Nutrition and energy expenditure in women with chronic obstructive pulmonary disease

Nighat Farooqi

Akademisk avhandling

som med vederbörligt tillstånd av Rektor vid Umeå universitet för avläggande av medicine doktorsexamen framläggs till offentligt försvar i Sal E04, målpunkt R-1 (byggnad 6E), Biomedicin, Norrlands Universitetssjukhus, fredagen den 27 januari, kl. 09:00.

Avhandlingen kommer att försvaras på svenska.

Fakultetsopponent: Professor, Tommy Cederholm, Institutionen för Folkhälsor- och vårdvetenskap, Klinisk nutrition och metabolism, Uppsala Universitet, Uppsala, Sverige.
Abstract

**Aim:** The overall objective of this thesis was to increase the knowledge and validate methods for assessment of total daily energy expenditure (TEE), energy requirement and energy intake (EI) in women with COPD. We also investigated the relationship of BMI with clinical characteristics of COPD in a population-based study. Due to the substantial and increasing morbidity in women with COPD, special attention was given to this group.

**Methods:** Resting metabolic rate (RMR) was measured by indirect calorimetry (IC). TEE was measured by criterion method, doubly labeled water (DLW) (Paper I-III) during a 14-day period, TEE was simultaneously assessed by SenseWear Armband, software version 5.1 and 6.1 (SWA5 respectively SWA6), and ActiHeart (paper I). EI was assessed by diet history interview and 7-day food diary (paper II), and energy requirement was predicted using pedometer-determined physical activity level (paper III). Energy requirement data was also acquired from studies concerning TEE measured by DLW in patients with COPD (paper IV). BMI and other characteristics in subjects with COPD were compared with non-COPD subjects in a population-based study, Obstructive Lung disease in Norrbotten study (OLIN) (paper V).

**Results:** There was a large variation in RMR and TEE measured by DLW in this group of women with COPD. The results of energy expenditure study showed that the SWA5 assessed TEE with good accuracy over a 14-day period in free-living women with COPD. However, the SWA6 and ActiHeart methods tend to underestimate TEE. A higher proportion of women were within ±5% of the TEE individually measured with the DLW method using SWA5 than SWA6 and AH (63%, 47%, 37% respectively). The agreement between the TEE measured by DLW and SWA5 was strong, and with SWA6 and ActiHeart it was lesser. Bland-Altman plots revealed no systematic bias for TEE. The reported EI was underestimated by 28% respectively 20 % when assessed by diet, and the 7-day food diary compared with the criterion method, DLW. More women were identified as valid-reporters based on their 7-day food diaries than on their diet histories (63% vs 32%). The accuracy of reported EI was only related to BMI. The agreement between the DLW and the EI methods was weak. The Bland-Altman plots revealed a slight systematic bias for both methods. The energy requirement predicted by pedometer-determined PAL multiplied by six different RMR equations was within a reasonable accuracy (±10%) of the measured TEE for all equations except one. The agreement between the DLW and four of six predicted TEE methods was strong. The Bland–Altman plots revealed no systematic bias for predicted energy requirement except for one. Estimated PAL from the pedometer was lower by 14 % than the measured criterion PAL.

The energy requirement calculation based on available TEE data measured by DLW varied by BW and FFM. Compared to men, women had a lower RMR and TEE/kg BW/day, and higher RMR and TEE/kg FFM/day. The correlates of RMR/kg BW were gender and forced expiratory volume in 1st second (FEV1) % of predicted value, of TEE/ kg BW the correlates were age and gender, and of TEE/kg FFM were age and FEV1 % predicted. BMI decreased significantly with increase in disease severity and correlated significantly to forced expiratory volume in 1st second % predicted.

In the population-based study (OLIN), subjects with COPD had lower BMI and a higher prevalence of under-weight than in non-COPD, and its sub-groups namely, normal lung function and restrictive spirometry pattern subjects. There was an independent association between COPD and low BMI. Fewer COPD subjects were obese than in the non-COPD, normal lung function and restrictive spirometry pattern groups. Among the subjects with COPD, women had a lower mean BMI and a higher proportion were under-weight than men. In COPD women with under-weight, FEV1 % predicted values increased with an increase in BMI.

**Conclusion:** Compared with the gold standard DLW method, the total daily energy expenditure can be assessed reliably by SenseWear Armband 5 in women with COPD, while other devices underestimated TEE. The energy intake was underestimated by diet history and 7-day food diary methods, and energy requirement was predicted with reasonable accuracy using pedometer-determined PAL and common RMR equations, compared with DLW. Furthermore, the energy requirement was determined per kg BW/day and per kg FFM/day, using DLW based TEE data in patients with COPD. In the population-based study (OLIN), subjects with COPD had lower BMI and higher prevalence of under-weight than subjects without COPD. There was a gender difference, which was particularly significant in COPD, for women to have lower mean BMI and a higher prevalence of under-weight. The present findings indicate that low BMI is common in COPD and needs to be intervened. For a successful nutritional treatment, it is imperative to assess the patient’s energy expenditure, intake, and the requirement objectively, considering the burden of COPD, especially in women.

**Keywords:** Energy expenditure and COPD; Energy intake and COPD; Energy requirement and COPD; Women with COPD; DLW and COPD; SenseWear Armband and COPD; ActiHeart and COPD; Pedometer-determined PAL; BMI and COPD.

**Language** English  
**ISSN** 0346-6612  
**Number of pages** 115 + 5 papers