

Safety Literature 27th January 2022

A hybrid model to identify fall occurrence from electronic health records

Fu S, Thorsteinsdottir B, Zhang X, Lopes GS, Pagali SR, LeBrasseur NK, Wen A, Liu H, Rocca WA, Olson JE, Sauver JS, Sohn S. *Int. J. Med. Inform.* 2022; 162: 104736.

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Abstract

INTRODUCTION: Falls are a leading cause of unintentional injury in the elderly. Electronic health records (EHRs) offer the unique opportunity to develop models that can identify fall events. However, identifying fall events in clinical notes requires advanced natural language processing (NLP) to simultaneously address multiple issues because the word "fall" is a typical homonym.

METHODS: We implemented a context-aware language model, Bidirectional Encoder Representations from Transformers (BERT) to identify falls from the EHR text and further fused the BERT model into a hybrid architecture coupled with post-hoc heuristic rules to enhance the performance. The models were evaluated on real world EHR data and were compared to conventional rule-based and deep learning models (CNN and Bi-LSTM). To better understand the ability of each approach to identify falls, we further categorize fall-related concepts (i.e., risk of fall, prevention of fall, homonym) and performed a detailed error analysis.

RESULTS: The hybrid model achieved the highest f1-score on sentence (0.971), document (0.985), and patient (0.954) level. At the sentence level (basic data unit in the model), the hybrid model had 0.954, 1.000, 0.988, and 0.999 in sensitivity, specificity, positive predictive value, and negative predictive value, respectively. The error analysis showed that that machine learning-based approaches demonstrated higher performance than a rule-based approach in challenging cases that required contextual understanding. The context-aware language model (BERT) slightly outperformed the word embedding approach trained on Bi-LSTM. No single model yielded the best performance for all fall-related semantic categories.

CONCLUSION: A context-aware language model (BERT) was able to identify challenging fall events that requires context understanding in EHR free text. The hybrid model combined with post-hoc rules allowed a custom fix on the BERT outcomes and further improved the performance of fall detection.

Language: en

Keywords

Fall; BERT; EHR; NLP

Association between daily activities and fall in older adults: an analysis of longitudinal ageing study in India (2017-18)

Nagarkar A, Kulkarni S. BMC Geriatr. 2022; 22(1): e203.

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Abstract

BACKGROUND: Declining functionality affects an individual's musculoskeletal integrity increasing the risk of fall and disability. Individuals with severe functional limitations are 5 times more likely to experience a fall. Thus, this paper investigated the association between functional decline and falls in older adults.

METHODS: This study uses secondary data from the Longitudinal Aging Study in India (2017-18). A total of 31,477 people over the age of 60 are included in the study. Descriptive statistics and bivariate analysis were performed to determine the association between activities of daily living (ADL), instrumental activities of daily living (IADL) and fall. Adjusted odds ratio was used to determine the association of ADL and IADL with fall while controlling for age, gender, balance and gait impairments.

RESULTS: The study reported 6352 fall episodes in 3270 participants aged 60 and above, over a period of 2 years. More than 30% of participants reported difficulty in ADL and IADL. Age and gender adjusted odds of fall were higher in participants with difficulty in more than 4 ADLs (AOR:1.32; CI:1.08 - 1.67) and in more than 2 IADL (AOR: 1.39; CI:1.02 - 1.89). Similarly, the odds of fall were higher for difficulty in ADL (AOR:1.31; CI:1.11 - 1.73) and IADL (AOR of 1.18; CI:1.07 - 1.29) controlling for gait and balance impairment. Difficulty in pushing-pulling objects (AOR: 1.30; CI: 1.15 - 1.46 & AOR: 1.40; CI: 1.21- 1.61) and getting up from the chair (AOR: 1.12; CI:1.01-1.26 & AOR: 1.27; CI: 0.99 - 1.26) was significantly associated with fall when adjusted for age, gender and balance and gait parameters.

CONCLUSIONS: This study provides the new insights into the association of fall and risk of functional decline, especially difficulty in pushing and pulling objects and getting up from a chair, can be incorporated in the primary screening of fall risk assessment.

Language: en

Keywords

India; Activities of daily living; Fall; Functionality; LASI

Association between free-living sit-to-stand transition characteristics, and lower-extremity performance, fear of falling, and stair negotiation difficulties among community-dwelling 75 to 85-year-old adults

Löppönen A, Karavirta L, Koivunen K, Portegijs E, Rantanen T, Finni T, Delecluse C, Van Roie E, Rantalainen T. *J. Gerontol. A Biol. Sci. Med. Sci.* 2022; ePub(ePub): ePub.

(Copyright © 2022, Gerontological Society of America)

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Abstract

BACKGROUND: Good sit-to-stand (STS) performance is an important factor in maintaining functional independence. This study investigated whether free-living STS transition volume and intensity, assessed by a thigh-worn accelerometer, is associated with characteristics related to functional independence.

METHODS: Free-living thigh-worn accelerometry was recorded continuously for three to seven days in a population-based sample of 75-, 80-, and 85-year-old community-dwelling people (479 participants; women $n = 287$, men $n = 192$). The records were used to evaluate the number and intensity (angular velocity of the sit-to-stand phase) of STS transitions. Associations with short physical performance battery (SPPB), five-times-sit-to-stand test (5xSTS), isometric knee extension force, self-reported fear of falls and self-reported difficulty in negotiating stairs were also assessed.

RESULTS: The number of STS transitions, mean and maximal angular velocity was lower in older age groups ($P < .05$). All variables were higher in men than in women ($P < .001$) and were positively associated with SPPB total points, knee-extension force (r ranged from 0.18 to 0.39, all $P < .001$) and negatively associated with 5xSTS ($r = -0.13 - -0.24$, all $P < .05$), lower extremity functional limitations ($P < .01$) fear of falls ($P < .01$) and stair negotiation difficulties ($P < .01$).

CONCLUSIONS: Free-living STS characteristics were related to lower-extremity performance, lower extremity functional limitations, self-reported fear of falls and stair negotiation difficulties, which can be a sensitive indicator of impending functional decline. Moreover, STS transitions may provide an indicator of adequacy of lower-limb muscle strength among older individuals.

Language: en

Keywords

chair rise; functional performance; geriatric assessment; physical function; physical performance

Effectiveness of Wii sports- based strategy training in reducing risk of falling, falls and improving quality of life in adults with idiopathic Parkinson's disease- a randomized comparative trial

Alagumoorthi G, Beulah JD, Thirunavukarasu S, Ramachandaran V, Kumaresan A. Clin. Rehabil. 2022; ePub(ePub): ePub.

(Copyright © 2022, SAGE Publishing)

DOI 10.1177/02692155221089030 **PMID** 35315706

Abstract

OBJECTIVE: To assess the effectiveness of Wii sports-based strategy training on risk of falling, falls and quality of life in adults with idiopathic Parkinson's disease.

DESIGN: Single blind, Randomised comparative trial. **SETTING:** Hospital and home.

SUBJECTS: Diagnosed as idiopathic Parkinson's disease, Hoehn-Yahr stage 2.5 to 4, history of at least 3 falls in the last 3 months. **INTERVENTION:** Experimental group participated in 30-40 min of Wii training, 3 session/week for 12 weeks and control group participated for the same duration in traditional balance training. During each session both the group received 30 min of conventional physiotherapy. **OUTCOMES:** Number of fallers, Fall rate, Berg balance scale, Timed up and go test, Parkinson's disease questionnaire 39, at baseline, 12(th) and 36(th) week after baseline.

RESULTS: We randomised 192 participants. Participant's characteristics were similar between Wii and control group at base line, in age 69.7 ± 10 , 68.5 ± 9.8 , disease severity 3.43 ± 0.56 , 3.42 ± 0.59 , and fall rate 10.47 ± 15.78 , 11.80 ± 18.95 (in mean \pm SD). At 12(th) week 28%(27), 51%(49) & 36(th) week 45%(42), 60%(57) in Wii-group, control group fell at least once, respectively. Wii group improved more than control group at 12(th), 36(th) week in number of fallers (-23%, $p < 0.001$) (-15%, $p < 0.039$), fall rates -2.635(-5.38 to 0.112), -1.476(-5.09 to 2.142) (difference in mean, Confidence Interval) and bodily discomfort component of PDQ 39.

CONCLUSION: A 12 weeks exercise training using the Wii sports-based strategy decreases the number of fallers, fall rate, measures of risk of falling but did not alter the quality of life in adults with idiopathic Parkinson's disease.

Language: en

Keywords

falls; quality of life; exercise; Parkinson; Wii training

Evaluation of peripheral neuropathy in lower limbs of patients with rheumatoid arthritis and its relation to fall risk

de Araújo Pereira F, de Almeida Lourenço M, de Assis MR. *Adv. Rheumatol.* 2022; 62(1): e9.

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Abstract

BACKGROUND: Rheumatoid Arthritis (RA) is a chronic disabling systemic disease characterized by joint inflammation, and extra-articular manifestations, including peripheral neuropathy, a condition that can be associated with changes in muscle strength, proprioception and postural balance contributing for the risk of falls. The objective of this study is to analyze the incidence of peripheral neuropathy in patients with RA and its association with the occurrence of falls.

METHODS: Patients were assessed by an electroneuromyography (ENMG) exam and by a questionnaire on accidental falls occurrence in the previous 12 months. They were also assessed on balance by the Short Physical Performance Battery (SPPB), functionality by the Health Assessment Questionnaire (HAQ), disease activity by the Disease Activity Score (DAS-28), neuropathic pain by the Questionnaire for the Diagnosis of Neuropathic Pain (DN4), and cutaneous sensitivity of the feet by the monofilament testing of Semmes-Weinstein. Monthly calls on falls were made in the subsequent six months. Data analysis was performed using the Shapiro-Wilk test for normality and Spearman, Chi-square, and T-student correlation tests, with a significant P level ≤ 0.05 .

RESULTS: A sample of 33 patients were evaluated. The incidence of peripheral neuropathy was 48.5%, of which 68.7% were axonal and 31.3% myelinic. The sensorimotor type was present in 64.7%, motor in 17.6%, and sensorial in 11.7% of the cases. Neuropathy was associated to balance ($P = 0.026$), neuropathic pain ($P = 0.016$), deep tendon reflexes absence ($P = 0,049$), altered skin sensitivity of the feet ($P = 0.029$) and fear of falling ($P = 0.001$). No association was found between peripheral neuropathy and age, gender, disease activity, or functionality. No significant association was found between peripheral neuropathy and occurrence of falls, in a 12-month retrospective and 6-month prospective evaluation.

CONCLUSION: Peripheral neuropathy has a high incidence in patients with RA, and is related to neuropathic pain, altered postural balance, but not to the occurrence of falls.

Language: en

Keywords

Accidental falls; Peripheral nervous system diseases; Postural balance; Rheumatoid arthritis

Evaluation of strategies to recruit and retain older people with dementia and their informal carers into a Tai Chi Trial to improve balance and prevent falls

Heward M, Johnson L, Nyman SR. *J. Frailty Sarcopenia Falls* 2022; 7(1): 1-12.

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DOI 10.22540/JFSF-07-001 **PMID** 35291569

Abstract

OBJECTIVES: Randomised control trials (trials) involving people with dementia lack detailed analysis of recruitment and retention strategies. To address this, we examined the effectiveness of strategies in "The TACIT Trial: TAI CHI for people with demenTia".

METHODS: We recruited dyads (people with dementia and carers) from 3 South of England sites utilising different strategies. Recruitment strategy effectiveness was measured by percent yield (number randomised of total referrals) and cost per randomised participant. Our retention strategy (maintaining contact with participants during weekly telephone calls) was measured by percent yield (number retained by six-month follow-up).

RESULTS: Of 359 dyads, 24% were randomised into the study (n=85). The most resource-intensive strategy (research nurses spending 30 minutes explaining the study) had the highest referral to randomisation rate. An incremental cost-effectiveness ratio suggested an alternative approach (nurses and doctors spending 5 minutes explaining the study) was most cost-effective. Retention rates were 86% (n=36/42; intervention group) and 81% (35/43; control group); main reasons for attrition were worsening health and lack of study interest.

CONCLUSIONS: The results demonstrate person-centred strategies enabling staff to spend time with participants were effective in supporting recruitment and retention. Those designing future trials must consider such strategies and the associated costs.

Language: en

Keywords

Falls; Exercise; Dementia; Recruitment and retention; Trial

Simulation versus written fall prevention education in older hospitalized adults: a randomized controlled study

DeWalt NC, Stahorsky KA, Sturges S, Bena JF, Morrison SL, Droblich Sulak L, Szczepinski L, Albert NM. *Clin. Nurs. Res.* 2022; ePub(ePub): ePub.

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DOI 10.1177/10547738221082192 **PMID** 35291853

Abstract

Using a randomized controlled, non-blinded, two-group design, differences in fall risk assessment, post-discharge sustainable fall risk changes, fall events and re-hospitalization were examined in 77 older adults who received a simulation (n = 36) or written (n = 41) education intervention. Between-group differences and changes in pre- versus post-fall risk assessment scores were examined using Pearson's chi-square, Wilcoxon rank sum or Fisher's exact tests (categorical variables) and two-sample t-tests (continuous variables). There were no statistically significant differences between groups in demographic characteristics. Patients who received simulation education had higher fall risk post-assessment scores than the written education group, $p = .022$. Change in fall risk assessment scores (post-vs.-pre; 95% confidence intervals) were higher in the simulation group compared to the written education group, 1.43 (0.37, 2.50), $p = .009$. At each post-discharge assessment, fall events were numerically fewer but not significantly different among simulation and education group participants. There were no statistically significant between-group differences in re-hospitalization.

Language: en

Keywords

prevention; education; falls; rehospitalization; simulation

The role of comprehensive geriatric assessment in predicting fall risk

Efendioglu EM, Cigiloglu A, Oztürk ZA. Ir. J. Med. Sci. 2022; ePub(ePub): ePub.

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DOI 10.1007/s11845-022-02978-z PMID 35296974

Abstract

BACKGROUND: The prevention of falls among older adults is one of the most important public health issues in today's aging society. There are many factors significantly affecting the risk of falls. **AIMS:** This study aimed to investigate the factors on fall risk in older adults.

METHODS: A total of 335 elderly outpatients aged 65 and over were included in this cross-sectional study. Comprehensive geriatric assessment was performed on the participants. Tinetti Balance and Gait Assessment Tool (TBGA) and Mini-Mental State Examination (MMSE) were used to assess fall risk and cognitive functions, respectively.

RESULTS: The mean age of 335 participants was 72.1 ± 6.0 years and 55.2% was female. Of the participants, 40.6% had a moderate-high fall risk according to TBGA and 31.6% had a history of falls within the last year. Although there was no significant difference in MMSE results between the medium-high fall risk group and the low fall risk group, higher MMSE attention and calculation domain score was found to be an independent variable for decreased fall risk and sarcopenia for increased fall risk ($p = 0.039$, OR = 0.70 and $p = 0.037$, OR = 3.43, respectively).

CONCLUSION: The role of sarcopenia in fall risk is well established. In this study, we also showed that attention and calculation play important roles in fall risk. Elderly individuals with low scores in attention and calculation domains need a more detailed assessment in terms of fall risk, even if cognitive functions are considered normal according to the MMSE.

Language: en

Keywords

Elderly; Fall risk; Attention and calculation; Cognitive assessment

The use of predictive fall models for older adults receiving aged care, using routinely collected electronic health record data: a systematic review

Seaman K, Ludlow K, Wabe N, Dodds L, Siette J, Nguyen A, Jorgensen M, Lord SR, Close JCT, O'Toole L, Lin C, Eymael A, Westbrook J. *BMC Geriatr.* 2022; 22(1): e210.

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DOI 10.1186/s12877-022-02901-2 **PMID** 35291948

Abstract

BACKGROUND: Falls in older adults remain a pressing health concern. With advancements in data analytics and increasing uptake of electronic health records, developing comprehensive predictive models for fall risk is now possible. We aimed to systematically identify studies involving the development and implementation of predictive falls models which used routinely collected electronic health record data in home-based, community and residential aged care settings.

METHODS: A systematic search of entries in Cochrane Library, CINAHL, MEDLINE, Scopus, and Web of Science was conducted in July 2020 using search terms relevant to aged care, prediction, and falls. Selection criteria included English-language studies, published in peer-reviewed journals, had an outcome of falls, and involved fall risk modelling using routinely collected electronic health record data. Screening, data extraction and quality appraisal using the Critical Appraisal Skills Program for Clinical Prediction Rule Studies were conducted. Study content was synthesised and reported narratively.

RESULTS: From 7,329 unique entries, four relevant studies were identified. All predictive models were built using different statistical techniques. Predictors across seven categories were used: demographics, assessments of care, fall history, medication use, health conditions, physical abilities, and environmental factors. Only one of the four studies had been validated externally. Three studies reported on the performance of the models.

CONCLUSIONS: Adopting predictive modelling in aged care services for adverse events, such as falls, is in its infancy. The increased availability of electronic health record data and the potential of predictive modelling to document fall risk and inform appropriate interventions is making use of such models achievable. Having a dynamic prediction model that reflects the changing status of an aged care client is key to this moving forward for fall prevention interventions.

Language: en

Keywords

Risk management; Falls; Information technology; Aged care; Fall risk; Health & safety; Health informatics; Older adults; Predictive modelling; Quality in health care

Effectiveness of a smartwatch app in detecting induced falls: observational study

Brew B, Faux SG, Blanchard E. JMIR Form. Res. 2022; 6(3): e30121.

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DOI 10.2196/30121 **PMID** 35311686

Abstract

BACKGROUND: Older adults are at an increased risk of falls with the consequent impacts on the health of the individual and health expenditure for the population. Smartwatch apps have been developed to detect a fall, but their sensitivity and specificity have not been subjected to blinded assessment nor have the factors that influence the effectiveness of fall detection been fully identified.

OBJECTIVE: This study aims to assess accuracy metrics for a novel fall detection smartwatch algorithm.

METHODS: We performed a cross-sectional study of 22 healthy adults comparing the detection of induced forward, side (left and right), and backward falls and near falls provided by a smartwatch threshold-based algorithm, with a video record of induced falls serving as the gold standard; a blinded assessor compared the two. Three different smartwatches with two different operating systems were used. There were 226 falls: 64 were backward, 51 forward, 55 left sided, and 56 right sided.

RESULTS: The overall smartwatch app sensitivity for falls was 77%, the specificity was 99%, the false-positive rate was 1.7%, and the false-negative rate was 16.4%. The positive and negative predictive values were 98% and 84%, respectively, while the accuracy was 89%. There were 249 near falls: the sensitivity was 89%, the specificity was 100%, there were no false positives, 11% were false negatives, the positive predictive value was 100%, the false-negative predictive value was 83%, and the accuracy was 93%.

CONCLUSIONS: Falls were more likely to be detected if the fall was on the same side as the wrist with the smartwatch. There was a trend toward some smartwatches and operating systems having superior sensitivity, but these did not reach statistical significance. The effectiveness data and modifying factors pertaining to this smartwatch app can serve as a reference point for other similar smartwatch apps.

Language: en

Keywords

elderly; falls; accelerometer; app fall detection; inertial sensors; mobile health; old age; older adult; smart watch; smartwatch; threshold-based algorithm

Gap between risk factors and prevention strategies? A nationwide survey of fall prevention among medical and surgical patients

Xia L, Zheng Y, Lin Z, Chen P, Mei K, Zhao J, Liu Y, Song B, Gao H, Sun C, Yang H, Wang Y, Song K, Yang Y, Luan X, Wen X, Yin X, Fu A, Cai Y, Xie L, Li Y, Lu J, Wu X, Wang R, Gu Z. *J. Adv. Nurs.* 2022; ePub(ePub): ePub.

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Abstract

AIMS: This study aimed to determine the extent to which nurses report assessing evidence-based falls risk factors and implementing targeted prevention for medical and surgical patients in China.

DESIGN: This study was a national online survey.

METHODS: The respondents were registered nurses working in medical and surgical units in 662 Chinese hospitals. The data concerning the falls risk factor assessments and targeted interventions implemented by nurses were collected online by the Nursing Management Committee of the Chinese Nursing Association in China in 2019.

RESULTS: In total, 68 527 valid questionnaires were returned (95.0%). In medical and surgical units, nurses were most likely to report assessing balance, mobility and strength (81.6%) and orthostatic hypotension (76.4%) in falls patients and least likely to report assessing continence (61.3%) and feet and footwear (55.8%). Ensuring the use of appropriate footwear (79.3%) and managing syncope, dizziness and vertigo (73.8%) were the most common multiple interventions, while managing postural hypotension (48.8%) and cognitive impairment (48.4%) was the least common. Nine falls risk factors with clearly matched multifactorial interventions were identified in medical and surgical units (68.2%-97.1%).

CONCLUSIONS: The implementation of multifactorial interventions in medical and surgical wards is inconsistent as reported by nurses in medical and surgical wards. Throughout China, nurses are generally concerned about falls risk factors and prevention for their patients; however, limited attention has been focused on continence, feet and footwear assessment and the management of cognitive impairment. Evidence-based falls prevention should be further tailored to the specific risk factors of each patient. **IMPACT:** Best practice guidelines for falls prevention in hospitals have been developed and published, and it is important for nurses to use these guidelines to guide practice. Our findings identify that in routine care, healthcare providers and hospitals can prevent falls.

Language: en

Keywords

risk factors; assessment; hospital; falls prevention; medical and surgical units; nurse

Variability and agreement of frailty measures and risk of falls, hospital admissions and mortality in TILDA

Kim DJ, Massa MS, Clarke R, Scarlett S, O'Halloran AM, Kenny RA, Bennett D. *Sci. Rep.* 2022; 12(1): e4878.

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DOI 10.1038/s41598-022-08959-7 PMID 35318402

Abstract

Little is known about the within-person variability of different frailty instruments, their agreement over time, and whether use of repeat assessments could improve the strength of associations with adverse health outcomes. Repeat measurements recorded in 2010-2011 (Wave 1) and 2012 (Wave 2) from The Irish Longitudinal Study on Ageing (TILDA) were used to classify individuals with frailty using the frailty phenotype (FP) and frailty index (FI). Within-person variability and agreement of frailty classifications were assessed using ANOVA and kappa (K) statistics, respectively. Associations of each frailty measure (wave 1, wave 2, or mean of both waves) with risk of falls, hospitalisations and all-cause mortality were assessed using logistic regression. Among 7455 individuals (mean age 64.7 [SD 9.9] years), within-person SD was 0.664 units (95% CI 0.654-0.671) for FP and 2 health deficits (SD 0.050 [0.048-0.051]) for FI. Agreement of frailty was modest for both measures, but higher for FI (K 0.600 [0.584-0.615]) than FP (K 0.370 [0.348-0.401]). The odds ratios (ORs) for all-cause mortality were higher for frailty assessed using the mean of two versus single measurements for FI (ORs for mortality 3.5 [2.6-4.9] vs. 2.7 [1.9-3.4], respectively) and FP (ORs for mortality 6.9 [4.6-10.3] vs. 4.0 [2.8-5.635], respectively). Frailty scores based on single measurements had substantial within-person variability, but the agreement in classification of frailty was higher for FI than FP. Frailty assessed using the mean of two or more measurements recorded at separate visits was more strongly associated with adverse health outcomes than those recorded at a single visit.

Language: en