RESEARCH
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Body Composition Measurement in Bronchiectasis: Comparison between Bioelectrical Impedance Analysis, Skinfold Thickness Measurement, and Dual-Energy X-ray Absorptiometry before and after Pulmonary Rehabilitation

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ABSTRACT

Background In individuals with bronchiectasis, fat-free mass depletion may be common despite a low prevalence of underweight and is considered a risk factor for increased morbidity and mortality. Techniques to adequately estimate fat-free mass and its changes over time are needed.

Objective The purpose of this study was to assess agreement among values obtained with three different body composition techniques: skinfold thickness measurement (STM), bioelectrical impedance analysis (BIA), and dual-energy x-ray absorptiometry (DXA).

Design The study was a secondary analysis of data from a randomized controlled trial.

Participants/setting A respiratory rehabilitation program was administered for 3 months to individuals with bronchiectasis from the bronchiectasis unit of the Regional University Hospital in Malaga, Spain, from September 2013 to September 2014. Individuals with a body mass index (calculated as kg/m^2) >18.5 who were aged 65 years or younger and those with a body mass index >20 who were older than 65 years were included.

Main outcome measures At baseline and at 3 and 6 months, body composition was determined by DXA and STM.

Statistical analyses performed Statistical concordance was assessed with the intraclass correlation coefficient (ICC), kappa coefficient, and the degree of agreement using the Bland Altman method. For comparison of the quantitative variables at baseline vs at 3 months and 6 months, the paired sample *t* test (or the Wilcoxon test) was used.

Results Thirty participants were included. Strong agreement was observed between body composition values determined by BIA and DXA in fat mass (ICC: 0.92) and fat-free mass (ICC: 0.87). Strong agreement was observed between STM and DXA in the values for fat-free mass (ICC: 0.91) and fat mass (ICC: 0.94), and lower agreement was observed for the longitudinal data and in the regional values. The mean difference between fat-free mass determined by BIA and DXA was + 4.7 with a standard deviation of 2.4 kg in favor of BIA. The mean difference between fat-free mass determined by STM and DXA was +2.3 with a standard deviation of 2.7 kg in favor of STM. Six individuals were classified as having a low fat-free mass index (20%) by DXA vs four by STM (13%; kappa: 0.76) and only two by BIA (6.6%; kappa: 0.44) compared with DXA.

Conclusions Despite good statistical agreement among values obtained with DXA, STM, and BIA, the study findings indicate that STM and BIA, above all, tended to overestimate fat-free mass compared with DXA.

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BRONCHIECTASIS IS A CONDITION INVOLVING IRREversible dilation of the bronchi and bronchioles as a consequence of the destruction of the elastic and muscular components of the bronchial wall. Bronchiectasis can be the outcome of many disorders that harm bronchial defense mechanisms and produce damage including alteration/imbalance in the mucociliary system, retention of secretions, and bacterial colonization.[1] The

prevalence of bronchiectasis has been estimated at 53 to 566 cases per 100, 000 persons.[2] Prevalence increases with age and female sex.[2]

The prevalence of malnutrition is high in individuals with chronic respiratory diseases, such as cystic fibrosis (CF), chronic obstructive pulmonary disease (COPD), and bronchiectasis, although in patients with the latter two diseases, there is a low prevalence of underweight.[3-5] Hence, in individuals with non-CF bronchiectasis, fat-free mass (FFM) depletion is common (about one-third of individuals) despite a low prevalence of underweight.[4] It is important to assess body composition with a precise technique. Body mass index (BMI; calculated as kg/m^2), however, is not sensitive enough to detect FFM depletion.[6,7] FFM depletion can influence the prognosis and treatment response, as well as the selection of candidates for pulmonary rehabilitation and adequate follow-up after its implementation.

A deterioration in nutritional status, especially a decrease in FFM, is directly related to a decline in lung function parameters, with a decrease in exercise capacity and a worsening of health-related quality of life.[3-5] A decrease in FFM has been proposed as a predictor of morbidity and mortality in patients with chronic respiratory diseases such as COPD, CF, and non-CF bronchiectasis.[3,5,8-12] In most of these studies, FFM was quantified by bio-electrical impedance analysis (BIA). Regional FFM determination by measurement of the mid-upper arm circumference or cross-sectional area of the thigh using computed tomography scan has also been shown to predict survival in individuals with COPD.[13,14] In individuals receiving oxygen therapy or ambulatory mechanical ventilation, FFM can be a sensitive and relevant nutritional parameter in relation to deterioration and disability.[15]

Dual-energy x-ray absorptiometry (DXA) was first developed to evaluate bone mass. It is also widely used and validated to measure FFM and fat mass and has been compared with other techniques for assessing body composition such as hydrostatic weighing, computed tomography, and magnetic resonance imaging. Currently, its use in the validation of other techniques is increasing, because it is considered the gold standard technique in clinical practice.[16]

Nonetheless, there is a need to know the degree of agreement between the values obtained with DXA and those obtained with other more easily implemented techniques in routine care, such as BIA or skinfold thickness measurement (STM), which are more readily available to health care teams. Although body composition has been evaluated in individuals with CF[7] and COPD,[17] this type of comparison has not been made in individuals with non-CF bronchiectasis either through measurements at a single point in time or longitudinally. Nor has there been an evaluation of the composition of regional body components (trunk, arms, legs) measured by DXA or BIA in this population. These measurements could be used to assess the presence of sarcopenia, which is related to increased mortality risk and causes impaired physical performance.[18] Furthermore, the different estimation formulas must be validated for each specific population.[17]

The objective of this study was to evaluate the agreement among values obtained with different body composition measurement techniques (STM, BIA, and DXA) to assess FFM and fat mass in individuals with bronchiectasis both at baseline and longitudinally (at 3 and 6 months) after participation in a pulmonary rehabilitation (PR) program. The proposed hypothesis is that both STM and BIA could provide sufficient precision to be used in clinical practice for evaluation of individuals with bronchiectasis.

RESEARCH SNAPSHOT

Research Question: What is the level of agreement among values obtained with the different techniques of body composition measurement for people with bronchiectasis?

Key Findings: Despite good statistical agreement of skinfold thickness measurement (STM) and bioelectrical impedance analysis (BIA) with dual-energy x-ray absorptiometry (DXA), STM, and particularly, BIA tend to overestimate fat-free mass (FFM). This could inappropriately classify participants with bronchiectasis as not having FFM depletion when in fact they have FFM depletion. However, given its simplicity and accuracy, STM could be a reasonable and inexpensive option for the nutritional assessment of individuals with non−cystic fibrosis bronchiectasis, when DXA is not available.

METHODS

This study was a secondary analysis of data from individuals participating in a prospective clinical trial in which they were randomly assigned to complete a structured PR program for 3 months vs PR together with a high-protein dietary supplement.[19] Participants were recruited from the bronchiectasis unit of the Regional University Hospital in Malaga, Spain, from September 2013 to September 2014. For this study, all 30 individuals included in the trial were evaluated in the same group, without differentiating between those who did and those who did not receive the high-protein supplement (Figure 1).

The inclusion criteria were as follows: a diagnosis of non-CF bronchiectasis, age 18 to 80 years, a BMI >18.5 for individuals age 65 or younger and a BMI >20 for those older than 65. In all cases, bronchiectasis was diagnosed by high-resolution computed tomography according to the criteria of Naidich and colleagues.[20] The PR program description and the effect of interventions on body composition measured by DXA have been published previously.[19] Demographic data, chronic colonization by pathogens, Bhalla scores on high-resolution computed tomography (scoring system that evaluates lung structural damage, with the maximum score being 25 points, which would be equivalent to normality),[21] FACED scale (multidimensional system capable of classifying the severity of bronchiectasis according to its prognosis, which includes forced expiratory volume in 1 second expressed as a percentage, age, whether there is colonization by *Pseudomonas aeruginosa*, number of lobes affected, and degree of dyspnea),[22] and spirometry data[23] were recorded.

The study was a secondary analysis of data from a randomized controlled trial that included individuals with bronchiectasis. At baseline and at 3 and 6 months, body composition was assessed using three techniques: STM, BIA, and DXA.

STM

Measurement of skinfolds (triceps, abdominal, biceps, and subscapular) was performed using a Holtain constant