

Leveraging feature selection for enhanced fall risk prediction in elderly using gait analysis

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Abstract

There is no effective fall risk screening tool for the elderly that can be integrated into clinical practice. Developing a system that can be easily used in primary care services is a current need. Current studies focus on the use of multiple sensors or activities to achieve higher accuracy. However, multiple sensors and activities reduce the availability of these systems. This study aims to develop a system to perform fall prediction for the elderly by using signals recorded from a single sensor during a short-term activity. A total of 168 features in the time and frequency domains were created using acceleration signals obtained from 71 elderly people. The features were weighted based on the ReliefF algorithm, and the artificial neural networks model was developed using the most important features. The best classification result was obtained using the 17 most important features of those weighted for $K = 20$ nearest neighbors. The highest accuracy was 82.2% (82.9% Sensitivity, 81.6% Specificity). The partially high accuracy obtained in our study shows that falling can be detected early with a sensor and a simple activity by determining the right features and can be easily applied in the assessment of the elderly during routine follow-ups.

Language: en

Keywords: Fall risk; Accelerometer; Fall prediction; Gait measures

Intrinsic capacity and recent falls in adults 80 years and older living in the community: results from the IISIRENTE Study

Cacciatore S, Marzetti E, Calvani R, Picca A, Salini S, Russo A, Tosato M, Landi F. Aging Clin. Exp. Res. 2024; 36(1): e169.

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Abstract

BACKGROUND: Falls in older adults significantly impact overall health and healthcare costs. Intrinsic capacity (IC) reflects functional reserve and is an indicator of healthy aging. **AIMS:** To explore the association between IC and recent falls (≤ 90 days) in community-dwelling octogenarians from the Aging and Longevity in the Sirente geographic area (IISIRENTE) study.

METHODS: The Minimum Data Set for Home Care (MDS-HC) and supplementary questionnaires and tests were used to assess the five IC domains: locomotion, cognition, vitality, psychology, and sensory. Scores in each domain were rescaled using the percent of maximum possible score method and averaged to obtain an overall IC score (range 0-100).

RESULTS: The study included 319 participants (mean age 85.5 ± 4.8 years, 67.1% women). Mean IC score was 80.5 ± 14.2 . The optimal IC score cut-off for predicting the two-year risk of incident loss of at least one activity of daily living (ADL) was determined and validated in a subset of 240 individuals without ADL disability at baseline (mean age 84.7 ± 4.4 years, 67.1% women). Participants were then stratified into low (< 77.6) and high (≥ 77.6) IC categories. Those with high IC (63.9%) were younger, more often males, and had lower prevalence of recent falls, disability, multimorbidity, and polypharmacy. Logistic regression models including IC as a continuous variable revealed a significant association between higher IC and lower odds of falls. This association was significant in the unadjusted (odds ratio [OR] 0.96, 95% confidence interval [CI] 0.94-0.98, $p < 0.001$), age- and sex-adjusted (OR 0.96, 95% CI 0.94-0.98, $p < 0.001$), and fully adjusted models (OR 0.96, 95% CI 0.93-0.99, $p = 0.003$). When considering IC as a categorical variable, unadjusted logistic regression showed a strong association between high IC and lower odds of falls (OR 0.31, 95% CI 0.16-0.60, $p < 0.001$). This association remained significant in both the age- and sex-adjusted (OR 0.30, 95% CI 0.15-0.59, $p < 0.001$) and fully adjusted models (OR 0.33, 95% CI 0.16-0.82, $p = 0.007$). The locomotion domain was independently associated with falls in the unadjusted (OR 0.98, 95% CI 0.97-0.99, $p < 0.001$), age- and sex-adjusted (OR 0.97, 95% CI 0.96-0.99, $p < 0.001$), and fully adjusted model (OR 0.98, 95% CI 0.96-0.99, $p < 0.001$).

DISCUSSION: This is the first study using an MDS-HC-derived instrument to assess IC. Individuals with higher IC were less likely to report recent falls, with locomotion being an independently associated domain.

CONCLUSIONS: Lower IC is linked to increased odds of falls. Interventions to maintain and improve IC, especially the locomotion domain, may reduce fall risk in community-dwelling octogenarians.

Language: en

Keywords: Humans; Risk Factors; Female; Male; Aged, 80 and over; Dementia; Frailty; Falls; *Accidental Falls/statistics & numerical data; *Independent Living; Geriatric Assessment/methods; *Activities of Daily Living; ADL; Aging/physiology; Cognitive decline; Disability; Functional reserve; Hip fracture; Intrinsic capacity; Malnutrition

Effect of vitamin D on risk of falls and fractures - The contribution of recent mega-trials

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Abstract

Three recently-completed, large clinical trials in the U.S, New Zealand, and Australia, referred to herein as the 'mega-trials', were conducted to determine the impact of supplemental vitamin D on a variety of outcomes including falls and fractures. The trials were similar in design and collectively included over 50,000 generally vitamin D replete, older men and women. The mega-trials established that vitamin D supplementation with the equivalent of 2000 to 3300 IU/d of vitamin D(3) had no favorable effect on risk of falls or fractures. This review focuses on specific design elements of the trials and how they likely influenced these trial findings. While these trials were in progress, evidence emerged that circulating 25-hydroxyvitamin D levels have a U-shaped association with risk of falling, raising concern about a potential untoward effect of high dose supplementation. There is compelling evidence that in older, vitamin D- and calcium-insufficient nursing home residents, the combination of vitamin D and calcium in modest replacement doses dramatically reduces the risk of hip and other fractures. Community-dwelling older adults in many populous countries around the globe have widespread vitamin D and calcium insufficiency. It is time to follow the evidence trail and determine the effect of vitamin D and calcium replacement on their risk of falls and fractures.

Language: en

Keywords: 25(OH)D; 25-Hydroxyvitamin D; Calcium intake; Falls; Fractures; Vitamin D supplementation

Mechanical property, efficacy, and user experience of an innovative wearable device in preventing fall-induced injuries

Hu K, Guan Z, He Z, Luo S, Fang H, Zhang Y, Ding L, Xu Y, Jiang L, Fu C, Zhao X, Jia J, Wu C. *Innov. Aging* 2024; 8(8): igae066.

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Abstract

BACKGROUND AND OBJECTIVES: With the global population aging at an unprecedented pace, the imminent surge in falls and fall-induced injuries necessitates urgent attention.

Innovative assistive technologies are crucial in addressing this daunting challenge. This study aimed to evaluate the mechanical properties, efficacy, safety, and user experience of the Intelligent Bone Protection Vest (IBPV), a novel, reusable, non-airbag wearable device.

RESEARCH DESIGN AND METHODS: The IBPV integrates a machine learning-based algorithm for real-time monitoring of wearer motion and a unique honeycomb-structured foldable cushion for fall impact attenuation. We evaluated the impact attenuation capabilities of the IBPV and conducted 2 human subject studies to assess its efficacy and safety.

Additionally, semistructured interviews were conducted to qualitatively explore its usability, safety, and opportunities for enhancement.

RESULTS: The compression tests confirmed the energy absorption capacity of the honeycomb-structured foldable cushion. In over 800 fall tests involving 14 young and middle-aged subjects using a touchdown fall test, as well as 7 older subjects using a novel fall simulation test, the IBPV demonstrated an overall protection rate exceeding 84%.

DISCUSSION AND IMPLICATIONS: These results underscored the potential of the IBPV in reducing fall-induced injuries by mitigating the impact force on the hip during falls. Future studies with more rigorous design are needed to confirm whether this active wearable device may serve as a dependable fall protection product.

Language: en

Keywords: Injury; Falls; Hip fracture

Effects of a multifactorial program with case management for falls prevention on functional outcomes in community-dwelling older people: a randomized clinical study

Novaes ADC, Ansai JH, Alberto SN, Caetano MJD, Rossi PG, de Melo ML, Gramani-Say K. *Healthcare (Basel)* 2024; 12(15).

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Abstract

Falls are among the top 10 causes of years lived with disability in people aged 75 and over. Preventive programs like case management (CM) are crucial.

OBJECTIVES: To evaluate the effects of a multifactorial fall prevention program based on CM on physical performance, the presence of pain, and the risk of falls and fractures in older people who have suffered falls.

METHODS: This randomized, single-blind clinical trial with parallel groups, Intervention Group (IG) and Control Group (CG), was composed of 55 older people with a history of falling, living in the community. All participants underwent an initial assessment via video call (containing anamnesis, timed up-and-go test, falls risk score, short physical performance battery, and clinical frax). The IG underwent CM, the physical exercise protocol, and the cognitive stimulation protocol. The CG was monitored through telephone calls and received general health and fall guidance.

RESULTS: No significant results were found in the physical capacity, the presence of pain, the risk of falls, or the fractures between the Intervention and Control Groups and between assessments.

CONCLUSION: This program was not effective in improving functional performance, but it was important for characterizing pain and the probability of fracture in the next 10 years in this population.

Language: en

Keywords: accidental falls; aged; risk management; physical exercise

A wrist-worn wearable device can identify frailty in middle-aged and older adults: the UK Biobank Study

Osuka Y, Chan LLY, Brodie MA, Okubo Y, Lord SR. J. Am. Med. Dir. Assoc. 2024; ePub(ePub): ePub.

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Abstract

OBJECTIVES: Digital gait biomarkers collected from body-worn devices can remotely and continuously collect movement types, quantity, and quality in real life. This study assessed whether digital gait biomarkers from a wrist-worn device could identify people with frailty in a large sample of middle-aged and older adults.

DESIGN: Cross-sectional study. **SETTING AND PARTICIPANTS:** A total of 5822 middle-aged (43-64 years) and 4344 older adults (65-81 years) who participated in the UK Biobank study. **MEASURES:** Frailty was assessed using a modified Fried's frailty assessment and was defined as having ≥ 3 of the 5 frailty criteria (weakness, low activity levels, slowness, exhaustion, and weight loss). Fourteen digital gait biomarkers were extracted from accelerometry data collected from wrist-worn sensors worn continuously by participants for up to 7 days.

RESULTS: A total of 238 (4.1%) of the middle-aged group and 196 (4.5%) of the older group were categorized as frail. Multivariable logistic regression analysis revealed that less daily walking (as assessed by step counts), slower maximum walking speed, and increased step time variability best-identified people with frailty in the middle-aged group (area under the curve [95% CI]: 0.70 [0.66-0.73]). Less daily walking, slower maximum walking speed, increased step time variability, and a lower proportion of walks undertaken with a manual task best-identified people with frailty in the older group (0.73 [0.69-0.76]).

CONCLUSIONS AND IMPLICATIONS: Our findings indicate that measures obtained from wrist-worn wearable devices worn in everyday life can identify individuals with frailty in both middle-aged and older people. These digital gait biomarkers may facilitate screening programs and the timely implementation of frailty-prevention interventions.

Language: en

Keywords: Aged; assessment; frailty; digital technology; early diagnosis; middle-aged

Timing of emergency medical services activations for falls

Sheridan E, Wiseman JM, Quatman CE. Arch. Gerontol. Geriatr. Plus 2024; 1(2): e100020.

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Abstract

OBJECTIVE: Falls are a major challenge to public health, particularly among older adults. Understanding factors that influence fall risk is pivotal in the prevention of falls and fall-related injuries. This study evaluated the timing of emergency medical service (EMS) activations for falls and transport patterns for adults age ≥ 65 .

METHODS: A patient care report system at a single fire-based emergency medical service agency in a suburban, Midwest city was retrospectively reviewed. Type of call (lift assist/fall), time of injury (time, day, and month), and demographics (sex, age) were collected for residents age ≥ 65 who activated 9-1-1 for a lift assist or fall.

RESULTS: 1169 calls met inclusion criteria. Mornings and afternoons were the time of day associated with falls (33 % and 36 % of EMS activations, respectively, vs. 21 % and 10 % for evenings and nights, respectively; $p = 0.002$) while day of the week and month were not associated with falls or lift assists. More males requested lift assists than females (256 vs. 238) and more females called for falls than males (408 vs. 267; $p < 0.001$). Falls were more likely to be associated with transport to the hospital than lift assists (78% vs. 7 %). Female sex was associated with increased risk for transport to the hospital (60 % of females vs. 40 % of males; $p < 0.001$).

CONCLUSIONS: Mornings and afternoons were associated with increased risk for falls and sex (female) with increased risk for transport to the hospital.

Language: en

Keywords: Community-based public health; EMS activation patterns; Fall risk; Falls epidemiology

Motor and non-motor factors of concern about falling and fear of falling in multiple sclerosis

Takla TN, Matsuda PN, Herring TE, Daugherty AM, Fritz NE. *J. Neurol. Phys. Ther.* 2024; ePub(ePub): ePub.

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Abstract

BACKGROUND AND PURPOSE: Despite the frequency of concern about falling (CAF) and fear of falling (FOF) in multiple sclerosis (MS), there remains a lack of clarity between FOF and CAF, though persons with MS have indicated that CAF and FOF are distinct constructs. Our team previously developed and validated a new questionnaire, the Concern and Fear of Falling Evaluation (CAFFE), to assess these concepts. This study aimed to examine CAF and FOF prevalence, and determine relationships among CAF, FOF, and self-reported motor, cognitive, and psychological function in MS relapsing (RRMS) and progressive (PMS) subtypes.

METHODS: In a single online survey, participants with MS completed questions about CAF and FOF, demographic information, the CAFFE, and self-report measures of motor, cognitive, and psychological function.

RESULTS: A total of 912 individuals completed the survey. Persons with PMS reported greater CAF (80.1%) and FOF (59.1%) than those with RRMS (57.0% and 41.6%, respectively). Persons with PMS endorsing FOF (yes/no) reported greater FOF on the CAFFE, greater avoidance behavior, greater walking impairment, and poorer motor function than people with RRMS ($P < 0.001$). Self-reported motor function, walking impairment, and avoidance behavior were highly correlated to the CAFFE across the overall sample ($P < 0.001$).

DISCUSSIONS AND CONCLUSIONS: These findings underscore the disparity between CAF and FOF, emphasize the importance of evaluating CAF and FOF in MS subtypes separately, and highlight both motor and non-motor factors contributing to CAF and FOF. Future work should focus on interventions that incorporate motor, cognitive, and psychological components to address CAF and FOF. **VIDEO ABSTRACT:** for more insights from the authors Supplemental Digital Content available at <http://links.lww.com/JNPT/A481>.

Effect of Tai Chi exercise on bone health and fall prevention in postmenopausal women: a meta-analysis

Zhang Y, Chen H. J. Orthop. Surg. Res. 2024; 19(1): e471.

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Abstract

BACKGROUND: The bone status of postmenopausal women is worsening. In fact, postmenopausal period is the high incidence stage of osteoporosis and falls. Notably, a recent study has pointed out that exercise can improve bone health in postmenopausal women. However, the effect of Tai Chi exercise on postmenopausal women is controversial. Therefore, a meta-analysis was designed to analyze the effect of Tai Chi exercise on bone health and fall prevention in postmenopausal women.

METHODS: The researches on Tai Chi improving the bone health of postmenopausal women before August 31, 2023 were collected from Chinese and English databases, such as PubMed, Embase, and Web of Science, etc. The risk of bias of the included studies was assessed using the Cochrane risk-of-bias tool for randomized trials. Besides, R software 4.3.1 was employed to analyze the effect sizes in the meta-analysis to summarize the impact of Tai Chi on vertebral bone mineral density, serum calcium, clinical balance scores, the number of falls, total falls, and health status scores in postmenopausal women.

RESULTS: There were 12 studies eventually included in this meta-analysis. A total of 1,272 postmenopausal women were involved, including 628 in the experimental group (intervention with Tai Chi exercise) and 644 in the control group (without any intervention). Briefly, postmenopausal women practicing Tai Chi presented a significant increase in vertebral bone density [standardized mean difference (SMD) = 0.37, 95% confidence interval (CI) (0.04-0.71), P = 0.03] and health status score [SMD = 0.25, 95% CI (0.01-0.49), P = 0.04]. In contrast, there were no significant differences for postmenopausal women between the two groups in terms of serum calcium [SMD = -0.01, 95% CI (-0.39, 0.36), P = 0.77], clinical balance [SMD = 0.17, 95% CI (-0.01, 0.46), P = 0.23], number of falls [SMD = -0.61, 95% CI (-1.24, 0.02), P = 0.06] and total falls [odds ratio = 0.35, 95% CI (0.11-1.12), P = 0.07].

CONCLUSION: Tai Chi exercise can improve the bone mineral density of postmenopausal women, thereby maintaining bone health. Hence, Tai Chi exercise is necessary to prevent osteoporosis.

Language: en

Keywords: Humans; Aged; Female; Middle Aged; Randomized Controlled Trials as Topic; *Accidental Falls/prevention & control; Fall; *Bone Density/physiology; *Osteoporosis, Postmenopausal/prevention & control; *Postmenopause/physiology;

*Tai Ji/methods; Bone health; Calcium/blood; Postmenopausal women; Postural Balance/physiology; Tai Chi