

Application Fields and Innovative Technologies

Digital Signatures of Caregiver Burden: Machine Learning Classification Using Multimodal In-Home Sensor Data B. Chimehi, J. Larivière-Chartier, B. Wallace, L. Ault, F. Knoefel, J. Kaye, Z. Beattie, J. Steele, L. Anderson, N. Thomas. *Gerontechnology* 25(s)

Purpose Caregiver burden is typically measured through self-report, and has not been studied using objective, continuous indicators of daily in-home activity. Sensor-based monitoring platforms, such as those developed through the Oregon Center for Aging & Technology (ORCATECH) [1], offer an opportunity to unobtrusively capture daily patterns and caregiving-related behaviors. While feasible, it remains unclear which sensor modalities best correspond to caregiver burden in dyads affected by cognitive impairment. This study aims to determine the sensor-based outcomes that are associated with caregiver burden levels using machine learning models trained on multimodal sensor combinations collected over 18 months.

Methods 47 spousal dyads were enrolled, each consisting of a person with cognitive impairment (PWCI) and their care partner. Following baseline assessments, the ORCATECH platform was installed in each home. Motion sensors, exit door contact sensors, bed sensors, wearable devices, a weight scale, and medication trackers provided continuous, high-frequency data on mobility, sleep, and health-related behaviors. Care partners completed weekly Zarit Burden Interview Short Form (ZBI-12) surveys [2].

Results and Discussion A total of 1,122 multisensor feature combinations were generated and evaluated based on classification accuracy and data completeness. 44 dyads contributed valid weekly data. The top-performing ML model was a Decision Tree Classifier trained on features from motion sensor and smartwatch steps from PWCI and their caregiver. This model achieved a weighted accuracy of 72%, outperforming all single-sensor and alternative configurations. Sensors measuring daily activity levels and environmental motion data produced the strongest predictive capability, supporting the potential of passive in-home sensing to identify behavioral markers of caregiver burden. These findings suggest that passive in-home sensing can enable early identification of elevated caregiver burden and facilitate timely implementation of support services before caregivers become overwhelmed.

References

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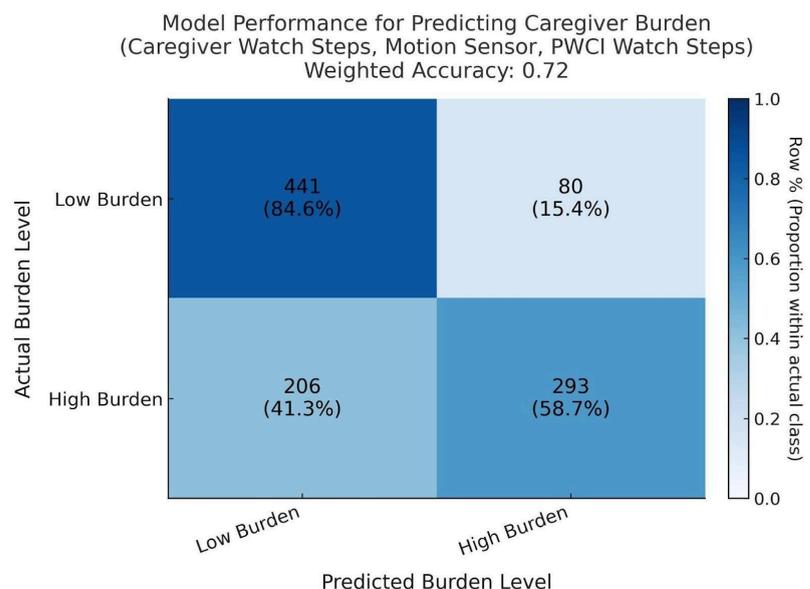


Figure 1: Confusion Matrix for Top Performing Model for combined sensors.