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Original Article

Levels of moderate–vigorous physical activity are low in Spanish children with cystic fibrosis: A comparison with healthy controls

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Abstract

Background: Physical activity (PA) is recommended as part of the treatment regimen for cystic fibrosis (CF) although objective methods have been scarcely used to monitor achievement of PA guidelines.
Methods: PA was measured by accelerometer in outpatient CF children (n = 47) and results were compared with those obtained in age- and gender-matched healthy controls (n = 39).
Results: 2.1% of the outpatients fulfilled PA guidelines (i.e. ≥60 min·day^{-1} of moderate-to-vigorous PA (MVPA)) vs. 34.2% of controls. Overall, lower MVPA levels were observed in CF patients than controls despite the former undergoing more light or total PA. Peak oxygen uptake was also lower in the CF group than in controls (37.5 ± 7.8 vs. 43.5 ± 7.6 ml·kg^{-1}·min^{-1}, $p = 0.002$) and was correlated with MVPA and vigorous PA in the former.
Conclusions: These findings support a need to promote PA interventions (including MVPA) targeted at improving cardiorespiratory fitness in CF children.

Keywords: Physical activity; Guidelines; Cardiorespiratory fitness

1. Introduction

Cystic fibrosis (CF) is an inherited genetic disorder that leads to progressive deterioration of lung function and physical capacity; it affects approximately one in 2500 newborns [1]. The median life expectancy of patients with CF is around 31 years [2]. Regular physical activity (PA) has become increasingly important and widely accepted as part of the therapy and rehabilitation programs in CF management [3]; although, PA remains underutilized and not always incorporated into routine CF management [3]. Several studies have reported beneficial effects of exercise training that include: slower lung function decline [4], enhanced airway clearance [5], improved nutritional status and quality of life [6] and reduced hospital admissions [7]. The additional training benefits for CF patients do not differ from those for healthy individuals and include mainly improved aerobic fitness and muscle strength [8,9].

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It is known that there is correlation between PA levels and aerobic fitness (as determined by peak oxygen uptake, VO_{2peak}) [10] and higher aerobic fitness is a predictor of survival in this disease [11–15]. It is consequently of medical interest to quantify actual PA levels in children with CF to help prescribe PA programs designed to improve their aerobic fitness.

Current guidelines indicate that children and adolescents should engage in at least 60 min of moderate to vigorous PA (MVPA) daily [16]. However, given that many children fail to reach this level of activity [17], there is a need to ensure that youths are meeting the PA guidelines recommended for optimal health outcomes. This is especially important in CF children; however, despite the known impact of PA on the health and quality of life of these children, there has been relatively little research evaluating the PA levels of this patient group. One of the reasons for this deficiency is that assessing PA in children using self- or parent-administered questionnaires has many limitations; children find it especially difficult to describe or quantify their PA levels [18]. Such limitations have led to an increasing interest in the use of more objective methods to monitor PA. As opposed to questionnaires, accelerometers can provide minute-by-minute recordings of PA and can therefore be used to objectively quantify PA [19].

To date, there are studies in which PA levels in children [6,20] or adults [21] with CF have been measured objectively by accelerometers. Yet the studies in CF children have some methodological limitations, i.e. use of activity counts rather than activity cut-point thresholds to quantify activity intensity [6] or insufficient number of accelerometer wearing days for appropriate PA analysis [20]. This situation makes it difficult to determine if children were performing light, MVPA or vigorous PA. There is a need for longer periods of monitoring PA objectively and the use of intensity cut-points to obtain information on usual PA levels in children with CF (including the comparison of weekend vs. weekday activity behavior) and on how well these patients comply with current PA guidelines. Such data would add valuable information to the existing literature and help health carers recommend PA more effectively.

The purpose of our study was to objectively measure PA levels in outpatient children with CF vs. age and gender-matched healthy controls over a week (as well as on week days vs. weekends), and to determine the proportion of them meeting the PA guidelines (primary outcome). VO_{2peak} was also determined in the two groups to examine its possible correlation with PA (secondary outcome). We hypothesized that children undergoing treatment for CF would show overall reduced MVPA levels compared to their healthy peers, with the majority of the former not meeting the PA guidelines.

2. Materials and methods

2.1. Participants

The research project was in accordance with the Declaration of Helsinki Research of 1974 (last modified in 2008) and was approved by the corresponding Review Board (Children's Hospital *Niño Jesús*; Madrid, Spain). Informed consent was obtained from the parents of each participant.

Participants were recruited by screening the medical records of this hospital's Pneumology department to select 113 children under treatment for CF. After the corresponding pneumologist provided consent, subjects were enrolled in the study if they met each of the inclusion criteria: outpatient diagnosed using a genetic test for CF and treated at the aforementioned hospital, and boy/girl aged 6–17 years living in the Madrid region (so that they could attend VO_{2peak} testing sessions). Exclusion criteria were: having severe lung deterioration (forced expiratory volume (FEV_1) < 50% the expected value), an unstable clinical condition (i.e. hospitalization within the previous 3 months), *Burkholderia cepacia* infection, or any condition (e.g. muscle–skeletal disorder) impairing exercise testing. According to these criteria, 73 children with CF were originally enrolled in the study; valid accelerometry data was obtained in 47 (see Fig. 1 for the flow diagram of the participants in the CF group) of whom 39 had also undergone a cardiorespiratory fitness test (see below).

The data of the CF children were compared to those of 39 age and gender-matched controls with complete accelerometry and VO_{2peak} data (see below) pooled from a total cohort of 118 children living in the same neighborhood. The same measurements (using the same methodology and equipment) were performed in the two groups during years 2010–2012, as explained below. Anthropometric and cardiorespiratory fitness evaluations were performed in the exercise physiology laboratory of the Children's Hospital *Niño Jesús* (CF group) and of the European University of Madrid (control group).

2.2. Measurements

2.2.1. Anthropometric data

Height without shoes was measured using a clinical stadiometer (Asimed T2, Barcelona, Spain) and recorded to the nearest millimeter. Body mass was determined to the nearest 0.05 kg using a balance scale (Ano Sayol S.L., Barcelona, Spain) with subjects in their underwear. Body mass index (BMI) was calculated as weight/height ($kg \cdot m^{-2}$). Skinfold thickness was measured with a Harpenden caliper (Holtan Crymych, United Kingdom) at the biceps, triceps, sub-scapular, abdominal, supra-iliac, thigh and calf areas following the criteria described elsewhere [22]. Percentage of body fat [23] was calculated from body density values using age- and gender-specific equations, i.e. for boys and girls aged ≤11 years [24], 12–15 years [25], and 16–18 years [26].

2.2.2. Accelerometry

PA was planned to be measured on 7 consecutive days (Thursday to Wednesday or Friday to Thursday) using the Actigraph GT3X accelerometer (Actigraph, Pensacola, FL, USA). All children wore the accelerometer in an elastic waistband on their right hip during the day, except while bathing or undertaking other water activities. Verbal and written instructions for the care and placement of the monitor were given to both the children and their parents. The GT3X is