GNYACSM Abstract

Predicting Pain to Support Exercise Participation after Spinal Cord Injury

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ABSTRACT

The expansion of mobile health and predictive modeling may be worthwhile tools to predict subjective pain experiences and tailor personalized approaches for health behaviors after spinal cord injury (SCI).
PURPOSE: This study examined whether exercise (hybrid functional electrical stimulation rowing) and smartphone-based health and mobility data could reliably forecast changes in pain intensity among people with SCI.
METHODS: Data were collected via Suunto memory belt (heart rate), rower C2 log cards (training duration/frequency) and personal smartphones (location details, self-reported mood, pain, health, mobility) among (N=12) community-living adults with SCI over 9 months. Data were combined to predict the pain in the subsequent week. We applied nonlinear random forest algorithms, first transforming absolute scores week-to-week: '0'=no change or lessened pain, & '1'=worsened pain. Due to potential data imbalances, we applied k-fold cross-validation for model robustness. We referenced the F1 score ($\geq$0.80) to assess model predictive accuracy.
RESULTS: Our analysis underscored that while exercise data alone was insufficient for accurate predictions about the forthcoming week's pain (F1=0.40), combining it with, prior self-reported outcomes considerably enhanced predictive accuracy. We achieved notable success in forecasting pain intensity a week ahead for multiple feature groups. For example, when predicting next week's pain, we obtained an F1 score of 0.83 using the combination of (current) pain interference, and the difference in the hours out of bed this week and rowing frequency compared to the previous week. Similarly, the triad of TRIMPS, and the difference in pain interference and anxiety this week compared to last week also yielded an F1 score of 0.83, further emphasizing the value of integrating diverse data sources. Partial Dependence Plots revealed a positive nonlinear relationship.
CONCLUSION: Through a combination of various exercise, health, mood, and mobility metrics collected in-situ, we were able to predict future pain intensity among exercisers with SCI, as reflected by commendable F1-scores. This underscores the intricacies of pain experiences, and the utility of non-linear predictive models to understand and support exercise participation for those with SCI.