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Original article

Relationships between respiratory parameters, exercise capacity and psychosocial factors in people with chronic obstructive pulmonary disease

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ABSTRACT

Background: Chronic obstructive pulmonary disease (COPD) affects respiratory functioning and psychosocial factors. However, little is known about perceived ability of people with COPD to engage in a regular exercise program. This study assessed respiratory parameters, exercise capacity, psychosocial factors and their relations in people with COPD.

Methods: This cross-sectional study involved patients with COPD recruited from a Nigerian university teaching hospital. Respiratory parameters including forced expiratory volume in 1 sec (FEV_1) and forced vital capacity (FVC) were assessed by using a spirometer and FEV_1/FVC ratio was calculated. Participants were sitting upright in a comfortable chair and wearing a nose clip for measurements. The procedure was performed in accordance with the American Thoracic Society criteria. Exercise capacity was assessed by the 6-min walk test (6MWT). Gait speed was assessed by the distance covered in 6 min. Perceived exercise self-efficacy (PESE) and rating of perceived exertion (RPE) were assessed by exercise self-efficacy and Borg scales, respectively. Data were analysed using descriptive and inferential statistics. Alpha level was set at $P < 0.05$.

Results: The mean age of the 125 participants was 62.0 ± 7.1 years (60% male). The mean values for FEV_1, FVC and FEV_1/FVC were 1.8 ± 0.6 L, 2.4 ± 0.5 L and 58.0 ± 8.8%, respectively, and the mean 6MWT and PESE values were 291.1 ± 41.6 m 63.1 ± 11.2%. Exercise capacity was correlated with mean values for the respiratory parameters FEV_1 ($r = 0.29$; $P = 0.035$), FVC ($r = 0.32$; $P = 0.045$) and FEV_1/FVC ratio ($r = 0.37$; $P = 0.007$), and both exercise capacity and PESE were correlated with gait speed ($r = 0.96$, $P = 0.001$ and $r = 0.57$; $P = 0.042$) and RPE ($r = 0.42$, $P = 0.050$ and $r = -0.44$; $P = 0.032$), but PESE was not correlated with respiratory parameter values ($P > 0.05$).

Conclusion: Participants with COPD demonstrated reduced respiratory parameter values and low exercise capacity but moderate PESE. We found significant correlations between exercise capacity and respiratory parameter values, but PESE was correlated with only gait speed and RPE. The study has implications for respiratory health promotion and exercise adherence.

1. Introduction

The prevalence of chronic obstructive pulmonary disease (COPD) is on the rise. Recent reports from the World Health Organization showed that more than 65 million people worldwide have moderate to severe COPD [1]. As well, more than 3 million people died of COPD in 2002, which corresponds to 5% of all adult deaths globally [1]. By 2030, COPD is estimated to be the third leading cause of death worldwide [1,2].

In most developing countries, including Nigeria, the burden of respiratory disease is largely unknown, although that of infectious and non-infectious respiratory diseases appears to be increasing

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[3]. About 2 decades ago, a nationwide survey of non-communicable diseases affirmed that COPD contributes significantly to the burden of non-communicable diseases [4].

COPD is a group of progressive lung diseases characterized by persistent cough, productive sputum, wheezing and difficulty breathing that leads to reduced pulmonary function, exercise intolerance, and worsening capability to perform activities of daily living [5]. Several risk factors for COPD include but are not limited to cigarette smoking, inhalation of poor-quality air, indoor cooking using biomass materials, especially among women, and long-term untreated or recurrent respiratory tract infections [6,7]. The detrimental consequences of a sedentary lifestyle in patients with COPD have substantially increased the interest in studies monitoring physical activity in the past decade [8]. Although pharmacological treatment of COPD has been effective in controlling infections, improving lung functioning and health-related quality of life, many patients still have poor exercise tolerance and severe disability in performing activities of daily living [9].

Physical exercise is beneficial for improving exercise capacity, relieving respiratory distress, work efficiency, and health-related quality of life and reducing disability among patients with COPD, independent of disease severity [10]. Similarly, participation in regular exercise programs improves aerobic capacity and rating of perceived exertion (RPE), also described as perceived exercise sensation, in patients with respiratory conditions [10,11]. To encourage regular participation in physical activity, the psychological aspect of performing prescribed exercises to enhance confidence and sustain exercise practice is paramount. Therefore, pulmonary exercise rehabilitation, including walking as a form of aerobic exercise, has been recommended as an integral part of COPD management [11]. However, exercise as a form of health behaviour could be hindered by a number of factors including personal, disease-progression, environmental and psychosocial factors [12].

Social cognitive theory suggests that knowledge of health risks and benefits is a prerequisite to change, but additional self-influences are necessary for change to occur [13]. Beliefs regarding personal efficacy are among some of the influences that play a central role in health behaviour. Initiating and maintaining a physical exercise program is related to one's perception of self-efficacy or perceived ability to overcome self-reported obstacles to exercise [14]. In prescribing exercise, the individual's exercise tolerance and perceived ability to exercise must be determined before engaging in an exercise program. However, few studies have assessed exercise capacity and psychosocial factors, including exercise self-efficacy, in patients with COPD in sub-Saharan Africa. Furthermore, little is known about any relations between respiratory parameter values, exercise capacity, perceived exercise self-efficacy (PESE) and the sensation of exercise rather than fatigue in people with COPD.

Hence, the aim of this study was to assess respiratory parameters, exercise capacity and psychosocial factors and their relations among Nigerian people with COPD.

2. Methods

2.1. Study design and participants

In this cross-sectional survey, purposive sampling was used to recruit patients with COPD attending the Chest Clinic, Medical Out-Patient Department, Obafemi Awolowo University Teaching Hospitals Complex (OAUTHC), Ile-Ife, Nigeria. We included participants $\geq$ 40 years old with a medical and clinical diagnosis of COPD at stage 2 (moderate: 50% $\leq$ force expiratory volume [FEV_1] < 80% predicted) or 3 (severe: 30% $\leq$ FEV_1 < 50% predicted) [2]. We excluded participants with a history of tuberculosis or recurrent haemoptysis, recent chest or abdominal surgery, self-reported eye problem including severe intra-ocular pressure, or a cognitive problem or neurologic condition that might limit the ability to walk. We calculated the sample size required by using the formula: $n = Z^2(P\ (1-P)/e^2$, where n is the required sample size, Z the z-value (z-value for 95% confidence level [1.96]), P the estimated proportion of an attribute present in the population, and e the desired level of precision (i.e., confidence level, expressed as a decimal [0.05]) [15]. The prevalence (P) of any functional disability (defined as an inability to independently perform any function) is 9.2% [16]. Hence, we needed to include a minimum of 125 people with COPD for this study.

2.2. Procedure

Ethical approval for this study was obtained from the Ethics and Research Committee of the OAUTHC (ERC/2016/02/20), Ile-Ife, Nigeria. The purpose of the study was explained to prospective participants and informed consent form was obtained from volunteers.

Sociodemographic characteristics and medications prescribed, including bronchodilators, were recorded and anthropometric characteristics were measured. Cardiovascular parameters including heart rate and systolic and diastolic blood were measured by using an electronic blood pressure device (Omron Intelli sense M6 Comfort, Japan) after 5 min of quiet sitting. Respiratory parameters were assessed by using a standard spirometer, and PESE and exercise sensation (RPE) were assessed by using a validated exercise self-efficacy scale and the 10-point Borg scale, respectively.

2.3. Assessment of respiratory parameters

Respiratory parameters, including FEV_1 and forced vital capacity (FVC), were assessed by using a standard spirometer (Moose PFT system; Cybermedic, Louisville, CO, USA, software v3.8D), which was calibrated daily. Spirometry tests were conducted in the chest clinic by one pulmonologist (OF) to limit test variability. Before the start of the test, the spirometry test procedure was demonstrated to the participant. Participants were in an upright seated position in a comfortable chair and were wearing a nose clip. One-way disposal mouthpieces were used and the inside of the rubber bellows was cleaned regularly with methylated spirits to minimize cross-infection. Three spirometry trials were performed in accordance with the American Thoracic Society criteria to ensure uniformity [17]. The FEV_1/FVC ratio was estimated from the FEV_1 and FVC values.

2.4. Assessment of exercise capacity: 6-min walk test (6MWT)

The 6MWT was carried out on a 30 m enclosed level ground walkway marked out with 2 cones. A length of 30 m has been shown to provide optimum distance [18]. Participants were allowed to sit for about 5 min before the test, and pre-treatment vital signs were taken during this period. Participants were instructed to walk as fast as they could from one marked point to the other while attempting to cover as much ground as possible in 6 min [19]. At intervals, participants were reminded of the time left to complete the task. The total distance covered in 6 min was measured and recorded to the nearest meter. Furthermore, the gait speed of each participant was calculated and recorded. RPE was then assessed by using the 10-point Borg scale and cardiovascular parameters were re-assessed immediately after the 6MWT in seated participants.

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