Energy expenditure measured with accelerometers and self-report questionnaire in people with intellectual disabilities

Running head: Energy expenditure in intellectual disability

The authors report no conflicts of interest'.

Abstract

Background: There are different instruments to measure energy expenditure in general population but we do not know whether these instruments can be used in people with intellectual disability. **Method:** The sample of 33 participants was invited to wear a triaxial accelerometer during seven consecutive days. Energy expenditure was measured with the IPAQ-S to gather data regarding the participant's descriptions of the physical activity performed. **Results:** Agreement between the accelerometers and IPAQ-S in terms of energy expenditure measurements was not reached ($p>0.05$). A significant correlation was found between moderate Metabolic Equivalent of Tasks (METs) measured with accelerometers and vigorous METs measured with the IPAQ-S ($r=-0.351$ [$p=0.045$]). **Conclusion:** The main conclusion of this study was a level of discrepancy between measurements taken using the IPAQ-S and the accelerometers in people with intellectual disability.

Keywords

Physical activity; assessment; intellectual disabilities; rehabilitation

Introduction

Approximately 1.5% of the general population in the world is diagnosed with an intellectual disability, and this percentage is increased in developed countries ("Discapacidad intelectual: aspectos generales," n.d.). Individuals with intellectual disability often engage in few physical activities, spending their free time in sedentary behaviours (around 80–95%) (Finlayson et al., 2010). The remainder of physical activity is performed in varying intensities (light, moderate and vigorous) (Carmeli et al., 2012). This awareness is important as performing physical activity reduces risk of hypertension, stroke, diabetes, colon and breast cancer, especially in individuals with intellectual disabilities (Takahashi et al., 2012). Physical activity also increases muscle strength, and improves balance, flexibility and the aerobic condition (Taylor et al., 2004).

To understand the quantity of energy expenditure that people with intellectual disability carry out, there are different scales and methods available. One of the most used methods is the International Physical Activity Questionnaire Short Version (IPAQ-S), which has been used to measure physical activity in people with intellectual disability in previous studies (Matthews et al., 2011; Pérez-Cruzado and Cuesta-Vargas, 2013). In addition, the use of accelerometers to measure physical activity and energy expenditure has increased, owing to their high reliability (Eston et al., 1998; Sirard and Pate, 2001). This is because accelerometers provide us with objective data about the physical activity performed while the accelerometer is worn. Accelerometers allow us to know the physical activity performed during a period of time, its duration and its intensity(Sirard and Pate, 2001).

Although accelerometers are instruments with a high level of reliability in terms of measuring physical activity in people with intellectual disability (Temple et al., 2000), Accelerometers are not able to differentiate between light, moderate and vigorous physical activity without the use of a specific cut-off point (Prince et al., 2015). Debido a la falta de unos puntos de corte específicos para las personas con discapacidad intelctual, son usados As a result, Freedson's cut-off points were used (Freedson et al., 1998) to determine the categories of physical activity. Although these cut-off points were validated in healthy people (Freedson et al., 1998), they have been used in different studies of people with intellectual disability (Izquierdo-Gomez et al., 2014; Matthews et al., 2011). However, these cut-off points have not been validated in this population

The objective of this study was to determine whether or not there was an agreement between the measurements of energy expenditure between the objective measurements from accelerometers and the measurements obtained from the self-reported questionnaire IPAQ-S in a sample of Spanish people with intellectual disability. We wanted to know whether there was agreement between the levels of energy expenditure (light, moderate and vigorous) measured with IPAQ-S and accelerometers using Freedson et al.'s (Freedson et al., 1998) cut-off points.

Method

Design

An observational study was carried out to determine the agreement between the measurements of energy expenditure from the IPAQ-S and accelerometers in a Spanish sample of people with intellectual disabilities.

Participants

The sample included 33 Spanish people (24 men and 9 women) between 18 and 60 years old with mild intellectual disability (Intelligence quotient = 55-70) («Information about intellectual disability: what is it? Effects of intellectual disability.» 2011) at an occupational centre, Aspromanis Industrial, in Malaga, Spain. The inclusion criteria were: participants that were responsible enough to wear the accelerometer for seven consecutive days and people that had the capability to read and write to answers for the self-reported questionnaire. The exclusion criteria was: people diagnosed with any

diseases that could prevent them from carrying out physical activity. Before the research commenced, we guaranteed the protection of the participants' data (Law 15/1999 of Data Protection). Informed consent was obtained from the participants or their family members to participate in the study.

Outcomes measures

We used the IPAQ-S to measure the physical activity performed by the participants over the previous seven days. With this scale, we can determine the light, moderate and vigorous activity, as well as the sedentary behaviour, that the participants were engaged in over the previous seven days. Participants have to report how many days per week they have performed physical activity and the duration in hours and minutes. This scale has been used in previous studies in people with intellectual disability (Matthews et al., 2011; Pérez-Cruzado and Cuesta-Vargas, 2013). And has an acceptable reliability within the Spanish population (Kappa coefficient = 0.60) (Román Viñas et al., 2012).

We used triaxial accelerometers (Actigraph Gt3x) to obtain objective measurements of physical activity and converted the data to energy expenditure. Accelerometers have previously been used in people with intellectual disability to measure physical activity (Izquierdo-Gomez et al., 2014; Matthews et al., 2011; Alexander C. Phillips and Holland, 2011).Debido a que no existen puntos de corte especificos para las persoans con

discapacidad intellectual, fueron usados los puntos de cortes apra la general population de Freedson et al. (Freedson, Melanson, & Sirard, 1998).

Procedure

We explained the objective of the study to the participants and then invited them to wear a small accelerometer on their hip (Actigraph Gt3x, 4.6 cm x 3.3 cm x 1.5 cm, 19 g) in order to measure physical activity over the next seven days. Before placing the accelerometers, we explained to the participants and their families how the accelerometers needed to be placed, highlighting the fact that the accelerometers had to always be located on the hip (including during sleep), and accelerometers could only be removed when the person showered or if there was any risk of contact with water. When this was explained and understood by the participants and their families, we placed the accelerometers Gt3x on the participants' hip using an elastic belt for maximum comfort. Accelerometers were programmed with a record sequence for the seven days, with a 1-second epoch of register frequency. Data from the accelerometers were analysed using Actilife software (v.6.6.2). Data from the accelerometers were filtered to determine the amount of physical activity that the participants participated in during the seven consecutive days, deleting the periods when the accelerometer was not worn for longer than 45 minutes. All participants wore the acceletometer during seven consecutive days. The data were analysed and we calculated light, moderate and vigorous energy expenditure using Freedson et al.'s (1998) cut-off points.

When the participants removed the accelerometers, self-report measures (IPAQ-S) were completed by participants in order to determine what types of physical activity the participant engaged in during the seven days that the accelerometer was worn. Participants received an explanation about light, moderate and vigorous physical activity, and the researchers ensured that all participants understood this. Data measured with IPAQ-S were transformed to METs following the IPAQ guidelines ("IPAQ_final-scoring.pdf," n.d.).

Statistical analysis

A database was created with data obtained from the IPAQ-S and the accelerometers. Descriptive data were extracted, with the means and standard deviations then calculated. A statistical analysis was performed to determine the agreement between the measurements obtained with the IPAQ-S and those obtained with the accelerometers, using a linear Pearson correlation with a 95% CI. We defined low correlation as $r \leq 0.3$, moderate correlation as $r > 0.3r \leq 0.6$ and high correlation as $r > 0.6$ (Portney and Watkins, 2009). Data were analysed using the statistical software SPSS package (version 20.0)

Ethical issues

The institutional review committee at the University of Malaga approved the procedures used in this study and ethical recommendations were taken into consideration at all stages during the research. Informed consent was obtained from all subjects, and study procedures were consistent with the Helsinki declaration.

Results

The participants had a mean age of 35.86 (±9.92). Their mean weight was 79.97 (±15.47) kilograms and their mean height was 169 (±12) centimetres.

In Table 1 and Table 2, we present the METs data obtained from the IPAQ-S and the accelerometers, as well as the correlations between them. Not significant correlations were found within the same categories (light, moderate and vigorous) between the IPAQ-S and the accelerometers, but it is also important to note that there was a significant correlation between moderate METs from the accelerometers and vigorous METs from the IPAQ (r=0.351 [p=0.045]). We did not find significant correlations between the total METs measured with the IPAQ-S and with the accelerometers (r=-0.162 [p=0.368]).

Discussion

To our knowledge, this is the first study that has analysed the agreement between categories (light, moderate and vigorous) in terms of energy expenditure, as measured by using the IPAQ-S and the accelerometers in Spanish people with intellectual disability.

A similar study was carried out with people diagnosed with intellectual disability in Glasgow (Matthews et al., 2011). In that study, the researchers compared the agreement

between physical activity measured with the IPAQ-S and the uniaxial accelerometers, but did not make comparisons by categories. Our results are not in concordance with the study of Matthews et al. (Matthews et al., 2011), as the results of Matthews et al.'s study suggest that there was an underestimation in the data obtained using the IPAQ-S. In contrast, the results of our study found an overestimation of data when using the IPAQ-S, with a mean difference of 6431.88 (±6738.02) between the total METs, as measured with the IPAQ and the accelerometers. This overestimation in people with intellectual disabilities is supported by previous published studies (Bermúdez et al., 2013; Boon et al., 2010).

In contrast, the METs data obtained with the accelerometers are consistent with previous studies that have measured energy expenditure in people with intellectual disability from different countries (Agiovlasitis et al., 2012; Alexander C Phillips and Holland, 2011), as well as in the Spanish population (Izquierdo-Gomez et al., 2014). The lack of concordance between the METs measured with the IPAQ-S and those recorded with the accelerometers could be explained by the lack of concordance between the Spanish version of the IPAQ-S and the accelerometers when measuring physical activity (Medina et al., 2013) and illustrate the need to modify the IPAQ-S in order to obtain a reliable METs measurement, as suggested by Spence et al. (Spence et al., 2010) and Curry and Thompson (Curry and Thompson, 2014).

When examining the data on the energy expenditure obtained from the IPAQ-S and the accelerometers by categories (light, moderate and vigorous), we did not find significant

correlations between them. In fact, we only found a significant correlation ($p<0.05$) between the vigorous METs measured with the IPAQ-S and the moderate METs measured with the accelerometers. Results of the current research are consistent with the results of previous studies (Matthews et al., 2011; McKeon et al., 2013) in which they found disagreement between categories of physical activity assessed with the IPAQ-S and accelerometers.

Although some research studies have found that accelerometers and self-reported scales are reliable tools to assess physical activity in people with intellectual disabilities (Frey et al., 2008; Temple and Stanish, 2008), these studies have not evaluated the level of agreement between both tools. The current research shows the disagreement between both tools since they do not provide the same information about physical activity performed.

The results of the current research show the level of disagreement between accelerometers and the self-reported IPAQ-S scale for both total physical activity and physical activity by categories (light, moderate and vigorous). It would be necessary, as suggested by other authors (Agiovlasitis et al., 2012), to establish specific new cut-off points for people with intellectual disabilities to stratify the physical activity performed by this population.

Study limitations and strengths

The main strength of this study is the measurement of energy expenditure in a Spanish population diagnosed with mild intellectual disability in order to determine the agreement between accelerometers and the IPAQ-S. It is also important to note that we obtained measurements using a triaxial accelerometer, while previous studies used uniaxial accelerometers.

On the other hand, some weaknesses of this study are that the sample size was relatively small, and it was not possible to establish new activity-level cut-off points for people with intellectual disability. It would be interesting to know the level of agreement and to establish new cut-off points for people with moderate and severe intellectual disability due to the fact that levels of physical activity in this population are different from those of the population with mild intellectual disability (Alexander C Phillips and Holland, 2011).

Conclusions

The main conclusion of this study is the knowledge of a lack of concordance between energy expenditure measured with the IPAQ-S and accelerometers in Spanish people with mild intellectual disability for each category of energy expenditure. It is, therefore, necessary to establish new cut-off points for this population.

Conflicts of interest

The authors declare that there are no conflicts of interest.

Authors´ contributions

CV have made contribution to conception of this study. PC participated in the collect of data. CV and PC participated in the analysis and interpretation of data and were involved in drafting the manuscript or revising it critically for important intellectual content. Both authors read and approved the final manuscript.

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Table 1. Mets per week obtained from the IPAQ-Short version and Accelerometer Gt3x

	Mean (±SD)
Vig_Met_IPAQ-S	4854.54 (±7357.96)
Mod_Met_IPAQ-S	541.21 (±624.41)
Light_Met_IPAQ-S	1619.03 (±2043.86)
Total_Met_IPAQ-S	7014.78 (±7509.26)
Vig_Met_ACC	17.66 (±56.84)
Mod_Met_ACC	140.48 (±199.69)
Light_Met_ACC	424.76 (±756.07)
Total_Met_ACC	582.90 (±771.24)

Vig: Vigorous; Mod: Moderate; IPAQ-S: International Physical Activity Questionnaire Short version; ACC: Accelerometer

Table 2. Agreement between METs obtained of IPAQ-Short version and Accelerometers Gt3x

	Vig_Met_ACC	**Mod_Met_ACC**	**Light_Met_ACC**
Vig_Met_IPAQ	-0.204 (0.256)	0.351 (0.045)*	-0.227(0.204)
Mod_Met_IPAQ	-0.118 (0.515)	-0.209 (0.242)	0.166 (0.356)
Light_Met_IPAQ	0.157 (0.382)	0.070 (0.697)	0.055 (0.761)

	Total_Met_ACC
Total_Met_IPAQ	-0.162 (0.368)

Vig: Vigorous; Mod: Moderate; IPAQ: International Physical Activity Questionnaire; ACC: Accelerometer

*:$p<0.05$