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Physical Activity Measurements Using Accelerometers and Pedometers in HIV-Infected People

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Abstract

Research suggest that physical activity (PA) is inversely related to numerous metabolic disorders in people who are living with HIV. Objective and accurate measurement of habitual PA in this population is essential for a better knowledge of the relationship between PA levels and health benefits. Pedometers and accelerometers are widely use in exercise science to obtain objective measurements of PA. This systematic review has been focused on the use of pedometers and accelerometers in HIV-infected population in order to verify the PA levels. The actual recommendation for healthy people of ≥ 10,000 steps•day^{-1} is unrealistically high for the population living with HIV. Compared with previous reports on healthy adults, people living with HIV have lower levels of PA. Few studies have assessed PA level using pedometers and accelerometers in people who are living with HIV, so it is not possible define the real PA patterns of HIV-infected yet because there is a lack of information about this issue. Future studies should assess PA objectively (pedometers and/or accelerometers) in people who are living with HIV in order to improve knowledge of PA levels and its relationship with health benefits.

Keywords: Physical activity; Exercise; Systematic review; Pedometers; Accelerometers; HIV; AIDS

Introduction

Physical activity (PA), defined as any bodily movement produced by skeletal muscles that results in energy expenditure [1], has been identified as priority area in general health promotion [2] and it has been recommended as part of the global strategy for prevention of non-transmissible diseases [3]. Nowadays Human Immunodeficiency Virus (HIV) is considered as a chronic disease because individuals have the potential to live upward of 20 years on highly active antiretroviral therapy [4].

The current PA guideline suggests that adults should engage in moderate-to-vigorous PA at least 30 minutes a day, five days a week [3]. Moreover, there are PA guidelines for other diseases such as: hypertension, coronary artery disease or cancer among others [5-7]. For example, hypertension patients are recommended primarily endurance exercise supplemented by resistance exercise (exercise frequency: all days of the week, intensity: moderate intensity (40-60% VO_2R), duration: ≥ 30 min•day^{-1} of continuous or accumulated PA). For people who are living with HIV there are no specific exercise recommendations although it has been demonstrated that PA in this people is inversely related to numerous metabolic disorders like high level of insulin resistance and triglycerides, muscle wasting, depression, osteopenia or dyslipidemia between others [8-12]. As well as PA can improve quality of life and self-efficacy, increase the number of CD4 T-lymphocyte counts and high-density lipoproteins [13-16].

Self-report PA measures through the completion of questionnaires, interviews and surveys are frequently used in research [5], because of they are easily administered and can provide information on the types of activities performed, although they do not capture activity patterns throughout the day [17] and perceived PA intensity depend on the experience and the stoicism of the person [18]. Criterion and objective methods of measuring PA are generally considered superior to these subjective methods. Objective PA measures have gained much attention lately to overcome limitations of self-report measures. Other methods of measuring PA include more direct, objective and physiological measures, such as measures of energy expenditure using direct calorimetry with doubly labeled water or heart rate response [5,6]. Other objective assessments of PA can be made with motion sensors, which measure activity in one or more planes of movement. The simplest objective instrument is a pedometer, which counts the steps that a person takes, and is particularly useful for capturing walking behavior [19]. More complex devices, known as accelerometers, can measure motion and also record the time and assess the intensity of the movement; this is more useful for characterizing the total volume of activity, and estimated energy expenditure [20-23]. Even though the main limitation of accelerometers to approximate energy expenditure is the impossibility to detect the full energy expenditure of certain activities such as walking, carrying a load or walking uphill, because acceleration do not change under these conditions, they provide completely objective information that is not dependent on a subjective response of people [24]. In general, there is scarce information regarding PA levels in HIV-infected individuals and the use of accelerometers and pedometers for measuring PA in HIV-infected people in epidemiological studies has been relatively uncommon. Accurate measurement of habitual PA is vital for a better understanding of associations between PA and health [25], and to address appropriate recommendation of PA to maintain good health [26].

This systematic review is focuses on the use of motion sensors (pedometers and accelerometers) in HIV-infected population in order to verify the PA levels.

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Our literature search was primarily based on the journals available in MEDLINE, the National Library of Medicine´s publication database covering the fields of life sciences, biomedicine, and health using a combination of key words (pedometers, accelerometers, exercise, physical activity, HIV, AIDS). Articles published after the end of July 2011 are not included in this review. The literature search was limited to articles published in English, Spanish and French. The eligibility criteria included observational studies that evaluated physical activity performed by HIV-infected adults. Prevalence, cross-sectional, and cohort studies that assessed physical activity using a pedometers or accelerometers were eligible.

Results and Discussion

Until 2004 there had not still been assessed PA level in people living with HIV [27].Since this year PA level in this population has been assessed by different methods. The most studies centered on PA levels in VIH-infected subjects have used questionnaires and only 3 studies used accelerometers or pedometers. Thus it is necessary more work in this field with people who are living with HIV.

Bopp et al. [27] determined the relationship between PA levels and viral load and CD4+ cell count in 66 men and women. PA levels were determined by wrist Actigraph accelerometer on the non-dominant hand of the subject for 3 days; who maintained their normal level of daily PA. Data are poorly described in the paper, the authors only reported an average PA minutes per day (144±31 min•day^{-1}) (Table 1). They concluded that there is an inverse relationship between activity, independent of intensity and stage of illness, and virus load in HIV-RNA infected people, however there are an association between daily PA levels and health benefits in HIV-infected. There are some limitations and concerns in this study: a) only 3 days were assessed [28], b) a wider range of age (18-64) was considered, for these reason and given the influence of age on PA level [28], it is very difficult to obtain significant and relevant normal PA level in people living with HIV.

Two studies used objective measurements to assess the accuracy of International Physical Activity Questionnaire (IPAQ) [14,29]. PA level was assessed by Ramirez-Marreno and coworkers in 58 Hispanic adults (23 women and 35 men) by accelerometers (uniaxial CSA or GT7164) and pedometers (Yamax Digiwalker) during 7 consecutive days [29]. The accelerometer was set at 1 minute epoch. All participants were previously instructed for the use of monitor devices, furthermore, all days they received a reminder telephone call asked the number of step and reminding the accelerometer protocol. The compliance criterion was defined as at least 5 days of data collection, including at least 1 weekend day and a minimum of 10 hours per day of record. The averages for activity counts per day, minutes per day at specific intensity levels, and minutes per week of moderate to vigorous PA (MVPA) using published cutoff points (Table 1) was calculated. The authors reported that people living with HIV showed an average of 120 min per week doing light activities and 700 min per week as inactivity. The activity counts per day was 262,833±114,984 (women: 22,737±80,013; men: 24,914±10,359) and the steps per day was 7,495±2,817 (women:

Authors	Participants	Monitor activity and setting	Protocol	Psysical Activity score used	Results: Physical Activity Levels	Conclusion
Boop CM [27] 2004	N=66 men and women Age: 18-64 years (39±8 years) All participants were on antiretroviral medications	Wrist atigraph (Ambulatory Monitoring, Inc., Ardsley, NY) Physical activity indes is calculated as the percentage of time units where actility levels were recorded at greater than zero	Worn 3 days. Monitor placement: non-dominant hand	Physical Activity index, mean physical activity level and acceleration activity	Average minutes of PA 144±31 min/day (Low, moderate and high intensity activities are all incluyed in this value)Ranging from 43 to 193 min)	Inverse relationship between activity, independent of intensity and stage of illness, and viral load in HIV-RNA infected individuals. There are an association between daily physical activity level and health benefits in HIV-infected individuals.
Ramirez- Marrero FA et al[20] 2008	N=58 Hispanic adults (23 women and 35 men) Age: 45.9 years (±9.3) 89% on antiretroviral therapy	Actigraph Model GT7164 (or CSA) (Actigraph, Fort Walton Beach, FL) 1 min epoch	Worn 7 consecutive days Activity monitor data were included in the analyses if at least 10 hour/day of register at least 5 days, at least 1 day on a weekend Monitor placement: right waist	Activity counts/day Activity counts/min at specific intensity levels Average min/week of MVPA using cut-points: Ligth activity = 101-1951 counts/min, moderate activity = 1952-5724 counts/min, vigorous actuvity > 5724) Step	Light activities: 120 min/week Inactivity: 700 min/week Activity counts/day: 262,833±114,984 (22,7370±80,013women) (24,9146±10,3592 men) Steps/day: 7,495±2,817 (7,886±2,662 women) (6,862±2,246men)	Hispanic participants living with HIV had lower levels of PA. Activity level recorded by International Physical Activity Questionnaire overestimated their activity level in comparasion accelerometry, especially among in moderate-intensity activities
Fillipas S et al.[14] 2010	N=30 males Age: 53.2 years (±10.2) 6(0.25-0.21 range) years on antiretroviral therapy	Actigraph GT1M (Actigraph, LLC, Pensacola, FL) 1 min epoch	Worn 7 consecutive days during all waking hours except during waer-based activities. Activity monitor data were included in the analyses if at least 600 minutes of register per day at least 5 days, 1 of which had to be on a weekend Monitor placement: right hip	Activity counts Energy Expenditure per week expressed as kilocalories per week Time spent in each activity (minutes/week) Step	Moderate activity: 237 min/week Vigorous activity: 8 min/week Activity counts/week: 176,7400±796,028 Step/week: 47,608.9±19,839.6	The International Physical Activity Questionnaire overstimates moderate and vigorous Physical Activity in HIV-Infected individuals compared with accelerometer data
		DigiWalker model 200 pedometer (Yamax Corporation, Tokyo, Japan)			Steps/day:7,594 (7,151±2,817women) (7,418±2,714men)	

Table 1: Relevant information of each paper that used objective measures to assessment physical activity levels in HIV-infected people. (HIV = Human Immunodeficiency Virus, PA = Physical Activity and MVPA = Moderate to Vigorous Physical Activity).

7,886±2,662; men: 6,862±2,246). Ramirez-Marrero et al. concluded (Table 1) that, compared with previous reports on healthy adults, Hispanic participants living with HIV had lower levels of PA as recorded by the ActiGraph and higher overestimation of their activity levels using the IPAQ. Furthermore, many participants who achieved ≥ 150 min per week of MVPA measured by accelerometers did not reach ≥ 10000 steps per day assessed by pedometers. For this reason, when it was possible, we propose the combined use of pedometers and accelerometers. The actual recommendation of steps for healthy people is established in several researches, in which cut-points were defined as follows: i). <5,000 steps•day^{-1} may be used as a 'sedentary lifestyle index'; (ii) 5,000-7,499 steps•day^{-1} is typical of daily activity excluding "sports/exercise" and might be considered 'low active'; (iii) 7,500-9,999 steps•day^{-1} likely includes some volitional activities (and/or elevated occupational activity demands) and might be considered 'somewhat active'; and (iv) >or=10000 steps•day^{-1} indicates the point that should be used to classify individuals as 'active'. Individuals who take >12,500 steps•day^{-1} are likely to be classified as 'highly active' [19,30]. Agree with Tudor et al. [19] and Ramirez-Marrero et al. [29] we consider that a goal of 10,000 steps•day^{-1} may not be sustainable for some special groups, such as people living with chronic diseases, i.e. people who are living with HIV.

The study of Fillipas [14] assessed PA levels during 7 consecutive days in 30 HIV-infected male by accelerometers (uniaxial GT1M Actigraph. Epoch: 1 minute). All participants were instructed for a correct use of monitor device. Only records for ≥10 hours per day and at least one day of the weekend were included for analyses. Activity counts were categorized into one of the three activity level: light (<3 MET: <1,953 counts), moderate (3-6 METS: 1,953-5,724) and vigorous (>6 METS: >5,725). Data are presented in table 1,237 min per week of moderate activity level and 8 min per week of vigorous activity were recorded. The activity counts per week were 176,740±796,028 and steps per week were 47,608±19,839.The limitations of this study include its relatively moderate sample size and the fact that it included a small number of participants who self-reported a low level of physical activity. All of the patients were recruited from a clinic that promotes a healthy lifestyle and most of them participate in regular physical activity [31]. Fillipas and coworkers concluded that the IPAQ questionnaire overestimated moderate and vigorous PA compared with accelerometer data, but no more descriptive data are shown. It would be interesting that authors provide detailed information referred to activity counts output.

There are evidences that suggest that people who are living with HIV have less PA levels than healthy populations, such as the number of steps per day(<10,000 steps•day^{-1}) and time doing physical activity (120 min per week doing light activities, 237 min per week of moderate activity level and 8 min per week of vigorous activity).

Conclusions

In conclusion, few studies have assessed PA level using pedometers and accelerometers in people who are living with HIV. So it is needed more work in this area because it is not possible determine the real PA patterns of HIV-infected yet, as well as there are not defined a specifically exercise guideline for people who are living with HIV due to lack of information about this issue. Future studies should assess PA objectively (pedometers and/or accelerometers) in people who are living with HIV in order to improve knowledge of PA levels and its relationship with health benefits. It is recommended that clinicians seeking precise measurements of physical activity also use an objective instrument, like an accelerometer or pedometer. To optimize the evaluation of this tool for use in this population, further research is needed to determine the cut-points for activity counts that actually remain unclear for HIV-infected people.

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