

## **4.1 Introduction**

Physical activity levels in patients with chronic obstructive pulmonary disease (COPD) are mostly presented as a total amount or as an average of multiple measurement days [44, 45, 46, 47, 48, 49]. Nevertheless, physical activity is a multi-dimensional construct which should be described by relevant constructs and measures [50]. A more detailed approach to physical activity data analysis could provide complementary information about the physical activity behaviour of patients with COPD. For example, patients with COPD have shown to perform bouts of moderate-to-vigorous physical activity, but the proportion of time in bouts and the frequency of bouts decreased with increasing disease severity [51].

Studies in different patient populations show that a more detailed analysis of physical activity can be achieved by plotting physical activity hourly patterns [50, 52, 53] and by applying cluster analysis to physical activity measures [52, 54, 55]. Physical activity hourly patterns provide a graphic representation of the temporal trends of physical activity intensities over the course of a day [50, 52, 53] and they have shown to provide useful information. Rochester et al [56], for example, observed a delayed morning start and a reduced peak of activity in patients with Parkinson's disease, while Evering and co-workers [57] observed a less physically active pattern in the afternoon and evening in patients with chronic fatigue syndrome. Cluster analysis [58], in turn, could be useful to identify subgroups of subjects with distinct physical activity characteristics. In middle-aged Chinese adults, Lee et al [52] were able to identify two clusters of subjects, one more active than the other. Male subjects in the least active cluster had higher body fat percentage and older age than those in the active group. These detailed analyses could then lead to new insights regarding subgroups of patients with COPD with specific physical activity patterns, which may be used in further investigations and intervention strategies [49, 59, 60]. Indeed, for specific groups of patients, greater and/or more sustainable results may be achieved if the focus shifts from an increase in moderate-to-vigorous activities towards a reduction in sedentary time [61, 62, 63, 64].

Therefore, the main contributions provided by this work are: to describe physical activity measures and physical activity hourly patterns in patients with COPD after stratification for generic and COPD-specific characteristics; and to identify clusters of patients with COPD based on physical activity measures.

## **4.2 Materials and methods**

### **4.2.1 Assessment of demographics, anthropometrics, lung function, and clinical data**

Age, sex, body mass index (BMI), post-bronchodilator forced expiratory volume in the first 1 second (FEV<sub>1</sub>, % of predicted), post-bronchodilator FEV<sub>1</sub> / forced vital capacity (FVC) ratio, diffusion capacity of the lung for carbon monoxide (DLCO, % of predicted), symptoms of dyspnoea by the modified Medical Research Council (mMRC) dyspnoea grade [65], and use of long-term oxygen therapy (LTOT, yes/no) were measured. In addition, the age, dyspnoea, and airflow obstruction (ADO) index was calculated, which predicts COPD mortality [66], and participants were stratified by BMI (underweight, <18.5 kg·m<sup>-2</sup>; normal weight, 18.5 to 24.99