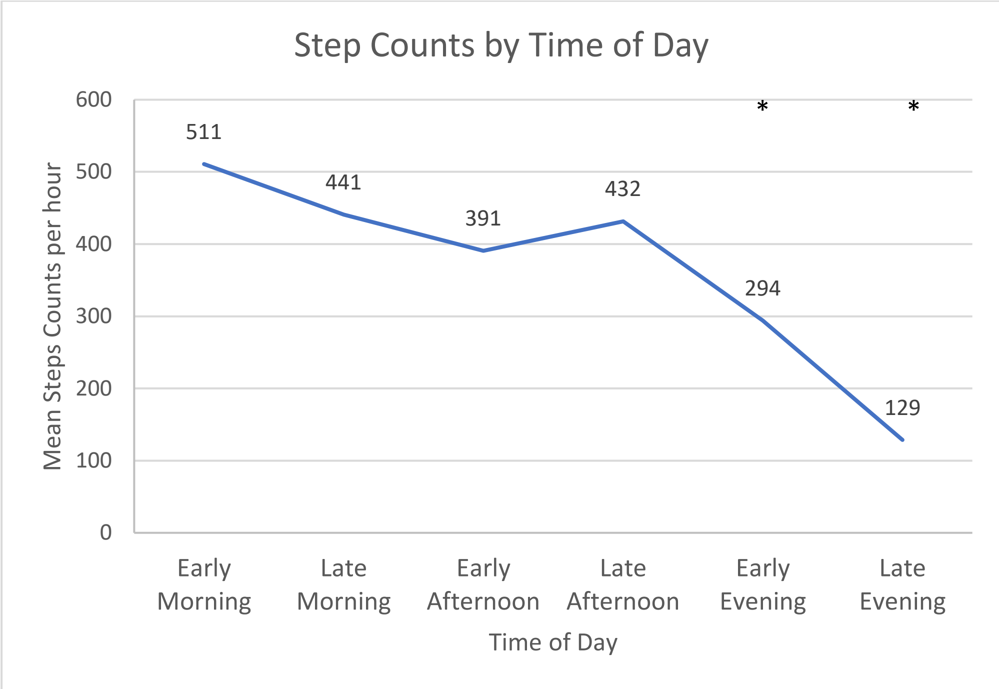

Figure 5-7 Pattern of step counts per hour through time of day. (* indicates statistically significant difference)

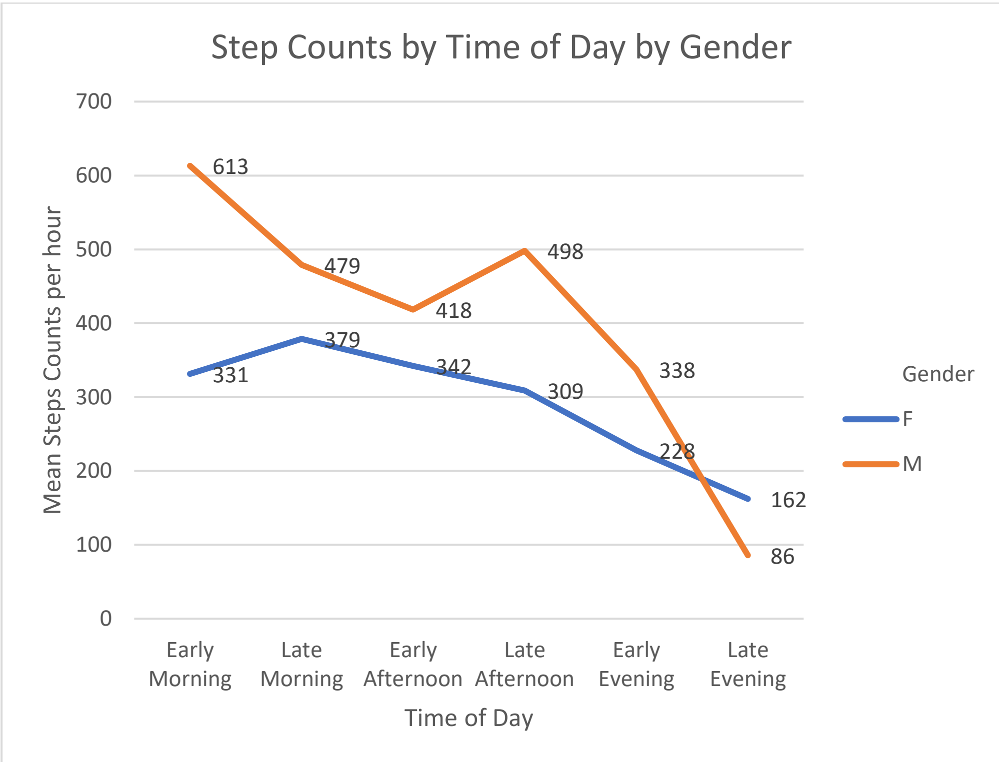

Figure 5-8 Pattern of step counts per hour through time of day by gender

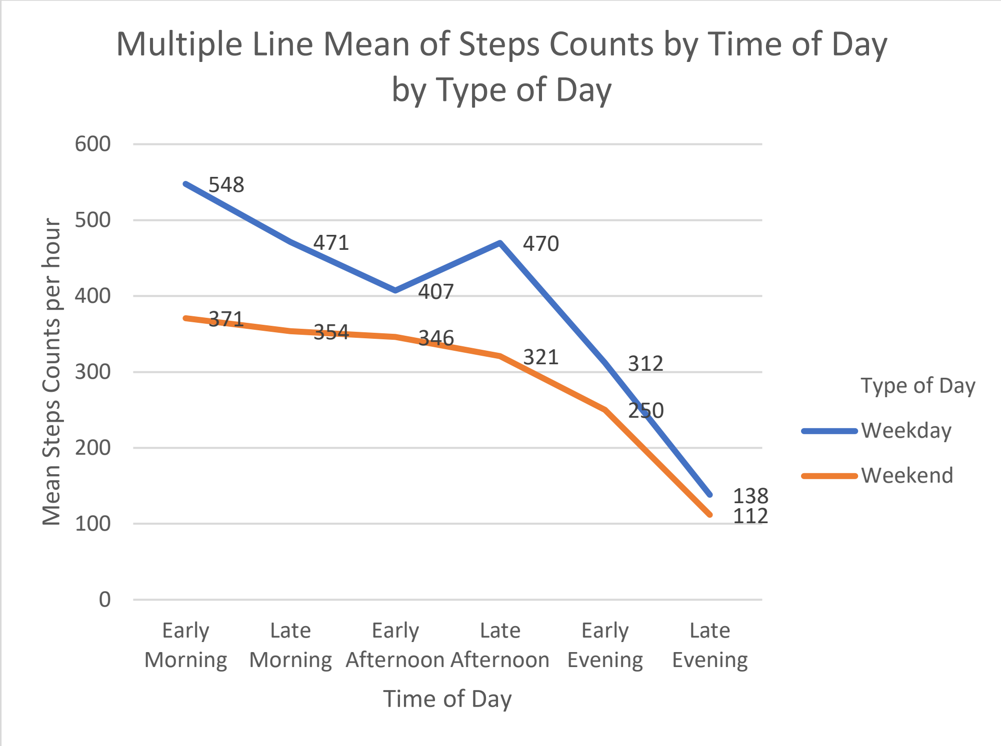

Figure 5-9 Pattern of step counts per hour through time of day by type of day

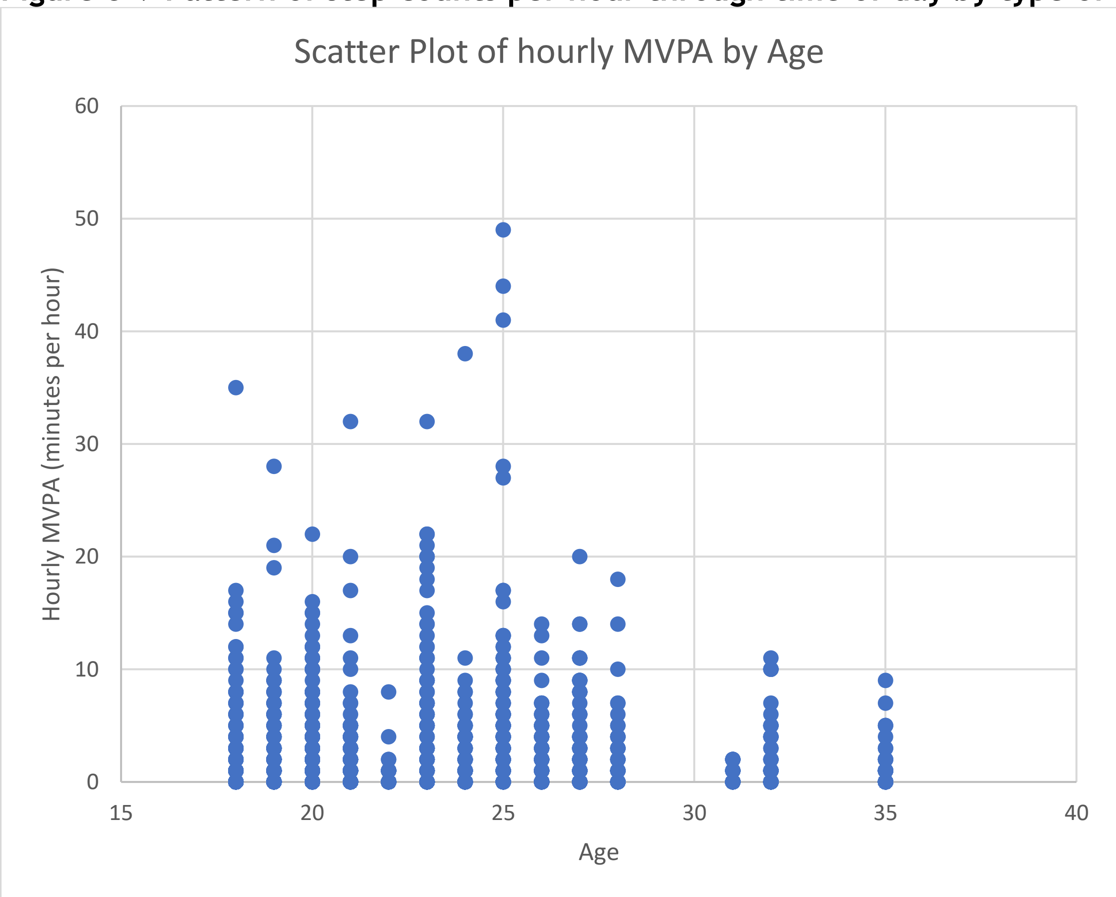

Figure 5-10 Trend of MVPA by age
Noted that each dot is a bout incidence, not an individual. AKA all age has 0 minute of MVPA, but older than 30 has no bout incidence above 15 minutes.

Chapter 6 General discussion

6.1 Summary of key findings

This PhD thesis provides an exploration into levels, patterns, and influences of sedentary behaviours and physical activity of adults with intellectual disabilities. The first study revealed the effect that environmental factors (neighbourhood quality and standard of local leisure services) had on TV hours in a population-based sample of UK adults with intellectual disabilities. The topic of environmental influences on sedentary behaviours is under studied, compared to the depth of research in other vulnerable populations such as older adults (Chastin et al., 2015), and ethnic minority groups in Europe (Langøien et al., 2017), and the US (Baker, 2019). The results highlight the importance of the environment on lifestyle behaviours of adults with intellectual disabilities.

At the time of developing this thesis, measuring and understanding physical activity or sedentary behaviours of adults with intellectual disabilities in Thailand was neglected and had not been investigated in any research studies. Addressing this research gap was considered essential as it is the basic knowledge to evaluate the situation of sedentary behaviours and physical activity in this vulnerable population. The results of the second study demonstrated that it was feasible to recruit, retain, and complete an accelerometer measurement protocol with Thai adults with intellectual disabilities from a community-based setting. The subsequent full-scale studies showed that Thai adults with intellectual disabilities had high sedentary behaviours and low physical activity and subsequently higher risks for associated negative health outcomes, especially in women. The key findings were that Thai adults with intellectual disabilities had an average sedentary time of 402 minutes per day and MVPA levels of 119 minutes per week. Only 32% of participants reached the guideline of 150 minutes of MVPA per week. Sedentary time was accumulated in short bouts. Participants were most physically active in the early morning and most sedentary in the late evening. MVPA and steps were higher during weekdays compared to the weekend. Women were less active and more sedentary than men. Having more severe levels of intellectual disabilities predicted the increase in percentage of time in sedentary behaviours and decrease in steps. The results also highlight the significance of using an Asian-specific BMI classification in Thai people.

6.2 Health related implications of environmental, cultural, and social aspects of health

6.2.1 Health inequality experienced by adults with intellectual disabilities in Asian countries

This thesis found that adults with intellectual disabilities in Thailand are less physically active and more sedentary, at levels that are likely to contribute to health inequalities compared to the general population. Understanding health inequalities is important for interpreting the results of this thesis and for informing future research needs, as this provides context on potential challenges when trying to change lifestyle behaviours and highlighting the important role that changing lifestyle behaviours could have.

Due to the lack of studies on health inequalities in Thai adults with intellectual disabilities, the closest references are studies in South Korea and Japan. A South Korean nationwide study of mortality rate and cause among people registered with intellectual disabilities founded that the standardized mortality rate of people with intellectual disabilities was 3.2 times higher than general population (Kim et al., 2022). The main causes of death in people with intellectual disabilities were circulatory diseases, neoplasms, and respiratory diseases (pneumonia), respectively (Kim et al., 2022). As previous findings in UK cohort studies indicated that pneumonia is a serious health concern of people with intellectual disabilities (Chang et al., 2017; Hosking et al., 2016), Japanese researchers conducted a retrospective cohort study using national inpatient database to evaluate pneumonia severity and in-hospital mortality in patients with intellectual disabilities (Hirose et al., 2022). The results showed that patients with intellectual disabilities significantly more severe pneumonia at admission compared to people without intellectual disabilities (24.5% vs. 9.5%; $P < 0.001$) and mediation analysis with logistic regression showed that 73.8% of the association between intellectual disabilities and pneumonia severity at admission was mediated by levels of activities of daily living (ADL). This suggested that people with intellectual disabilities have difficulties from low activities of daily living, so their pneumonia becomes worsen before they are able to access health care (Hirose et al., 2022). The pathways that low ADL could affect health could be difficulty in feeding, communicating symptoms, managing medications, and mobility to medical facilities. Therefore, if functional fitness and health could be improved through lifestyle behaviours, this could reduce the risk of these negative health outcomes and lower the mortality risk. The situation on health inequalities faced by Thai adults with intellectual disabilities is unknown. More research must be done to address what health inequalities are there and how lifestyle behaviours could contribute to them.

There is qualitative research reported on the implementation of Thailand's national universal developmental screening programme for young children (Morrison et al., 2018). They found a major obstacle in the screening programme was in the miscommunication with caregivers, especially grandparents. Due to worker migration to urban areas for better economic opportunities, a considerable number of parents left their children in the care of grandparents in rural areas of Thailand. There are several factors contributing to the gap in communication between health workers and grandparent caregivers, including the high workload of health workers, lack of understandable materials about health screening, the importance of developmental stimulation, and the potential improvement from treatments of health problems. Without caregivers understanding tests and the life-long benefits for children, it has led to a lack of attendance at follow-up appointments and fails to access crucial interventions for children with developmental disabilities (Morrison et al., 2018). This means children with intellectual disabilities in rural Thailand are facing significant health inequalities and immediate action from public health is extremely needed.

6.2.2 Healthcare in Thailand

Thailand is one of the few lower-middle-income countries in the world that have a universal healthcare system that provides health service to Thai citizens free of charge (Hughes & Leethongdee, 2007). Operating since 2002, the system has been struggling with financing (Jongudomsuk et al., 2015), increased workload (Tipayamongkholgul et al., 2016), and shortage of staff (Wiwanitkit, 2011). With free available healthcare, there is an increase in access in rural areas that led to an expansion of medical needs, resulting overwhelming number of daily out-patients, and created an over-work situation for personnel (Wiwanitkit, 2011).

To battle the heavy workload on the system and reduce government's financial burden of healthcare, policy makers also decided to advocate more for health promotion, disease prevention, and established Thai Health Promotion Foundation (Sopitarchasak et al., 2015). However, this move did not fix the difficulties inside the healthcare system. It seems like the current situation in the Thailand healthcare system will not be sustainable with so many unsolved and worsening problems. However, as the health care system is moving towards a focus on health promotion and early intervention, this could provide an excellent opportunity to include lifestyle behaviour change information, which is accessible for adults with intellectual disabilities, into this health strategy.

Intellectual disabilities are an area of focus in the health care system, as there are two specialist hospitals under the Ministry of Public Health, Rajanukul hospital in Bangkok and Northern Child Development Centre in Chiangmai. Specialist services and training programmes are covered by the universal healthcare for Thai people with intellectual disabilities (Pejarasangharn & Churesigaew, 2021). Furthermore, to promote physical activity in children with intellectual disabilities, the Thai Health Promotion Foundation provided a specific guideline for guardians/carers to teach their children how to exercise (Suphawibul & Krabuanrat, 2021). However, the guideline is not in an accessible language with multiple technical terms in English, such as “Sensory Receptor”, “Locomotor Movement”, and “Manipulative Movement”.

This shows the lack of understanding of the need for accessible information and could prevent people from getting essential information, resulting in a cost ineffective health promotion effort. Moreover, the policy on adults with intellectual disabilities has been focussed on getting people into the workforce, as seen in Empowerment Of Persons With Disabilities Act (2007)(Chulanont, 2007). This is beneficial to the financial status of adults with intellectual disabilities, with potential to secondarily improve physical activity and sedentary behaviours. However, there is no primary focus on these lifestyle behaviours in Thai adults with intellectual disabilities. Overall, health promotion for adults with intellectual disabilities, beside medical and psychiatric practices, is neglected. Therefore, this is an area requiring additional research and policy focus because if healthy lifestyles were promoted for adults with intellectual disabilities, keeping them in good health, the burden on the healthcare system could be reduced.

6.2.3 Bangkok metropolitan environment and physical activity

From the first study (Chapter 2 Individual, interpersonal, and environmental correlates of sedentary behaviours in adults with intellectual disabilities, p.28), it was found that the sedentary behaviours of adults with intellectual disabilities were greatly influenced by environmental factors, i.e., neighbourhood quality and standard of local leisure services. Whilst the data for this study was collected from adults living in the UK, the findings highlight the importance of upstream environmental effects to lifestyle behaviours of adults with intellectual disabilities.

Bangkok is the capital city of Thailand, a developing country in southeast Asia. The city became the capital of Siam (the previous name of Thailand) in 1782 (Sternstein, 2021). Similar to the global trend of rapidly expanding cities and surrounding suburban area, the urban area of Bangkok has grown beyond the established boundaries into the five adjacent provinces— Nonthaburi, Pathum Thani, Nakhon Pathom, Samut Prakan, and Samut Sakhon, forming the Bangkok Metropolitan Region (BMR)(Trethanya & Perera, 2009). Currently, Bangkok Metropolitan Region has approximately 11 million people living in it, according to the most recent consensus in 2021 by the Civil Registration Office (Jongjira, 2022). As the centre of Thailand’s economy, Bangkok Metropolitan Region is the destination of migrant workers, both domestic and expats. It was likely that the number of unregistered migrant workers in the area had been underestimated by at least 4 million (Dhakal & Shrestha, 2016). With recent civil unrest happening in Myanmar, the neighbouring country from where almost 80% of the expats originate, the unregistered migrant workers in the area are likely increasing (Sarapirom et al., 2020). In contrast to the rising population and growing in size, the regulations by Bangkok Metropolitan Administration (BMA) are still limited to the original city boundaries. The outgrown areas of Bangkok Metropolitan Region are under the jurisdiction of the provincial and local governments where urban planning regulations are questionable, and the city growth has been ineffective with inadequate developmental control and environmental management (Trethanya & Perera, 2009). This highlights that Bangkok is a densely populated city with no effective policy on making this a safe and accessible city for the people who live there.

A walkability of Bangkok report by the GoodWalk study in 2015 that showed only 2.5% of the total Bangkok Metropolitan Region area was considered good enough to walk in, compared to 60% of the inner city (Kulsrisombat, 2015). Walking is the most basic mode of transportations, and it is difficult to walk in cities that are not designed for walking. In general, walking accounts for only 14% of all mode of transportations in Bangkok, which is less than half of those in London (30%) or New York (39%) (Sanit & Ratanawaraha, 2020). This could be because most streets in Bangkok were designed for car traffic, and pedestrian’s ability to walk is not a priority for city planners (Vichiensan & Nakamura, 2021). Bangkok walking infrastructure has many flaws, such as, no pavement around residential areas, uneven surfaces, inadequate streetlights, and obstacles from power line poles, street advertising, parked vehicles, street food stalls, and motorcycle taxi stations (Wethyavivorn & Sukwattanakorn, 2019). The narrow and low-quality pavements were rich with conflicts between pedestrians and motorcycle taxis that ride, stop, and provide services on pavement (Pongprasert & Kubota, 2017).

All these barriers resulted in pedestrians feeling unsafe to walk (Vichiensan & Nakamura, 2021). Interestingly, a survey on pedestrian safety found that 40% of motorcycle taxi customers decided not to walk distances of 500-1000 metres because of fear of accidents with motorcycles (Pongprasert & Kubota, 2017). If Thai adults in the general population perceive walking as not safe, it would be even less likely for Thai adults with intellectual disabilities to choose to walk because similar to general adults, adults with intellectual disabilities mentioned comparable barriers of physical activity such as lack of sidewalks, perceived safety, and health concerns or injuries (Frey et al., 2005; Howie et al., 2012; Robertson & Emerson, 2010; Temple, 2007). Furthermore, a study in 2017 showed that difficulties with daily transportation led to adverse mental health effects on for elderly people as they had reduced social participation and felt social exclusion (Tansawat et al., 2017). These barriers to travelling and subsequent social exclusion could be felt by Thai adults with intellectual disabilities as well. Because “walking is the most likely way all adults can achieve the recommended levels of physical activity”(NICE, 2012, p. 31), these barriers preventing people from walking need to be eliminated, otherwise increasing population’s physical activity would likely be unachievable.

Public greenspace and air quality are considered as key indicators for healthy and sustainable urban cities (WHO, 2012). Access to recreation was positive for physical activity in older adults in low-middle income countries (Cleland et al., 2019). A survey of older Thais living in low-socioeconomic urban communities across metropolitan Bangkok found that neighbourhood environment and facilities had a positive indirect effect on physical activity (Kraithaworn et al., 2011). However, Bangkok has green space of approximately 1.8m^2 per capita (Thaiutsa et al., 2008), much lower to the minimum of 9m^2 per capita recommended by the World Health Organization (WHO, 2012). There is a 20-year plan by Bangkok Metropolitan Administration to increase green space to the minimum level by the year 2032 (Binthaisong et al., 2013). However, the green space coverage in Bangkok from 2000 to 2019 has been on a decreasing trend instead (Song et al., 2021).

In recent years, the problem of air pollution and annual haze crisis episodes have become a growing concern for the general public in Thailand (Teerasuphaset & Culp, 2020). Pollution Control Department has reported that in Bangkok Metropolitan Region there were approximately 3 month periods per year that people were exposed to air pollution exceeding the standard limit (PCD, 2019). The mean of fine particle (PM2.5) concentration was $77.0 \pm 21.2\ \mu g\ m^{-3}$, three times higher than the Thai National Ambient standard of $25\ \mu g\ m^{-3}$, with the main source (accounted for 43.7%) of pollution from vehicular exhaust (ChooChuay et al., 2020). During the haze episodes, Bangkok Metropolitan Administration and Pollution Control Department have recommended vulnerable people to stay indoors, using air filters, and cancel all outdoor activities (Lefevre, 2018; Sangiam & McNeil, 2020). This recommendation, which applies to people with intellectual disabilities, will therefore increase sedentary behaviours and decreases physical activity of people in the Bangkok metropolitan area.

With the environmental effects of the low levels of greenspace, poor air quality, and inaccessibility to daily transportation in Bangkok Metropolitan Region, lifestyle behaviours of adults with intellectual disabilities living in the area could greatly affected. A good example that Bangkok should consider replicating to support change for the better is Glasgow city. Since 2019, Glasgow city declared a commitment to achieve the goal of net-zero emission by 2030 (Richardson, 2019). One of the strategies is to make active transport the first and natural choice for everyday journeys (Richardson & Gillespie, 2022). The shift to active transport will benefit not only the climate and environment, but also Glaswegians' health and wellbeing. Unfortunately, Bangkokians with and without intellectual disabilities still need to wait for such a plan to be recognised by Bangkok Metropolitan Administration.

To mobilize a nationwide healthy lifestyle transformation that includes Thai adults with intellectual disabilities, expanding collaboration to non-health sectors and further actions from policymakers are essential. There are numerous policy adjustments that could be changed in favour of active lifestyles and transportations, such as urban planning, walking infrastructure, and built environment (Topothai et al., 2016). Local governments have a key role to mobilize local resources for local needs. However, to change any infrastructure on the streets of Thailand requires a total agreement and collaborations from multiple central government agencies. The ability of local government is limited and can be sanctioned by control from central government agencies. Therefore, the key to success could be lie on decentralization of control of power from the central government agencies to the local elected offices.

The findings reported in chapters four and five in this thesis suggest that adults with intellectual disabilities experience significant inequalities in physical activity and sedentary behaviours, that are likely to be contributing to poorer health. In the studies reported in this thesis, it was not feasible to examine the contributions of the socio-ecological environment to lifestyle behaviour patterns due to time and resource constraints. However, in addition to the results reported in chapter 2, previous global studies have emphasised the differential negative impact that neighbourhood (Emerson, 2014), economic (Hao & Razman, 2022) and policy effects (Bossink et al., 2017) can have on the lifestyle behaviours of individuals across the lifespan with intellectual disabilities. The findings reported in this thesis that the demographic factors gender, level of intellectual disabilities and age are predictors of lifestyle behaviours further highlight the likely importance of the broader socio-ecological framework to changing the physical activity levels and sedentary behaviours of adults with intellectual disabilities.

The Global Action Plan on Physical Activity 2018 – 2030 (GAPPA; WHO, 2018) uses a socio-ecological framework to address disparities in physical activity participation due to disabilities, gender, age, and other protected characteristics (Carty et al., 2021). However, the general lack of research around physical activity and sport participation of disabled people is seen as a barrier to achieving the GAPPA aims to reduce disparities (Martin Ginis et al., 2021). The importance of further research in low- and middle-income countries is particularly salient.

Whilst the initial research in this thesis examining the physical activity levels and sedentary behaviours of Thai adults with intellectual disabilities is limited in scope, it can provide a platform to move on develop our understanding further. The numerous structural and environmental barriers to physical activity participation experienced by Thai adults with intellectual disabilities may not be the same as in other Western countries. This further highlights the need to focus on the lifestyle behaviours in Thai adults with intellectual disabilities and create evidence base specific to this group, rather than generalising evidence from other countries.

6.3 Need for intervention development and additional data to inform this

Noncommunicable diseases (NCDs) are estimated to account for 74% of total mortality in Thailand (WHO, 2018) and have accounted for a large proportion of health care expenditure (Topothai et al., 2016). One of the key challenges that Thailand faces in improving lifestyle behaviours and decreasing the risk of NCDs is the lack of implementing societal changes or effective behaviour change programmes, such as creating infrastructure suitable for active transport (Topothai et al., 2016). One of the policy actions required for Thailand to effectively increase physical activity and reduce sedentary behaviour is to create an environment that supports everyday physical activity (Topothai et al., 2016). At the very least, the cities need to enable people to safely walk. When risk of accidents still outweighs the benefits from active travel, it is unlikely that people with or without intellectual disabilities would change their lifestyle behaviours.

Since the Ministry of Public Health of Thailand created a target for sedentary behaviours and physical activity in 2003, there has been a surge of research studies on these subjects in the Thai general population (Liangruenrom, 2020). A report from the National Health and Welfare Survey in 2015 showed a low prevalence of physical activity among Thai adults, with a declining trend since 2004 (Liangruenrom et al., 2017). Evidence on sedentary behaviours in Thais was very limited (Liangruenrom et al., 2018). Compared to Thai adults without intellectual disabilities, Thai adults with intellectual disabilities had a lower percentage of people who met the recommended physical activity levels of the World Health Organization (32% vs 42%)(Liangruenrom et al., 2017). This thesis has shown that Thai adults with intellectual disabilities are at higher risk of adverse health outcomes from low levels of physical activity and high sedentary time. However, there is no research focus on this population. The lack of research data impedes the development of interventions to change these modifiable behaviours and subsequently tackle preventable diseases and deaths in this population.

Currently, health promotion on lifestyle behaviours is limited to the health-sector and relatively neglected in Thailand’s NCDs prevention, compared to biomedical interventions (Topothai et al., 2016). What is being done in these health-sectors is also at an individual level, e.g., promoting gym use. As most Thai adults with intellectual disabilities are likely to be from more deprived backgrounds, these health promotion strategies that require funding may be ineffective. Therefore, as there is currently no successful sedentary behaviours and physical activity intervention that target specifically at adults with intellectual disabilities, it might be more practical to consider a systems-level approach that focuses on the issues identified within this thesis, e.g., the walkability of Bangkok (Kohl et al., 2012).

Furthermore, intervention development should also consider other identified influences on the sedentary behaviour and physical activity of adults with intellectual disabilities and explore the relevance in a Thai context. Previous research has identified that the lifestyle behaviours of adults with intellectual disabilities depend on carers and social support in some degree (Matthews et al., 2016). Therefore, it may be important to incorporate walking into carers everyday travel, which would subsequently enable adults with intellectual disabilities to walk as well. One influencer on sedentary behaviours and physical activity of adults with intellectual disabilities is environment, yet this is understudied (Bossink et al., 2017). Since one of the significant findings of this thesis is the role of the environment, further exploration of environmental influences in a Thai context is required.

The research described within this thesis aligns with existing frameworks for intervention development. The behavioural epidemiological framework specifies that understanding influences of a behaviour, e.g., sedentary behaviour or physical activity, in the population and context of interest is the first stage of intervention development (Sallis et al., 2000). Past research relating to sedentary behaviour and physical activity in people with intellectual disabilities has primarily focussed on correlates, with a lack of research focussing specifically on sedentary behaviours (Oppewal et al., 2018; Pitchford et al., 2018). This thesis therefore adds important contributions to the knowledge base as it not only explores correlates of sedentary behaviour but also investigates patters of sedentary behaviour, which will enable more targeted interventions to be developed.

6.4 Limitations

There are limitations in this thesis that derive from the fundamental problems of behavioural activity measurement. The objective measurements used in this thesis for sedentary behaviour and physical activity lack population-specific or consistent protocols developed specially for adults with intellectual disabilities. Also, subjective measurements depend on cognitive abilities that are affected by intellectual disabilities such as memory, recall, and abstract concepts, such as duration and intensity. Specific to this thesis, the use of TV time as a proxy of sedentary behaviours in the first study might not be accurate, as people with severe to profound intellectual disabilities may have high levels of sedentary behaviours, but less likely to have high screen time, including TV (Oppewal et al., 2018).

People with intellectual disabilities that are recruited to research are likely to be more able individuals. Individuals with severe and profound levels of intellectual disabilities are a hard-to-reach group, are difficult to recruited, and therefore not fully represented in this research. This limits the generalisation of the results to the whole population of people with intellectual disabilities.

Specific to this thesis, a potential limitation was the use of the same primary data in study 3 and 4. Due to COVID-19 pandemic, the plan for in-depth exploration of environment and carers roles on sedentary behaviours and physical activity of Thai adults with intellectual disabilities had to be cancelled. In addition, it was observed that previous studies in Thailand misclassified physical inactivity as sedentary behaviours(Liangruenrom, 2020). Therefore, although the same primary data was used, this demonstrates that it was used to investigate previously unexplored research questions and still contributed new knowledge.

Additionally, one of the difficulties in doing research in Thailand was the lack of availability and stability of open data. It was hard to access original local research publications, or even governmental reports. Most of the time, the problems were broken links, removed webpages, and unreadable files. These stability problems could be the results of the insufficiency of human resources and limited investment in the IT infrastructure by the Thai government (Triyason et al., 2017). This is a huge barrier to connect, share data, and continuing research between different academic groups, and could potentially have led to relevant research being overlooked or not identified through the searches used within this thesis.

6.5 Strengths

This thesis is the first to objectively measured sedentary behaviours and physical activity of Thai adults with intellectual disabilities. It explored cross cultural factors on sedentary behaviours of UK and Thai adults with intellectual disabilities. This thesis is one of the few studies to explore environmental factors relating to sedentary behaviour and physical activity in adults with intellectual disabilities. The studies also reveal several valuable areas for consideration in future studies of sedentary behaviours and physical activity in Thai adults with intellectual disabilities, including: a successful recruitment and retention strategy; feasible and enjoyable methods and motivation; advantages and disadvantages of using accelerometers on Thai adults with intellectual disabilities (Matthews et al., 2016).

6.6 Future research

The following recommendations for future research are based on the findings of this thesis.

- Research should explore environmental and neighbourhood effects on sedentary behaviours and physical activity in Thai adults with intellectual disabilities. To see the differences between urban and rural environment, or air quality, research should collect data of sedentary behaviours and physical activity of adults with intellectual disabilities across other regions of Thailand.

- There are maps of safe walking routes in major cities of Thailand, but these maps are not specifically designed for adults with intellectual disabilities. To promote physical activity and active transport in Thai adults with intellectual disabilities, research should tailor the maps to be in an accessible format, which could potentially be tested as an intervention.

- To represent more of all adults with intellectual disabilities, research should increase the recruitment of adults with more severe levels of intellectual disabilities.

- Sedentary behaviours and physical activity of adults with intellectual disabilities depends on support from carers. Research should elaborate on the context and barriers perceived by carers.

Appendices

Appendix 1 Ethical approval

University of Glasgow

Ethical approval removed due to confidentiality issues.

Appendix 2 Participant information sheet (in Thai)

เอกสารชี้แจงข้อมูลแก่ผู้เข้าร่วมโครงการวิจัย

ชื่อโครงการวิจัย: การศึกษาความเป็นไปได้ของการใช้อุปกรณ์ตรวจวัดปริมาณและรูปแบบของพฤติกรรมเนือยนิ่งในกลุ่มผู้ใหญ่ไทยที่บกพร่องทางสติปัญญา

ผู้สนับสนุนการวิจัย: Institute of health and Wellbeing, University of Glasgow

<u>ผู้วิจัยหลัก</u>

ชื่อ นางสาวเขมาภา ชูเสมอ

ตำแหน่ง นักศึกษาปริญญาเอก

หน่วยงานที่สังกัด Institute of health and Wellbeing, University of Glasgow

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หมายเลขโทรศัพท์ XXXXXXXXXX

<u>ผู้วิจัยร่วม 1</u>

ชื่อ อาจารย์วนิดา ชนินทยุทธวงศ์

ตำแหน่ง นักจิตวิทยาคลินิกเชี่ยวชาญ

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เรียน อาสาสมัครผู้รับการวิจัยทุกท่าน

ท่านได้รับเชิญให้เข้าร่วมในโครงการวิจัยนี้เนื่องจากท่านเป็นผู้หนึ่งที่มีคุณสมบัติตรงตามข้อกำหนดงานวิจัย -ก่อนที่ท่านจะตัดสินใจเข้าร่วมในการศึกษาวิจัยดังกล่าว ขอให้ท่านอ่านเอกสารฉบับนี้อย่างถี่ถ้วน เพื่อให้ท่านได้ทราบถึงเหตุผลและรายละเอียดของการศึกษาวิจัยในครั้งนี้ หากท่านมีข้อสงสัยใดๆ เพิ่มเติม กรุณาซักถามจากทีมงานของผู้ทำวิจัย หรือผู้ร่วมทำวิจัยซึ่งจะเป็นผู้สามารถตอบคำถามและให้ความกระจ่างแก่ท่านได้

ท่านสามารถขอคำแนะนำในการเข้าร่วมโครงการวิจัยนี้จากครอบครัว เพื่อน หรือแพทย์ประจำตัวของท่านได้ ท่านมีเวลาอย่างเพียงพอในการตัดสินใจโดยอิสระ ถ้าท่านตัดสินใจแล้วว่าจะเข้าร่วมในโครงการวิจัยนี้ ขอให้ท่านลงนามในเอกสารแสดงความยินยอมของโครงการวิจัยนี้

<u>เหตุผลความเป็นมา</u>

ผู้ที่บกพร่องทางสติปัญญาใช้เวลาส่วนใหญ่ไปกับกิจกรรมเนือยนิ่ง (เช่น การนั่งดูทีวีนานๆ) ซึ่งอาจทำให้เกิดโรคอ้วนและปัญหาสุขภาพตามมามากมาย การวัดพฤติกรรมเนือยนิ่งมีความสำคัญต่อการเพิ่มความรู้ซึ่งจะต่อยอดนำไปสู่การพัฒนากลยุทธ์เพื่อช่วยลดระยะเวลาเนือยนิ่ง และอาจช่วยปรับปรุงสุขภาพโดยรวมได้ในที่สุด

ตัววัดความเร่ง เป็นอุปกรณ์ขนาดเล็กใช้สวมรอบเอว และช่วยวัดการเคลื่อนไหว ทำให้เราสามารถบอกได้ว่าผู้สวมใส่ใช้เวลาเท่าใดไปกับการนั่งนานๆ อุปกรณ์นี้ใช้กันอย่างแพร่หลาย แต่ยังไม่เคยมีการใช้ในคนไทยที่บกพร่องทางสติปัญญา

<u>วัตถุประสงค์ของการศึกษา</u>

โครงการวิจัยนี้มีวัตถุประสงค์เพื่อเรียนรู้พฤติกรรมเนือยนิ่งของคนไทยที่บกพร่องทางสติปัญญา โดยจะทำการตรวจสอบให้แน่ใจก่อนว่าวิธีวิจัยเช่นนี้สามารถทำได้จริง

จำนวนอาสาสมัครในโครงการวิจัย คือ 50 คน

<u>วิธีการที่เกี่ยวข้องกับการวิจัย</u>

หลังจากท่านให้ความยินยอมที่จะเข้าร่วมในโครงการวิจัยนี้ และมีคุณสมบัติตามเกณฑ์คัดเข้า ท่านจะได้รับการนัดหมายกับผู้ทำวิจัยตามวันและเวลาที่ท่านสะดวก สำหรับการเยี่ยมบ้าน ผู้ทำวิจัยจะสาธิตวิธีการใส่อุปกรณ์ตัววัดความเร่ง ซึ่งจะคาดไว้รอบเอวเหมือนใส่เข็มขัด โดยให้ตัวเครื่องสีแดงอยู่เหนือขาขวา ดังรูป

จากนั้นท่านจะใส่อุปกรณ์นี้ติดตัวเป็นระยะเวลา 7 วัน ตั้งแต่ตอนเช้าจนเข้านอน ยกเว้นขณะอาบน้ำหรือว่ายน้ำ (อุปกรณ์ไม่กันน้ำ ถ้าเปียกจะพังได้) นอกจากนั้นจะให้ญาติใกล้ชิดของท่านช่วยบันทึกเวลาที่ใส่และถอดอุปกรณ์ในแต่ละวัน ลงในตารางบันทึกเวลาประจำวันที่ผู้วิจัยจัดให้ เพื่อใช้ประกอบการวิเคราะห์ข้อมูล แต่จะไม่มีการบันทึกกิจกรรมใด ๆ ของ ท่าน ตารางบันทึกเวลานี้มีการระบุชื่อของ ท่านและผู้ดูแล ดังนั้นเพื่อเป็นการรักษาความลับของ ท่าน ทางผู้วิจัยจะทำลายเอกสารทิ้งหลังจากถ่ายโอนข้อมูลซึ่ง ตัดทอนชื่อของท่านและผู้ดูแลออกไปแล้ว โดยข้อมูลจะถูก อ้างอิงด้วยหมายเลขเฉพาะ เท่านั้น หากมีข้อสงสัยหรือปัญหาใด ๆ อาสาสมัครหรือผู้ดูแลสามารถติดต่อผู้วิจัยได้ตามช่องทางที่ระบุไว้ในส่วนท้ายของตารางบันทึกเวลาประจำวัน จากนั้นเมื่อครบสัปดาห์ ผู้วิจัยจะเข้าเยี่ยมบ้านอีกครั้งเพื่อขอเก็บอุปกรณ์คืน โดยตลอดระยะเวลาที่ท่านอยู่ในโครงการวิจัย คือ 7 วัน และพบผู้วิจัยทั้งสิ้น 2 ครั้ง

ความรับผิดชอบของอาสาสมัครผู้เข้าร่วมในโครงการวิจัย

หากท่านตกลงเข้าร่วมโครงการครั้งนี้ ท่านจะได้รับอุปกรณ์ตัววัดความเร่ง ให้ท่านใส่รอบเอวคล้ายเข็มขัด อุปกรณ์นี้**ห้ามเปียกน้ำ** หรือกระแทกรุนแรง และโปรดส่งคืนให้กับผู้วิจัยเมื่อครบหนึ่งสัปดาห์

หากเกิดความเสียหายขึ้นกับอุปกรณ์ ท่านไม่ต้องรับผิดชอบค่าใช้จ่ายใด ๆ ทั้งสิ้น

ความเสี่ยงที่อาจได้รับ

ตัววัดความเร่งเป็นอุปกรณ์ขนาดเล็ก และน้ำหนักเบา ใส่เหมือนใส่เข็มขัด ไม่ทำให้เจ็บปวด และไม่ก่อให้เกิดความเสี่ยงใด ๆ ต่อร่างกาย หากท่านต้องการ จะใส่ให้แนบเนีย นไม่เป็นที่สังเกตจากคนรอบข้าง ก็สามารถทำได้

ประโยชน์ที่อาจได้รับ

แม้จะไม่มีประโยชน์ต่อท่านโดยตรง แต่ ภายหลังสิ้นสุดการวิจัย ท่านจะได้รู้ว่าแต่ละวันท่านใช้เวลานั่งนานเท่าไร พร้อมได้รับคำแนะนำที่เป็นประโยชน์ต่อสุขภาพของท่าน ผลการวิจัยจะช่วยให้เราเข้าใจพฤติกรรมเนือยนิ่งในคนไทยที่บกพร่องทางสติปัญญา ซึ่งเราจะใช้ในการพัฒนาเพื่อปรับปรุงสุขภาพของคนที่มีบกพร่องทางสติปัญญาต่อไป และเราหวังว่าจะมีความสุขกับมีส่วนร่วมในการวิจัยนี้

ข้อปฏิบัติของท่านขณะที่ร่วมในโครงการวิจัย

ขอให้ท่านปฏิบัติดังนี้

- ขอให้ท่านให้ข้อมูลทางการแพทย์ของท่านทั้งในอดีต และปัจจุบัน แก่ผู้ทำวิจัยด้วยความสัตย์จริง
- ขอให้ท่านใส่อุปกรณ์ตัววัดความเร่ง ทุกวัน ตั้งแต่เช้าจนก่อนเข้านอน เป็นเวลา 7 วัน ยกเว้นเวลาอาบน้ำ หรือว่ายน้ำ
- ขอให้ผู้ดูแลของท่านลงบันทึกเวลาที่ท่านใส่และถอดอุปกรณ์ในทุก ๆ วัน ลงในตารางที่จัดให้

- ขอให้ท่านดูแลอุปกรณ์ไม่ให้เปียกน้ำ เสียหาย หรือสูญหาย และคืนให้กับผู้ทำวิจัยหลังครบเวลา
- ขอให้ท่านแจ้งให้ผู้ทำวิจัยทราบความผิดปกติที่เกิดขึ้นระหว่างที่ท่านร่วมในโครงการวิจัย

อันตรายที่อาจเกิดขึ้นจากการเข้าร่วมในโครงการวิจัย และความรับผิดชอบของผู้ทำวิจัย /ผู้สนับสนุนการวิจัย

หากพบอันตรายที่เกิดขึ้นจากการวิจัย ท่านจะได้รับการรักษาอย่างเหมาะสมทันที และท่านปฏิบัติตามคำแนะนำของทีมผู้ทำวิจัยแล้ว ผู้ทำวิจัย /ผู้สนับสนุนการวิจัยยินดีจะรับผิดชอบค่าใช้จ่ายในการรักษาพยาบาลของท่าน ผู้วิจัยจะรับผิดชอบอันตรายที่เกิดขึ้นจากการเข้าร่วมงานวิจัย นอกจากนี้การลงนามในเอกสารให้ความยินยอม ไม่ได้หมายความว่าท่านได้สละสิทธิ์ทางกฎหมายตามปกติที่ท่านพึงมี

ในกรณีที่ท่านได้รับอันตรายใด ๆ หรือต้องการข้อมูลเพิ่มเติมที่เกี่ยวข้องกับโครงการวิจัย ท่านสามารถติดต่อกับผู้ทำวิจัยคือ นางสาวเขมาภา ชูเสมอ ที่หมายเลขโทรศัพท์ 0918795108 ได้ตลอด 24 ชั่วโมง

ค่าใช้จ่ายของท่านในการเข้าร่วมการวิจัย

ท่านจะไม่มีค่าใช้จ่ายใด ๆ ที่จะต้องรับผิดชอบ

การเข้าร่วมและการสิ้นสุดการเข้าร่วมโครงการวิจัย

การเข้าร่วมในโครงการวิจัยครั้งนี้เป็นไปโดยความสมัครใจ หากท่านไม่สมัครใจจะเข้าร่วมการศึกษาแล้ว ท่านสามารถถอนตัวได้ตลอดเวลา การขอถอนตัวออกจากโครงการวิจัยจะไม่มีผลต่อการดูแลรักษาโรคของท่านแต่อย่างใด

ผู้ทำวิจัยอาจถอนท่านออกจากการเข้าร่วมการวิจัย เพื่อเหตุผลด้านความปลอดภัยของท่าน หรือเมื่อผู้สนับสนุนการวิจัยยุติการดำเนินงานวิจัย หรือ หากท่านไม่สามารถปฏิบัติตามคำแนะนำของผู้ทำวิจัย เช่น ทำให้ตัววัดความเร่งเสียหายโดยตั้งใจ

การปกป้องรักษาข้อมูลความลับของอาสาสมัคร

ข้อมูลที่อาจนำไปสู่การเปิดเผยตัวท่าน จะได้รับการปกปิดและจะไม่เปิดเผยแก่สาธารณชน ในกรณีที่ผลการวิจัยได้รับการตีพิมพ์ ชื่อและที่อยู่ของท่านจะต้องได้รับการปกปิดอยู่เสมอ โดยจะใช้เฉพาะรหัสประจำโครงการวิจัยของท่าน

จากการลงนามยินยอมของท่านผู้ทำวิจัย และผู้สนับสนุนการวิจัยสามารถเข้าไปตรวจสอบบันทึกข้อมูลทางการแพทย์ของท่านได้แม้จะสิ้นสุดโครงการวิจัยแล้วก็ตาม หากท่านต้องการยกเลิกการให้สิทธิ์ดังกล่าว ท่านสามารถแจ้ง หรือเขียนบันทึกขอยกเลิกการให้คำยินยอม โดยส่งไปที่ นางสาวเขมาภา ชูเสมอ มหาวิทยาลัยราชภัฏนครศรีธรรมราช

หากท่านขอยกเลิกการให้คำยินยอมหลังจากที่ท่านได้เข้าร่วมโครงการวิจัยแล้ว ข้อมูลส่วนตัวของท่านจะไม่ถูกบันทึกเพิ่มเติม อย่างไรก็ตามข้อมูลอื่น ๆ ของท่านอาจถูกนำมาใช้เพื่อประเมินผลการวิจัย และท่านจะไม่

สามารถกลับมาเข้าร่วมในโครงการนี้ได้อีก ทั้งนี้เนื่องจากข้อมูลของท่านที่จำเป็นสำหรับใช้เพื่อการวิจัยไม่ได้ถูกบันทึก

<u>สิทธิ์ของผู้เข้าร่วมในโครงการวิจัย</u>

ในฐานะที่ท่านเป็นผู้เข้าร่วมในโครงการวิจัย ท่านจะมีสิทธิ์ดังต่อไปนี้

1. ท่านจะได้รับทราบถึงลักษณะและวัตถุประสงค์ของการวิจัยในครั้งนี้
2. ท่านจะได้รับการอธิบายเกี่ยวกับระเบียบวิธีการของการวิจัยและอุปกรณ์ที่ใช้ในการวิจัยครั้งนี้
3. ท่านจะได้รับการอธิบายถึงความเสี่ยงและความไม่สบายที่จะได้รับจากการวิจัย
4. ท่านจะได้รับการอธิบายถึงประโยชน์ที่ท่านอาจจะได้รับจากการวิจัย
5. ท่านจะมีโอกาสได้ซักถามเกี่ยวกับงานวิจัยหรือขั้นตอนที่เกี่ยวข้องกับงานวิจัย
6. ท่านจะได้รับการแจ้งให้ทราบโดยเร็ว หากมีข้อมูลใหม่เกี่ยวข้องกับโครงการวิจัย
7. ท่านจะได้รับทราบว่าการยินยอมเข้าร่วมในโครงการวิจัยนี้ ท่านสามารถขอถอนตัวจากโครงการเมื่อไรก็ได้ โดยผู้เข้าร่วมในโครงการวิจัยสามารถขอถอนตัวจากโครงการโดยไม่ได้รับผลกระทบใด ๆ ทั้งสิ้น
8. ท่านจะได้รับเอกสารข้อมูลคำอธิบายสำหรับผู้เข้าร่วมในโครงการวิจัยและสำเนาเอกสารใบยินยอมที่มีทั้งลายเซ็นและวันที่
9. ท่านมีสิทธิ์ในการตัดสินใจว่าจะเข้าร่วมในโครงการวิจัยหรือไม่ก็ได้ โดยปราศจากการใช้อิทธิพลบังคับข่มขู่หรือการหลอกลวง

หากท่านไม่ได้รับการชดเชยอันควรต่อการบาดเจ็บหรือเจ็บป่วยที่เกิดขึ้นโดยตรงจากการวิจัย หรือท่านไม่ได้รับการปฏิบัติตามที่ปรากฏในเอกสารข้อมูลคำอธิบายสำหรับผู้เข้าร่วมในการวิจัย ท่านสามารถร้องเรียนได้ที่ คณะกรรมการพิจารณาจริยธรรมการวิจัยในมนุษย์ สถาบันราชานุกูล 4737 ถนนดินแดง แขวงดินแดง เขตดินแดง กรุงเทพมหานคร 10400 โทร. 02-2488900 ต่อ 70326 ในเวลาราชการ

ขอขอบคุณในการร่วมมือของท่านมา ณ ที่นี้

Appendix 3 Device manual (in Thai)

คู่มือการใส่อุปกรณ์วัดความเร่ง

ประกอบการศึกษาความเป็นไปได้ของการใช้อุปกรณ์ตรวจวัดปริมาณ และรูปแบบของพฤติกรรมเนือยนิ่ง
ในกลุ่มผู้ใหญ่ไทยที่บกพร่องทางสติปัญญา โดยนางสาวเขมาภา ชูเสมอ

นี่คือ อุปกรณ์วัดความเร่ง ค่ะ
ใส่เพื่อวัดว่าเรานั่งนานแค่ไหน

จุกสีดำ นี้ต้องอยู่ด้าน **<u>บน</u>** เวลาใส่

ใส่รอบตัวได้เหมือนเข็มขัด
รัดให้แน่นพอดี ไม่เลื่อน

ตัวเครื่องสีแดงต้องอยู่เหนือขา **<u>ขวา</u>** ค่ะ

ระวังไม่ให้เกิดอันตรายจากการเล่นสายรัดด้วยนะคะ

ให้ใส่ทั้งวัน ตั้งแต่เช้า **<u>ยกเว้นตอนอาบน้ำ</u>**
แล้วถอดตอนจะเข้านอน

บันทึกเวลาที่ใส่และเวลาที่ถอดลงในตารางทุกวัน

อุปกรณ์นี้ **<u>ห้ามเปียก</u>** นะคะ

อย่าใส่อาบน้ำ อย่าใส่ว่ายน้ำ อย่าทำตกน้ำ

ใส่ทั้งหมด **7 วัน**

แล้วเราจะไปเก็บอุปกรณ์กลับค่ะ

ถ้ามีข้อสงสัย หรือปัญหาใด ๆ
สอบถามได้ที่ น.ส.เขมาภา ชูเสมอ
โทร: 0918795108
อีเมล: k.chusamer.1@research.gla.ac.uk

Appendix 4 Diary (in Thai)

ID________

ตารางบันทึกประจำวัน

ประกอบการศึกษาความเป็นไปได้ของการใช้อุปกรณ์ตรวจวัดปริมาณและรูปแบบ
ของพฤติกรรมเนือยนิ่งในกลุ่มผู้ใหญ่ไทยที่บกพร่องทางสติปัญญา

อาสาสมัครชื่อ: ________________________________

ผู้ดูแลชื่อ: ________________________________

ใส่เครื่องตั้งแต่วันที่: ________________ถึง________________

กรุณากรอกข้อมูลในแต่ละวันลงในตารางนี้
โดยลงเวลาที่ใส่อุปกรณ์วัดความเร่งในตอนเช้า และถอดออกในตอนท้ายของวัน
หากถอดเครื่องออกในระหว่างวัน โปรดระบุในช่องหมายเหตุ 1) เวลาที่ไม่ได้ใส่ และ 2) สาเหตุของการถอด

วัน	วันในสัปดาห์	เวลาใส่เครื่อง	เวลาถอดเครื่อง	หมายเหตุ
1.				
2.				
3.				
4.				
5.				
6.				
7.				

หากมีข้อสงสัยใด ๆ โปรดติดต่อ: เขมาภา ชูเสมอ โทร: 0918795108
อีเมล์: k.chusamer.1@research.gla.ac.uk

Appendix 5 Consent form (in Thai)

หนังสือแสดงเจตนายินยอมเข้าร่วมการวิจัย

ชื่อโครงการวิจัยเรื่อง การศึกษาความเป็นไปได้ของการใช้อุปกรณ์ตรวจวัดปริมาณ และรูปแบบของพฤติกรรมเนือยนิ่งในกลุ่มผู้ใหญ่ไทยที่บกพร่องทางสติปัญญา

หมายเลขผู้เข้าร่วม --

วันให้คำยินยอม วันที่______________เดือน____________________________พ.ศ________________

ข้าพเจ้า นาย/นาง/นางสาว

ที่อยู่

ได้อ่านรายละเอียดจากเอกสารข้อมูลสำหรับผู้เข้าร่วมโครงการวิจัยที่แนบมาฉบับวันที่ 18 มิถุนายน พ.ศ. 2563 และข้าพเจ้ายินยอมเข้าร่วมโครงการวิจัยโดยสมัครใจ

ข้าพเจ้าได้รับสำเนาเอกสารแสดงความยินยอมเข้าร่วมในโครงการวิจัยที่ข้าพเจ้าได้ลงนาม และ วันที่ พร้อมด้วยเอกสารข้อมูลสำหรับผู้เข้าร่วมโครงการวิจัย ทั้งนี้ก่อนที่จะลงนามในใบยินยอมให้ทำการวิจัยนี้ ข้าพเจ้าได้รับการอธิบายจากผู้วิจัยถึงวัตถุประสงค์ของการวิจัย ระยะเวลาของการทำวิจัย วิธีการวิจัย ความเสี่ยง ที่อาจเกิดขึ้นจากการวิจัย รวมทั้งประโยชน์ที่จะเกิดขึ้นจากการวิจัย อย่างละเอียด ข้าพเจ้ามีเวลาและโอกาสเพียงพอในการซักถามข้อสงสัยจนมีความเข้าใจอย่างดีแล้ว โดยผู้วิจัยได้ตอบคำถามต่าง ๆ ด้วยความเต็มใจไม่ปิดบังซ่อนเร้นจนข้าพเจ้าพอใจ

ข้าพเจ้ารับทราบจากผู้วิจัยว่าหากเกิดความเสี่ยงหรืออันตรายใด ๆ จากการวิจัยดังกล่าว ข้าพเจ้าจะได้รับการรักษาพยาบาลโดยไม่เสียค่าใช้จ่าย และจะได้รับค่าชดเชยจากผู้วิจัย โดยข้าพเจ้าสามารถทำคำร้องไปยังสหราชอาณาจักรที่ซึ่งโครงการวิจัยนี้ เริ่มต้น โดยผู้วิจัยยินดีให้ความช่วยเหลือผู้เข้าร่วมโครงการทั้งในด้านภาษาและการติดต่อประสานงาน

ข้าพเจ้ามีสิทธิ์ที่จะบอกเลิกเข้าร่วมในโครงการวิจัยเมื่อใดก็ได้ โดยไม่จำเป็นต้องแจ้งเหตุผล และการบอกเลิกการเข้าร่วมการวิจัยนี้ จะไม่มีผลต่อการรักษาโรคหรือสิทธิอื่น ๆ ที่ข้าพเจ้าจะพึงได้รับต่อไป

ผู้วิจัยรับรองว่าจะเก็บข้อมูลส่วนตัวของข้าพเจ้าเป็นความลับ และจะเปิดเผยได้เฉพาะเมื่อได้รับการยินยอมจากข้าพเจ้าเท่านั้น บุคคลอื่นในนามของผู้สนับสนุนการวิจัย หรือคณะกรรมการพิจารณาจริยธรรมการวิจัยในคน อาจได้รับอนุญาตให้เข้ามาตรวจและประมวลข้อมูลของข้าพเจ้า ทั้งนี้จะต้องกระทำไปเพื่อวัตถุประสงค์เพื่อตรวจสอบความถูกต้องของข้อมูลเท่านั้น

ผู้วิจัยรับรองว่าจะไม่มีการเก็บข้อมูลใด ๆ เพิ่มเติม หลังจากที่ข้าพเจ้าขอยกเลิกการเข้าร่วมโครงการวิจัย และต้องการให้ทำลายเอกสารทั้งหมดที่สามารถสืบค้นถึงตัวข้าพเจ้าได้

ข้าพเจ้าเข้าใจว่า ข้าพเจ้ามีสิทธิ์ที่จะตรวจสอบหรือแก้ไขข้อมูลส่วนตัวของข้าพเจ้า และสามารถยกเลิกการให้สิทธิ์ในการใช้ข้อมูลส่วนตัวของข้าพเจ้าได้ โดยต้องแจ้งให้ผู้วิจัยรับทราบ

ข้าพเจ้าได้ตระหนักว่าข้อมูลในการวิจัยรวมถึงข้อมูลทางการแพทย์ของข้าพเจ้าที่ไม่มีการเปิดเผยชื่อ จะผ่านกระบวนการต่าง ๆ เช่น การเก็บข้อมูล การบันทึกข้อมูลในแบบบันทึกและในคอมพิวเตอร์ การตรวจสอบ การวิเคราะห์ และการรายงานข้อมูลเพื่อวัตถุประสงค์ทางวิชาการ รวมทั้งการใช้ข้อมูลทางการแพทย์ในอนาคต เท่านั้น

ข้าพเจ้าได้อ่านข้อความข้างต้นและมีความเข้าใจดีทุกประการแล้ว ยินดีเข้าร่วมในการวิจัยด้วยความเต็มใจ จึงได้ลงนามในเอกสารแสดงความยินยอมนี้

....ลงนามผู้ให้ความยินยอม
(..) ชื่อผู้ยินยอมตัวบรรจง
วันที่ ....เดือน..................................พ.ศ...........................

ข้าพเจ้าได้อธิบายถึงวัตถุประสงค์ของการวิจัย วิธีการวิจัย อันตราย หรืออาการไม่พึงประสงค์หรือความเสี่ยงที่อาจเกิดขึ้นจากการวิจัย รวมทั้งประโยชน์ที่จะเกิดขึ้นจากการวิจัยอย่างละเอียด ให้ผู้เข้าร่วมในโครงการวิจัยตามนามข้างต้นได้ทราบและมีความเข้าใจดีแล้ว พร้อมลงนามลงในเอกสารแสดงความยินยอมด้วยความเต็มใจ

....ลงนามผู้ทำวิจัย
(..) ชื่อผู้ทำวิจัย ตัวบรรจง
วันที่ ....เดือน..................................พ.ศ...........................

....ลงนามพยาน
(..) ชื่อพยาน ตัวบรรจง
วันที่ ....เดือน..................................พ.ศ...........................

Appendix 6 SPSS statistical output

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B) Lower	Upper
Step 1[a]	Having children(1)	-2.005	.410	23.941	1	.000	.135	.060	.301
	employment status (1)	-.744	.325	5.234	1	.022	.475	.251	.899
	standard of local services: leisure binary(1)	.673	.294	5.253	1	.022	1.961	1.102	3.487
	Having children(1) by neighborhood quality(1)	1.483	.403	13.547	1	.000	4.408	2.001	9.711
	Constant	.386	.300	1.658	1	.198	1.471		

a. Variable(s) entered on step 1: Having children, employment status , standard of local services: leisure binary, Having children * neighborhood quality .

Figure SPSS 1 Final logistic regression model for TV hours for adults with intellectual disabilities (study 1).

Descriptive Statistics

Time in Sedentary Bout

Time of Day	Type of Day	Count	Mean	Standard Deviation	Coefficient of Variation
Early Afternoon	Weekday	3356	5.41	8.254	152.6%
	Weekend	1216	5.42	8.180	151.0%
	Total	4572	5.41	8.234	152.2%
Early Evening	Weekday	1614	6.07	9.032	148.7%
	Weekend	775	5.61	8.496	151.5%
	Total	2389	5.92	8.863	149.7%
Early Morning	Weekday	1956	5.60	8.630	154.1%
	Weekend	634	4.43	5.892	132.9%
	Total	2590	5.32	8.061	151.6%
Late Afternoon	Weekday	2948	5.23	7.520	143.9%
	Weekend	1042	5.01	7.248	144.5%
	Total	3990	5.17	7.449	144.1%
Late Evening	Weekday	368	6.46	9.707	150.3%
	Weekend	122	10.18	13.097	128.7%
	Total	490	7.38	10.759	145.7%
Late Morning	Weekday	3164	5.16	7.420	143.7%
	Weekend	1106	4.86	7.348	151.2%
	Total	4270	5.09	7.402	145.6%
Total	Weekday	13406	5.45	8.114	148.9%
	Weekend	4895	5.23	7.803	149.3%
	Total	18301	5.39	8.033	149.1%

Figure SPSS 2 Descriptive statistics on sedentary bout duration (study 3)

Estimates of Fixed Effects[a]

Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Intercept	4.905670	.157966	18294	31.055	.000	4.596041	5.215299
[TimeofDay=Early Afternoon]	.327856	.170732	18294	1.920	.055	-.006794	.662506
[TimeofDay=Early Evening]	.852744	.205154	18294	4.157	.000	.450623	1.254864
[TimeofDay=Early Morning]	.227136	.199810	18294	1.137	.256	-.164511	.618782
[TimeofDay=Late Afternoon]	.086450	.176640	18294	.489	.625	-.259782	.432681
[TimeofDay=Late Evening]	2.295995	.382643	18294	6.000	.000	1.545979	3.046011
[TimeofDay=Late Morning]	0[b]	0	.	.	.	.	.
[TypeofDay=Weekday]	.242348	.134153	18294.000	1.807	.071	-.020604	.505300
[TypeofDay=Weekend]	0[b]	0	.	.	.	.	.

a. Dependent Variable: Time in Sedentary Bout.

b. This parameter is set to zero because it is redundant.

Figure SPSS 3 Mixed linear model showing significant difference in sedentary bout duration in early evening and late evening (study 3)

Estimates of Fixed Effects[a]

Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Intercept	5.230770	.388097	80.658	13.478	.000	4.458529	6.003010
[TimeofDay=Early Afternoon]	.630403	.326201	17966.981	1.933	.053	-.008983	1.269789
[TimeofDay=Early Evening]	.870679	.372746	17995.394	2.336	.020	.140060	1.601297
[TimeofDay=Early Morning]	-.182753	.416406	17975.168	-.439	.661	-.998948	.633442
[TimeofDay=Late Afternoon]	.339006	.340670	17981.974	.995	.320	-.328740	1.006751
[TimeofDay=Late Evening]	5.513227	.760194	17996.686	7.252	.000	4.023173	7.003281
[TimeofDay=Late Morning]	0[b]	0	.	.	.	.	.
[TypeofDay=Weekday]	.290089	.275516	17983.620	1.053	.292	-.249949	.830127
[TypeofDay=Weekend]	0[b]	0	.	.	.	.	.
[TimeofDay=Early Afternoon] * [TypeofDay=Weekday]	-.295617	.379677	17967.555	-.779	.436	-1.039819	.448586
[TimeofDay=Early Afternoon] * [TypeofDay=Weekend]	0[b]	0	.	.	.	.	.
[TimeofDay=Early Evening] * [TypeofDay=Weekday]	.081585	.440771	17978.772	.185	.853	-.782368	.945538
[TimeofDay=Early Evening] * [TypeofDay=Weekend]	0[b]	0	.	.	.	.	.
[TimeofDay=Early Morning] * [TypeofDay=Weekday]	.152787	.477413	17977.087	.320	.749	-.782988	1.088562
[TimeofDay=Early Morning] * [TypeofDay=Weekend]	0[b]	0	.	.	.	.	.
[TimeofDay=Late Afternoon] * [TypeofDay=Weekday]	-.279923	.394722	17975.772	-.709	.478	-1.053616	.493769
[TimeofDay=Late Afternoon] * [TypeofDay=Weekend]	0[b]	0	.	.	.	.	.
[TimeofDay=Late Evening] * [TypeofDay=Weekday]	-3.435669	.869035	17981.368	-3.953	.000	-5.139061	-1.732278
[TimeofDay=Late Evening] * [TypeofDay=Weekend]	0[b]	0	.	.	.	.	.
[TimeofDay=Late Morning] * [TypeofDay=Weekday]	0[b]	0	.	.	.	.	.
[TimeofDay=Late Morning] * [TypeofDay=Weekend]	0[b]	0	.	.	.	.	.

a. Dependent Variable: Time in Sedentary Bout (min).

b. This parameter is set to zero because it is redundant.

Figure SPSS 4 Mixed linear model showing significant difference in sedentary bout duration between weekday and weekend in late evening (study 3)

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
						Significance				95% Confidence Interval of the Difference	
		F	Sig.	t	df	One-Sided p	Two-Sided p	Mean Difference	Std. Error Difference	Lower	Upper
BoutDuration	Equal variances assumed	13.238	.000	-3.347	488	.000	.001	-3.72381	1.11250	-5.90969	-1.53792
	Equal variances not assumed			-2.888	167.257	.002	.004	-3.72381	1.28923	-6.26906	-1.17855

Figure SPSS 5 T-test confirming significant difference in sedentary bout duration between weekday and weekend in late evening (study 3)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	365.792	15.128		24.179	.000	335.110	396.473					
	Gender	88.065	24.924	.507	3.533	.001	37.518	138.613	.507	.507	.507	1.000	1.000
2	(Constant)	492.099	45.665		10.776	.000	399.394	584.805					
	Gender	77.404	22.991	.446	3.367	.002	30.730	124.079	.507	.495	.440	.974	1.026
	BMI	-4.913	1.693	-.384	-2.901	.006	-8.350	-1.475	-.456	-.440	-.379	.974	1.026

a. Dependent Variable: Sedentary time min/day

Figure SPSS 6 Regression showing predictors on total sedentary time (study 3)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	78.639	14.024		5.608	.000	49.913	107.365		
	Gender	6.660	4.015	.340	1.659	.108	-1.564	14.884	.403	2.479
	Age cal (Y)	-.100	.370	-.048	-.271	.789	-.859	.658	.539	1.857
	BMI	-.605	.548	-.420	-1.105	.279	-1.727	.517	.118	8.509
	BMI 25cutpoint	1.870	4.032	.197	.464	.646	-6.389	10.129	.094	10.606
	BMI 23cutpoint	-2.832	3.323	-.340	-.852	.401	-9.639	3.974	.107	9.387
	Employment	2.807	4.279	.108	.656	.517	-5.959	11.573	.621	1.610
	ID level	5.494	2.432	.330	2.259	.032	.512	10.475	.796	1.256
	Living with M or F	-.878	2.346	-.054	-.374	.711	-5.683	3.927	.813	1.229
	Most assignment	-3.139	4.723	-.141	-.665	.512	-12.813	6.536	.375	2.665
2	(Constant)	76.811	12.092		6.352	.000	52.080	101.543		
	Gender	6.431	3.861	.329	1.666	.107	-1.466	14.328	.422	2.369
	BMI	-.588	.535	-.408	-1.098	.281	-1.682	.507	.119	8.389
	BMI 25cutpoint	2.076	3.896	.218	.533	.598	-5.893	10.044	.098	10.229
	BMI 23cutpoint	-3.190	3.000	-.383	-1.063	.296	-9.325	2.945	.127	7.903
	Employment	2.467	4.025	.095	.613	.545	-5.765	10.698	.680	1.471
	ID level	5.456	2.389	.328	2.284	.030	.571	10.342	.799	1.252
	Living with M or F	-1.004	2.262	-.062	-.444	.660	-5.631	3.623	.847	1.181
	Most assignment	-3.677	4.215	-.166	-.872	.390	-12.297	4.943	.456	2.193
3	(Constant)	76.292	11.873		6.426	.000	52.044	100.541		
	Gender	6.636	3.782	.339	1.755	.090	-1.087	14.359	.428	2.335
	BMI	-.637	.516	-.442	-1.234	.227	-1.692	.417	.125	8.024
	BMI 25cutpoint	1.986	3.838	.209	.517	.609	-5.853	9.825	.098	10.201
	BMI 23cutpoint	-2.949	2.911	-.354	-1.013	.319	-8.893	2.995	.131	7.644
	Employment	2.342	3.961	.090	.591	.559	-5.748	10.431	.683	1.464
	ID level	5.647	2.318	.339	2.436	.021	.912	10.381	.825	1.212
	Most assignment	-3.606	4.155	-.162	-.868	.392	-12.091	4.880	.457	2.189
4	(Constant)	72.998	9.903		7.372	.000	52.802	93.195		
	Gender	6.633	3.737	.339	1.775	.086	-.988	14.254	.428	2.335
	BMI	-.485	.419	-.336	-1.157	.256	-1.339	.370	.185	5.411
	BMI 23cutpoint	-2.033	2.282	-.244	-.891	.380	-6.688	2.622	.208	4.815
	Employment	1.819	3.784	.070	.481	.634	-5.899	9.537	.731	1.368
	ID level	5.533	2.280	.332	2.426	.021	.882	10.184	.833	1.201
	Most assignment	-3.668	4.104	-.165	-.894	.378	-12.038	4.702	.457	2.188
5	(Constant)	72.002	9.566		7.527	.000	52.517	91.486		
	Gender	6.364	3.650	.325	1.744	.091	-1.070	13.799	.438	2.282
	BMI	-.419	.392	-.291	-1.071	.292	-1.217	.378	.207	4.842
	BMI 23cutpoint	-2.129	2.246	-.256	-.948	.350	-6.704	2.446	.209	4.777
	ID level	5.422	2.241	.326	2.419	.021	.856	9.987	.841	1.189
	Most assignment	-3.790	4.046	-.171	-.937	.356	-12.033	4.452	.459	2.179
6	(Constant)	67.260	8.102		8.302	.000	50.777	83.744		
	Gender	8.812	2.544	.450	3.464	.001	3.636	13.987	.899	1.113
	BMI	-.378	.388	-.262	-.974	.337	-1.168	.412	.209	4.781
	BMI 23cutpoint	-2.346	2.230	-.282	-1.052	.301	-6.883	2.191	.212	4.727
	ID level	5.545	2.233	.333	2.483	.018	1.001	10.088	.844	1.185
7	(Constant)	59.697	2.305		25.894	.000	55.012	64.382		
	Gender	8.501	2.522	.434	3.371	.002	3.376	13.626	.913	1.095
	BMI 23cutpoint	-4.242	1.087	-.510	-3.903	.000	-6.450	-2.033	.889	1.124
	ID level	5.111	2.187	.307	2.337	.025	.667	9.555	.879	1.137

a. Dependent Variable: Percentage of time in sedentary

Figure SPSS 7 Regression showing predictors on percentage of time in sedentary (study 3)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	.895	.849		1.054	.301	-.844	2.634		
	Gender	-.245	.243	-.249	-1.008	.322	-.743	.253	.403	2.479
	Age cal (Y)	-.025	.022	-.242	-1.130	.268	-.071	.021	.539	1.857
	BMI	.038	.033	.529	1.155	.258	-.030	.106	.118	8.509
	BMI 25cutpoint	-.290	.244	-.608	-1.190	.244	-.790	.210	.094	10.606
	BMI 23cutpoint	.257	.201	.615	1.280	.211	-.155	.669	.107	9.387
	Employment	-.024	.259	-.018	-.091	.928	-.554	.507	.621	1.610
	ID level	-.210	.147	-.251	-1.428	.164	-.512	.091	.796	1.256
	Most assignment	.092	.286	.082	.320	.751	-.494	.677	.375	2.665
	Living with M or F	-.101	.142	-.123	-.708	.485	-.391	.190	.813	1.229
2	(Constant)	.926	.764		1.213	.235	-.635	2.488		
	Gender	-.241	.235	-.245	-1.027	.313	-.721	.239	.418	2.391
	Age cal (Y)	-.026	.021	-.247	-1.231	.228	-.069	.017	.589	1.697
	BMI	.037	.030	.512	1.239	.225	-.024	.098	.139	7.186
	BMI 25cutpoint	-.286	.236	-.599	-1.215	.234	-.768	.196	.098	10.236
	BMI 23cutpoint	.258	.198	.616	1.305	.202	-.146	.662	.107	9.378
	ID level	-.209	.144	-.249	-1.452	.157	-.502	.085	.807	1.238
	Most assignment	.096	.276	.086	.348	.730	-.469	.662	.388	2.579
	Living with M or F	-.101	.140	-.123	-.721	.477	-.386	.185	.814	1.229
3	(Constant)	.984	.734		1.340	.190	-.515	2.484		
	Gender	-.299	.162	-.304	-1.844	.075	-.630	.032	.849	1.177
	Age cal (Y)	-.023	.019	-.220	-1.208	.237	-.062	.016	.696	1.436
	BMI	.036	.029	.503	1.237	.226	-.024	.097	.140	7.153
	BMI 25cutpoint	-.279	.231	-.583	-1.205	.237	-.751	.193	.099	10.149
	BMI 23cutpoint	.252	.194	.601	1.298	.204	-.144	.648	.108	9.299
	ID level	-.212	.141	-.253	-1.502	.143	-.500	.076	.811	1.232
	Living with M or F	-.106	.136	-.130	-.780	.441	-.385	.172	.826	1.211
4	(Constant)	1.009	.729		1.385	.176	-.477	2.496		
	Gender	-.285	.160	-.290	-1.782	.085	-.612	.041	.859	1.164
	Age cal (Y)	-.026	.019	-.245	-1.377	.178	-.064	.012	.719	1.391
	BMI	.030	.028	.420	1.078	.290	-.027	.088	.150	6.669
	BMI 25cutpoint	-.293	.229	-.613	-1.278	.211	-.760	.174	.099	10.088
	BMI 23cutpoint	.287	.187	.686	1.532	.136	-.095	.669	.114	8.792
	ID level	-.192	.138	-.229	-1.392	.174	-.473	.089	.839	1.191
5	(Constant)	1.635	.442		3.702	.001	.735	2.535		
	Gender	-.273	.160	-.277	-1.704	.098	-.599	.053	.864	1.158
	Age cal (Y)	-.025	.019	-.242	-1.358	.184	-.064	.013	.719	1.391
	BMI 25cutpoint	-.164	.196	-.344	-.838	.409	-.564	.235	.136	7.356
	BMI 23cutpoint	.335	.182	.800	1.834	.076	-.037	.706	.120	8.300
	ID level	-.162	.135	-.193	-1.195	.241	-.437	.114	.876	1.142
6	(Constant)	1.570	.433		3.627	.001	.690	2.451		
	Gender	-.281	.159	-.286	-1.769	.086	-.605	.042	.867	1.153
	Age cal (Y)	-.021	.018	-.203	-1.184	.245	-.058	.015	.774	1.293
	BMI 23cutpoint	.195	.073	.465	2.679	.011	.047	.342	.753	1.328
	ID level	-.166	.135	-.198	-1.234	.226	-.440	.108	.877	1.140
7	(Constant)	1.086	.143		7.615	.000	.796	1.376		
	Gender	-.239	.156	-.243	-1.534	.134	-.556	.078	.913	1.095
	BMI 23cutpoint	.161	.067	.385	2.394	.022	.024	.298	.889	1.124
	ID level	-.158	.135	-.189	-1.171	.250	-.433	.116	.879	1.137
8	(Constant)	.980	.110		8.867	.000	.755	1.204		
	Gender	-.204	.154	-.207	-1.323	.194	-.516	.109	.949	1.053
	BMI 23cutpoint	.141	.065	.337	2.158	.038	.008	.274	.949	1.053
9	(Constant)	.890	.088		10.107	.000	.711	1.068		
	BMI 23cutpoint	.161	.064	.384	2.495	.017	.030	.291	1.000	1.000

a. Dependent Variable: Log_MVPA

Figure SPSS 8 Regression showing predictors on log transformed MVPA (study 4)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	172.158	125.456		1.372	.181	-84.827	429.143		
	Gender	-28.277	35.916	-.195	-.787	.438	-101.847	45.293	.403	2.479
	Age cal (Y)	4.533	3.314	.293	1.368	.182	-2.254	11.321	.539	1.857
	BMI	-1.014	4.901	-.095	-.207	.838	-11.052	9.025	.118	8.509
	BMI 25cutpoint	31.364	36.071	.445	.870	.392	-42.524	105.252	.094	10.606
	BMI 23cutpoint	-10.965	29.726	-.177	-.369	.715	-71.857	49.927	.107	9.387
	Employment	15.484	38.284	.081	.404	.689	-62.937	93.905	.621	1.610
	ID level	-39.608	21.755	-.320	-1.821	.079	-84.170	4.954	.796	1.256
	Most assignment	14.294	42.251	.087	.338	.738	-72.253	100.842	.375	2.665
	Living with M or F	-9.579	20.985	-.079	-.456	.652	-52.565	33.407	.813	1.229
2	(Constant)	151.141	72.338		2.089	.046	3.192	299.090		
	Gender	-28.962	35.167	-.199	-.824	.417	-100.887	42.963	.407	2.458
	Age cal (Y)	4.615	3.235	.298	1.426	.164	-2.002	11.232	.546	1.831
	BMI 25cutpoint	27.556	30.500	.391	.903	.374	-34.824	89.936	.128	7.842
	BMI 23cutpoint	-12.589	28.193	-.204	-.447	.659	-70.250	45.071	.115	8.731
	Employment	12.362	34.597	.064	.357	.723	-58.396	83.121	.736	1.359
	ID level	-40.784	20.649	-.330	-1.975	.058	-83.016	1.447	.854	1.170
	Most assignment	14.210	41.546	.086	.342	.735	-70.761	99.181	.375	2.665
	Living with M or F	-10.562	20.099	-.088	-.525	.603	-51.669	30.546	.857	1.166
3	(Constant)	156.683	69.455		2.256	.032	14.837	298.530		
	Gender	-37.675	23.884	-.259	-1.577	.125	-86.454	11.103	.856	1.168
	Age cal (Y)	5.083	2.888	.328	1.760	.089	-.816	10.981	.665	1.503
	BMI 25cutpoint	28.285	29.975	.401	.944	.353	-32.931	89.502	.128	7.804
	BMI 23cutpoint	-13.522	27.644	-.219	-.489	.628	-69.979	42.936	.116	8.650
	Employment	10.100	33.455	.053	.302	.765	-58.225	78.425	.763	1.310
	ID level	-41.421	20.260	-.335	-2.045	.050	-82.797	-.046	.861	1.161
	Living with M or F	-11.374	19.662	-.094	-.578	.567	-51.531	28.782	.870	1.150
4	(Constant)	152.338	66.944		2.276	.030	15.805	288.871		
	Gender	-37.972	23.512	-.261	-1.615	.116	-85.925	9.980	.857	1.166
	Age cal (Y)	5.269	2.780	.340	1.895	.067	-.401	10.939	.697	1.435
	BMI 25cutpoint	28.331	29.532	.402	.959	.345	-31.900	88.561	.128	7.803
	BMI 23cutpoint	-12.649	27.087	-.205	-.467	.644	-67.893	42.595	.117	8.555
	ID level	-41.423	19.960	-.335	-2.075	.046	-82.132	-.713	.861	1.161
	Living with M or F	-10.580	19.198	-.088	-.551	.586	-49.734	28.574	.886	1.129
5	(Constant)	159.089	64.561		2.464	.019	27.582	290.595		
	Gender	-36.927	23.117	-.254	-1.597	.120	-84.015	10.161	.865	1.156
	Age cal (Y)	4.733	2.501	.306	1.892	.068	-.362	9.828	.840	1.191
	BMI 25cutpoint	15.672	11.578	.222	1.354	.185	-7.910	39.255	.813	1.229
	ID level	-41.797	19.699	-.338	-2.122	.042	-81.923	-1.671	.863	1.159
	Living with M or F	-9.032	18.677	-.075	-.484	.632	-47.076	29.012	.913	1.096
6	(Constant)	149.356	60.628		2.463	.019	26.008	272.704		
	Gender	-36.138	22.790	-.249	-1.586	.122	-82.506	10.229	.870	1.150
	Age cal (Y)	4.593	2.455	.297	1.870	.070	-.403	9.588	.851	1.174
	BMI 25cutpoint	14.514	11.195	.206	1.296	.204	-8.262	37.290	.850	1.177
	ID level	-40.495	19.286	-.328	-2.100	.043	-79.734	-1.257	.879	1.137
7	(Constant)	133.664	59.999		2.228	.033	11.731	255.597		
	Gender	-37.023	23.007	-.255	-1.609	.117	-83.779	9.733	.870	1.149
	Age cal (Y)	5.422	2.394	.350	2.265	.030	.557	10.288	.913	1.095
	ID level	-34.365	18.884	-.278	-1.820	.078	-72.743	4.012	.936	1.069
8	(Constant)	91.515	55.193		1.658	.106	-20.531	203.562		
	Age cal (Y)	6.459	2.358	.417	2.740	.010	1.673	11.246	.985	1.015
	ID level	-27.565	18.819	-.223	-1.465	.152	-65.769	10.639	.985	1.015
9	(Constant)	82.434	55.709		1.480	.148	-30.549	195.417		
	Age cal (Y)	6.034	2.377	.390	2.539	.016	1.214	10.854	1.000	1.000

a. Dependent Variable: Light

Figure SPSS 9 Regression showing predictors on LPA (study 4)

Coefficients[a]

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.	95.0% Confidence Interval for B Lower Bound	Upper Bound	Collinearity Statistics Tolerance	VIF
1	(Constant)	3.796	.481		7.898	.000	2.811	4.780		
	Gender	-.068	.138	-.127	-.495	.624	-.350	.214	.403	2.479
	Age cal (Y)	.000	.013	-.004	-.017	.987	-.026	.026	.539	1.857
	BMI	-.003	.019	-.067	-.141	.889	-.041	.036	.118	8.509
	BMI 25cutpoint	-.008	.138	-.030	-.057	.955	-.291	.275	.094	10.606
	Employment	.039	.147	.055	.264	.794	-.262	.339	.621	1.610
	BMI 23cutpoint	.104	.114	.458	.916	.367	-.129	.338	.107	9.387
	ID level	-.171	.083	-.376	-2.057	.049	-.342	-.001	.796	1.256
	Most assignment	.055	.162	.091	.341	.736	-.276	.387	.375	2.665
	Living with M or F	-.072	.080	-.162	-.896	.378	-.237	.093	.813	1.229
2	(Constant)	3.792	.414		9.163	.000	2.946	4.638		
	Gender	-.069	.132	-.128	-.519	.608	-.339	.202	.422	2.369
	BMI	-.003	.018	-.066	-.143	.888	-.040	.035	.119	8.389
	BMI 25cutpoint	-.007	.133	-.029	-.056	.956	-.280	.265	.098	10.229
	Employment	.038	.138	.054	.275	.785	-.244	.320	.680	1.471
	BMI 23cutpoint	.104	.103	.455	1.009	.321	-.106	.314	.127	7.903
	ID level	-.171	.082	-.376	-2.098	.045	-.339	-.004	.799	1.252
	Most assignment	.054	.144	.089	.375	.711	-.241	.349	.456	2.193
	Living with M or F	-.072	.077	-.163	-.934	.358	-.231	.086	.847	1.181
3	(Constant)	3.804	.343		11.092	.000	3.104	4.505		
	Gender	-.069	.130	-.128	-.528	.601	-.334	.197	.422	2.369
	BMI	-.003	.015	-.080	-.211	.835	-.034	.028	.170	5.883
	Employment	.040	.131	.056	.305	.762	-.227	.307	.728	1.373
	BMI 23cutpoint	.100	.080	.439	1.248	.222	-.064	.264	.200	4.991
	ID level	-.171	.080	-.375	-2.136	.041	-.335	-.008	.804	1.243
	Most assignment	.054	.142	.089	.383	.705	-.235	.344	.456	2.191
	Living with M or F	-.073	.076	-.163	-.954	.348	-.228	.083	.849	1.178
4	(Constant)	3.746	.198		18.873	.000	3.341	4.151		
	Gender	-.071	.127	-.132	-.557	.582	-.331	.189	.425	2.351
	Employment	.032	.123	.045	.259	.798	-.219	.283	.797	1.255
	BMI 23cutpoint	.086	.041	.376	2.100	.044	.002	.169	.751	1.332
	ID level	-.175	.076	-.385	-2.299	.028	-.331	-.020	.859	1.164
	Most assignment	.056	.139	.093	.405	.688	-.228	.340	.459	2.180
	Living with M or F	-.077	.072	-.173	-1.074	.291	-.223	.069	.923	1.083
5	(Constant)	3.748	.195		19.184	.000	3.350	4.146		
	Gender	-.075	.125	-.140	-.602	.552	-.329	.179	.432	2.316
	BMI 23cutpoint	.089	.038	.392	2.382	.023	.013	.166	.861	1.162
	ID level	-.176	.075	-.385	-2.337	.026	-.329	-.023	.859	1.164
	Most assignment	.053	.137	.088	.390	.699	-.225	.332	.462	2.164
	Living with M or F	-.074	.070	-.167	-1.062	.296	-.217	.068	.946	1.057
6	(Constant)	3.806	.125		30.473	.000	3.552	4.061		
	Gender	-.110	.085	-.206	-1.297	.204	-.283	.063	.905	1.105
	BMI 23cutpoint	.090	.037	.394	2.422	.021	.014	.165	.861	1.161
	ID level	-.178	.074	-.391	-2.414	.022	-.329	-.028	.867	1.154
	Living with M or F	-.076	.069	-.172	-1.110	.275	-.216	.064	.951	1.051
7	(Constant)	3.698	.078		47.649	.000	3.540	3.855		
	Gender	-.101	.085	-.189	-1.192	.241	-.274	.071	.913	1.095
	BMI 23cutpoint	.082	.037	.362	2.253	.031	.008	.157	.889	1.124
	ID level	-.169	.074	-.370	-2.290	.028	-.318	-.019	.879	1.137
8	(Constant)	3.643	.063		57.757	.000	3.515	3.771		
	BMI 23cutpoint	.090	.036	.393	2.469	.019	.016	.163	.914	1.094
	ID level	-.151	.073	-.332	-2.084	.044	-.299	-.004	.914	1.094

a. Dependent Variable: Log_steps

Figure SPSS 10 Regression showing predictors on log transformed steps (study 4)

References

Abdulhussein, D., Yap, T. E., Manzar, H., Miodragovic, S., & Cordeiro, F. (2022). Factors impacting participation in research during the COVID-19 pandemic: results from a survey of patients in the ophthalmology outpatient department. *Trials*, *23*(1), 1-9.

Abualghaib, O., Groce, N., Simeu, N., Carew, M. T., & Mont, D. (2019). Making Visible the Invisible: Why Disability-Disaggregated Data is Vital to "Leave No-One Behind". *Sustainability*, *11*(11).

Altman, D. G., & Royston, P. (2006). The cost of dichotomising continuous variables. *Bmj*, *332*(7549), 1080. https://doi.org/10.1136/bmj.332.7549.1080

Annual report of the disabled people in Thailand 2020. (2022). Bangkok, Thailand Retrieved from https://dep.go.th/en/law-academic/knowledge-base/annual-report

APA, A. P. A. (2013). *Diagnostic and statistical manual of mental disorders: DSM-5* (Vol. 10). Washington, DC: American psychiatric association (APA).

Atkin, A. J., Gorely, T., Clemes, S. A., Yates, T., Edwardson, C., Brage, S., . . . Biddle, S. J. (2012). Methods of Measurement in epidemiology: Sedentary Behaviour. *International Journal of Epidemiology*, *41*(5), 1460-1471. https://doi.org/10.1093/ije/dys118

Baker, B. (2019). *ASSESSING THE IMPACT OF ENVIRONMENTAL FACTORS ON SEDENTARY BEHAVIOR* University of Texas]. https://digitalcommons.library.tmc.edu/uthsph_dissertsopen/43

Banks, E., Lim, L., Seubsman, S.-A., Bain, C., & Sleigh, A. (2011). Relationship of obesity to physical activity, domestic activities, and sedentary behaviours: cross-sectional findings from a national cohort of over 70,000 Thai adults. *BMC Public Health*, *11*(1), 762. https://doi.org/10.1186/1471-2458-11-762

Benton, M. L., Abraham, A., LaBella, A. L., Abbot, P., Rokas, A., & Capra, J. A. (2021). The influence of evolutionary history on human health and disease. *Nature Reviews Genetics*, *22*(5), 269-283. https://doi.org/10.1038/s41576-020-00305-9

Bergström, H., Hagströmer, M., Hagberg, J., & Elinder, L. S. (2013). A multi-component universal intervention to improve diet and physical activity among adults with intellectual disabilities in community residences: a cluster randomised controlled trial. *Res Dev Disabil*, *34*(11), 3847-3857. https://doi.org/10.1016/j.ridd.2013.07.019

Bhasavanich, P. (1993). *The effects of different child rearing practices and types of curriculum approaches upon the creative thinking of kindergarten students in Thailand* University of Massachusetts Amherst].

Biddle, S. (2011). Fit or sit? Is there a psychology of sedentary behaviour? *Sport & Exercise Psychology Review*, *7*, 5-10.

Billingham, S. A., Whitehead, A. L., & Julious, S. A. (2013). An audit of sample sizes for pilot and feasibility trials being undertaken in the United Kingdom registered in the United Kingdom Clinical Research Network database. *BMC Med Res Methodol*, *13*, 104. https://doi.org/10.1186/1471-2288-13-104

Binthaisong, S., Kamphaengphet, D., In-tha-ka, N., & Deemark, C. h. (2013). *Executive Summary: 20-year Development Plan for Bangkok Metropolis*. Retrieved from https://webportal.bangkok.go.th/public/user_files_editor/130/BMA-developmentplan/P20ys(2556-2575)sumEN.pdf

Biswas, A., Oh, P. I., Faulkner, G. E., Bajaj, R. R., Silver, M. A., Mitchell, M. S., & Alter, D. A. (2015). Sedentary time and its association with risk for disease incidence, mortality, and hospitalization in adults: a systematic review and meta-analysis. *Ann Intern Med*, *162*(2), 123-132. https://doi.org/10.7326/m14-1651

Boat, T. F., Wu, J. T., & National Academies of Sciences, E. a. M. (2015). Clinical characteristics of intellectual disabilities. In *Mental disorders and disabilities among low-income children*. National Academies Press (US).

Bodde, A. E., & Seo, D. C. (2009). A review of social and environmental barriers to physical activity for adults with intellectual disabilities. *Disabil Health J*, *2*(2), 57-66. https://doi.org/10.1016/j.dhjo.2008.11.004

Bondár, R. Z., di Fronso, S., Bortoli, L., Robazza, C., Metsios, G. S., & Bertollo, M. (2020). The effects of physical activity or sport-based interventions on psychological factors in adults with intellectual disabilities: a systematic review. *J Intellect Disabil Res*, *64*(2), 69-92. https://doi.org/10.1111/jir.12699

Bossink, L. W. M., van der Putten, A. A., & Vlaskamp, C. (2017). Understanding low levels of physical activity in people with intellectual disabilities: A systematic review to identify barriers and facilitators. *Res Dev Disabil*, *68*, 95-110. https://doi.org/10.1016/j.ridd.2017.06.008

Bualar, T. (2014). Barriers to employment: voices of physically disabled rural women in Thailand. *Community, Work & Family*, *17*(2), 181-199. https://doi.org/10.1080/13668803.2013.806125

Bull, F. C., Al-Ansari, S. S., Biddle, S., Borodulin, K., Buman, M. P., Cardon, G., . . . Willumsen, J. F. (2020). World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *Br J Sports Med*, *54*(24), 1451-1462. https://doi.org/10.1136/bjsports-2020-102955

Burack, J. A., Evans, D. W., Russo, N., Napoleon, J.-S., Goldman, K. J., & Iarocci, G. (2021). Developmental Perspectives on the Study of Persons with Intellectual Disability. *Annual Review of Clinical Psychology*, *17*(1), 339-363. https://doi.org/10.1146/annurev-clinpsy-081219-090532

Bursac, Z., Gauss, C. H., Williams, D. K., & Hosmer, D. W. (2008). Purposeful selection of variables in logistic regression. *Source Code for Biology and Medicine*, *3*(1), 17. https://doi.org/10.1186/1751-0473-3-17

Byrom, B., Stratton, G., Mc Carthy, M., & Muehlhausen, W. (2016). Objective measurement of sedentary behaviour using accelerometers. *Int J Obes (Lond)*, *40*(11), 1809-1812. https://doi.org/ijo2016136 [pii]

10.1038/ijo.2016.136 [doi]

Care, U. D. o. H. a. S. (2019). *UK Chief Medical Officers' Physical Activity Guidelines*. London

Carty, C., van der Ploeg, H. P., Biddle, S. J. H., Bull, F., Willumsen, J., Lee, L., . . . Milton, K. (2021). The First Global Physical Activity and Sedentary Behavior Guidelines for People Living With Disability. *Journal of Physical Activity and Health*, *18*(1), 86-93. https://doi.org/10.1123/jpah.2020-0629

Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public health reports (Washington, D.C. : 1974)*, *100*(2), 126-131.

Chaiwanichsiri, D., Sanguanrungsirikul, S., & Suwannakul, W. (2000). Poor physical fitness of adolescents with mental retardation at Rajanukul School, Bangkok. *J Med Assoc Thai*, *83*(11), 1387-1392.

Chalwanichsiri D, Sa-nguanrungsirikul S, & W., S. (2000). Cardiovascular risk of students with mental retardation at Rajanukul School, Bangkok. *Chula Med J*, *Sep; 44(9)*, 669 - 677.

Chan, A. S. Y. (2014). Psychosocial and physical activity behaviour among adults with intellectual disabilities in Hong Kong. *Advances in Mental Health and Intellectual Disabilities*, *8*(2), 138-146. https://doi.org/10.1108/AMHID-11-2012-0006

Chang, C.-K., Chen, C.-Y., Broadbent, M., Stewart, R., & O'Hara, J. (2017). Hospital admissions for respiratory system diseases in adults with intellectual disabilities in Southeast London: a register-based cohort study. *BMJ open*, *7*(3), e014846.

Chastin, S. F. M., Buck, C., Freiberger, E., Murphy, M., Brug, J., Cardon, G., . . . on behalf of the, D. c. (2015). Systematic literature review of determinants of sedentary behaviour in older adults: a DEDIPAC study. *The International Journal of Behavioral Nutrition and Physical Activity*, *12*, 127. https://doi.org/10.1186/s12966-015-0292-3

Chau, J. Y., Grunseit, A., Midthjell, K., Holmen, J., Holmen, T. L., Bauman, A. E., & Van der Ploeg, H. P. (2015). Sedentary behaviour and risk of mortality from all-causes and cardiometabolic diseases in adults: evidence from the HUNT3 population cohort. *British Journal of Sports Medicine*, *49*(11), 737-742. https://doi.org/10.1136/bjsports-2012-091974

Chau, J. Y., Grunseit, A. C., Chey, T., Stamatakis, E., Brown, W. J., Matthews, C. E., . . . van der Ploeg, H. P. (2013). Daily sitting time and all-cause mortality: a meta-analysis. *PLoS One*, *8*(11), e80000. https://doi.org/10.1371/journal.pone.0080000

Cheausuwantavee, T., & Keeratiphanthawong, S. (2021). Employment for Persons with Disabilities in Thailand: Opportunities and Challenges in the Labor Market. *Journal of Population and Social Studies*, *29*, 384-400. https://doi.org/http://doi.org/10.25133/JPSSv292021.024

Chomyounk, J. (1995). *A study of physical fitness of mentally retarded students in Bangkok Metropolis* Chulalongkorn University.]. Bangkok.

ChooChuay, C., Pongpiachan, S., Tipmanee, D., Suttinun, O., Deelaman, W., Wang, Q., . . . Cao, J. (2020). Impacts of PM2.5 sources on variations in particulate chemical compounds in ambient air of Bangkok, Thailand. *Atmospheric Pollution Research*, *11*(9), 1657-1667. https://doi.org/https://doi.org/10.1016/j.apr.2020.06.030

Chow, B. C., Choi, P. H. N., & Huang, W. Y. J. (2018). Physical Activity and Physical Fitness of Adults with Intellectual Disabilities in Group Homes in Hong Kong. *Int J Environ Res Public Health*, *15*(7). https://doi.org/10.3390/ijerph15071370

Chulanont, S. (2007). *Empowerment of Persons with Disabilities Act, B.E. 2550 (2007)*. Retrieved from http://law.m-society.go.th/law2016/uploads/lawfile/593114244ee36.pdf

Cleland, C., Reis, R. S., Ferreira Hino, A. A., Hunter, R., Fermino, R. C., Koller de Paiva, H., . . . Ellis, G. (2019). Built environment correlates of physical activity and sedentary behaviour in older adults: A comparative review between high and low-middle income countries. *Health Place*, *57*, 277-304.

Clemes, S., Edwardson, C., Connelly, J., Konstantinidis, T., Koivula, R., Yates, T., . . . Biddle, S. (2012). Validity of the ActiGraph GT3X + inclinometer and different counts per minute cut-points for the assessment of sedentary behaviour. *Journal of Science and Medicine in Sport*, *15*, S68. https://doi.org/10.1016/j.jsams.2012.11.164

Collins, P., & Bilge, S. (2016). What is Intersectionality? Using intersectionality as an analytic tool. *Intersectionality*, 1-21.

Consultation, W. E. (2004). Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet*, *363*(9403), 157-163. https://doi.org/10.1016/s0140-6736(03)15268-3

Dairo, Y. M., Collett, J., Dawes, H., & Oskrochi, G. R. (2016). Physical activity levels in adults with intellectual disabilities: A systematic review. *Prev Med Rep*, *4*, 209-219. https://doi.org/10.1016/j.pmedr.2016.06.008

Das-Munshi, J., Chang, C. K., Bakolis, I., Broadbent, M., Dregan, A., Hotopf, M., . . . Stewart, R. (2021). All-cause and cause-specific mortality in people with mental disorders and intellectual disabilities, before and during the COVID-19 pandemic: cohort study. *Lancet Reg Health Eur*, *11*, 100228. https://doi.org/10.1016/j.lanepe.2021.100228

Dean, E. E., Shogren, K. A., Hagiwara, M., & Wehmeyer, M. L. (2018). How does employment influence health outcomes? A systematic review of the intellectual disability literature. *Journal of Vocational Rehabilitation*, *49*, 1-13. https://doi.org/10.3233/JVR-180950

Dhakal, S., & Shrestha, A. (2016). Bangkok, Thailand. In (pp. 63-80).

Diaz, K. M., Howard, V. J., Hutto, B., Colabianchi, N., Vena, J. E., Safford, M. M., . . . Hooker, S. P. (2017). Patterns of Sedentary Behavior and Mortality in U.S. Middle-Aged and Older Adults: A National Cohort Study. *Ann Intern Med*, *167*(7), 465-475. https://doi.org/10.7326/m17-0212

Ding, D., Lawson, K. D., Kolbe-Alexander, T. L., Finkelstein, E. A., Katzmarzyk, P. T., van Mechelen, W., & Pratt, M. (2016). The economic burden of physical inactivity: a global analysis of major non-communicable diseases. *Lancet*, *388*(10051), 1311-1324. https://doi.org/10.1016/s0140-6736(16)30383-x

Dunstan, D. W., Barr, E. L., Healy, G. N., Salmon, J., Shaw, J. E., Balkau, B., . . . Owen, N. (2010). Television viewing time and mortality: the Australian Diabetes, Obesity and Lifestyle Study (AusDiab). *Circulation*, *121*(3), 384-391. https://doi.org/10.1161/circulationaha.109.894824

Eaton, S. B. (2003). An evolutionary perspective on human physical activity: implications for health. *Comp Biochem Physiol A Mol Integr Physiol*, *136*(1), 153-159. https://doi.org/10.1016/s1095-6433(03)00208-3

Edwardson, C. L., Winkler, E. A. H., Bodicoat, D. H., Yates, T., Davies, M. J., Dunstan, D. W., & Healy, G. N. (2017). Considerations when using the activPAL monitor in field-based research with adult populations. *Journal of Sport and Health Science*, *6*(2), 162-178. https://doi.org/https://doi.org/10.1016/j.jshs.2016.02.002

Ellenkamp, J. J., Brouwers, E. P., Embregts, P. J., Joosen, M. C., & van Weeghel, J. (2016). Work Environment-Related Factors in Obtaining and Maintaining Work in a Competitive Employment Setting for Employees with Intellectual Disabilities: A Systematic Review. *J Occup Rehabil*, *26*(1), 56-69. https://doi.org/10.1007/s10926-015-9586-1

Emerson, E. (2005). Underweight, obesity and exercise among adults with intellectual disabilities in supported accommodation in Northern England [https://doi.org/10.1111/j.1365-2788.2004.00617.x]. *Journal of Intellectual Disability Research*, *49*(2), 134-143. https://doi.org/https://doi.org/10.1111/j.1365-2788.2004.00617.x

Emerson, E. (2011). Health status and health risks of the "hidden majority" of adults with intellectual disability. *Intellect Dev Disabil*, *49*(3), 155-165. https://doi.org/10.1352/1934-9556-49.3.155

Emerson, E., Blacher, J., Einfeld, S., Hatton, C., Robertson, J., & Stancliffe, R. J. (2014). Environmental risk factors associated with the persistence of conduct difficulties in children with intellectual disabilities and autistic spectrum disorders. *Res Dev Disabil*, *35*(12), 3508-3517. https://doi.org/10.1016/j.ridd.2014.08.039

Emerson, E., & Hatton, C. (2014). *Health inequalities and people with intellectual disabilities*. Cambridge University Press.

Emerson, E., Hatton, C., Baines, S., & Robertson, J. (2016). The physical health of British adults with intellectual disability: cross sectional study. *Int J Equity Health*, *15*, 11. https://doi.org/10.1186/s12939-016-0296-x [doi]

Emerson, E., Hatton, C., Robertson, J., & Baines, S. (2014). Perceptions of neighbourhood quality, social and civic participation and the self rated health of British adults with intellectual disability: cross sectional study. *BMC public health*, *14*, 1252-1252. https://doi.org/10.1186/1471-2458-14-1252

Emerson, E., & Heslop, P. (2010). A working definition of Learning Disabilities.

Empowerment of Persons with Disabilities Act, B.E. 2550 (2007). (2007). Retrieved from http://law.m-society.go.th/law2016/uploads/lawfile/593114244ee36.pdf

Esliger, D. W., & Tremblay, M. S. (2007). Physical activity and inactivity profiling: the next generation. *Can J Public Health*, *98 Suppl 2*, S195-207.

Feito, Y. (2010). *A Comparison of Commonly Used Accelerometer Based Activity Monitors in Controlled and Free-Living Environment* University of Tennessee]. https://trace.tennessee.edu/utk_graddiss/881

Finlayson, J., Turner, A., & Granat, M. H. (2011). Measuring the Actual Levels and Patterns of Physical Activity/Inactivity of Adults with Intellectual Disabilities. *Journal of Applied Research in Intellectual Disabilities*, *24*(6), 508-517. https://doi.org/doi:10.1111/j.1468-3148.2011.00633.x

Frey, G. C., Buchanan, A. M., & Rosser Sandt, D. D. (2005). “I'd Rather Watch TV”: An Examination of Physical Activity in Adults With Mental Retardation. *Mental Retardation*, *43*(4), 241-254. https://doi.org/10.1352/0047-6765(2005)43[241:IRWTAE]2.0.CO;2

Ghosh, S., Choi, P., Brown, S. P., Motl, R. W., & Agiovlasitis, S. (2021). Levels and patterns of sedentary behavior in men and women with intellectual disability. *Disabil Health J*, *14*(3), 101059. https://doi.org/10.1016/j.dhjo.2020.101059

Guthold, R., Stevens, G. A., Riley, L. M., & Bull, F. C. (2018). *The Lancet Global Health*, *6*(10), e1077-e1086. https://doi.org/10.1016/S2214-109X(18)30357-7

Hamburg, N. M., McMackin, C. J., Huang, A. L., Shenouda, S. M., Widlansky, M. E., Schulz, E., . . . Vita, J. A. (2007). Physical inactivity rapidly induces insulin resistance and microvascular dysfunction in healthy volunteers. *Arterioscler Thromb Vasc Biol*, *27*(12), 2650-2656. https://doi.org/10.1161/atvbaha.107.153288

Hao, Y., & Razman, R. (2022). The association of socioeconomic status with sedentary behaviour and moderate-to-vigorous intensity physical activity among children with intellectual disability. *International Journal of Developmental Disabilities*, 1-12. https://doi.org/10.1080/20473869.2022.2133445

Harris, L., McGarty, A. M., Hilgenkamp, T., Mitchell, F., & Melville, C. A. (2018). Correlates of objectively measured sedentary time in adults with intellectual disabilities. *Prev Med Rep*, *9*, 12-17. https://doi.org/10.1016/j.pmedr.2017.11.010

Harris, L., McGarty, A. M., Hilgenkamp, T., Mitchell, F., & Melville, C. A. (2019). Patterns of objectively measured sedentary behaviour in adults with intellectual disabilities. *J Appl Res Intellect Disabil*, *32*(6), 1428-1436. https://doi.org/10.1111/jar.12633

Hassiotis, A. (2020). The Intersectionality of Ethnicity/race and Intellectual and Developmental Disabilities: Impact on Health Profiles, Service Access and Mortality. *Journal of Mental Health Research in Intellectual Disabilities*, *13*(3), 171-173. https://doi.org/10.1080/19315864.2020.1790702

Hatton, C., Emerson, E., Robertson, J., & Baines, S. (2017). The Mental Health of British Adults with Intellectual Impairments Living in General Households. *Journal of Applied Research in Intellectual Disabilities*, *30*(1), 188-197. https://doi.org/10.1111/jar.12232

Healy, G. N., Clark, B. K., Winkler, E. A., Gardiner, P. A., Brown, W. J., & Matthews, C. E. (2011). Measurement of adults' sedentary time in population-based studies. *Am J Prev Med*, *41*(2), 216-227. https://doi.org/10.1016/j.amepre.2011.05.005

Healy, G. N., Dunstan, D. W., Salmon, J., Cerin, E., Shaw, J. E., Zimmet, P. Z., & Owen, N. (2008). Breaks in sedentary time: beneficial associations with metabolic risk. *Diabetes Care*, *31*(4), 661-666. https://doi.org/10.2337/dc07-2046

Healy, G. N., Matthews, C. E., Dunstan, D. W., Winkler, E. A., & Owen, N. (2011). Sedentary time and cardio-metabolic biomarkers in US adults: NHANES 2003-06. *Eur Heart J*, *32*(5), 590-597. https://doi.org/10.1093/eurheartj/ehq451

Helsel, B. C., Ptomey, L. T., Washburn, R. A., Sherman, J., Rice, A., Foster, R., & Donnelly, J. E. (2022). 253 Physical activity patterns in adolescents and young adults with intellectual and developmental disabilities. *Journal of Clinical and Translational Science*, *6*(s1), 41-41. https://doi.org/10.1017/cts.2022.136

Heslop, P., Blair, P. S., Fleming, P., Hoghton, M., Marriott, A., & Russ, L. (2014). The Confidential Inquiry into premature deaths of people with intellectual disabilities in the UK: a population-based study. *The Lancet*, *383*(9920), 889-895. https://doi.org/10.1016/S0140-6736(13)62026-7

Hirose, N., Morita, K., Jo, T., Hagiwara, Y., Matsui, H., Fushimi, K., & Yasunaga, H. (2022). Differences in disease severity and in-hospital mortality in patients hospitalised for pneumonia with and without intellectual disabilities: A matched-pair retrospective cohort study using nationwide in-patient database. *Journal of Intellectual & Developmental Disability*, *47*(1), 65-73. https://doi.org/10.3109/13668250.2021.1877644

Hongchayangkool, K., Sutheravut, P., & Kaewtong, Y. (2018). *Guideline to increase physical activity in Thais*. Institute of Health Systems Management, Prince of Songkla University.

Hosking, F. J., Carey, I. M., Shah, S. M., Harris, T., DeWilde, S., Beighton, C., & Cook, D. G. (2016). Mortality among adults with intellectual disability in England: comparisons with the general population. *American Journal of Public Health*, *106*(8), 1483-1490.

Hosmer, D. W., Lemeshow, S., & Sturdivant, R. X. (2013). *Applied Logistic Regression*. Wiley.

Howie, E. K., Barnes, T. L., McDermott, S., Mann, J. R., Clarkson, J., & Meriwether, R. A. (2012). Availability of physical activity resources in the environment for adults with intellectual disabilities. *Disabil Health J*, *5*(1), 41-48. https://doi.org/10.1016/j.dhjo.2011.09.004

Hsieh, K., Hilgenkamp, T. I. M., Murthy, S., Heller, T., & Rimmer, J. H. (2017). Low Levels of Physical Activity and Sedentary Behavior in Adults with Intellectual Disabilities. *Int J Environ Res Public Health*, *14*(12). https://doi.org/10.3390/ijerph14121503

Hsieh, K., Rimmer, J. H., & Heller, T. (2014). Obesity and associated factors in adults with intellectual disability. *Journal of Intellectual Disability Research*, *58*(9), 851-863. https://doi.org/doi:10.1111/jir.12100

Hsu, P.-J., Chou, H.-S., Pan, Y.-H., Ju, Y.-Y., Tsai, C.-L., & Pan, C.-Y. (2021). Sedentary Time, Physical Activity Levels and Physical Fitness in Adults with Intellectual Disabilities. *International Journal of Environmental Research and Public Health*, *18*(9). https://doi.org/10.3390/ijerph18095033

Hughes, D., & Leethongdee, S. (2007). Universal Coverage In The Land Of Smiles: Lessons From Thailand's 30 Baht Health Reforms. *Health Affairs*, *26*(4), 999-1008. https://doi.org/10.1377/hlthaff.26.4.999

Hughes-McCormack, L. A., Rydzewska, E., Henderson, A., MacIntyre, C., Rintoul, J., & Cooper, S. A. (2018). Prevalence and general health status of people with intellectual disabilities in Scotland: a total population study. *J Epidemiol Community Health*, *72*(1), 78-85. https://doi.org/10.1136/jech-2017-209748

Iwanaga, K., Wu, J. R., Chan, F., Rumrill, P., Wehman, P., Brooke, V. A., . . . Taylor, J. (2021). A systematic review of systematic reviews of secondary health conditions, health promotion, and employment of people with intellectual disabilities. *The Australian Journal of Rehabilitation Counselling*, 1-28. https://doi.org/10.1017/jrc.2021.2

Jacinto, M., Vitorino, A. S., Palmeira, D., Antunes, R., Matos, R., Ferreira, J. P., & Bento, T. (2021). Perceived Barriers of Physical Activity Participation in Individuals with Intellectual Disability-A Systematic Review. *Healthcare (Basel)*, *9*(11). https://doi.org/10.3390/healthcare9111521

Jahoda, A., Kemp, J., Riddell, S., & Banks, P. (2008). Feelings About Work: A Review of the Socio-emotional Impact of Supported Employment on People with Intellectual Disabilities. *Journal of Applied Research in Intellectual Disabilities*, *21*(1), 1-18. https://doi.org/https://doi.org/10.1111/j.1468-3148.2007.00365.x

Jarutwanitpong, J. (2016). *Effects of Once-A-Week Group Exercise Program on Physical Performance in O verweight Persons with Mild Intellectual Disabilities*.

Jeerapong, S. (2011). *The Effects of Exercises by using Basic Movement Activities on Balance Ability of Autistic Children.* Chulalongkorn University.]. Bangkok.

Jones, E. M., & Schoon, I. (2008). Child cognition and behaviour. In K. Hansen & H. Joshi (Eds.), *Millennium Cohort Study Third Survey: A user's guide to initial findings*. Centre for Longitudinal Studies, Institute of Education, University of London.

Jongjira, T. (2022). *Report on Thai population*. Retrieved from https://stat.bora.dopa.go.th/stat/pk/pk_64.pdf

Jongudomsuk, P., Srithamrongsawat, S., Patcharanarumol, W., Limwattananon, S., Pannarunothai, S., Vapatanavong, P., . . . Fahamnuaypol, P. (2015). The Kingdom of Thailand Health System Review. *Health Systems in Transition*, *5*.

Kim, Y., Welk, G. J., Braun, S. I., & Kang, M. (2015). Extracting objective estimates of sedentary behavior from accelerometer data: measurement considerations for surveillance and research applications. *PLoS One*, *10*(2), e0118078. https://doi.org/10.1371/journal.pone.0118078

Kim, Y.-S., Kim, J.-H., Kwon, S., & Ho, S. (2022). Mortality rate and cause among people with intellectual disabilities in South Korea: A nationwide representative cross-sectional study from 2015 to 2019. *PLOS Global Public Health*, *2*(7), e0000744. https://doi.org/10.1371/journal.pgph.0000744

Kohl, H. W., Craig, C. L., Lambert, E. V., Inoue, S., Alkandari, J. R., Leetongin, G., & Kahlmeier, S. (2012). The pandemic of physical inactivity: global action for public health. *The Lancet*, *380*(9838), 294-305. https://doi.org/https://doi.org/10.1016/S0140-6736(12)60898-8

Konharn, K. (2012). *Accelerometer-Based Physical Activity Levels and Sedentary Behavior under Free-Living Conditions in Thai Adolescents* University of Porto].

Kraithaworn, P., Sirapo-ngam, Y., Piaseu, N., Nityasuddhi, D., & Gretebeck, K. A. (2011). Factors predicting physical activity among older Thais living in low socioeconomic urban communities. *Pacific Rim International Journal of Nursing Research*.

Kroll, T., & Mannan, H. (2022). 202Capability Approach to Aid Systems-Thinking in Addressing Right to Health of Persons with Disabilities. In F. Vallières, H. Mannan, N. Kodate, & F. Larkan (Eds.), *Systems Thinking for Global Health: How can systems-thinking contribute to solving key challenges in Global Health?* (pp. 0). Oxford University Press. https://doi.org/10.1093/oso/9780198799498.003.0016

Kulsrisombat, N. (2015). *GoodWalk: Report on the project first stage*.

Langøien, L. J., Terragni, L., Rugseth, G., Nicolaou, M., Holdsworth, M., Stronks, K., . . . on behalf of the, D. c. (2017). Systematic mapping review of the factors influencing physical activity and sedentary behaviour in ethnic minority groups in Europe: a DEDIPAC study. *International Journal of Behavioral Nutrition and Physical Activity*, *14*(1), 99. https://doi.org/10.1186/s12966-017-0554-3

Laohapakdee, R. (2012). *The effects of mai plong exercise program on motor ability and social skills of the child with autistic spectrum disorder* Chulalongkorn University]. Bangkok.

Lee, I. M., Shiroma, E. J., Lobelo, F., Puska, P., Blair, S. N., & Katzmarzyk, P. T. (2012). Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. *Lancet*, *380*(9838), 219-229. https://doi.org/10.1016/s0140-6736(12)61031-9

Lefevre, A. S. (2018). Bangkok air pollution warning, children asked to stay indoors. *Reuters*. https://www.reuters.com/article/us-thailand-weather-idUSKBN1FS0ZF

Leitzmann, M. F., Jochem, C., & Schmid, D. (2018). *Sedentary Behaviour Epidemiology*. Springer International Publishing.

Lennox, N., Taylor, M., Rey-Conde, T., Bain, C., Purdie, D. M., & Boyle, F. (2005). Beating the barriers: recruitment of people with intellectual disability to participate in research. *Journal of Intellectual Disability Research*, *49*(4), 296-305. https://doi.org/https://doi.org/10.1111/j.1365-2788.2005.00618.x

Leung, W., Siebert, E. A., & Yun, J. (2017). Measuring physical activity with accelerometers for individuals with intellectual disability: A systematic review. *Research in Developmental Disabilities*, *67*, 60-70. https://doi.org/https://doi.org/10.1016/j.ridd.2017.06.001

Liangruenrom, N. (2020). *Trends and Correlates of Physical Activity and Sedentary Behaviour in the Thai Population* Victoria University].

Liangruenrom, N., Craike, M., Biddle, S. J. H., Suttikasem, K., & Pedisic, Z. (2019). Correlates of physical activity and sedentary behaviour in the Thai population: a systematic review [journal article]. *BMC Public Health*, *19*(1), 414. https://doi.org/10.1186/s12889-019-6708-2

Liangruenrom, N., Suttikasem, K., Craike, M., Bennie, J. A., Biddle, S. J. H., & Pedisic, Z. (2018). Physical activity and sedentary behaviour research in Thailand: a systematic scoping review. *BMC Public Health*, *18*(1), 733. https://doi.org/10.1186/s12889-018-5643-y

Liangruenrom, N., Topothai, T., Topothai, C., Suriyawongpaisan, W., Limwattananon, S., Limwattananon, C., . . . Tangcharoensathien, V. (2017). Do Thai People Meet Recommended Physical Activity Level?: The 2015 National Health and Welfare Survey. *Journal of Health Systems Research*, *11*, 1-16.

Livingston, G., Sommerlad, A., Orgeta, V., Costafreda, S. G., Huntley, J., Ames, D., . . . Mukadam, N. (2017). Dementia prevention, intervention, and care. *Lancet*, *390*(10113), 2673-2734. https://doi.org/10.1016/s0140-6736(17)31363-6

Lundberg, P. C. (2000). Cultural Care of Thai Immigrants in Uppsala: A Study of Transcultural Nursing in Sweden. *Journal of Transcultural Nursing*, *11*(4), 274-280. https://doi.org/10.1177/104365960001100405

Lynch, L., McCarron, M., Eustace-Cook, J., Burke, É., & McCallion, P. (2022). Physical health effects of sedentary behaviour on adults with an intellectual disability: A scoping review. *J Intellect Disabil*, 17446295221107281. https://doi.org/10.1177/17446295221107281

Lynch, L. a. M., M and McCallion, P and Burke, E. (2021). Sedentary behaviour levels in adults with an intellectual disability: a systematic review and meta-analysis [version 2; peer review: 1 approved]. *HRB Open Research*, *4*(69). https://doi.org/10.12688/hrbopenres.13326.2

Martin Ginis, K. A., van der Ploeg, H. P., Foster, C., Lai, B., McBride, C. B., Ng, K., . . . Heath, G. W. (2021). Participation of people living with disabilities in physical activity: a global perspective. *Lancet*, *398*(10298), 443-455. https://doi.org/10.1016/s0140-6736(21)01164-8

Matthews, L., Hankey, C., Penpraze, V., Boyle, S., Macmillan, S., Miller, S., . . . Melville, C. A. (2011). Agreement of accelerometer and a physical activity questionnaire in adults with intellectual disabilities. *Prev Med*, *52*(5), 361-364. https://doi.org/10.1016/j.ypmed.2011.02.001

Matthews, L., Mitchell, F., Stalker, K., McConnachie, A., Murray, H., Melling, C., . . . Melville, C. (2016). Process evaluation of the Walk Well study: a cluster-randomised controlled trial of a community based walking programme for adults with intellectual disabilities. *BMC Public Health*, *16*(1), 527. https://doi.org/10.1186/s12889-016-3179-6

McCartney, G., Popham, F., McMaster, R., & Cumbers, A. (2019). Defining health and health inequalities. *Public Health*, *172*, 22-30. https://doi.org/10.1016/j.puhe.2019.03.023

McFall, S. (2013). Understanding Society: Cognitive Ability Measures. *Colchester, UK: ISER, University of Essex*.

McKeon, M., Slevin, E., & Taggart, L. (2013). A pilot survey of physical activity in men with an intellectual disability. *J Intellect Disabil*, *17*(2), 157-167. https://doi.org/10.1177/1744629513484666

McTiernan, A., Friedenreich, C. M., Katzmarzyk, P. T., Powell, K. E., Macko, R., Buchner, D., . . . Piercy, K. L. (2019). Physical Activity in Cancer Prevention and Survival: A Systematic Review. *Med Sci Sports Exerc*, *51*(6), 1252-1261. https://doi.org/10.1249/mss.0000000000001937

Melville, C. A., McGarty, A., Harris, L., Hughes-McCormack, L., Baltzer, M., McArthur, L. A., . . . Cooper, S. A. (2018). A population-based, cross-sectional study of the prevalence and correlates of sedentary behaviour of adults with intellectual disabilities. *J Intellect Disabil Res*, *62*(1), 60-71. https://doi.org/10.1111/jir.12454

Melville, C. A., Mitchell, F., Stalker, K., Matthews, L., McConnachie, A., Murray, H. M., . . . Mutrie, N. (2015). Effectiveness of a walking programme to support adults with intellectual disabilities to increase physical activity: walk well cluster-randomised controlled trial. *International Journal of Behavioral Nutrition and Physical Activity*, *12*(1), 125. https://doi.org/10.1186/s12966-015-0290-5

Melville, C. A., Oppewal, A., Schafer Elinder, L., Freiberger, E., Guerra-Balic, M., Hilgenkamp, T. I. M., . . . Gine-Garriga, M. (2017). Definitions, measurement and prevalence of sedentary behaviour in adults with intellectual disabilities - A systematic review. *Prev Med*, *97*, 62-71. https://doi.org/10.1016/j.ypmed.2016.12.052

Melville, C. A., Oppewal, A., Schäfer Elinder, L., Freiberger, E., Guerra-Balic, M., Hilgenkamp, T. I. M., . . . Giné-Garriga, M. (2017). Definitions, measurement and prevalence of sedentary behaviour in adults with intellectual disabilities - A systematic review. *Prev Med*, *97*, 62-71. https://doi.org/10.1016/j.ypmed.2016.12.052

Mikulovic, J., Vanhelst, J., Salleron, J., Marcellini, A., Compte, R., Fardy, P. S., & Bui-Xuan, G. (2014). Overweight in intellectually-disabled population: physical, behavioral and psychological characteristics. *Res Dev Disabil*, *35*(1), 153-161. https://doi.org/10.1016/j.ridd.2013.10.012

Mirza, M., Siebert, S., Pratt, A., Insch, E., McIntosh, F., Paton, J., . . . McInnes, I. B. (2022). Impact of the COVID-19 pandemic on recruitment to clinical research studies in rheumatology. *Musculoskeletal Care*, *20*(1), 209.

Mitchell, E. J., Ahmed, K., Breeman, S., Cotton, S., Constable, L., Ferry, G., . . . McDonald, A. (2020). It is unprecedented: trial management during the COVID-19 pandemic and beyond. *Trials*, *21*(1), 784. https://doi.org/10.1186/s13063-020-04711-6

Mitchell, F., Stalker, K., Matthews, L., Mutrie, N., Melling, C., McConnachie, A., . . . Melville, C. A. (2018). A qualitative exploration of participants' experiences of taking part in a walking programme: Perceived benefits, barriers, choices and use of intervention resources [https://doi.org/10.1111/jar.12326]. *Journal of Applied Research in Intellectual Disabilities*, *31*(S1), 110-121. https://doi.org/https://doi.org/10.1111/jar.12326

Morrison, J. D., Chunsuwan, I. D., Bunnag, P. D., Gronholm, P. C. D., & Lockwood Estrin, G. D. (2018). Thailand's national universal developmental screening programme for young children: action research for improved follow-up. *BMJ Glob Health*, *3*(1), e000589. https://doi.org/10.1136/bmjgh-2017-000589

Moss, S. J., & Czyz, S. H. (2018). Level of agreement between physical activity levels measured by ActiHeart and the International Physical Activity Questionnaire in persons with intellectual disability. *Disabil Rehabil*, *40*(3), 360-366. https://doi.org/10.1080/09638288.2016.1258092

Müller, A. M., Chen, B., Wang, N. X., Whitton, C., Direito, A., Petrunoff, N., & Müller-Riemenschneider, F. (2020). Correlates of sedentary behaviour in Asian adults: A systematic review. *Obesity Reviews*, *21*(4), e12976. https://doi.org/10.1111/obr.12976

NCCIH, N. C. f. C. a. I. H. (2017). *Pilot Studies: Common Uses and Misuses*. https://www.nccih.nih.gov/grants/pilot-studies-common-uses-and-misuses

NHS. (2019). Learning disability Mortality Review (LeDeR) programme: action from learning. *NHS England*.

NHS. (2021). Learning Disability Mortality Review (LeDeR) Programme: Annual report 2020.

NICE, N. I. f. H. a. C. E. (2012). *Physical activity: walking and cycling*. National Institute for Health and Care Excellence (NICE).

Nicholson, L., Colyer, M., & Cooper, S.-A. (2013). Recruitment to intellectual disability research: a qualitative study. *Journal of Intellectual Disability Research*, *57*(7), 647-656. https://doi.org/https://doi.org/10.1111/j.1365-2788.2012.01573.x

Nordstrøm, M., Hansen, B. H., Paus, B., & Kolset, S. O. (2013). Accelerometer-determined physical activity and walking capacity in persons with Down syndrome, Williams syndrome and Prader–Willi syndrome. *Research in Developmental Disabilities*, *34*(12), 4395-4403. https://doi.org/https://doi.org/10.1016/j.ridd.2013.09.021

O'Leary, L., Cooper, S.-A., & Hughes-McCormack, L. (2018). Early death and causes of death of people with intellectual disabilities: A systematic review. *Journal of Applied Research in Intellectual Disabilities*, *31*(3), 325-342. https://doi.org/https://doi.org/10.1111/jar.12417

Obrusnikova, I., Firkin, C. J., Cavalier, A. R., & Suminski, R. R. (2022). Effects of resistance training interventions on muscular strength in adults with intellectual disability: a systematic review and meta-analysis. *Disabil Rehabil*, *44*(17), 4549-4562. https://doi.org/10.1080/09638288.2021.1910738

Olsen, M. I., Halvorsen, M. B., Søndenaa, E., Langballe, E. M., Bautz-Holter, E., Stensland, E., . . . Anke, A. (2021). How do multimorbidity and lifestyle factors impact the perceived health of adults with intellectual disabilities? [https://doi.org/10.1111/jir.12845]. *Journal of Intellectual Disability Research*, *65*(8), 772-783. https://doi.org/https://doi.org/10.1111/jir.12845

Oppewal, A., Hilgenkamp, T. I., van Wijck, R., & Evenhuis, H. M. (2013). Cardiorespiratory fitness in individuals with intellectual disabilities--a review. *Res Dev Disabil*, *34*(10), 3301-3316. https://doi.org/10.1016/j.ridd.2013.07.005

Oppewal, A., Hilgenkamp, T. I. M., Schäfer Elinder, L., Freiberger, E., Rintala, P., Guerra-Balic, M., . . . Melville, C. A. (2018). Correlates of Sedentary Behaviour in Adults with Intellectual Disabilities-A Systematic Review. *Int J Environ Res Public Health*, *15*(10). https://doi.org/10.3390/ijerph15102274

Oviedo, G. R., Tamulevicius, N., & Guerra-Balic, M. (2019). Physical Activity and Sedentary Time in Active and Non-Active Adults with Intellectual Disability: A Comparative Study. *Int J Environ Res Public Health*, *16*(10). https://doi.org/10.3390/ijerph16101761

Oviedo, G. R., Travier, N., & Guerra-Balic, M. (2017). Sedentary and Physical Activity Patterns in Adults with Intellectual Disability. *Int J Environ Res Public Health*, *14*(9). https://doi.org/10.3390/ijerph14091027

O'Donoghue, G., Perchoux, C., Mensah, K., Lakerveld, J., van der Ploeg, H., Bernaards, C., . . . Nazare, J.-A. (2016). A systematic review of correlates of sedentary behaviour in adults aged 18–65 years: a socio-ecological approach [journal article]. *BMC Public Health*, *16*(1), 163. https://doi.org/10.1186/s12889-016-2841-3

PALtechnologies. (2022). *Why activPAL?* . https://www.palt.com/why-activpal/

PCD, P. C. D. (2019). *National action plan for air pollution 2019-2024*. Retrieved from https://www.pcd.go.th/wp-content/uploads/2021/02/pcdnew-2021-02-18_08-03-46_086635.pdf

Pejarasangharn, U., & Churesigaew, C. (2021). Health Services for Intellectually Disabled in Thailand. วารสารสุขภาพจิตแห่งประเทศไทย, *10*(1), 55-61.

Peltopuro, M., Ahonen, T., Kaartinen, J., Seppälä, H., & Närhi, V. (2014). Borderline Intellectual Functioning: A Systematic Literature Review. *Intellectual and Developmental Disabilities*, *52*(6), 419-443. https://doi.org/10.1352/1934-9556-52.6.419

Peltzer, K., & Pengpid, S. (2016). Leisure Time Physical Inactivity and Sedentary Behaviour and Lifestyle Correlates among Students Aged 13–15 in the Association of Southeast Asian Nations (ASEAN) Member States, 2007–2013. *International Journal of Environmental Research and Public Health*, *13*(2), 217.

Pitchford, E. A., Dixon-Ibarra, A., & Hauck, J. L. (2018). Physical Activity Research in Intellectual Disability: A Scoping Review Using the Behavioral Epidemiological Framework. *American Journal on Intellectual and Developmental Disabilities*, *123*(2), 140-163. https://doi.org/10.1352/1944-7558-123.2.140

Pongprasert, P., & Kubota, H. (2017). Switching from motorcycle taxi to walking: A case study of transit station access in Bangkok, Thailand. *IATSS Research*, *41*(4), 182-190. https://doi.org/https://doi.org/10.1016/j.iatssr.2017.03.003

Prince, S. A., Reed, J. L., McFetridge, C., Tremblay, M. S., & Reid, R. D. (2017). Correlates of sedentary behaviour in adults: a systematic review. *Obes Rev*, *18*(8), 915-935. https://doi.org/10.1111/obr.12529

Ptomey, L. T., Willis, E. A., Lee, J., Washburn, R. A., Gibson, C. A., Honas, J. J., & Donnelly, J. E. (2017). The feasibility of using pedometers for self-report of steps and accelerometers for measuring physical activity in adults with intellectual and developmental disabilities across an 18-month intervention [https://doi.org/10.1111/jir.12392]. *Journal of Intellectual Disability Research*, *61*(8), 792-801. https://doi.org/https://doi.org/10.1111/jir.12392

Rana, D., Westrop, S., Jaiswal, N., Germeni, E., McGarty, A., Ells, L., . . . Wu, O. (2024). Lifestyle modification interventions for adults with intellectual disabilities: systematic review and meta-analysis at intervention and component levels. *Journal of Intellectual Disability Research*, *n/a*(n/a). https://doi.org/https://doi.org/10.1111/jir.13098

Ranjan, S., Nasser, J. A., & Fisher, K. (2018). Prevalence and potential factors associated with overweight and obesity status in adults with intellectual developmental disorders [https://doi.org/10.1111/jar.12370]. *Journal of Applied Research in Intellectual Disabilities*, *31*(S1), 29-38. https://doi.org/https://doi.org/10.1111/jar.12370

Richardson, A. (2019). Glasgow's Climate Plan: Our Response to the Climate and Ecological Emergency. In: Glasgow City Council.

Robertson, J., Beyer, S., Emerson, E., Baines, S., & Hatton, C. (2019). The association between employment and the health of people with intellectual disabilities: A systematic review. *Journal of Applied Research in Intellectual Disabilities*, *32*(6), 1335-1348. https://doi.org/https://doi.org/10.1111/jar.12632

Robertson, J., & Emerson, E. (2010). Participation in Sports by People with Intellectual Disabilities in England: A Brief Report [https://doi.org/10.1111/j.1468-3148.2009.00540.x]. *Journal of Applied Research in Intellectual Disabilities*, *23*(6), 616-622. https://doi.org/https://doi.org/10.1111/j.1468-3148.2009.00540.x

Rowley, N., Steele, J., Wade, M., Copeland, R. J., Mann, S., Liguori, G., . . . Jimenez, A. (2020). Are Exercise Referral Schemes Associated With an Increase in Physical Activity? Observational Findings Using Individual Patient Data Meta-Analysis From the National Referral Database. *J Phys Act Health*, *17*(6), 621-631. https://doi.org/10.1123/jpah.2019-0435

Sallis, J. F., Owen, N., & Fotheringham, M. J. (2000). Behavioral epidemiology: A systematic framework to classify phases of research on health promotion and disease prevention. *Annals of Behavioral Medicine*, *22*(4), 294-298. https://doi.org/10.1007/BF02895665

Sangiam, T., & McNeil, R. (2020). Bangkok schools remain open amidst air pollution crisis. https://thainews.prd.go.th/en/news/detail/TCATG201217095956194

Sanit, P., & Ratanawaraha, A. (2020). Urbanites 4.0: The Futures of Thai Urban Life. *National Research Council of Thailand*.

Sarapirom, K., Muensakda, P., & Sriwanna, T. (2020). Lifestyles of Myanmar migrant workers under Thai socio-cultural context: A challenge of state management in the future. *Interdisciplinary Research Review*, *15*(5), 8-15.

Saulnier, M. D. (2016). Vineland Adaptive Behavior Scales. In: Slides.

Schalock, R. L., Borthwick-Duffy, S. A., Bradley, V. J., Buntinx, W. H., Coulter, D. L., Craig, E. M., . . . Reeve, A. (2010). *Intellectual disability: Definition, classification, and systems of supports*. American Association on Intellectual and Developmental Disabilities (AAIDD).

Schalock, R. L., Luckasson, R., & Tassé, M. J. (2021). *Intellectual disability: Definition, classification, and systems of supports* (12th ed.). American Association on Intellectual and Developmental Disabilities (AAIDD).

Schalock, R. L., Luckasson, R. A., & Shogren, K. A. (2007). The Renaming of Mental Retardation: Understanding the Change to the Term Intellectual Disability. *Intellectual and Developmental Disabilities*, *45*(2), 116-124. https://doi.org/10.1352/1934-9556(2007)45[116:TROMRU]2.0.CO;2

Schmid, D., & Leitzmann, M. F. (2014). Television viewing and time spent sedentary in relation to cancer risk: a meta-analysis. *J Natl Cancer Inst*, *106*(7). https://doi.org/10.1093/jnci/dju098

Schuch, F. B., Vancampfort, D., Richards, J., Rosenbaum, S., Ward, P. B., & Stubbs, B. (2016). Exercise as a treatment for depression: A meta-analysis adjusting for publication bias. *Journal of Psychiatric Research*, *77*, 42-51. https://doi.org/https://doi.org/10.1016/j.jpsychires.2016.02.023

Skivington, K., Matthews, L., Simpson, S. A., Craig, P., Baird, J., Blazeby, J. M., . . . Moore, L. (2021). A new framework for developing and evaluating complex interventions: update of Medical Research Council guidance. *BMJ*, *374*, n2061. https://doi.org/10.1136/bmj.n2061

Smith, B., Kirby, N., Skinner, B., Wightman, L., Lucas, R., & Foster, C. (2018). Physical activity for general health benefits in disabled adults: Summary of a rapid evidence review for the UK Chief Medical Officers' update of the physical activity guidelines.

Smith, G. (2018). Step away from stepwise. *Journal of Big Data*, *5*(1), 32. https://doi.org/10.1186/s40537-018-0143-6

Song, Y., Aryal, J., Tan, L., Jin, L., Gao, Z., & Wang, Y. (2021). Comparison of changes in vegetation and land cover types between Shenzhen and Bangkok. *Land Degradation & Development*, *32*(3), 1192-1204. https://doi.org/https://doi.org/10.1002/ldr.3788

Sopitarchasak, S., Adulyanon, S., & Lorthong, T. (2015). Thai Health Promotion Foundation: innovative enabler for health promotion. *World health & population*, *16*, 62-71.

St John, L., Borschneck, G., & Cairney, J. (2020). A Systematic Review and Meta-Analysis Examining the Effect of Exercise on Individuals With Intellectual Disability. *Am J Intellect Dev Disabil*, *125*(4), 274-286. https://doi.org/10.1352/1944-7558-125.4.274

Stamatakis, E., Ekelund, U., Ding, D., Hamer, M., Bauman, A. E., & Lee, I. M. (2019). Is the time right for quantitative public health guidelines on sitting? A narrative review of sedentary behaviour research paradigms and findings. *Br J Sports Med*, *53*(6), 377-382. https://doi.org/10.1136/bjsports-2018-099131

Stanish, H. I. (2004). Accuracy of Pedometers and Walking Activity in Adults with Mental Retardation. *Adapted Physical Activity Quarterly*, *21*(2), 167-179. https://doi.org/10.1123/apaq.21.2.167

Sternstein, L. (2021). Bangkok. In *Encyclopedia Britannica*.

Strath, S. J., Kaminsky, L. A., Ainsworth, B. E., Ekelund, U., Freedson, P. S., Gary, R. A., . . . Swartz, A. M. (2013). Guide to the assessment of physical activity: Clinical and research applications: a scientific statement from the American Heart Association. *Circulation*, *128*(20), 2259-2279. https://doi.org/10.1161/01.cir.0000435708.67487.da

Suphawibul, M., & Krabuanrat, C. (2021). *Guideline teaching exercise to children with intellectual disabilities*. Thai Health Promotion Foundation.

Tanlamai, U., Jaikengkit, A.-O., Jarutach, T., Rajkulchai, S., & Ritbumroong, T. (2022). Use of daily posture and activity tracking to assess sedentary behavior, toss-and-turns, and sleep duration of independently living Thai seniors. *Health Informatics Journal*, *28*(1), 14604582211070214. https://doi.org/10.1177/14604582211070214

Tansawat, T., Kishi, K., Choocharukul, K., & Kanitpong, K. (2017). Transport Difficulty and Its Effects on Feelings of Social Exclusion in Thai Elderly: A Structural Equation Modeling (SEM) Approach. *Journal of the Eastern Asia Society for Transportation Studies*, *12*, 538-555. https://doi.org/10.11175/easts.12.538

Tassé, M. (2017). *Diagnostic Adaptive Behavior Scale: User's manual*.

Teerasuphaset, T., & Culp, J. (2020). STAY SAFE IN THE PM 2.5 In. Chulalongkorn University.

Temple, V. A. (2007). Barriers, enjoyment, and preference for physical activity among adults with intellectual disability. *International Journal of Rehabilitation Research*, *30*(4).

ThaiHealth, T. H. P. F. (2021). *Thai Health timeline and progress*. https://www.thaihealth.or.th/%e0%b9%80%e0%b8%aa%e0%b9%89%e0%b8%99%e0%b8%97%e0%b8%b2%e0%b8%87%e0%b8%81%e0%b8%b2%e0%b8%a3%e0%b8%aa%e0%b8%a3%e0%b9%89%e0%b8%b2%e0%b8%87%e0%b8%aa%e0%b8%b8%e0%b8%82/

Thaiutsa, B., Puangchit, L., Kjelgren, R., & Arunpraparut, W. (2008). Urban green space, street tree and heritage large tree assessment in Bangkok, Thailand. *Urban Forestry & Urban Greening*, *7*(3), 219-229. https://doi.org/https://doi.org/10.1016/j.ufug.2008.03.002

The UK Household Longitudinal Study.

Tipayamongkholgul, M., Luksamijarulkul, P., Mawn, B., Kongtip, P., & Woskie, S. (2016). Occupational Hazards in the Thai Healthcare Sector. *New Solut*, *26*(1), 83-102. https://doi.org/10.1177/1048291116633871

Topothai, T., Chandrasiri, O., Liangruenrom, N., & Tangcharoensathien, V. (2016). Renewing commitments to physical activity targets in Thailand. *The Lancet*, *388*(10051), 1258-1260. https://doi.org/10.1016/S0140-6736(16)30929-1

Totsika, V., Hastings, R. P., Vagenas, D., & Emerson, E. (2014). Parenting and the Behavior Problems of Young Children With an Intellectual Disability: Concurrent and Longitudinal Relationships in a Population-Based Study. *American Journal on Intellectual and Developmental Disabilities*, *119*(5), 422-435. https://doi.org/10.1352/1944-7558-119.5.422

Tremblay, M. (2012). Letter to the editor: standardized use of the terms "sedentary" and "sedentary behaviours". *Appl Physiol Nutr Metab*, *37*(3), 540-542. https://doi.org/10.1139/h2012-024

Tremblay, M. S., Aubert, S., Barnes, J. D., Saunders, T. J., Carson, V., Latimer-Cheung, A. E., . . . Chinapaw, M. J. M. (2017). Sedentary Behavior Research Network (SBRN) - Terminology Consensus Project process and outcome. *Int J Behav Nutr Phys Act*, *14*(1), 75. https://doi.org/10.1186/s12966-017-0525-8

Tremblay, M. S., Colley, R. C., Saunders, T. J., Healy, G. N., & Owen, N. (2010). Physiological and health implications of a sedentary lifestyle. *Appl Physiol Nutr Metab*, *35*(6), 725-740. https://doi.org/10.1139/h10-079

Trethanya, S., & Perera, R. (2009). Environmental Assessment for Small- and Medium-Scale Road Projects Implemented in Local Authority Areas: A Case Study from Thailand.

Triyason, T., Tassanaviboon, A., & Arpnikanondt, C. (2017). Hybrid Cloud Architecture for Connected Thai Government Agency. Proceedings of the 9th International Conference on Management of Digital EcoSystems,

Troiano, R. P., Berrigan, D., Dodd, K. W., Masse, L. C., Tilert, T., & McDowell, M. (2008). Physical activity in the United States measured by accelerometer. *Med Sci Sports Exerc*, *40*(1), 181-188. https://doi.org/10.1249/mss.0b013e31815a51b3

Tudor-Locke, C., Craig, C. L., Brown, W. J., Clemes, S. A., De Cocker, K., Giles-Corti, B., . . . Blair, S. N. (2011). How many steps/day are enough? for adults. *International Journal of Behavioral Nutrition and Physical Activity*, *8*(1), 79. https://doi.org/10.1186/1479-5868-8-79

Umb Carlsson, Õ. (2021). Health-promotion intervention in a group home: Perspectives of residents, staff and rehabilitation professionals. *Journal of Intellectual Disabilities*, *25*(2), 210-229. https://doi.org/10.1177/1744629519874970

Upadhaya, S., Yu, J. X., Oliva, C., Hooton, M., Hodge, J., & Hubbard-Lucey, V. M. (2020). Impact of COVID-19 on oncology clinical trials. *Nat Rev Drug Discov*, *19*(6), 376-377.

Veerman, J. L., Healy, G. N., Cobiac, L. J., Vos, T., Winkler, E. A., Owen, N., & Dunstan, D. W. (2012). Television viewing time and reduced life expectancy: a life table analysis. *Br J Sports Med*, *46*(13), 927-930. https://doi.org/10.1136/bjsm.2011.085662

10.1136/bjsports-2011-085662

Vichiensan, V., & Nakamura, K. (2021). Walkability Perception in Asian Cities: A Comparative Study in Bangkok and Nagoya. *Sustainability*, *13*(12), 6825.

Wannasuntad, S. (2007). *Factors Predicting Thai Children's Physical Activity* (Publication Number ProQuest ID: Wannasuntad_ucsf_0034D_1085.REDACTED. Merritt ID: ark:/13030/m5n29txd.) University of California]. Retrieved from https://escholarship.org/uc/item/19d5n94w

Warburton, D. E., Nicol, C. W., & Bredin, S. S. (2006). Health benefits of physical activity: the evidence. *Cmaj*, *174*(6), 801-809. https://doi.org/10.1503/cmaj.051351

Waree, W. (2021). The Effects of Yoga Training on Physical fitness, Balance and Concentration level in Children with Autistic Attention-Deficit Hyperactivity. *Journal of Health Research and Innovation*, *4*(2), 77-91.

Westrop, S. C., Melville, C. A., Muirhead, F., & McGarty, A. M. (2019). Gender differences in physical activity and sedentary behaviour in adults with intellectual disabilities: A systematic review and meta-analysis. *J Appl Res Intellect Disabil*, *32*(6), 1359-1374. https://doi.org/10.1111/jar.12648 [doi]

Wetchapanpesat, S., Charoenwannying, L., Phensirikul, T., & <div style="">Kingjaturat, N. (2021). *Thailand Strategic Plan: Covid-19* (978-616-11-4550-7). O. o. t. P. S. Division of Strategy and Planning, Ministry of Public Health. https://ddc.moph.go.th/viralpneumonia/eng/file/main/en_Thailand%20Covid-19%20plan_MOPH_2021.pdf

Wethyavivorn, P., & Sukwattanakorn, N. (2019). Problems and barriers affecting sustainable commuting: Case study of people's daily commute to Kasetsart University, Bangkok, Thailand. *IOP Conference Series: Earth and Environmental Science*, *329*, 012011. https://doi.org/10.1088/1755-1315/329/1/012011

WHO. (2004). Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet*, *363*(9403), 157-163. https://doi.org/10.1016/s0140-6736(03)15268-3

WHO. (2012). Health indicators of sustainable cities in the context of the Rio+ 20 UN. Conference on Sustainable Development WHO. https://sustainabledevelopment. un. org/partnerships/rio20,

WHO. (2018). Global action plan on physical activity 2018–2030: more active people for a healthier world.

WHO. (2020). WHO guidelines on physical activity and sedentary behaviour. *World Health Organization*.

WHO, W. H. O. (2004). ICD-10 : international statistical classification of diseases and related health problems : tenth revision. In (2nd ed.). Geneva: World Health Organization.

WHO, W. H. O. (2018). Noncommunicable diseases country profiles 2018.

WHO, W. H. O. (2019). ICD-11 : international statistical classification of diseases and related health problems : eleventh revision. In (2nd ed.). Geneva: World Health Organization.

Wilmot, E. G., Edwardson, C. L., Achana, F. A., Davies, M. J., Gorely, T., Gray, L. J., . . . Biddle, S. J. (2012). Sedentary time in adults and the association with diabetes, cardiovascular disease and death: systematic review and meta-analysis. *Diabetologia*, *55*(11), 2895-2905. https://doi.org/10.1007/s00125-012-2677-z

Wiwanitkit, V. (2011). Mandatory rural service for health care workers in Thailand. *Rural Remote Health*, *11*(1), 1583.