

Safety Literature 29<sup>th</sup> May 2022

**Comparison of the Clinical-Functional Vulnerability Index and the Frailty Phenotype for the identification of falls in older individuals: a cross-sectional study**

Moreira NB, Bento PCB, Vieira E, da Silva JLP, Rodacki ALF. Ann. Phys. Rehabil. Med. 2022; ePub(ePub): ePub.

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**Abstract**

**BACKGROUND:** Frailty increases the risk of falls, disability and death in older adults. The Cardiovascular Health Study identified a frailty phenotype (the Fried Phenotype) that was primarily based on physical domains. Instruments that incorporate additional domains (e.g., cognitive, disability or mood) may more accurately identify falls.

**OBJECTIVES:** The study aimed i) to evaluate the association between falls and the number of phenotypes identified by the Fried Phenotype and CFVI-20 scores and ii) to compare the strength of the association between falls and each frailty instrument.

**METHODS:** This study used the CFVI-20 and the Fried Phenotype and reported falls during the last twelve months. Logistic regression models, odds ratios (ORs), and ROC curves were used to identify associations and perform comparisons ( $p < 0.05$ ). The reporting of the study followed the Strobe guidelines.

**RESULTS:** This study included 1,826 individuals (mean 70.9 (SD 7.3) years old). Prevalence of pre-frailty and low vulnerability was high (72% and 69%) and comparable between frailty instruments. The number of Fried phenotypes increased the odds of having fallen in the past 12 months (OR: 1.5 to 29.5) and the CFVI-20 scores (11% increase/unit change). The CFVI-20 identified falls more accurately than the Fried Phenotype (AUC: 0.68 vs. 0.60,  $p < 0.001$ ).

**CONCLUSIONS:** The number of phenotypes and the CFVI-20 scores were associated with falls; continuous scores identified falls more accurately than categorical classifications. The CFVI-20 was more strongly associated with falls in community-dwelling older adults than the Fried Phenotype.

Language: en

**Keywords**

aged; risk factors; accidental falls; frail elderly

## **Correlation analysis of physical fitness and its impact on falls in 2130 community-dwelling older adults: a retrospective cross-sectional study**

Lin WS, Hsu NW, Lee MJ, Lin YY, Tsai CC, Pan PJ. BMC Geriatr. 2022; 22(1): e447.

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DOI 10.1186/s12877-022-03138-9 PMID 35606737

### **Abstract**

**BACKGROUND:** As the community-dwelling population ages in Taiwan, concerns regarding long-term care have grown more urgent. Physical fitness plays a key role in enabling community-dwelling older adults to independently complete daily tasks and avoid falling accidents. However, the effect of physical fitness on falls and other fitness-related factors remains poorly understood.

**METHODS:** In this retrospective cross-sectional study, 2130 community-dwelling older adults were recruited from a rural region of Taiwan. Each of these participants completed a demographics interview and frailty questionnaire and reported their history of falls. We evaluated each participant's height and body weight measurements, calf circumference, bone mass density, and results on the grip strength, single-leg standing, chair sit-and-reach, 8-ft up-and-go, 30-second chair stand, 2-minute step, 30-second arm curl, 6-m walk, and back scratch tests to determine their overall physical fitness, which consisted of their body composition, muscular strength and endurance, flexibility, and cardiopulmonary fitness.

**RESULTS:** The prevalence of falls in the preceding year among the older adults surveyed was 20.8%, and the resultant hospitalization rate was 10.9%. The older adults who were more physically active in the past week, had regular exercise habits, lived with family, and had no history of hospitalization due to falls, exhibited greater performance on the physical fitness tests. Three time fallers exhibited lower levels of overall physical fitness than did those who had not fallen. The nonfallers outperformed the fallers in grip strength (participants who had not fallen and those who had fallen once, twice, or three times in the preceding year:  $24.66 \pm 0.19$  vs.  $23.66 \pm 0.35$  vs.  $20.62 \pm 0.71$  vs.  $22.20 \pm 0.90$  kg) and single-leg standing duration ( $19.38 \pm 0.39$  vs.  $16.33 \pm 0.78$  vs.  $13.95 \pm 1.67$  vs.  $12.34 \pm 1.82$  seconds).

**CONCLUSIONS:** Exercise habits, living status, hospitalization due to falls, and amount of exercise were all associated with physical fitness in community-dwelling older adults. The results of all of the assessments indicated that the participants who had fallen three times exhibited lower levels of physical fitness than did those who had not fallen in the previous year. Physical measurements, including grip strength and single-leg standing duration, are associated with an individual's risk of falling, which indicates that they should be considered in the development of geriatric physical fitness and fall-prevention programs.

Language: en

### **Keywords**

Falls; Physical fitness; Geriatric population; Grip strength; Single-leg standing

**Costs of hospital admission authorizations due to falls among older people in the Brazilian National Health System, Brazil, 2000-2020: a descriptive study**

Lima JS, Quadros DV, Silva SLC, Tavares JP, Pai DD. Epidemiol. Serv. Saude 2022; 31(1): e2021603.

(Copyright © 2022, Coordenação-Geral de Desenvolvimento da Epidemiologia em em Serviços / Secretaria de Vigilância em Saúde / Ministério da Saúde)

**DOI** 10.1590/S1679-49742022000100012 **PMID** 35588512

**Abstract**

**OBJECTIVE:** To describe the costs of hospital admission authorizations (AIHs) due to falls among older people within the Brazilian National Health System (SUS).

**METHODS:** This was a descriptive cost analysis study, based on data from the SUS's Hospital Information System, related to AIH due to falls among older people (60 years and older), between 2000 to 2020. A descriptive analysis was performed and cost measurement was based on a macro-costing method.

**RESULTS:** 1,746,097 AIHs due to falls among older people were recorded, and the total cost was found to be BRL 2,315,395,702.75. The proportion of hospitalization costs was higher among those aged 80 years and older (36.9%), female (60.4%) and the Southeast region of the country (57.3%). The average length of stay in hospital ranged from 5.2 to 7.5 days.

**CONCLUSION:** The high costs identified showed the need for investments in more effective measures in order to prevent and mitigate the damage caused by falls among older people.

Language: en

## **Epidemiology of falls in 25 Australian residential aged care facilities: a retrospective longitudinal cohort study using routinely collected data**

Wabe N, Seaman KL, Nguyen A, Siette J, Raban MZ, Hibbert P, Close J, Lord SR, Westbrook JI. *Int. J. Qual. Health Care* 2022; ePub(ePub): ePub.

(Copyright © 2022, Oxford University Press)

DOI 10.1093/intqhc/mzac050 PMID 35588391

### **Abstract**

**BACKGROUND:** Falls are frequent among older adults and have significant health and economic consequences. There have been few studies on the epidemiology of falls in residential aged care facilities (RACFs). This study aimed to determine the incidence of falls in RACFs using longitudinal routinely collected incident data over five years (Jul 2014-Dec 2019).

**METHODS:** A retrospective cohort study using fall incident data from 25 RACFs in Sydney, NSW, Australia. Incidents relating to a population of 6,163 aged care residents aged  $\geq 65$  years were included. Outcome measures were incidents of all falls; injurious falls, and requiring hospitalisation. Risk-adjusted incidence rate (IR) for each outcome indicator for each of the 25 facilities was calculated.

**RESULTS:** A total of 27,878 falls were reported over 3,906,772 resident days (a crude rate of 7.14/1000 resident days; 95% confidence interval (CI) 6.81-7.48). Of these, 10,365 (37.2%) were injurious and 2,733 (9.8%) required hospitalisation. The crude IR for injurious falls was 2.65/1000 resident days (95% CI 2.53-2.78) and 0.70 (95% CI 0.66-0.74) for falls requiring hospitalisation. The incidence of falls was significantly higher in respite compared to permanent residents for all falls (adjusted incident rate ratio (aIRR) 1.33; 95% CI 1.18-1.51) and injurious falls (aIRR 1.30; 95% CI 1.14-1.48) and for men compared to women for all outcomes (all falls aIRR 1.69; 95% CI 1.54-1.86; injurious falls aIRR 1.87; 95% CI 1.71-2.04 and falls requiring hospitalisation aIRR 1.29; 95% CI 1.12-1.48). The risk-adjusted IRs per 1000 resident days between facilities varied substantially (all falls 0.57-12.93 falls; injurious falls 0.25-4.47 and falls requiring hospitalisation 0.10-1.70).

**CONCLUSION:** Falls are frequent in RACFs, often resulting in injury and hospitalisation. The study provides robust and comprehensive information that may help inform future initiatives to minimise the incidence of falls in RACFs.

Language: en

### **Keywords**

Accidental falls; aged care; fall injuries; fall-related hospitalisations; falls epidemiology; falls incidence

## Explainable fall risk prediction in older adults using gait and geriatric assessments

Mishra AK, Skubic M, Despina LA, Popescu M, Keller J, Rantz M, Abbott C, Enayati M, Shalini S, Miller S. *Front. Digit. Health* 2022; 4: e869812.

(Copyright © 2022, Frontiers Media)

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### Abstract

Older adults aged 65 and above are at higher risk of falls. Predicting fall risk early can provide caregivers time to provide interventions, which could reduce the risk, potentially avoiding a possible fall. In this paper, we present an analysis of 6-month fall risk prediction in older adults using geriatric assessments, GAITRite measurements, and fall history. The geriatric assessments included were Activities of Daily Living (ADL), Instrumental Activities of Daily Living (IADL), Mini-Mental State Examination (MMSE), Geriatric Depression Scale (GDS), and Short Form 12 (SF12). These geriatric assessments are collected by staff nurses regularly in senior care facilities. From the GAITRite assessments on the residents, we included the Functional Ambulatory Profile (FAP) scores and gait speed to predict fall risk. We used the SHAP (SHapley Additive exPlanations) approach to explain our model predictions to understand which predictor variables contributed to increase or decrease the fall risk for an individual prediction. In case of a high fall risk prediction, predictor variables that contributed the most to elevate the risk could be further examined by the health providers for more personalized health interventions. We used the geriatric assessments, GAITRite measurements, and fall history data collected from 92 older adult residents (age =  $86.2 \pm 6.4$ , female = 57) to train machine learning models to predict 6-month fall risk. Our models predicted a 6-month fall with an AUC of 0.80 (95% CI of 0.76-0.85), sensitivity of 0.82 (95% CI of 0.74-0.89), specificity of 0.72 (95% CI of 0.67-0.76), F1 score of 0.76 (95% CI of 0.72-0.79), and accuracy of 0.75 (95% CI of 0.72-0.79). These results show that our early fall risk prediction method performs well in identifying residents who are at higher fall risk, which offers care providers and family members valuable time to perform preventive actions.

Language: en

### Keywords

older adults; fall risk; explainable AI; gait; fall prediction; GAITRite; geriatric assessments; machine learning (ML)

## **Factors of functional disability in the social participation of older adults living alone with fall experience**

Jung SJ, Tak SH. *J. Appl. Gerontol.* 2022; ePub(ePub): ePub.

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**DOI** 10.1177/07334648221104791 **PMID** 35606686

### **Abstract**

The fall experiences of older adults living alone lead to restrictions in their social participation. This study aimed to examine the factors that influence functional disability in social participation (FSP) among older adults who live alone and have experienced falls. This study used secondary data of 493 older adults living alone who experienced a fall, which were collected from the 2017 National Survey of Older Koreans. Multiple linear regression analyses were performed. Factors, such as old age, sex, economic status, frequency of drinking, and number of acquaintances, significantly related to functional disability in terms of social participation. In addition, poor muscle strength, depression, and cognitive decline comprised predictors of FSP. The findings of this study revealed that it is important to comprehensively evaluate the social participation of older adults who live alone and have experienced falls.

Language: en

### **Keywords**

fall experience; functional disability; living alone; social participation

## How accurate are geriatricians' fall predictions?

Wilbur J, Jogerst G, Butler N, Xu Y. BMC Geriatr. 2022; 22(1): e436.

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DOI 10.1186/s12877-022-03129-w PMID 35585524

### Abstract

**BACKGROUND:** Older patients are at increased risk of falling and of serious morbidity and mortality resulting from falls. The ability to accurately identify older patients at increased fall risk affords the opportunity to implement interventions to reduce morbidity and mortality. Geriatricians are trained to assess older patients for fall risk. If geriatricians can accurately predict fallers (as opposed to evaluating for individual risk factors for falling), more aggressive and earlier interventions could be employed to reduce falls in older adult fallers. However, there is paucity of knowledge regarding the accuracy of geriatrician fall risk predictions. This study aims to determine the accuracy of geriatricians in predicting falls.

**METHODS:** Between October 2018 and November 2019, a convenience sample of 100 subjects was recruited from an academic geriatric clinic population seeking routine medical care. Subjects performed a series of gait and balance assessments, answered the Stay Independent Brochure and were surveyed about fall incidence 6-12 months after study entry. Five geriatricians, blinded to subjects and fall outcomes, were provided the subjects' data and asked to categorize each as a faller or non-faller. No requirements were imposed on the geriatricians' use of the available data. These predictions were compared to predictions of an examining geriatrician who performed the assessments and to fall outcomes reported by subjects.

**RESULTS:** Kappa values for the 5 geriatricians who used all the available data to classify participants as fallers or non-fallers compared with the examining geriatrician were 0.42 to 0.59, indicating moderate agreement. Compared to screening tools' mean accuracy of 66.6% (59.6-73.0%), the 5 geriatricians had a mean accuracy for fall prediction of 67.4% (57.3-71.9%).

**CONCLUSIONS:** This study adds to the scant knowledge available in the medical literature regarding the abilities of geriatricians to accurately predict falls in older patients. Studies are needed to characterize how geriatrician assessments of fall risk compare to standardized assessment tools.

Language: en

### Keywords

Prediction; Older adults; Screening; Fall risk

## **Incidence of accidental falls and development of a fall risk prediction model among elderly patients with diabetes mellitus: a prospective cohort study**

Cheng Z, Li X, Xu H, Bao D, Mu C, Xing Q. *J. Clin. Nurs.* 2022; ePub(ePub): ePub.

(Copyright © 2022, John Wiley and Sons)

**DOI** 10.1111/jocn.16371 **PMID** 35596277

### **Abstract**

**AIMS:** To investigate the incidence of accidental falls and develop a fall risk prediction tool in elderly patients with diabetes mellitus.

**BACKGROUND:** The risk of fall in elderly patients with diabetes is higher than that in the general elderly, there is fewer fall assessment tools for elderly patients with diabetes.

**DESIGN:** A prospective cohort study.

**METHODS:** Between June and September 2019, a total of 1007 elderly patients with diabetes were enrolled from a tertiary specialist diabetes hospital in Tianjin and were prospectively followed up for 6 months to determine outcomes of accidental falls through telephone. Demographic and diseases related factors were collected at baseline. Incidence of falls was investigated, and a nomogram was developed based on logistic regression model. SPSS 21.0 and R 3.6.3 were used to analyse the data. The article was reported in accordance with STROBE guidelines.

**RESULTS:** Among 1007 elderly patients, 950 finished the follow-up. A total of 133 falls occurred in 93 patients during the follow-up period, with a fall rate of 9.79%. Diabetic peripheral neuropathy, walking aids, depression, fall history, fatigue and sex were independent predictors of accidental fall in diabetes elderly patients. The sensitivity and specificity of the predictive model were 73.12% and 52.63%, respectively, and a fall risk prediction nomogram was developed based on the regression model.

**CONCLUSIONS:** A nomogram including 6 easily available prediction factors (diabetic peripheral neuropathy, walking aids, depression, fall history within 1 year, fatigue, sex) was developed, and it can be used in safety management among Chinese elderly patients diagnosed with diabetes. **RELEVANCE TO CLINICAL PRACTICE:** Nomogram can be used to identify diabetic elderly patients at high risk of accidental falls.

Language: en

### **Keywords**

aged; accidental falls; diabetes mellitus; prospective cohort study; risk prediction tool

## **Mixed evidence of an association between self-rated hearing difficulties and falls: prospective analysis of two longitudinal studies**

Kiely KM, Khalatbari-Soltani S, Blyth FM, Naganathan V, Handelsman DJ, Waite LM, Le Couteur DG, Mortby ME, Cumming RG, Anstey KJ. *Gerontology* 2022; ePub(ePub): ePub.

(Copyright © 2022, Karger Publishers)

**DOI** 10.1159/000524311 **PMID** 35598592

### **Abstract**

**INTRODUCTION:** This study aimed to assess the extent to which a single item of self-reported hearing difficulties is associated with future risk of falling among community-dwelling older adults.

**METHODS:** We used data from two Australian population-based cohorts: three waves from the PATH Through Life study (PATH;  $n = 2,048$ , 51% men, age  $66.5 \pm 1.5$  SD years) and three waves from the Concord Health and Ageing in Men Project (CHAMP;  $n = 1,448$ , 100% men with mean age  $77.3 \pm 5.3$  SD years). Hearing difficulties were recorded on a four-point ordinal scale in PATH and on a dichotomous scale in CHAMP. The number of falls in the past 12 months was reported at each wave in both studies. In CHAMP, incident falls were also ascertained by triannual telephone call cycles for up to four years. Multivariable-adjusted random intercept negative binomial regression models were used to estimate the association between self-reported hearing difficulties and number of falls reported at the following wave or 4-monthly follow-ups.

**RESULTS:** In PATH, self-reported hearing difficulties were associated with a higher rate of falls at follow-up (incidence rate ratio = 1.15, 95% CI = 1.03-1.27 per a one-level increase in self-reported hearing difficulties), after adjusting for sociodemographic characteristics, health behaviours, physical functioning, balance, mental health, medical conditions, and medications. There were no significant associations between hearing difficulties and the rate of falls based on either repeated survey or 4-monthly follow-ups in CHAMP.

**CONCLUSION:** Though we find mixed results, findings from PATH data indicate an ordinal measure of self-reported hearing loss may be predictive of falls incidence in young-old adults. However, the null findings in the male-only CHAMP preclude firm conclusions of a link between hearing loss and falls risk.

Language: en

### **Keywords**

Falls; Cohort study; Self-report; Hearing loss

## **Near-fall detection in unexpected slips during over-ground locomotion with body-worn sensors among older adults**

Wang S, Miranda F, Wang Y, Rasheed R, Bhatt T. *Sensors (Basel)* 2022; 22(9): e3334.

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**DOI** 10.3390/s22093334 **PMID** 35591025

### **Abstract**

Slip-induced falls are a growing health concern for older adults, and near-fall events are associated with an increased risk of falling. To detect older adults at a high risk of slip-related falls, this study aimed to develop models for near-fall event detection based on accelerometry data collected by body-fixed sensors. Thirty-four healthy older adults who experienced 24 laboratory-induced slips were included. The slip outcomes were first identified as loss of balance (LOB) and no LOB (NLOB), and then the kinematic measures were compared between these two outcomes. Next, all the slip trials were split into a training set (90%) and a test set (10%) at sample level. The training set was used to train both machine learning models ( $n = 2$ ) and deep learning models ( $n = 2$ ), and the test set was used to evaluate the performance of each model. Our results indicated that the deep learning models showed higher accuracy for both LOB (>64%) and NLOB (>90%) classifications than the machine learning models. Among all the models, the Inception model showed the highest classification accuracy (87.5%) and the largest area under the receiver operating characteristic curve (AUC), indicating that the model is an effective method for near-fall (LOB) detection. Our approach can be helpful in identifying individuals at the risk of slip-related falls before they experience an actual fall.

Language: en

### **Keywords**

deep learning; machine learning; balance loss; gait-slip; near-fall

## **Preventing and managing falls in adults with cardiovascular disease: a scientific statement from the American Heart Association**

Denfeld QE, Turrise S, MacLaughlin EJ, Chang PS, Clair WK, Lewis EF, Forman DE, Goodlin SJ. *Circ. Cardiovasc. Qual. Outcomes* 2022; ePub(ePub): ePub.

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**DOI** 10.1161/HCQ.000000000000108 **PMID** 35587567

### **Abstract**

Falls and fear of falling are a major health issue and associated with high injury rates, high medical care costs, and significant negative impact on quality of life. Adults with cardiovascular disease are at high risk of falling. However, the prevalence and specific risks for falls among adults with cardiovascular disease are not well understood, and falls are likely underestimated in clinical practice. Data from surveys of patient-reported and medical record-based analyses identify falls or risks for falling in 40% to 60% of adults with cardiovascular disease. Increased fall risk is associated with medications, structural heart disease, orthostatic hypotension, and arrhythmias, as well as with abnormal gait and balance, physical frailty, sensory impairment, and environmental hazards. These risks are particularly important among the growing population of older adults with cardiovascular disease. All clinicians who care for patients with cardiovascular disease have the opportunity to recognize falls and to mitigate risks for falling. This scientific statement provides consensus on the interdisciplinary evaluation, prevention, and management of falls among adults with cardiac disease and the management of cardiovascular care when patients are at risk of falling. We outline research that is needed to clarify prevalence and factors associated with falls and to identify interventions that will prevent falls among adults with cardiovascular disease.

Language: en

### **Keywords**

aged; falls; accidental falls; age-friendly; AHA Scientific Statements; cardiovascular diseases

## **Relationships between muscle parameters and history of falls and fractures in the Hertfordshire Cohort Study: do all muscle components relate equally to clinical outcomes?**

Laskou F, Westbury LD, Fuggle NR, Edwards MH, Cooper C, Dennison EM. *Calcif. Tissue Int.* 2022; ePub(ePub): ePub.

(Copyright © 2022, Holtzbrinck Springer Nature Publishing Group)

**DOI** 10.1007/s00223-022-00986-w **PMID** 35590077

### **Abstract**

In previous work, relationships between muscle and bone size and strength have been demonstrated and were stronger in females, suggesting possible sexual dimorphism. Here we examine sex-specific associations between individual muscle sarcopenia components with clinical outcomes (falls and fractures). 641 participants were recruited. Muscle mass was assessed as cross-sectional area (CSA) by peripheral quantitative computed tomography of the calf, grip strength (GpS) by Jamar dynamometry and function by gait speed (GtS). Falls and fractures were self-reported. Ordinal and logistic regression were used to examine the associations between muscle measurements and outcomes with and without adjustment for confounders. Mean (SD) age was 69.3 (2.6) years. CSA, GpS, and GtS were greater among males ( $p < 0.002$ ). A higher proportion of females had fallen since age 45 (61.3% vs 40.2%,  $p < 0.001$ ); in the last year (19.9% vs 14.1%,  $p = 0.053$ ); and reported a previous fracture since age 45 (21.8% vs 18.5%,  $p = 0.302$ ), than males. Among females, greater CSA was related to reduced risk of falling and fewer falls in the previous year in fully adjusted analysis only ( $p < 0.05$ ); higher GpS was related to lower risk of falls since age 45 in unadjusted analysis ( $p = 0.045$ ) and lower risk of fracture since age 45 in both unadjusted and fully adjusted analysis ( $p < 0.045$ ). No statistically significant associations were observed for GtS among either sex for any relationships between muscle measurements and clinical outcomes studied. We observed relationships between muscle mass and strength but not function with falls and fractures in females only; further longitudinal studies are required to reproduce these results.

Language: en

### **Keywords**

Falls; Fractures; Sarcopenia; Gait speed; Muscle mass; Muscle strength

## **Smartphone-based gait and balance assessment in survivors of stroke: a systematic review**

Peters J, Abou L, Wong E, Dossou MS, Sosnoff JJ, Rice LA. *Disabil. Rehabil. Assist. Technol.* 2022; ePub(ePub): ePub.

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**DOI** 10.1080/17483107.2022.2072527 **PMID** 35584288

### **Abstract**

**PURPOSE:** Gait and balance impairments are associated with falls and reduced quality of life among survivors of stroke (SS). Effective methods to assess these impairments at-home and in-clinic can help reduce fall risks and improve functional outcomes. Smartphone technology may be able to evaluate these impairments. This review aims to summarize the validity, reliability, sensitivity, and specificity of smartphone applications for determining gait and balance disorders in SS.

**METHOD:** Database search through PubMed, Web of Science, Scopus, CINAHL, and SportDiscuss was conducted to retrieve studies that explored the use of smartphone-based applications for assessing gait and balance disorders in SS. Two independent reviewers screened potential articles to determine eligibility for inclusion. Eligible studies were summarized for participant and study characteristics, validity, reliability, sensitivity, and specificity of smartphone assessments.

**METHODological** quality assessment of studies was performed using the NIH Quality Assessment Tool.

**RESULTS:** Seven cross-sectional studies were included in the review. Quality assessment revealed all studies had low risk of bias. Three of the included studies examined the validity, four examined the reliability, and two examined the specificity and sensitivity of smartphone-based application assessments of gait and balance in SS. Studies revealed that smartphones were valid, reliable, specific, and sensitive. Six of the seven included studies intended their use for SS and one study for clinicians.

**CONCLUSION:** Preliminary evidence supports that smartphone-based gait and balance assessments are valid, reliable, sensitive, and specific in SS in laboratory settings. Future research is needed to test smartphone-based gait and balance assessments in home settings and determine optimal wear sites for assessments.

**IMPLICATIONS FOR REHABILITATION:** Smartphone-based gait and balance assessments are feasible, valid and reliable for survivors of stroke. The findings may guide future research to standardize the use of smartphone to assess gait and balance in this population. The remote use of smartphone-based assessments to predict fall risk in survivors of stroke needs to be explored.

Language: en

### **Keywords**

balance; fall prevention; gait; mobile device; remote assessment; smartphone application; Stroke

## The developments and iterations of a mobile technology-based fall risk health application

Hsieh KL, Frechette ML, Fanning J, Chen L, Griffin A, Sosnoff JJ. *Front. Digit. Health* 2022; 4: e828686.

(Copyright © 2022, Frontiers Media)

DOI 10.3389/fdgth.2022.828686 PMID 35574255

### Abstract

Falls are a prevalent and serious health concern across clinical populations. A critical step in falls prevention is identifying modifiable risk factors, but due to time constraints and equipment costs, fall risk screening is rarely performed. Mobile technology offers an innovative approach to provide personalized fall risk screening for clinical populations. To inform future development, this manuscript discusses the development and testing of mobile health fall risk applications for three unique clinical populations [older adults, individuals with Multiple Sclerosis (MS), and wheeled-device users]. We focus on key lessons learned and future directions to improve the field of fall risk mHealth. During the development phase, we first identified fall risk factors specific to each population that are measurable with mobile technology. Second, we determined whether inertial measurement units within smartphones can measure postural control within the target population. Last, we developed the interface of each app with a user-centered design approach with usability testing through iterative semi-structured interviews. We then tested our apps in real-world settings. Our cumulative work demonstrates that mobile technology can be leveraged to provide personalized fall risk screening for different clinical populations. Fall risk apps should be designed and tailored for the targeted group to enhance usefulness and feasibility. In addition, fall risk factors measured with mobile technology should include those that are specific to the population, are measurable with mobile technology, and can accurately measure fall risk. Future work should improve fall risk algorithms and implement mobile technology into fall prevention programs.

Language: en

### Keywords

older adults; smartphone; fall prevention; mHealth; multiple sclerosis; non-ambulatory

## The relationship of falls with achieved 25-hydroxyvitamin D levels from vitamin D supplementation: the STURDY Trial

Michos ED, Kalyani RR, Blackford AL, Sternberg AL, Mitchell CM, Juraschek SP, Schrack JA, Wanigatunga AA, Roth DL, Christenson RH, Miller ER, Appel LJ. *J. Endocr. Soc.* 2022; 6(6): bvac065.

(Copyright © 2022, Endocrine Society)

DOI 10.1210/jendso/bvac065 PMID 35592513

### Abstract

**CONTEXT:** The Study to Understand Fall Reduction and Vitamin D in You (STURDY), a randomized trial enrolling older adults with low 25-hydroxyvitamin D [25(OH)D], demonstrated vitamin D supplementation  $\geq 1000$  IU/day did not prevent falls compared with 200 IU/day, with doses  $\geq 2000$  IU/day potentially showing safety concerns.

**OBJECTIVE:** To examine associations of achieved and change in 25(OH)D concentrations after 3 months of vitamin D supplementation with fall risk.

**DESIGN:** Observational analysis of trial data. **SETTING:** General community.

**PARTICIPANTS:** A total of 637 adults aged  $\geq 70$  with baseline 25(OH)D concentrations 10 to 29 ng/mL and elevated fall risk. Three-month on-treatment absolute 25(OH)D; absolute and relative changes from baseline. **MAIN OUTCOME MEASURES:** Incident first fall (primary) and first consequential fall (injury or sought medical care) up to 24 months. Cox models were adjusted for sociodemographics, season, Short Physical Performance Battery, and body mass index.

**RESULTS:** At baseline, mean (SD) age was 77.1 (5.4) years and 25(OH)D was 22.1 (5.1) ng/mL; 43.0% were women and 21.5% non-White. A total of 395 participants experienced  $\geq 1$  fall; 294 experienced  $\geq 1$  consequential fall. There was no association between absolute achieved 25(OH)D and incident first fall (30-39 vs  $< 30$  ng/mL hazard ratio [HR], 0.93; 95% CI, 0.74-1.16;  $\geq 40$  vs  $< 30$  ng/mL HR, 1.09; 95% CI, 0.82-1.46; adjusted overall  $P = 0.67$ ), nor absolute or relative change in 25(OH)D. For incident consequential first fall, the HR (95% CI) comparing absolute 25(OH)D  $\geq 40$  vs  $< 30$  ng/mL was 1.38 (0.99-1.90).

**CONCLUSION:** Achieved 25(OH)D concentration after supplementation was not associated with reduction in falls. Risk of consequential falls may be increased with achieved concentrations  $\geq 40$  ng/mL. **TRIAL REGISTRATION:** ClinicalTrials.gov: NCT02166333.

Language: en

### Keywords

fall risk; vitamin D; 25-hydroxyvitamin D

## Backward relative to forward walking speed and falls in older adults with dementia

Toots A, Domellöf ME, Lundin-Olsson L, Gustafson Y, Rosendahl E. *Gait Posture* 2022; 96: 60-66.

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### Abstract

**BACKGROUND:** Adults with dementia have a high risk of falls and fall-related injuries. A greater slowing of backward walking speed (BWS) relative to forward (FWS) has been indicated with older age, and slower BWS has been related to an increased risk of falls. Similarly, slow BWS relative to FWS has been observed in people with dementia. **RESEARCH QUESTION:** Is slower BWS, and slower BWS relative to FWS associated with increased risk of prospective falls in older adults with dementia? **METHODS:** In total, 52 women and 12 men with dementia living in nursing homes, mean age 86 years, and mean Mini-Mental State Examination score of 14.2 points were included. BWS and FWS was measured over 2.4 m, and the directional difference (DD) calculated ( $100 * ((FWS - BWS) / FWS)$ ). Falls were followed for 6 months by review of fall incident reports in electronic medical records at nursing homes and the regional healthcare provider.

**RESULTS:** Altogether, 95 falls occurred with mean incidence rate 3.1 falls per person-years. Of included participants, 15 (23%) fell once, and 17 (27%) fell twice or more. In negative binomial regression analyses, greater DD was associated with lower prospective incidence fall rate ratio, IRR (IRR= 0.96,  $p < .001$ ), while BWS was not (IRR= 0.04,  $p = .126$ ).

**SIGNIFICANCE:** In this study of adults with dementia, slower BWS was not associated with prospective falls. However, slower BWS relative to forward (greater DD) was associated with fewer falls, and possibly a protective response. This is novel research, yet results are promising and indicate that assessing walking speed in multiple directions may inform fall risk in adults with dementia.

Language: en

### Keywords

Accidental falls; Alzheimer's; Gait

## Falls from ladders: injury patterns and outcomes

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### Abstract

**BACKGROUND:** Our contemporary understanding of the impact of falls from ladders remains limited. The purpose of this study was to examine the injury patterns and outcomes of falls from ladders. Our hypothesis was that age affects both injury type and outcomes.

**METHODS:** The NTDB was queried for all patients who fell from a ladder (01/2007-12/2017). Participants were stratified into 4 groups according to age:  $\leq 15$ , 16-50, 51-65, and  $> 65$  years. Univariate and multivariate analyses were performed to compare the injury patterns and outcomes between the groups.

**RESULTS:** A total of 168,227 patients were included for analysis. Median age was 56 years (IQR: 45-66), 86.1% were male, and median ISS was 9 (IQR: 4-13). Increasing age was associated with a higher risk of severe trauma (ISS  $> 15$ : 8.8% vs 13.7% vs 17.5% vs 22.0%,  $p < 0.001$ ). Head injuries followed a U-shaped distribution with pediatric and elderly patients representing the most vulnerable groups. Overall, fractures were the most common type of injury, in the following order: lower extremity 27.3%, spine 24.9%, rib 23.1%, upper extremity 20.1%, and pelvis 10.3%. The overall ICU admission rate was 21.5%; however, it was significantly higher in the elderly (29.1%). In-hospital mortality was 1.8%. The risk of death progressively increased with age with a mortality rate of 0.3%, 0.9%, 1.5%, and 3.6%, respectively ( $p < 0.001$ ). Strong predictors of mortality were GCS  $\leq 8$  on admission (OR 29.80, 95% CI 26.66-33.31,  $p < 0.001$ ) and age  $> 65$  years (OR 4.07, 95% CI 3.535-4.692,  $p < 0.001$ ). Only 50.8% of elderly patients were discharged home without health services, 16.5% were discharged to nursing homes and 15.2% to rehabilitation centers.

**CONCLUSION:** Falls from ladders are associated with considerable morbidity and mortality, especially in the elderly. Head injuries and fractures are common and often severe. An intensified approach to safe ladder use in the community is warranted. LEVEL OF EVIDENCE: IV.

Language: en

## **Migraine and balance impairment: influence of subdiagnosis, otoneurological function, falls, and psychosocial factors**

Carvalho GF, Luedtke K, Pinheiro CF, Moraes R, Lemos TW, Carneiro CG, Bigal ME, Dach F, Bevilacqua-Grossi D. *Headache* 2022; 62(5): 548-557.

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### **Abstract**

**OBJECTIVE:** To assess the balance sensory organization among patients with migraine, considering the influence of migraine subdiagnosis, otoneurological function, falls, and psychosocial factors.

**BACKGROUND:** Migraine has been associated with vestibular symptoms and balance dysfunction; however, neither comprehensive balance assessment nor associated factors for greater impairment have been addressed thus far.

**METHODS:** Patients from a tertiary headache clinic with a diagnosis of episodic migraine with aura (MWA), without aura (MWoA), and chronic migraine (CM) were included for this cross-sectional study (30 patients per group). Thirty headache-free controls (CG) were recruited. Participants underwent a comprehensive evaluation protocol, including the Sensory Organization Test (SOT) and otoneurological examination. Questionnaires about fear of falls, dizziness disability, and kinesiophobia were administered.

**RESULTS:** All migraine groups presented lower composite SOT scores than controls (CG: 82.4 [95% confidence interval (CI): 79.5-85.3], MWoA: 76.5 [95% CI: 73.6-79.3], MWA: 66.5 [95% CI: 63.6-69.3], CM: 69.1 [95% CI: 66.3-72.0];  $p < 0.0001$ ). Compared to controls and to MWoA, MWA and CM groups exhibited greater vestibular (CG: 75.9 [95% CI: 71.3-80.4], MWoA: 67.3 [95% CI: 62.7-71.8], MWA: 55.7 [95% CI: 51.2-60.3], CM: 58.4 [95% CI: 53.8-63.0];  $p < 0.0001$ ) and visual functional impairment (CG: 89.6 [95% CI: 84.2-94.9], MWoA: 83.2 [95% CI: 77.9-88.6], MWA: 68.6 [95% CI: 63.3-74.0], CM: 71.9 [95% CI: 66.5-77.2],  $p < 0.0001$ ). Fall events during the assessment were documented more often among patients with migraine (CG: 0.0, interquartile range [IQR], 0.0, 0.0); MWoA: 1.0 [IQR: 1.0, 1.0], MWA: 2.0 [IQR: 1.8, 4.3], CM: 1.0 [IQR: 1.0, 2.0];  $p = 0.001$ ). The SOT scores correlated with fear of falls ( $r = -0.44$ ), dizziness disability ( $r = -0.37$ ), kinesiophobia ( $r = -0.38$ ), and migraine frequency ( $r = -0.38$ ). There was no significant influence of the vestibular migraine diagnosis in the study outcomes when used as a covariate in the analysis (composite score [ $F = 3.33$ ,  $p = 0.070$ ], visual score [ $F = 2.11$ ,  $p = 0.149$ ], vestibular score [ $F = 1.88$ ,  $p = 0.172$ ], somatosensory score [ $F = 0.00$ ,  $p = 0.993$ ]).

**CONCLUSIONS:** Aura and greater migraine frequency were related to falls and balance impairment with sensory input manipulation, although no otoneurological alterations were detected. The diagnosis of vestibular migraine does not influence the balance performance. The vestibular/visual systems should be considered in the clinical examination and treatment of patients with migraine.

Language: en

### **Keywords**

aura; computerized dynamic posturography; postural balance; primary headache disorders; vestibular function tests; vestibular migraine

**Risk factors for falls among children aged 0-18 years: a systematic review**

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**Abstract**

**BACKGROUND:** Accidental falls are the most common cause of injury in children. These falls not only result in pain and injury to children but also can pose a significant financial burden to their families and society. The aim of this study is to identify risk factors for falls in children.

**METHODS:** We conducted a systematic review of the literature describing falls in children aged 0-18 years. Studies of falls from a height of 1 m or more were excluded from the analysis. We analyzed the included studies to identify risk factors for falls.

**RESULTS:** A total of 1496 articles were initially retrieved, leading to an included set of nine articles, which were published from 1995 to 2021. Risk factors related to fall injury in children aged 0-18 years included age, sex, extroversion, rural areas, history of falls, family factors, caregiver factors, medication use, intravenous therapy, tests requiring movement, disease factors and long hospital stay.

**CONCLUSION:** We identified 12 risk factors affecting falls in children, including individual characteristics and family and social factors.

Language: en

**Keywords**

Systematic review; Risk factors; Accidental falls