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The use of Internet of Things (IoT) technology for identification of eating events in an older adult population, a proof-of-concept study

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Internet of Things (IoT) technologies have the potential to integrate information technology with assistive technologies and are viewed as key drivers in the future of home-based healthcare delivery[(1)]. Considering malnutrition remains one of the most common nutritional challenges amongst older adult populations[(2)], the ability to detect the frequency of eating events in a longitudinal and unobtrusive manner presents an innovative opportunity for early detection and intervention in this area. As part of the wider study exploring the feasibility of an IoT-based system "NEX" to support older adults to live independently[(3)], this current study aims to investigate the accuracy of an IoT- based system deployed in older adult's homes to detect eating events based on triggering of a range of sensors in the home. Six older adult participants (age range 63–87 years, 67% (4/6) female) were recruited to take part in pilot testing of the NEX system in their homes for a 10-week period. The NEX system consists of a smartwatch (measurement of sleep and step count), voice-activated assistant (entertainment and reminder functionality), contact sensors (detect opening and closing of doors and cupboards), smart plugs (measure energy usage of appliances) and motion sensors (detect movement, temperature, humidity and light in the home). Data from these IoT sensors are gathered together and analysed in a holistic way to detect activities in the home. Researchers completed 2 non-consecutive 24-hour dietary recalls with participants using an online tool Foodbook24[(4)] with all participants. This data collection provided ground truth data on eating occasions required to develop algorithm mining association rules[(5)] for subsequent automated detection of eating events. Meal- based recall data was exported from Foodbook24 in CSV format for descriptive analysis. Only eating events that occurred in the home were further analysed with sensor data using a data modelling approach based on a sliding window and association rule mining. Across the 6 participants, 42 sensor-triggered events (events with more than one sensor used) were detected over a 2-day period. Of these events, 78% (33/42) were identified as eating events via the Foodbook24 recall data, the remaining 22% (9/42) were identified during the ground truth data collection as cleaning or food preparation activities. Comparing the Foodbook24 recall data to the sensor data, the sensor-based information provided an 82% (27/33) success rate in the identification of eating events. The remaining 18% (6/33) were eating events that were not captured in the sensor data. Although further research is warranted in this area, these efforts highlight real potential in using IoT systems and data analytics to facilitate timely nutrition interventions in this population.

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