

Safety Literature 24th May 2020

A survey on recent advances in wearable fall detection systems

Ramachandran A, Karuppiah A. Biomed. Res. Int. 2020; 2020: e2167160.

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Abstract

With advances in medicine and healthcare systems, the average life expectancy of human beings has increased to more than 80 yrs. As a result, the demographic old-age dependency ratio (people aged 65 or above relative to those aged 15-64) is expected to increase, by 2060, from ~28% to ~50% in the European Union and from ~33% to ~45% in Asia (Ageing Report European Economy, 2015). Therefore, the percentage of people who need additional care is also expected to increase. For instance, per studies conducted by the National Program for Health Care of the Elderly (NPHCE), elderly population in India will increase to 12% of the national population by 2025 with 8%-10% requiring utmost care. Geriatric healthcare has gained a lot of prominence in recent years, with specific focus on fall detection systems (FDSs) because of their impact on public lives. According to a World Health Organization report, the frequency of falls increases with increase in age and frailty. Older people living in nursing homes fall more often than those living in the community and 40% of them experience recurrent falls (World Health Organization, 2007). Machine learning (ML) has found its application in geriatric healthcare systems, especially in FDSs. In this paper, we examine the requirements of a typical FDS. Then we present a survey of the recent work in the area of fall detection systems, with focus on the application of machine learning. We also analyze the challenges in FDS systems based on the literature survey.

Language: en

Age, comorbidities and fear of fall: mortality predictors associated with fall-related fractures

Magdalini V, Petros I, Constantinos T, Garyfalia S P, Emmanouil P, Christos K, George K, Kalliopi A, George S, Symeon H P. *Maedica (Buchar)* 2020; 15(1): 18-23.

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Abstract

OBJECTIVES: To determine mortality predictors following fall related fractures in older patients.

MATERIALS AND METHODS: Patients aged ≥ 70 years hospitalized for fall related fractures were prospectively evaluated. Mortality was the main outcome. Age, functional-cognitive function, medications, comorbidities, fall history, fear of falls were also assessed. **Outcomes:** A total of 100 patients were enrolled. Ninety-one out of 100 (91%) suffered a hip fracture; 92 (92%) had surgery. The one-year post-discharge mortality was 20%. Univariate analysis revealed that older age, increased Charlson comorbidity index, low abbreviated mental test on admission, low modified Barthel index (MBI), fear of falls and delirium were significantly correlated with one-year post discharge mortality ($p=.03$, $p=.003$, $p=.04$, $p=.005$, $p=.004$, $p=.015$, respectively).

CONCLUSION: Age, fear of falls and Charlson comorbidity index are predictors of one-year mortality after hospitalization for fracture. It is of utmost importance to identify older patients suffering from fracture at risk of dying that may benefit from patient-centered care.

Language: en

Characterizing the impact of fear of falling on activity and falls in older adults with glaucoma

E JY, Mihailovic A, Kuo PL, West SK, Friedman DS, Gitlin LN, Li T, Schrack JA, Ramulu PY. *J. Am. Geriatr. Soc.* 2020; ePub(ePub): ePub.

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Abstract

OBJECTIVE: Fear of falling (FoF) may alter mobility in older adults, especially among those with visual impairment. Using a longitudinal prospective cohort of older glaucoma patients, we investigated whether and how FoF is associated with future falls and physical activity.

DESIGN: Prospective observational cohort study. **SETTING:** Hospital-based single-center recruitment. **PARTICIPANTS:** Individuals with glaucoma or suspected glaucoma.

MEASUREMENTS: FoF was measured annually over a 3-year period using the University of Illinois at Chicago FoF Questionnaire, with lower Rasch-analyzed FoF scores (in logit units) indicating less fear. Participants recorded falls prospectively over the 3-year period using monthly mail-in calendars. Daily steps were collected annually over 7 days using an accelerometer. Visual field (VF) sensitivity was derived by combining sensitivities from monocular VF results. Participants completed questionnaires to determine other demographic/health characteristics. Multivariate random effects models evaluated within-participant changes in fall rates and physical activity across study years.

RESULTS: At lower FoF levels ($FoF \leq 0$), each one-unit worsening in FoF score across study years was associated with 2.73 times higher odds of reporting at least one fall in the next year (95% confidence interval [CI] = 1.55-4.81) but was not associated with average daily steps ($P = .44$). Similar results were seen when fall rates were normalized by number of steps taken ($P = .97$). At higher FoF levels ($FoF > 0$), inter-year changes in FoF scores were not significantly associated with reporting a fall in the following year ($P = .78$) but were associated with 407 fewer average daily steps per one-unit change in FoF (95% CI = -743 to -71).

CONCLUSION: FoF is an important psychological factor associated with mobility in glaucoma patients, although specific aspects of mobility (fall rates vs activity levels) affected vary by the degree of FoF. Our findings suggest that customizing behavioral interventions for older adults based on their levels of FoF may be an important strategy for fall prevention and activity promotion.

Language: en

Keywords

falls; fear of falling; glaucoma; physical activity; vision loss

Fear of falling and mortality among older adults in Korea: analysis of the Korean Longitudinal Study of Aging

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Abstract

BACKGROUND: The fear of falling (FOF) has been reported in a high percentage of elderly people. An excessive FOF is a major concern among the elderly because it can lead to permanent disability. However, the impact of FOF on mortality has been insufficiently studied. The aim of this study was to investigate the impact of FOF on mortality among the elderly in Korea.

METHODS: This was a prospective study carried out using the database of the Korean Longitudinal Study of Aging, a nationwide study of community-dwelling adults in Korea. Study participants included 3,421 adults, aged 65 years or older, without either severe cognitive impairment (Korean version of Mini-Mental Status Examination ≥ 10), or previous history of cancer. We used Cox proportional hazards models to investigate the association between FOF and all-cause mortality.

RESULTS: This study included 1,474 men and 1,947 women. Cox regression showed that participants with FOF had an increased risk of mortality (mild: hazard ratio [HR], 1.25; 95% confidence interval [CI], 1.01-1.54; moderate: HR, 1.59; 95% CI, 1.23-2.05) after adjusting for confounding variables. In a subgroup analysis, FOF was still a significant risk factor of mortality for patients with no previous history of falling after adjusting for other risk factors, as in the full model, except for history of falling (HR, 1.65; 95% CI, 1.27-2.13).

CONCLUSION: We found that FOF was a significant risk factor for mortality in the elderly in Korea. Further studies on the effects and mechanism of FOF on mortality are needed.

Language: en

Keywords

Accidental Falls; Aged; Fear; Mortality

Impact of pain on reactive balance and falls in community-dwelling older adults: a prospective cohort study

Hirase T, Okubo Y, Menant J, Lord SR, Sturnieks DL. Age Ageing 2020; ePub(ePub): ePub.

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Abstract

BACKGROUND: pain is associated with increased postural sway and falls in older adults. However, the impact of pain on reactive balance induced by postural perturbations and how this might predispose older adults to falls is not known.

OBJECTIVE: to investigate whether any pain, back/neck pain and lower limb pain are associated with poor reactive balance and prospective fall outcomes in older adults.

DESIGN: 12-month prospective cohort study.

SETTING: community.

SUBJECTS: 242 community-dwelling older adults aged 70+ years.

METHODS: participants completed a questionnaire on the presence of pain and underwent force-controlled waist-pull postural perturbations while standing. Force thresholds for stepping, step initiation time, step velocity and step length were quantified. Falls were monitored with monthly falls calendars for 12-months.

RESULTS: participants with lower limb pain had significantly lower force thresholds for stepping. Those with any pain or pain in the back/neck had longer step initiation time, slower step velocity and shorter step length. The three pain measures (any pain, back/neck pain, lower limb pain) were significantly associated with multiple falls when adjusted for age, sex, body mass index, use of polypharmacy, strength and walking speed. In mediation analyses, there was a significant indirect effect of reactive balance for the relationship between back/neck pain and falls with fractures.

CONCLUSIONS: older people with pain have impaired reactive balance and an increased risk of falls. Reactive balance partially mediated the association between pain and fall-related fractures. Further research is required to confirm the findings of this study.

Language: en

Keywords

accidental falls; pain; older people; reactive balance

Impaired multisensory integration predisposes the elderly people to fall: a systematic review

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Abstract

Background: This systematic review pooled all the latest data and reviewed all the relevant studies to look into the effect of multisensory integration on the balance function in the elderly. **Methods:** PubMed, Web of Science and Scopus were searched to find eligible studies published prior to May 2019. The studies were limited to those published in Chinese and English language. The quality of the included studies was assessed against the Newcastle-Ottawa Scale or an 11-item checklist, as recommended by Agency for Healthcare Research and Quality (AHRQ). Any disagreement among reviewers was resolved by comparing notes and reaching a consensus. **Results:** Eight hundred thirty-nine records were identified and 17 of them were included for systematic review. The result supported our assumption that multisensory integration works on balance function in the elderly. All the 17 studies were believed to be of high or moderate quality. **Conclusions:** The systematic review found that the impairment of multisensory integration could predispose elderly people to fall. Accurate assessment of multisensory integration can help the elderly identify the impaired balance function and minimize the risk of fall. And our results provide a new basis for further understanding of balance maintenance mechanism. Further research is warranted to explore the change in brain areas related to multisensory integration in the elderly.

Language: en

Keywords

balance; multisensory integration; neurophysiology; older adults; systematic review

Motoric cognitive risk syndrome using Three-item Recall Test and its associations with fall-related outcomes: the Korean Frailty and Aging Cohort Study

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Abstract

Motoric cognitive risk (MCR) syndrome is originally defined as the presence of subjective cognitive complaints (SCCs) and slow gait (SG). MCR is well known to be useful for predicting adverse health outcomes, including falls and dementia. However, around four out of five older Korean adults reported SCCs, thereby, it may not be discriminative to define MCR in Korea. We adopted the three-item recall (3IR) test, instead of SCCs, to define MCR. This cross-sectional analysis included 2133 community-dwelling older adults aged 70-84 years, without dementia or any dependence in activities of daily living from the Korean Frailty and Aging Cohort Study. The newly attempted criteria of MCR using 3IR were met by 105 participants (4.9%). MCR using 3IR showed synergistic effects on fall-related outcomes, whereas the conventional definition of MCR using SCCs was not superior to SG only. MCR using 3IR was associated with falls (odds ratio [OR]: 1.92; 95% confidence interval (CI): 1.16-3.16), recurrent falls (OR: 2.19; 95% CI: 1.12-4.32), falls with injury (OR: 1.98; 95% CI: 1.22-3.22), falls with fracture (OR: 2.51; 95% CI: 1.09-5.79), fear of falling (OR: 3.00; 95% CI: 1.83-4.92), and low activities-specific balance confidence (OR: 3.13; 95% CI: 1.57-6.25). We found that MCR using 3IR could be useful in predicting fall-related outcomes in a cultural background reporting more SCCs, such as Korea.

Language: en

Keywords

cognitive function; fall; gait speed; motoric cognitive risk syndrome; older adults; three-item recall

Psychometric testing of the Fall Risks for Older People in the Community screening tool (FROP-Com screen) for community-dwelling people with stroke

Ng SSM, Liu TW, Kwong PWH, Choy HM, Fong TYK, Lee JYC, Tan YL, Tong GYH, Wong CCY, Lai CYY, Tse MMY. PLoS One 2020; 15(5): e0233045.

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Abstract

OBJECTIVE: The Falls Risk for Older People in the Community assessment (FROP-Com) was originally developed using 13 risk factors to identify the fall risks of community-dwelling older people. To suit the practical use in busy clinical settings, a brief version adopting 3 most fall predictive risk factors from the original FROP-Com, including the number of falls in the past 12 months, assistance required to perform domestic activities of daily living and observation of balance, was developed for screening purpose (FROP-Com screen). The objectives of this study were to investigate the inter-rater and test-retest reliability, concurrent and convergent validity, and minimum detectable change of the FROP-Com screen in community-dwelling people with stroke. **PARTICIPANTS:** Community-dwelling people with stroke ($n = 48$) were recruited from a local self-help group, and community-dwelling older people ($n = 40$) were recruited as control subjects.

RESULTS: The FROP-Com screen exhibited moderate inter-rater (Intraclass correlation coefficient [ICC]_{2,1} = 0.79, 95% confidence interval [CI]: 0.65-0.87) and test-retest reliability (ICC_{3,1} = 0.70, 95% CI: 0.46-0.83) and weak associations with two balance measures, the Berg Balance Scale (BBS) ($\rho = -0.38$, $p = 0.008$) and the Timed "Up & Go" (TUG) test ($\rho = 0.35$, $p = 0.016$). The screen also exhibited a moderate association with the Chinese version of the Activities-specific Balance Confidence Scale (ABC-C) (ABC-C; $\rho = -0.65$, $p < 0.001$), a measure of subjective balance confidence.

CONCLUSIONS: The FROP-Com screen is a reliable clinical tool with convergent validity paralleled with subjective balance confidence measure that can be used in fall risk screening of community-dwelling people with stroke. However, one individual item, the observation of balance, will require additional refinement to improve the potential measurement error.

Language: en

The moderating role of social factors in the relationship between an incident of fall and depressive symptoms: a study with a national sample of older adults in South Korea

Rhee MK, Jang Y, Kim SY, Chang S. *Aging Ment. Health* 2020; ePub(ePub): ePub.

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Abstract

OBJECTIVES: The purpose of the study was to examine the effect of an incident of fall on depressive symptoms and the moderating role of social factors (marital status, living arrangement, family network, and friend network) in older adults in South Korea. We hypothesized that the adverse mental health effect of a fall would be pronounced among those who lack social resources (e.g., no spouse, living alone, and social disconnectedness).

METHOD: Using the 2017 National Survey of Older Koreans, data were drawn from 8,522 survey participants (aged 65 or older). Multivariate linear regression models of depressive symptoms were examined with an array of predictors: (1) demographic and health variables, (2) social factors, (3) an incident of fall, and (4) interactions between falls and social factors.

RESULTS: More than 15% of the sample had at least one fall in the past 12 months. Higher levels of depressive symptoms were associated with an incident of fall, not married and living alone, and lack of family and friend networks. Not married and living alone and family network significantly moderated the relationship between falls and depressive symptoms. The adverse mental health effect of a fall was more pronounced among those who were not married and living alone and who reported not having any close family members than their counterparts.

CONCLUSION: The findings highlight the critical role of family and social resources in protecting older Koreans from the negative mental health consequences of a fall.

FINDINGS also provide implications for developing fall prevention and management programs, suggesting prioritizing older adults with limited social resources.

Language: en

Keywords

older adults; depression; Fall; South Korea; social resources

Turning duration and steps predict future falls in poststroke hemiplegic individuals: a preliminary cohort study

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DOI 10.1080/10749357.2020.1760644 PMID 32397952

Abstract

Introduction: Turning was reported as one of the activities that most frequently leads to falling among stroke patients. This study investigated whether the duration and steps of a 180° turn while walking can distinguish retrospective fallers from non-fallers and predict future falls in a 1-year period in patients with poststroke hemiplegia. **Methods:** Thirty stroke patients were recruited. They were instructed to get up from a chair, walk straight 3 m, turn around, and return to seated position to assess the 180° walking-turn task. Turning performance was measured by two inertial sensor units of Physilog. Turn duration and steps were recorded for analysis. The numbers of retrospective and prospective falls were also obtained. **Results:** No significant difference was observed between retrospective stroke fallers and non-fallers in turn duration and steps. Turn duration and steps were significantly greater in prospective stroke fallers than in non-fallers. The cutoff turn duration of 4 s (area under the curve 0.75, 95% CI: 0.56-0.93, sensitivity 67%, specificity 80%, $p = .04$) and turn step of 7 steps (area under the curve 0.73, 95% CI: 0.51-0.94, sensitivity 56%, specificity 85%, $p = .05$) were found to most accurately predict prospective stroke fallers from non-fallers. **Conclusions:** Turn duration and steps were unable to discriminate between retrospective fallers and non-fallers but could predict prospective falls in patients with stroke. More than 4 s or 7 steps to complete a 180° turn while walking can be a predictor for patients with stroke at an increased risk of falling.

Language: en

Keywords

Falls; prediction; stroke; turning

Hip fracture risk functions for elderly men and women in sideways falls

Kleiven S. J. *Biomech.* 2020; 105: e109771.

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Abstract

Falls among the elderly cause a huge number of hip fractures world-wide. The objective is to generate hip fracture force risk functions for elderly women and men in sideways falls which can be used for determining effectiveness of fall prevention measures as well as for individual assessment of fracture risk at the clinics. A literature survey was performed and ten publications were identified who contained several hundred individual femoral neck fracture forces in sideways fall for both elderly women and men. Theoretical distributions were tested for goodness of fit against the pooled dataset with the Anderson-Darling test (AD-test) and root mean square errors (RMSE) were extracted. According to the AD-test, a Weibull distribution is a plausible model for the distribution of hip fracture forces. A simple, exponential two-parameter Weibull function was therefore proposed, having a RMSE below 2.2% compared to the experimental distribution for both men and women. It was demonstrated that elderly women only can endure nearly half the proximal femur force for 5 and 10% fracture risk as elderly men. It should be noted though, that women were found to have significantly lesser body height and body weight which would produce less impact force during falls from standing height. The proposed sex-specific hip fracture risk functions can be used for biomechanically optimizing hip protectors and safety floors and for determining their effectiveness as a fall prevention measure.

Language: en

Keywords

Elderly; Hip fracture; Risk functions; Sideways falls

Incidence of falls in a cohort of critical adults: a cause for concerns?

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DOI 10.1590/1983-1447.2020.20190167 **PMID** 32401856

Abstract

OBJECTIVE: To describe the incidence and to report the cases of falls in a cohort of critical adults.

METHOD: A prospective cohort study, conducted in 2018 at an adult Intensive Care Unit (ICU) in the south of Brazil. The patients were followed up from admission to discharge; observations were made in the morning and afternoon. The clinical and care variables were evaluated. The descriptive analysis was performed followed by the reporting of the cases.

RESULTS: 551 patients were monitored during 6 [3-12.7] days of hospitalization, generating 7,839 observations. There were four cases of falls, with an incidence rate of 5.1/10.000 observations/day - confidence interval of 99% [0.9 to 16] and density of incidence of 7/10.000 observations/day - confidence interval of 99% [1.2 to 22]. No serious harms were observed.

CONCLUSION: Falls occur less in the ICU, which can be explained by the use of safe care practices.

Language: en