

Population based screening for assessment of falls and mobility using wearable sensors

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Abstract: Falls are the among the most frequent and costly population health issues, costing \$50Bn in the US and €25Bn in the EU, each year. In the past 10 years, a range of digital technologies have been introduced to quantitatively address falls risk assessment, risk detection and management. Large datasets can be generated by incorporating these platforms into routine clinical practice, leading to opportunities for developing new insights on the prevalence and nature of falls risk in the ageing population. This paper presents an analysis of such a dataset, incorporating functional mobility and falls risk factor data from 8521 adults.

I. INTRODUCTION

Falls are the most frequent cause of accidental death and disability, thought to cost \$50bn each year in the United States alone [1]. Extensive research has shown that falls are not inevitable and can be reduced significantly (20-50%) by appropriate early intervention [2]. Effective early intervention is contingent on accurate screening and referral for patients at higher risk of experiencing a fall. Assessment of functional mobility is a critical element in quantifying and understanding the nature of falls risk and measuring response to remedial interventions in the assessment and management of falls. Increasingly, digital technologies are being used to carry out screening programs in the primary care and community settings. This is leading to the generation of large datasets that can provide insights into the challenges and nature of falls risk, enabling more efficient design of preventative strategies at a population level.

II. DATA

We report a descriptive analysis of 14,611 records from 8,521 participants (72.7±12.0 years, 5,392 female) assessed using a digital falls risk assessment protocol in 38 organizations across 6 countries. The data consist of wearable sensor data captured during the Timed Up and Go (TUG) test and self-reported questionnaire data on falls risk factors.

A supervising user consented the participant and collected the data using Kinesis QTUG™ (Kinesis Health Technologies, Dublin, Ireland). Each participant carried out the TUG test wearing body-worn inertial measurement units (IMUs) on each leg below the knee. QTUG calculates statistical measures of falls risk and mobility based on a large independent reference dataset.

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III. RESULTS

Questionnaire data was available for 6,954 participants, with 1,779 (25.6%) reporting a history of falls in the previous 12 months. 4,475 falls were reported in total with 854 participants reporting recurrent (two or more) falls. 26.4% of participants were considered to be at high or very high risk of falls (based on QTUG fall risk estimates), this is lower than some estimates and may reflect difficulties with underreporting and self-reported recall. 1008 of 6295 (21.5%) of participants who did not report any falls in the previous 12 months were found to be at high risk of falls, which could suggest these are participants with undetected risk who could stand to benefit most from preventative screening programs. 153 of 745 (20.5%) of participants with complete data who reported recurrent falls in the previous 12 months were found to be at low risk of falls.

Based on QTUG mobility scores, 2.7% of participants were found to have impaired gait symmetry while 29.8% of patient records indicated impaired (slow) walking speed. This might suggest that asymmetric gait is less prevalent than slow walking speed or high gait variability (observed in 19.5%), which is associated with falls. Problems with transfers (e.g. getting out of a chair), which is associated with poor lower limb and core strength were found in 17.5% of participants, problems turning (associated with poor balance or vestibular problems) were found in 13.9%.

IV. DISCUSSION

To our knowledge, this is the first study to report descriptive statistics for a large sample (N=8,521) of wearable sensor measures of fall risk and mobility impairment. Objective assessment of functional mobility, and associated falls risk, can take place in routine clinical practice such as primary care, or even in the home, without the need for highly trained personnel. This enables implementation of accurate community-based falls risk screening programs that can lead to a more preventative and streamlined approach to assessment and mitigation of falls risk in the community. Understanding factors associated with fall risk, such as gait variability or slow walking speed, may improve fall risk prevention interventions in targeting specific problems leading to future falls or mobility impairment.

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