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ORIGINAL ARTICLE

Validity of the ActiReg system in assessing energy requirement in chronic obstructive pulmonary disease patients

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KEYWORDS
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Summary
Background & aims: Malnutrition and weight loss are common in patients with chronic obstructive pulmonary disease (COPD) and effective nutritional support relies on accurate assessment of energy requirement. This could only be performed by measuring energy expenditure using objective methods. The aim of this study was to examine the validity of the ActiReg system in assessing energy requirement in non-hospitalized patients with severe COPD, using doubly labelled water (DLW) as criterion method.
Methods: Total energy expenditure (TEE) was assessed from 14 days DLW analysis in 13 patients. During the first 7 days TEE was simultaneously assessed using the ActiReg system, combining measured resting energy expenditure (REE) with physical activity monitoring.
Results: A difference of -88 (782) kJ d^{-1} ($P = 0.69$) was observed between the ActiReg system and DLW. REE explained 52% of the variation in TEE from DLW. Adding physical activity energy expenditure from the ActiReg system ($PAEE_{AR} = TEE_{AR}$–REE) increased the explained variation in TEE from DLW with 16%.
Conclusions: The ActiReg system is valid in assessing energy requirement in non-hospitalized patients with severe COPD. The unique feature of being able to discriminate within both the low intensity activity range and moderate-to-high intensity activity range makes the ActiReg system a valuable tool in clinical nutritional support.

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Introduction

Malnutrition and weight loss are common in patients with chronic obstructive pulmonary disease (COPD),[1–4] and low body mass index (BMI)[5,6] and low fat-free mass[7,8] are independent predictors of mortality in COPD. Most of the studies performing nutritional treatment of COPD patients have shown positive effects on body composition, muscle strength and/or respiratory function.[9,10] Hence, nutritional support maintaining energy balance and lean body mass is an important part of the treatment of COPD patients. However, without knowledge of the individual physical activity level (PAL) and energy requirement, maintenance of energy balance and lean body mass is not to be expected.[11]

Nutritional support for maintenance of energy balance in chronic diseases with malnutrition is most often performed by using prediction equations of resting energy expenditure (REE), and by adding different "theoretical" factors covering the disease-specific effect on the energy requirement and physical activity.[12] This can lead to variable and inaccurate assessments of energy requirement[13–16] and hence, create large discrepancies between the nutrition support given and the actual amount needed by the individual patient. The heterogeneity in COPD patients makes it difficult to provide individually adapted nutritional support by using these prediction equations and disease-specific factors. Large variations have been shown in both their total energy expenditure (TEE) and PAL.[17] Also, when measured REE has been compared to commonly used prediction equations, large individual differences appeared.[17] Together, this suggests that energy requirement should be assessed by direct measurement. The choice of method depends on whether the patent is hospitalized or not. The doubly labelled water (DLW) method is considered to be the golden standard method for assessment of TEE and could be used in both hospitalized and non-hospitalized patients, but the cost of using the method renders it inappropriate for daily clinical use. Technical advances in the field of indirect calorimetry have produced more user-friendly devices and increased the possibility to measure REE and TEE in hospitalized patients, but they are not well-suited for assessment of TEE under free-living conditions.

Motion detectors have been used frequently in COPD patients to describe their physical activity[18–22] but only once for the assessment of their energy expenditure.[11] However, when validating their ability to assess TEE under free-living conditions, the results have been varying and the bias at individual level is still not satisfying.[23–30] Also, the validating studies have been performed in healthy subjects. No validity study of motion detectors has been performed in COPD patients.

Chronically ill patients may be limited to rather low intensity activities due to their disease and these activities are difficult to quantify using questionnaires or interviews. Still, such activities contribute considerably to TEE. It has been reported that COPD patients are less physical active than healthy controls.[18,20,22] Hence, an important quality of the activity monitoring system is to discriminate between different low intensity activities. The ActiReg system contributes a new approach to physical activity monitoring by combining body position to body motion and emphasising also the low-intensity activities.[31] A simplified calculation model has been developed to generate TEE by combining the body position, body motion and REE. The ActiReg system may be a useful instrument in a routinely assessment of energy requirement in COPD patients and in other patient groups for effective nutrition support. The ActiReg system has been validated against indirect calorimetry and DLW in young healthy males and females,[31] but never in COPD patients or in any other patient group. The aim of this study was to examine the validity of the ActiReg system in assessing energy expenditure in non-hospitalized patients with severe COPD, using DLW as criterion method.

Materials and methods

Study design

In a study of the outcome of a physiotherapy programme in underweight patients with severe COPD, energy expenditure was assessed using 14 days DLW analysis. During the first 7 days energy expenditure was simultaneously assessed by an activity monitor (ActiReg). REE was measured at the beginning of the 14 days measurement period together with body composition. Effects of the physiotherapy programme on energy expenditure will be presented elsewhere.

Subjects

All subjects were recruited consecutively from the outpatient COPD-unit at the Department of Respiratory Medicine, Sahlgrenska University Hospital, Göteborg, Sweden. Fifteen patients (6 males and 9 females) with severe and stable COPD,