Frailty Identification using Heart Rate Response to Walking and Machine Learning Approach

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Previous research showed that frailty can influence autonomic nervous system and consequently heart rate (HR) behaviors in response to physical activities, which can ultimately influence the homeostatic state among older adults. While most studies have focused on resting-state HR characteristics, the objective of the current study was to classify pre-frail/frail vs. non-frail older adults using HR response to physical activity. For this study, 85 older adults (≥65 years) were recruited and stratified into frailty groups based on the Fried frailty phenotype as the gold standard. Groups consisted of 27 non-frail (age=78.70±7.32) and 58 pre-frail/frail individuals (age=81.00±8.14). Participants performed a normal speed walking as the physical task, while HR was measured using a wearable ECG and timing of the walking was recorded using a synchronized accelerometer sensor. HR was recorded using a two-lead setup attached to the left side of the torso and under the rib cage on the left side. After pre-processing, we extracted RR interval time series. We implemented logistic regression, XGBoost, and multilayer perceptron (MLP) to classify participants into frailty groups. We performed a 5-fold cross-validation procedure to account for the training and testing assignment of the data. Results showed that the MLP model with three hidden layers and 20, 15, and 10 units in each layer could best classify two frailty classes with an F1-score of 82%. These findings showed that measures of HR dynamics might provide an objective marker for frailty screening.