

### 6.5.3 Trends in routines activation

Figure 41 shows the average values of the estimated time spent in each routine for all the 977 COPD patients, the matched 66 COPD patients, the matched 66 healthy subjects, and for the 977 COPD patients stratified according to their disease severity, where GOLD1 and GOLD4 indicate, respectively, the least and most severe stage of COPD. Each point in the figure identifies the mean over all the subjects of each group, where each subject is represented by the mean of the time spent in the different routines over the assessed weekdays (left) and weekend days (right). Comparison between the time spent in each of the 15 routines in the 977 COPD patients and the subgroup used to extract the routines (see inside the green dashed rectangles in Figure 41) shows that there are no statistical differences ( $p > 0.2$ ) in the time spent in each routine between the two groups in both assessed weekdays and weekend days. This indicates that the model is able to generalize across many COPD patients. When matched COPD and healthy subjects are compared (see inside the red rectangles in Figure 41), we found statistical differences between the two groups ( $p < 0.05$ ) during weekdays in R2, R3, R5, R10, R11, R12, R14, R15. During weekend days, statistical differences were found in R3, R4, R7, R14, R15. A reduced number of statistical differences in the weekend days indicates that the two groups assume a more similar behaviour during these days. This might be due to the fact that healthy subjects could still be active workers or that they perform weekly activities such as grocery shopping. On the contrary, they might use the weekend days to sleep more and rest. These assumptions could be confirmed by an increased value of the time spent in R2 and R11 during the weekend days of healthy subjects. High values of these two routines characterize only the COPD patients group during the weekdays. Comparing healthy subjects and the four different COPD groups (see inside the dashed blue rectangles in Figure 41), we observe five main trends over the different stages of the disease both in weekdays and weekend days. R2 and R11 are increasing with the increase of COPD severity. R2 represents a medium-inactive PA routine composed for the 39% by  $[L, L_1^d, L_3^{ST}, L_1^{GSR}]$  and by the 31% by  $[VL, L_2^d, L_2^{ST}, L_2^{GSR}]$ . The first PA descriptor represents light intensity movements characterized by short duration that cause a high increase of the temperature. The second term represents very light intensity movements of long duration that cause a moderate increase of physiological responses (high body temperature and high GSR). The positive trend is interrupted in the most severe group of patients that compensate a smaller value for R2 with a higher value of R11 and R15. A high value of the time spent in R11 could be associated with the most severe patients since their conditions might force them to spend more time in bed. R15 is characterized mainly by light intensity PA terms characterized by higher physiological responses if compared with R2. This might indicate a bigger effort in performing activities. The increased value of R2 for healthy subjects during weekend days has been discussed previously. Another rising trend is shown by R11 representing the time spent, while performing very inactive behaviour (mainly sleeping). On the other hand, we note that R3, R12, and R14 decrease with an increase in COPD severity. These three routines indicate movements performed with medium-high activity intensities characterized by small physiological responses. Of particular, interest are R3, R12 since they are weakly, but significantly correlated with  $FEV_1$ , %predicted ( $\rho = 0.3$ ,  $p = 2 \times 10^{-23}$ ,  $\rho = 0.2$ ,  $p = 5.8 \times 10^{-11}$ , respectively), and R14 weakly correlated with  $FEV_1$  ( $\rho = 0.2$ ,  $p = 3 \times 10^{-5}$ ). No correlation was found with age and BMI indicating that these discovered routines are decoupled from these variables. Statistical differences ( $p < 0.0001$ ) have been found in the percentage of activation of R3 and R14 between healthy subject