REVIEW

Measuring Overall Physical Activity for Cardiac Rehabilitation Participants: A Review of the Literature

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Background	Assessment of physical activity (PA) for cardiac rehabilitation (CR) participants is critical to monitor changes. However, the validity and reliability of PA measures to assess PA throughout the day, not only during exercise training, is poorly investigated.
Aim	To establish a reliable and valid measure to assess overall PA in CR participants.
Methods	A narrative literature review was performed based on a systematic search of EMBASE, CINAHL, MEDLINE and PubMed databases. Eight studies comparing two or more PA measures with at least one direct measure met the inclusion criteria.
Results	Methodological designs were heterogeneous. Correlations and levels of agreement between self-reported measures and direct measures were weak to moderate, while the correlations between direct measures were high. Of the direct measures, the SenseWear armband had the highest validity, and the PA diary and MobilePAL questionnaires performed better than other self-reported PA measures.
Conclusion	Direct measures were more valid and reliable than self-reported measures. No recommendation for a definitive PA measure was made due to lack of strong evidentiary support for one PA measure over another. There is a need for accurate measures of overall PA in evaluating current and changing PA levels following CR.
Keywords	Cardiac rehabilitation • Physical activity assessment • Questionnaire • Activity monitor • Validity • Reliability

Introduction

Cardiovascular disease (CVD) is a major cause of death and disability [1]. However, both cardiac and total mortality may be reduced by cardiac rehabilitation (CR) [2] particularly when supervised, structured exercise is included. The benefits of exercise include stabilisation or reversal of the atherosclerotic process and psychological well-being [3,4], particularly when exercise achieves recommended levels over the whole day, not only during supervised exercise training at CR but also at home [5]. However, non-adherence to PA recommendations remains a major concern in the CR population [6], and methods are needed to accurately quantify overall PA, not just in supervised CR sessions.

Accurate quantification of PA in CR is crucial [7]. Accuracy is important to monitor trajectories of PA, assess the effectiveness of interventions, examine dose-response relationships, and define which PA dimensions (i.e. frequency,

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duration and intensity) are important for specific health outcomes [7]. Nonetheless, measuring PA in the CR setting is challenging because there are substantial variations in the population including age, diagnoses, disease severity, and stage of recovery [7]. In general, self-reported and direct measures are proposed in the literature on measurement of PA and their strengths, weaknesses, reliability and validity are comprehensively discussed in a number of reviews [7–9]. Self-reported measures that assess overall PA are the most frequently used approaches in CR due to their practicality and cost-effectiveness [7]. However, most self-reported PA measures for cardiac patients have great variability, low validity and reliability, and are typically suitable for epidemiologic studies rather than CR settings [7].

Direct measures of PA are likely to be superior to indirect measures in minimising over- or under-reporting. Of direct measures, accelerometry technologies have distinct benefits in continuously measuring activities of daily living, metabolic expenditures (METs), and step counts [10,11]. Use of such measures enables clinicians to monitor the progress of the patients' activity levels remotely (i.e. outside of CR settings) and intervene in a timely way. For instance, step counts and active minutes tracked per day could be used to evaluate if the patient attains the CR daily PA recommendation (10,000 steps/day or 30 minutes or more of moderate to vigorous physical activity [MVPA]) [10].

To date, there is a substantial body of literature related to the validity and reliability of PA measures in healthy people [8,9,12]. There are, however, far fewer validation studies for people with existing CHD in CR settings [13,14]. Hence, achieving a precise measurement of overall PA in cardiac patients during and following rehabilitation remains a significant clinical and public health issue [7]. The aim of this study is to establish a reliable and valid measure to assess overall PA in CR participants by performing a narrative literature review that compares two or more PA measures with at least one direct measure.

Methods

Search Strategy

A search strategy was developed in consultation with the health librarian. The following electronic databases were searched: EMBASE; CINAHL; MEDLINE; and PubMed. A search of Google Scholar and a hand search of the reference lists in the selected studies were also performed to identify further relevant studies. The key search terms included: (1) ''physical activity'', or ''exercise''; (2) ''cardiac rehabilitation'' or ''secondary prevention''; (3) ''survey'', ''measure'', ''instrument'', ''questionnaire'', ''monitor'' or ''track''; (4) ''validity'', or ''development''.

Eligible for review were primary research studies published in English that reported evidence for validity and/or reliability on self-reported and/or direct measures of PA among CR participants including randomised controlled trials and validation studies. Only studies including adult participants who were commencing or had completed a CR program were eligible. Studies that compared two or more PA measures with at least one direct measure were also eligible. Finally, the primary outcomes were validity and/or reliability on self-reported and/or direct measures of PA that examined the PA construct, including measures such as frequency, intensity and duration of activity rather than physical function or fitness in a CR setting.

Screening of Search Findings

The initial search output was 461 studies (summarised in Figure 1). Where there was uncertainty regarding eligibility, the full text was evaluated and a decision made following discussion between two team members (MA and RG). After assessment of the abstract of each study and a hand search of the reference list, 13 potentially relevant studies were identified and were subject to a full-text review. Of the 13 studies, 5 did not meet the inclusion criteria and were excluded from this review.

Quality Appraisal

The Kowalski et al. (2012) [8] checklist was used to assess the quality of the reviewed studies (see Appendix A). It consists of 21 items (nine quality of reporting criteria, three external validity criteria, and nine internal validity criteria) with a maximum score of 22 points. Overall, total scores of the reviewed studies ranged from 10 to 18, with a mean total score of 14.3. The external validity ratings of most studies were moderate with a range of items from one to two and a mean external validity score of 1.6. Similarly, the internal validity ratings of most studies were moderate with a range of items from two to seven and a mean internal validity score of 4.8.

Results

The main characteristics of the eight studies of PA measures in CR are summarised in Table 1, validity outcomes are synthesised in Table 2, and reliability outcomes in Table 3.

Participants and Setting

In total, the eight studies involved 397 participants, although sample sizes varied, ranging from 9 [15] to 73 [16]. The mean age ranged from 57.6 [17] to 72.1 [18] years and mean BMI ranged from 27 [14] to 32.8 [11] kg/m^2, with the minority of participants, female (21.5%). Cardiac diagnoses of participants were diverse, but the predominant diagnosis was myocardial infarction. Most of the reviewed studies indicated a low PA population, with participants having an average 7134 ± 2808 steps/day [15]; spending 95 ± 76 [18] or 119.5 [16] minutes of MVPA/week; a minority (only 3%) achieving the recommended PA levels of 30 minutes of MVPA/day [13]; and reaching a PA energy expenditure of 1.69 ± 0.1 METs/minutes [19]. Recruitment of participants in relation to CR enrolment varied: before commencing CR [18]; current enrolments [11,13,15,16,19]; CR completed [17]; and