## Title

# A pilot survey of physical activity in men with an intellectual disability

Michael Mc Keon, School of Nursing, Dublin City University, Dublin 9, Ireland.

Eamonn Slevin, School of Nursing, University of Ulster, Northern Ireland.

Laurence Taggart, School of Nursing, University of Ulster, Northern Ireland.

## Abstract

People with intellectual disability are reported as a sedentary population with increased risks of poor health due to an inactive and sedentary lifestyle. As the benefits of physical activity are acknowledged, measuring physical activity accurately is important to help identify reasons for low and high physical activity in order to assist and maintain recommended levels for optimal health. This paper reports a pilot study undertaken to validate the use of a physical activity monitor (Sensewear Armband) and the International Physical Activity Questionnaire (IPAQ) as instruments for measuring and exploring physical activity of men with intellectual disability. The design was a one group descriptive study and data were collected over a 7 day period from 17 men. The Sensewear Armband enabled continuous and long-term measurement of 14 objective physical activity metrics. The IPAQ examined details of physical activity reported over the 7 days. Equivalent results were found in both instruments indicating a positive correlation between the Sensewear Armband and the IPAQ. The results show 50% have low activity levels and the national recommended physical activity levels been achieved at a very low active intensity. No sustainable high physical activity intensity levels were recorded. The results confirmed the Sensewear Armband and the IPAQ as a practical means of measuring and understanding physical activity levels of men with intellectual disability.

**Keywords**: intellectual disability, men, physical activity, pilot, monitors, survey

## Introduction

The terms physical activity, exercise, and fitness have been used interchangeably, however the terms describe different concepts. Physical activity is the principal term used in research with exercise and fitness used as related terms. Caspersen et al. (1985) defined physical activity *"as any bodily movement produced by skeletal muscles that requires energy expenditure"* (p. 126). With the application of modern technology physical activity can be accurately measured and is principally reported in categories of low, moderate, and high physical activity levels (United States Department of Health and Human Services, 2008). As the benefits of physical activity are progressively acknowledged, measuring physical activity accurately in a population is important to help identify reasons for low and high activity in order to assist and maintain recommended levels of physical activity for optimal health.

The World Health Organisation (2009) identified physical activity as a preventative health measure that is critically important for the health and wellbeing of people of all ages. Evidence from the past 10 years has suggested that physical activity levels in people with intellectual disabilities are low and sedentary. Emerson (2005) found the lack of physical activity to be a significant behavioural risk to health among people with intellectual disability. Physical activity studies of people with intellectual disability identified significant inactivity and associated behaviour risks to health for the majority of this population (Moss 2009; Temple and Stanish 2009). Prasher and Janicki (2002) and Havercamp et al (2004) identified health disparities among people with intellectual disability who live a sedentary inactive lifestyle with greater risk of obesity and chronic diseases. Sedentary inactive lifestyles range from the inactivity of people with severe and profound intellectual disability who have mobility and physical disabilities to people with mild intellectual disability, with no physical disabilities, very mobile, but either unable or reluctant to be active.

Haveman et al (2010) suggested that while physical activity improves health status, people with intellectual disability have low physical activity levels. Moss (2009) found that inactivity was a major risk factor for heart disease and Bhaumik et al (2008) identified inactivity as one of the main contributing factors to higher levels of obesity in people with intellectual disability. The wider living environment can restrict people with intellectual disability being active and certain syndromes sustain obesity which restricts peoples' activity levels.

The RCN (2006, 2011) identified lack of physical activity and a sedentary lifestyle result in specific health needs for people with intellectual disabilities. Frey et al (2005) found barriers, benefits and choices to physical activity similar to the general population. However, Temple (2007) argued that accessibility was the main barrier to physical activity for people with intellectual disability and the least active individual has no accessibility to physical activity options. Temple and Walkley (2007) and Bodde & Seo (2009) identified a range of barriers to physical activity such as transportation, financial limits, lack of awareness of options, negative support from care givers, and a lack of clear policy in the area of physical activity.

Encouraging physical activity in people with intellectual disability has been found beneficial to health and a way to improve overall quality of life (Carmeli et al., 2009; Lynnes et al., 2009; Moss 2009). Despite the barriers faced by people with intellectual disability to physical activity several studies have identified ways to improve and increase physical activity. Chapman et al (2005, 2008) identified the role of support and guidance by health practitioner to improve lifestyles of people with intellectual disability as effective in reducing weight and improving awareness about the importance of physical activity. In addition, Temple (2009) and Yalon-Chamovitz & Weiss (2008) reported that when providing personal, social support, and motivation for people with intellectual disability to partake in physical activities, improvement in levels of activity, reduced health risks and enhanced quality of life were observed.

Measuring physical activity levels is an important element of physical activity research. Tudor-Locke and Bassett (2004) argue that accurate measurements of physical activity behaviours were necessary to address a sedentary lifestyle. Conversely, Frey et al. (2008) and Temple and Stanish (2008) suggest that there are significant methodological limitations that restricts clear conclusions in recording physical activity levels in intellectual disability populations. Emerson (2005) found the study of physical activity in intellectual disability restrictive and not reliable, where 44% of the study population were deemed not capable of physical activity. One of the consistent limitations in physical activity studies was obtaining a sufficient sample size to generalise to a wider intellectual disability population (Temple and Stanish 2008). Draheim et al. (2002) identified limitations to using a questionnaire in studies of physical activity in intellectual disabilities. Yang and Hsu (2010) argued that physical activity questionnaires depend on personal observation and subjective interpretations create inconsistent results. Temple and Stanish (2008) suggested that questionnaires need to be validated to determine if their findings are useful.

Measurement scales and categories used in research help identify reasons for low and high physical activity to assist and maintain recommended levels of physical activity. Temple (2009) argued that results of physical activity studies are only generalisable to active intellectual disability population and research needs to focus on population with low activity. Frey et al. (2008) suggested that a single gender allows a greater understanding of results in physical activity studies where combined gender studies obscures physical activity patterns and restricts clear conclusions. The Royal College of Nursing (2006) argued that along with common diseases found in men, the lack of physical activity and a sedentary lifestyle is a specific health concern for all men. People with intellectual disability are a multifaceted group of people and a single gender study can provide a more complete representation to support physical activity studies.

To overcome methodological limitations in recording physical activity levels in an intellectual disability population, the literature pointed to the used of motion sensors and questionnaires together. Frey et al. (2008) and Temple and Stanish (2008) recommend the use of motion sensors as a direct and objective means of measuring physical activity as the sensor does not rely on recall. They suggest that motion sensors can supplement and complement the use of survey questionnaire where both are compatible tools to use in measuring physical activity. This pilot study aimed to validate the use of the physical activity monitor, Sensewear Armband (Bodymedia, 2007a) and the International Physical Activity Questionnaire (International Physical Activity Questionnaire, 2002) in developing a methodology to measure and explore the physical activity of men with intellectual disability.

## Method

The study aim was to test two instruments used to measure and assess physical activity of men with intellectual disability prior to their use in a larger study. A convenient sample of men (n = 17) were identified and invited to take part in the study from a non-denominational voluntary body providing services for people with intellectual disability in a major city. A strata-sample approach was used in order to get a representative sample across the different levels of intellectual disability. The mean age of the sample was 42 years. Table (1) outlines the participants' demographic profile. The design was a descriptive study divided into two parts, wearing the Sensewear Armband monitor for a week and completing the IPAQ at the end of the week.

The Sensewear Armband monitor was used to measure and provide objective data of physical activity levels over a 7 day period. The Sensewear Armband was placed on the upper right arm and secured by an elastic velcro strap. The Sensewear Armband contains a number of sensors that record changes in measurements of body acceleration and temperatures. These measurements were converted into physical activity data which quantifies the duration, frequency, and intensity of the physical activity performed. The Sensewear Armband enabled automatic and continuous measurement of physical activity in a non-invasive way within an independent living environment. Yang and Hsu (2010) identified the Sensewear Armband as a practical wearable monitor to measure and assess physical activity in either a laboratory setting or an independent living environment. The key reported measurements from the monitor calculated and reported on energy expenditure in kilocalories (kCal), number of steps, physical activity duration and physical activity levels/intensity in metabolic equivalent of task (METs), and sleep duration and efficiency. Ainsworth et al. (2011) suggested measuring physical activity in metabolic equivalents of task, referred to as METs. For example, one MET is defined as the energy it takes to sit quietly watching TV, two METs is the equivalent to a slow walk and three METs is equivalent to walking fast.

The IPAQ was developed at an international level to study and compare physical activity levels of different populations and is maintained at the Karolinska Institute in Sweden. The IPAQ was developed to estimate levels of physical activity based on participant recall of the last 7 days of their physical activity (International Physical Activity Questionnaire, 2002). The IPAQ assessed physical activity undertaken across a set of four domains, work, transport, housekeeping and leisure related activities. The IPAQ measures results in METs and classifies results into three category levels, low, moderate, and high physical activity levels. Heesch et al. (2010) suggested that the IPAQ could be modified for use among people with various cognitive difficulties. Craig et al. (2003) argued that the IPAQ has reasonable measurable properties for monitoring physical activity levels among adults in diverse settings. Lante and Walkley (2008) found the IPAQ as a suitable measurement tool to collect physical activity data of people with intellectual disability. In using the IPAQ, pictures of physical activity topics were used to assist the participants with communication difficulties. The use of picture cards supported and enhanced participation in the IPAQ. Reid et al. (2009) found that pictures of sports and physical activity topics were reliable and valid to motivate people with intellectual disability to take part in a questionnaire process.

The participants were asked to wear the Sensewear Armband for a week at all times and were required to only remove it for showering, bathing or swimming. The Sensewear Armband was collected at the end of a week and the IPAQ was completed at that time. Sensewear Professional Software, Version 6.2 was used to analyse and generate reports from the Sensewear Armband data (Bodymedia, 2007b). The Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire was used to analyse and generate results from the IPAQ data (International Physical Activity Questionnaire, 2005). The Statistical Package for Social Sciences, SPSS verson18.0 was used to generate descriptive and inference analysis (IBM SPSS, 2009).

## Ethical concerns

Ethical approval was sought from and granted by the ethical committees of the care provider services and the university involved in the study. A rigorous process and procedure of obtaining consent for the study was set out to allow participants to be fully informed, autonomous, and empowered to consent as part of the study. An initial information meeting describing the survey was provided to the participants and included an opportunity for questions and answers. Consent was obtained primarily from each individual participant. A letter of invitation, a study information question and answer sheet and a comprehensive consent form was sent to each potential participant. All written documents had easy to read sections and illustrative images were included to aid with the consent process. Participants were provided with space and time to assent to participate in the study. Where a person lacked the capacity to consent, in line with the legal jurisdiction applied in relation to power of attorney, a proxy decision maker (staff carer or parent) was identified. Where proxy consent was used the person with ID was yet again provided with space and time to assent to participate in the study (NDA 2009). Temple and Walkley (2003) found that proxy reporting of physical activity behaviour provided meaningful data for intellectual disability studies as long as ethical principles such as beneficence and autonomy were adhered to. This consent process allowed for a wide level of understanding and a plan to manage any possible change that a participant may have experienced over the lifespan of the study. Throughout the study, it was emphasized that consent was freely given and participants could withdraw from the study at any time without any effect.

## Results

The Sensewear Armband and the IPAQ results are outlined in Table 2 and Table 3. Each instrument provided a distinctive breakdown of the physical activity results. Both instruments reported in categories of low/sedentary, moderate and high/vigorous physical activity levels. The key measurements produced by the Sensewear Armband were monitor duration times, physical activity duration, steps, activity intensity levels, energy expenditure levels, lying, and sleep duration and efficiency. The key measurements produced by the IPAQ were categories of low, moderate and high physical activity levels. Comparative percentages of the four IPAQ physical activity domains were estimated for each physical activity category. The final section in the IPAQ referred to sitting and data recorded was converted into percentages for weekdays and weekends. With both instruments measuring the same parameters a correlation analysis was carried out. Pearson correlation found a significant relationship at the 0.01 level (1-tailed) between the results of the Sensewear Armband and the IPAQ results. Table 4 & 5 provides details of the IPAQ activity categories results along side levels of intellectual disability and levels of mobility, non ambulant, and wheelchair participant.

## Discussion

The study successfully determined the feasibility of using the Sensewear Armband and the IPAQ to accurately measure physical activity in men with intellectual disability. The overall results found by both instruments are comparable to previous research that found more than 50% of people with intellectual disability as having low physical activity levels (Walsh et al., 2008). The Sensewear Armband measurements of steps, active energy levels, and active duration times had a significant positive correlation with the physical activity categories of the IPAQ. An increase in physical activity levels detected in the Sensewear Armband measurements saw a corresponding change from a low to a high active category level in the IPAQ. This suggests that not only were these two instruments practical in measuring physical activity in this population but they also allowed for cross validation between the instruments.

The Sensewear Armband measurement of monitor duration on the body allowed the researcher to check the validity of each participant's results (Table 2). Times when the monitor was taken off was clearly recorded and evident. With instruction to wear the Sensewear Armband for 7 days, a mean compliance rate of 5 days wearing the monitor was gained. Almeida et al. (2011) found that wearing the Sensewear Armband for 2 to 4 days predicted more than 80% of the variance across 7 days monitoring and allowed measurements with Intraclass Correlation Coefficients above .80. The compliance rate allowed the Sensewear Armband sufficient time to provide accurate, objective measurements of physical activity levels. 7 day monitoring allowed for both weekdays and weekend day levels of physical activity to be included and analysed in the study.

The strength of the IPAQ was found in its ability to identify where activities originated from within the four activity domains of work, transport, housekeeping and leisure. Work and transport played a significant role in people who had high levels of physical activity (Table 3). The IPAQ allowed the men to partake in the research process by answering the IPAQ. The men had a variety of communication styles, levels of disability, and displayed a certain level of acquiescence. An expected level of acquiescence was apparent which is common in intellectual disability studies (Emerson et al. 2004). The use of physical activity picture cards made it possible for participants to respond and be supported in answering the IPAQ. The IPAQ was inclusive and fostered participation of people with intellectual disability in parts of the research process as suggested by Emerson et al. (2004)

There were limitations in the use of these instruments. A percentage difference of +7% in the IPAQ low and moderate activity categories compared with the Sensewear Armband active energy levels were found. The difference can be indirectly accounted for by the Sensewear Armband inability to be used during water activities. Swimming, which is a common activity in intellectual disability, was not monitored by the Sensewear Armband however it was recorded in the IPAQ. The main limitations of the IPAQ were the subjective nature of the results and the need, in some cases, for proxy staff support in completing the questionnaire. An indication of the subjective nature of the answers to the IPAQ was found in difficulties that participants had in estimating the time they spent sitting. The seasonal variability of physical activity was a limitation as the data were captured in the summer time where there were more opportunities to be active.

Although both instruments had limitations in monitoring and measuring physical activity, when used in combination they monitored each other's limitations. The IPAQ identified water based activities, while the Sensewear Armband could validate all activity including levels of sitting or sedentary activity. The Sensewear Armband provided objective measurements that could validate the IPAQ subjective results. This study confirmed the suggestions of Frey et al. (2008) and Temple and Stanish (2008) that accelerometers and questionnaire surveys can be compatible tools to use in the measurement of physical activity in people with intellectual disability.

In this study involving only 17 men with an intellectual disability, it is concerning that over 50% of the men do not take part in high levels of physical activities. Almost all participants with severe and profound intellectual disability had low activity levels. Those with high activity levels all had a mild intellectual disability. However, the moderate activity category comprised all three levels of intellectual disability indicating the potential of activity regardless of a person's level of disability (Table 4). While levels of intellectual disability appears to influence the rate of physical activity, been fully mobile appear to have a stronger influence on physical activity levels. The non ambulant and wheelchair user all had low physical activity levels. An even number of fully mobile people were found in each category of low, moderate and high physical activity (Table5). The study results suggest that non ambulant and wheelchair user may start at a lower baseline level of activity and are at a disadvantage when measuring activity in contrast to full mobile people. The potential for physical activity of non ambulant and wheelchair user may be small and obscure due to mobility disabilities and would require further research.

While the results show 50% moderate and high levels of physical activity, the Sensewear Armband indicated a low overall level of active intensity in 94% of these men. Low level of active intensity is a common feature found in studies of physical activity in intellectual disability. Finlayson et al. (2009) found low activity levels and low intensity of physical activities in people with intellectual disability. Stanish and Draheim (2007) found similar results where the intensity of walking was low and not at a level to gain health benefits. If this was found to be similar in a larger scale study it would confirm the sedentary nature of this population of men. Emerson (2005) reported that not taking part in adequate levels of physical activity can lead to health problems for people with intellectual disability. Emerson (2005) suggested that studies of physical activity in intellectual disability were restrictive and unreliable. The approaches used in this study could be used to provide a base line of objective measurements on which to start changing levels of physical activity in people with intellectual disability, no matter how small. The instruments could provide baseline measurements in the planning, undertaking, and evaluating of health and health promotion programmes targeting all aspects of physical activity for people with intellectual disability.

In order to improve physical activity levels of people with intellectual disability changes are needed in future service delivery and research. People with intellectual disability should be offered a means and comprehensive support to be physical activity mindful of the national physical activity guidelines. Intellectual disability services should ensure the feasibility and importance of a physical activity promotional program in individuals' daily life. This study illustrates the possibilities of providing baseline measurements and evaluation evidence of effective physical activity promotional models. For long term physical activity interventions to be successful further research is needed on multi-disciplinary programs which incorporate physical activity monitoring that are responsive to people with intellectual disability and in line with physical activity national guidelines. Physical activity education and training should be offered to people with intellectual disability including care staff and family members. Melville et al (2009) found a low level of knowledge in healthy lifestyles of people with intellectual disability among carers and argued for training and education in this area. Intellectual disability providers should be educated about the importance of physical activity for health and in addition be willing partner in each and all activities. Mahy et al (2010) identified that physical activity is better when support staff participate in the activities. They argued that the primary focus should be to develop physical activity policies to minimize the barriers and follow this with training and support for staff.

**Conclusion**

The Sensewear Armband and the IPAQ were successfully used to measure and assess physical activity of men with intellectual disability. The Sensewear Armband enabled automatic, continuous and objective measurements of physical activity in a non-invasive and independent living environment. The Sensewear Armband measurements have the capacity to be useful in many other areas of health monitoring. The measurements can assist problems with sleep, diet, medication, behaviour and weight. The IPAQ while providing subjective measurements of physical activity allowed for the exploration and classification of activities of a complex group and managed the acquiescence displayed in intellectual disabilities. The Sensewear Armband and the IPAQ work well together in providing an authentic picture of physical activity in men with intellectual disability. The results of the study provided a statistically significant correlation between the Sensewear Armband and the IPAQ. The endorsement by men with intellectual disability to use the Sensewear Armband provided a practical approach in measuring levels of physical activity in research. The IPAQ allowed for the inclusion of men with intellectual disability in part of the research process and an opportunity for the individual to understand physical activity. It is a concern that over 50% of these men participate in very little high level physical activities. While the aim of the study was not to promote physical activity, an acknowledgement certificate and results of the physical activity survey were given to each participant at a feedback meeting to promote awareness of the participant physical activity levels. The information provided by the Sensewear Armband and IPAQ are valuable to plan, implement and make changes in physical activity behaviour in order to assist and maintain recommended levels of physical activity for optimal health for men with an intellectual disability.

**Correspondence** should be addressed to:
Mr Michael Mc Keon, School of Nursing, Dublin City University, Dublin 9, Ireland. E-mail: michael.mckeon@dcu.ie - Tel: + 353-1-7008539.

**Declaration of interest**
There is no interest to declare.

**Table 1.** Demographic data

| (n=17) | ***n*** | **%** |
|---|---|---|
| Age groups | | |
| 19 – 39 | 5 | 30% |
| 40 – 59 | 12 | 70% |
| Residential type | | |
| Home | 10 | 59% |
| Independent | 5 | 29% |
| Community | 2 | 12% |
| Level of disability | | |
| Mild | 6 | 35% |
| Moderate | 2 | 12% |
| Severe & Profound | 9 | 53% |
| Mobility | | |
| Non -Ambulant | 1 | 6% |
| Wheelchair user | 4 | 23% |
| Full mobility | 12 | 71% |

**Table 2.** Sensewear Armband results

| | **Minimum** | **Maximum** | **Mean** | **Std. Deviation** |
|---|---|---|---|---|
| Total Monitor Duration on body (*h*) | 17 | 100 | 74 | 28 |
| Monitor Duration on body /day (*h*) | 4 | 21 | 16 | 6 |
| Physical Activity Duration /day (*h/min*) | 0 | 3.16 | 1.24 | 1.01 |
| Steps /day(no.) | 44 | 21219 | 5308 | 5502 |
| Sedentary activity (*h/min*) | 4.00 | 24.00 | 15.00 | 6.00 |
| Moderate activity (*h/min*) | 0 | 3.15 | 1.21 | 1.00 |
| Vigorous activity (*h/min*) | 0 | 0.14 | 0.03 | 0.04 |
| Very Vigorous activity (*h/min*) | 0 | 0 | 0 | 0 |
| Total Energy Expenditure (*kcal/day*) | 1016 | 3780 | 1970 | 598 |
| Active Energy Expenditure *(kcal/day*) | 3.00 | 1611 | 377 | 425 |
| Total Average METS *(kcal/kg/hr)* | 1.00 | 1.90 | 1.40 | 0.24 |
| Lying Down (*h/min*) | 1.27 | 9.12 | 6.08 | 2.46 |
| Sleep Duration (*h/min*) | 0.52 | 7.25 | 5.03 | 2.10 |
| Sleep Efficiency (%) | 59% | 91% | 76% | 10.17% |

**Table 3.** Results of the International Physical Activity Questionnaire and physical activity domains

| **Category Level** ***(% of n)*** | **Work/Job** | **Transport** | **House/ Garden** | **Leisure/ Sports** | **Sitting Weekdays** | **Sitting Weekend** |
|---|---|---|---|---|---|---|
| **53% Low Activity** | 0% Work | 100% Private Bus | 11% Garden or housework | Low intensity | 67% | 67% |
| **23% Moderate Activity** | 25% Work | 50% Private Bus | 50% Garden or housework | Moderate intensity | 25% | 25% |
| **23% High Activity** | 100% Work | 75% Public bus | 100% Garden and housework | High intensity | 0% | 0% |

**Table 4.** Results of the International Physical Activity Questionnaire and level of disability

| Level of Intellectual Disability | International Physical Activity Questionnaire Results | | |
|---|---|---|---|
| | Low Activity | Moderate Activity | High Activity |
| | *N* | *N* | *N* |
| Mild Intellectual Disability | 0 | 2 | 4 |
| Moderate Intellectual Disability | 1 | 1 | 0 |
| Severe & Profound Intellectual Disability | 8 | 1 | 0 |

***Table 5.*** Results of the International Physical Activity Questionnaire and level of mobility

| Level of Mobility | International Physical Activity Questionnaire Results | | |
|---|---|---|---|
| | Low Activity | Moderate Activity | High Activity |
| | *N* | *N* | *N* |
| Non Ambulant | 1 | 0 | 0 |
| Wheelchair | 4 | 0 | 0 |
| Full Mobility | 4 | 4 | 4 |

References:

Ainsworth BE, Haskell WL, Herrmann SD, Meckes N, Bassett Jr DR, Tudor-Locke C, Greer JL, Vezina J, Whitt-Glover MC, Leon AS. (2011) Compendium of Physical Activities: a second update of codes and MET values. *Medicine and Science in Sports and Exercise* 43 (8): 1575-1581.

Almeida, G., Chester, M., Kwonho Jeong, W., Moore, CG., and Piva, SR. (2011) Physical Activity Measured by the Sensewear Armband in Women With Rheumatoid Arthritis. *Physical Therapy* 91: 1367-1376.

Bhaumik S., McGrother C.W., Thorp C.F., Tyrer F. & Watson J.M. (2008) Body mass index in adults with intellectual disability: distribution, associations and service implications: a population-based prevalence study. *Journal of Intellectual Disability Research* 52(4): 287-298.

Bodde, A. E. and Seo, D. (2009). A review of social and environmental barriers to physical activity for adults with intellectual disabilities. *Disability and Health Journal* 2 (2): 57-66.

Bodymedia (2007a) *Senseware body monitoring system (BMS)* Available at: http://www.bodymedia.com/ (accessed 12 June 2012).

Bodymedia (2007b) *Sensewear Professional Software Version. 6.2*. http://www.bodymedia.com/Available at: http://sensewear.bodymedia.com/Support/SW-User-Guides/SenseWear-6-2-Software-Manual (accessed 12 June 2012).

Carmeli, E., Barak, S., Morad, M. and Kodesh, E. (2009) Physical exercises can reduce anxiety and improve quality of life among adults with intellectual disability. *International SportMed Journal* 10: 77-85.

Caspersen C. J., Powell K.E., and Christenson G. M. (1985) Physical Activity, Exercise, and Physical Fitness: Definitions and Distinctions for Health-Related Research. *Public Health Reports* 100: 126-131.

Chapman, M.J., Craven, M.J. & Chadwick, D.D. (2005) Fighting fit? An evaluation of health practitioner input to improve healthy living and reduce obesity for adults with learning disabilities. *Journal of Intellectual Disabilities* 9 (2): 131-144.

Chapman, M.J., Craven, M.J. & Chadwick, D.D. (2008) Following up Fighting fit: The long term impact of health practitioner input on obesity and BMI amongst adults with intellectual disabilities. *Journal of Intellectual Disabilities* 12, 30-323.

Craig, C. L., Marshall, A. L., Sjostrom, M., Bauman, A. E., Booth, M. L., and Ainsworth, B. E. (2003) International physical activity questionnaire: 12-country reliability and validity. *Medicine & Science in Sports & Exercise* 35: 381-395.

Draheim, C. C., Williams, D. P. and McCubbin, J. A. (2002) Differences in cardiovascular disease risk between non-diabetic adults with Down syndrome and mental retardation. *American Journal of Mental Retardation* 107: 201-21.

Emerson, E. (2005) Underweight, obesity and exercise among adults with intellectual disabilities in supported accomodation in Northern England. *Journal of Intellectual Disability Research* 49 (2): 134-143.

Emerson. E., Hatton, C., Thompson, T. and Parmenter, T. (2004) *The International Handbook of Applied Research in Intellectual Disabilities.* London: Wiley.

Finlayson, J., Jackson, A., and Cooper, S. (2009) Understanding predictors of low physical activity in adults with intellectual disabilities. *Journal of Applied Research in Intellectual Disabilities* 22: 236-247.

Frey, G. C., Buchanan, A., Rosser, & Sandt D. D. (2005) "I'd rather watch TV": An examination of physical activity in adults with mental retardation. *Mental Retardation* 43, 241-254.

Frey, G. C., Stanish, H. I. and Temple, V. A. (2008) Physical activity of youth with intellectual disability: review and research agenda. *Adapted Physical Activity Quarterly* 25: 95-117.

Haveman, M., Heller, T., Lee, L., Maaskant, M., Shooshtari, S., and Strydom, A. (2010) Major Health Risks in Aging Persons With Intellectual Disabilities: An Overview of Recent Studies. *Journal of Policy and Practice in Intellectual Disabilities* 7 (1) 59–69.

Havercamp, S M., Scandlin, D,. and Roth, M. (2004) Health Disparities Among Adults with Developmental Disabilities, Adults with Other Disabilities, and Adults Not Reporting Disability in North Carolina *Public Health Reports* / July–August 2004 / Volume 119.

Heesch, KC., Spence, RR., and Brown WJ. (2010) Exercise and cancer rehabilitation: A systematic review. *Cancer Treatment Reviews* 36: 185-194.

IBM SPSS (2009) *PASW Statistics 18.* Available at: http://www-01.ibm.com/software/analytics/spss/ (accessed 12 June 2012).

International Physical Activity Questionnaire (2002) *International Physical Activity Questionnaire (IPAQ), long last 7 days self-administered format.* Available at: http://www.ipaq.ki.se/ (accessed 12 June 2012).

International Physical Activity Questionnaire (2005) *Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire – Short and Long Forms.* http://www.ipaq.ki.se/ipaq.htmAvailable at: http://www.ipaq.ki.se/scoring.htm (accessed 12 June 2012).

Lante, K. and Walkley, J. (2008) International Physical Activity Questionnaire - Intellectual Disability (IPAQ-ID). *Journal of Intellectual Disability Research* 52: 747-747.

Lynnes, M. D., Nichols, D. and Temple, V. A. (2009) Fostering independence in health-promoting exercise. *Journal of Intellectual Disabilities* 13: 143-159.

Mahy, J., Shields, N., Taylor, N.F., and K J Dodd. (2010) Identifying facilitators and barriers to physical activity for adults with Down syndrome. *Journal of Intellectual Disability Research* 54 (9): 795-805.

Melville, C. A., Hamilton, S., Miller, S. (2009) Carer knowledge and perceptions of healthy lifestyles for adults with intellectual disabilities. *Journal of Applied Research in Intellectual Disabilities* 22 (3): 298-306.

Moss, S. J. (2009) Changes in coronary heart disease risk profile of adults with intellectual disabilities following a physical activity intervention. *Journal of Intellectual Disability Research* 53: 735-744.

National Disability Authority (2009) *Ethical Guidance for Research with People with Disabilities.* Dublin: National Disability Authority.

Prasher, Vee P. and Janicki, Matthew P. (ed.) 2002. *Physical Health of Adults with Intellectual Disabilities*. Oxford: Blackwell.

Reid, G., Vallerand, R. J., Poulin, C. and Crocker, P. (2009) The development and validation of the pictorial motivation scale in physical activity. *Motivation and Emotion* 33: 161-172.

Royal College of Nursing (2006) *Meeting the health needs of people with learning disabilities. Guidance for nursing staff.* London: Royal College of Nursing.

Royal College of Nursing (2011) *Meeting the health needs of people with learning disabilities. Guidance for nursing staff.* London: Royal College of Nursing.

Stanish, H. I. and Draheim, C. C. (2007) Walking activity, body composition and blood pressure in adults with intellectual disabilities. *Journal of Applied Research in Intellectual Disabilities* 20:183-190.

Temple, V. A. (2007) Barriers, enjoyment, and preference for physical activity among adults with intellectual disability. *International Journal of Rehabilitation Research* 30 (4): 281-287.

Temple, V. A. (2009) Factors associated with high levels of physical activity among adults with intellectual disability. *International Journal of Rehabilitation Research* 32: 89-92.

Temple, V. A. and Stanish, H. I. (2008) Physical activity and persons with intellectual disability: some considerations for Latin America. *Salud Publica De Mexico* 50: 185-193.

Temple, V. A. and Stanish, H. I. (2009) Pedometer-measured physical activity of adults with intellectual disability: predicting weekly step counts. *American Journal on Intellectual & Developmental Disabilities* 114: 15-22.

Temple, V. A. and Walkley, J. W. (2003) Physical activity of adults with intellectual disability. *Journal of Intellectual and Developmental Disability* 28: 342-352.

Temple, V. A. and Walkley, J. W. (2007) Perspectives of constraining and enabling factors for health-promoting physical activity by adults with intellectual disability. *Journal of Intellectual & Developmental Disability* 32: 28-38.

Tudor-Locke C, and Bassett D.R. Jr. (2004) How many steps/day are enough? Preliminary pedometer indices for public health. *Sports Medicine* 34: 1-8.

U.S. Department of Health and Human Services (2008) *Physical Activity Guidelines for Americans.* Atlanta: U.S. Department of Health and Human Services.

Walsh, P. N., Hall, L. and Ryan D. (2008) *POMONA II Final report Health indicators for people with intellectual disability*. Ireland: University College Dublin.

World Health Organization (2009) *Global Strategy on Diet, Physical Activity and Health.* Geneva: World Health Organization.

Yalon-Chamovitz, S. and Weiss, P.L. (2008) Virtual reality as a leisure activity for young adults with physical and intellectual disabilities. *Research in Developmental Disabilities*, 29: 273-287.

Yang, C. and Hsu, Y. (2010) A Review of Accelerometry-Based Wearable Motion Detectors for Physical Activity Monitoring. *Sensors* 10: 7772-7788.