days in the least active cluster. Irrespective of the cluster, patients seem to perform the activities with the highest intensity during the morning, which was also observed after stratification for different characteristics (Figure 18, Figure 19 and Figure 20). This should be taken into account when planning interventions such as energy conservation techniques, which have as one of the main aims to reduce unnecessary energy expenditure associated with activities of daily living [88].

4.6.3 Clinical relevance

Patients with COPD spent around 80% of their daily time in activities of very light intensity (Table V). Previous studies in COPD have focused on increasing the time in moderate-to-vigorous intensity [44, 51, 89], but there is emerging literature in other populations suggesting that health benefits can be achieved by decreasing time in very light intensity and increasing the participation in light intensity physical activities [61, 90, 91, 92].

Physical activity hourly patterns and physical activity clustering provide details on the duration and intensity of physical activities over the course of a day, as well as identify groups with specific physical activity patterns, which can broaden the understanding of physical activity in patients with COPD. Indeed, based on the results shown it can be speculated that cluster 1 is probably at increased risk of having a worse prognosis due to the combination of health-threatening characteristics (e.g., more time very light intensity, less time in moderate-to-vigorous intensity). Moreover, identifying groups with specific physical activity patterns seems to be useful information for tailoring physical activity enhancing interventions. Cluster 1, for instance, spent a median of 15 min·day-1 only in moderate-to-vigorous intensity, which is half of the recommended by international guidelines [81], and more than 15 hours in very light intensity (i.e., sedentary behaviour), which is more than two times of what other studies have considered as harmful (i.e., 7 hours) [93, 87]. This cluster therefore, could benefit from an intervention focusing not only on increasing the amount of time in moderate-to-vigorous intensity, but also on reducing the time in very light intensity. Cluster 4, on the other hand, seems to spend enough time in moderate-to-vigorous intensity (i.e., >30 min·day-1 in 10-min bouts), but would probably benefit from an intervention aiming to reduce the time in very light intensity, which is over 11 hours. To date, interventions targeting physical activity enhancement had limited impact in patients with COPD [59, 89, 94], but none of these interventions targeted specific physical activity patterns.

Decreasing the time in very light intensity without necessarily increasing the time in moderate-to-vigorous intensity would mean focusing on light intensity activities. Reductions in sedentary time by increases in light activities might be more realistic for patients with COPD, which in fact could help pave the way to posterior increases in the time in more intense activities [61, 63, 64]. This is supported by a recent study which demonstrated that greater quantity of low-intensity physical activity reduces the risk of COPD hospitalisation [62]. Of note, in that study high-intensity physical activity did not produce any risk reduction.

4.6.4 Strengths and Methodological Considerations

We have analysed a large and diverse sample of patients with COPD with objectively assessed physical activity data. This allowed detailed analyses of daily physical activity, even