A generalisable methodology for stability assessment of walking aid users

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Abstract

To assist balance and mobility, older adults are often prescribed walking aids. Nevertheless, surprisingly their use has been associated with increased falls-risk. To address this finding we first need to characterise a person's stability while using a walking aid. Therefore, we present a generalisable method for the assessment of stability of walking frame (WF) users. Our method, for the first time, considers user and device as a combined system. We define the combined centre of pressure (CoPsystem) of user and WF to be the point through which the resultant ground reaction force for all feet of both the WF and user acts if theresultant moment acts only around an axisperpendicular tothe ground plane. We also define the combined base of support (BoSsystem) to be the convex polygon formed by the boundaries of the anatomical and WF feet in contact with the ground and interconnecting lines between them. To measure these parameters we have developed an instrumented WF with a load cell in each foot which we use together with pressure-sensing insoles and a camera system, the latter providing the relative position of the WF and anatomical feet. Software uses the resulting data to calculate the stability margin of the combined system, defined as the distance between CoPsystem and the nearest edge of BoSsystem. Our software also calculates the weight supported through the frame and when each foot (of user and/or frame) is on the floor. Finally, we present experimental work demonstrating the value of our approach.

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Association of benzodiazepine and Z-drug use with the risk of hospitalisation for fall-related injuries among older people: a nationwide nested case-control study in Taiwan

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Abstract

BACKGROUND: Non-benzodiazepine hypnotics (Z-drugs) are advocated to be safer than benzodiazepines (BZDs). This study comprehensively investigated the association of BZD and Z-drug usage with the risk of hospitalisation for fall-related injuries in older people.

METHODS: This study used the Taiwan National Health Insurance Database with a nested matched case-control design. We identified 2238 elderly patients who had been hospitalised for fall-related injuries between 2003 and 2012. They were individually matched (1:4) with a comparison group by age, sex, and index year. Conditional logistic regression was used to determine independent effects of drug characteristics (type of exposure, dosage, half-life, and polypharmacy) on older people.

RESULTS: Older people hospitalisation for fall-related injuries were significantly associated with current use of BZDs (adjusted odds ratio [AOR] = 1.32, 95% confidential interval [CI] = 1.17-1.50) and Z-drugs (AOR = 1.24, 95%CI = 1.05-1.48). At all dose levels of BZDs, high dose levels of Z-drugs, long-acting BZD, and short-acting BZD use were all significantly increased the risk of fall-related injuries requiring hospitalisation. Polypharmacy, the use of two or more kinds of BZDs, one kind of BZD plus Z-drugs and two or more kinds of BZDs plus Z-drugs, also significantly increased the risk (AOR = 1.61, 95% CI = 1.38-1.89; AOR = 1.65, 95% CI = 1.08-2.50, and AOR = 1.58, 95% CI = 1.21-2.07).
CONCLUSIONS: Different dose levels and half-lives of BZDs, a high dose of Z-drugs, and polypharmacy with BZDs and Z-drugs were associated with an increased risk of fall-related injury requiring hospitalisation in older people. Physicians should balance the risks and benefits when prescribing these drug regimens to older people considering the risk of falls.
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Burden and correlates of falls among rural elders of South India: Mobility and Independent Living in Elders Study

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Abstract
AIM: Falls are an important contributor to loss of function, morbidity, and mortality in elders. Little is known about falls in Indian populations. The objective of this cross-sectional report was to identify the prevalence and correlates of falls in a cohort of 562 rural southern Indian men and women.
METHODS: Risk factors included demographics, anthropometrics, self-reported health, medical history, physical function, vision, depression, and lifestyle. Odds ratios were calculated using logistic regression.
RESULTS: 71 (13%) subjects reported at least 1 fall in the past year. Prevalence was higher among women (17%) than men (8%), P = 0.003. Sex and age showed significant interaction (P = 0.04) whereby falls prevalence increased with age among women but decreased among men. Correlates of falls among men included a history of osteoarthritis (OA) (odds ratio (OR): 6.91; 95% CI: 1.4-33.1), depression (OR:9.6; 3.1-30.1), and greater height (OR per 1 standard deviation increase: 2.33; 1.1-5.1). Among women, poor physical performance (OR: 3.33; 1.13-9.86) and history of cardiovascular disease (CVD) (OR: 2.42; 1.01-5.80) were independently associated with falls. IMPLICATIONS: Prevalence of falls in elderly South Indians was lower than published reports from western countries and likely reflects low exposure to fall risks. Patterns with age differed in men and women and may reflect sex differences in the accuracy of age recall. Presence of comorbidities specifically OA, CVD, and depression was independent correlate of falling.
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Chair rise capacity and associated factors in older home-care clients
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Abstract

AIMS: The aim of this study was to investigate the ability of older home-care clients to perform the five times chair rise test and associated personal characteristics, nutritional status and functioning.

METHODS: The study sample included 267 home-care clients aged ≥75 years living in Eastern and Central Finland. The home-care clients were interviewed at home by home-care nurses, nutritionists and pharmacists. The collected data contained sociodemographic factors, functional ability (Barthel Index, IADL), cognitive functioning (MMSE), nutritional status (MNA), depressive symptoms (GDS-15), medical diagnoses and drug use. The primary outcome was the ability to perform the five times chair rise test.

RESULTS: Fifty-one per cent (n=135) of the home-care clients were unable to complete the five times chair rise test. Twenty-three per cent (n=64) of the home-care clients had good chair rise capacity (≤17 seconds). In a multivariate logistic regression analysis, fewer years of education (odds ratio [OR] = 1.11, 95% confidence interval [CI] 1.04-1.18), lower ADL (OR = 1.54, 95% CI 1.34-1.78) and low MNA scores (OR = 1.12, 95% CI 1.04-1.20) and a higher number of co-morbidities (OR = 1.21, 95% CI 1.02-1.43) were associated with inability to complete the five times chair rise test.

CONCLUSIONS: Poor functional mobility, which was associated with less education, a high number of co-morbidities and poor nutritional status, was common among older home-care clients. To maintain and to prevent further decline in functional mobility, physical training and nutritional services are needed. (NutOrMed, ClinicalTrials.gov Identifier: NCT02214758).

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Continuous detection of human fall using multimodal features from Kinect sensors in scalable environment

Tran TH, Le TL, Hoang VN, Vu H. Comput. Methods Programs Biomed. 2017; 146: 151-165.

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Abstract

BACKGROUND AND OBJECTIVES: Automatic detection of human fall is a key problem in video surveillance and home monitoring. Existing methods using unimodal data (RGB / depth / skeleton) may suffer from the drawbacks of inadequate lighting condition or unreliability. Besides, most of proposed methods are constrained to a small space with off-line video stream.

METHODS: In this study, we overcome these encountered issues by combining multi-modal features (skeleton and RGB) from Kinect sensor to take benefits of each data characteristic. If a skeleton is available, we propose a rules based technique on the vertical velocity and the height to floor plane of the human center. Otherwise, we compute a motion map from a continuous gray-scale image sequence, represent it by an improved kernel descriptor then input to a linear Support Vector Machine. This combination speeds up the proposed system and avoid missing detection at an unmeasurable range of the Kinect sensor. We then deploy this method with multiple Kinects to deal

with large environments based on client server architecture with late fusion techniques.

RESULTS: We evaluated the method on some freely available datasets for fall detection. Compared to recent methods, our method has a lower false alarm rate while keeping the highest accuracy. We also validated on-line our system using multiple Kinects in a large lab-based environment. Our method obtained an accuracy of 91.5% at average frame-rate of 10fps.

CONCLUSIONS: The proposed method using multi-modal features obtained higher results than using unimodal features. Its on-line deployment on multiple Kinects shows the potential to be applied in to any of living space in reality.

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Development and validity of methods for the estimation of temporal gait parameters from heel-attached inertial sensors in younger and older adults

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Abstract

The heel is likely a suitable location to which inertial sensors are attached for the detection of gait events. However, there are few studies to detect gait events and determine temporal gait parameters using sensors attached to the heels. We developed two methods to determine temporal gait parameters: detecting heel-contact using acceleration and detecting toe-off using angular velocity data (acceleration-angular velocity method; A-V method), and detecting both heel-contact and toe-off using angular velocity data (angular velocity-angular velocity method; V-V method). The aim of this study was to examine the concurrent validity of the A-V and V-V methods against the standard method, and to compare their accuracy. Temporal gait parameters were measured in 10 younger and 10 older adults. The intra-class correlation coefficients were excellent in both methods: compared with the standard method (0.80 to 1.00). The root mean square errors of stance and swing time in the A-V method were smaller than the V-V method in older adults, although there were no significant discrepancies in the other comparisons. Our study suggests that inertial sensors attached to the heels, using the A-V method in particular, provide a valid measurement of temporal gait parameters.

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Development of a falls registry: a pilot study

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Abstract

Each year approximately 1 in 4 healthy older adults aged 65+ years and 1 in 2 aged 80+ years living in the community will fall. Fall-related injuries are the leading cause of death and disability and cost the United States approximately $31 billion annually. Currently, no repository of scene data exists that informs prevention programs regarding circumstances that contribute to older adult falls. This was a multicenter (4 sites: Kansas, Maryland, Oregon, and Texas) pilot study consisting of interviews of older (55+ years) patients who had been admitted to a trauma center with fall-related injuries. Questions included information regarding environment, behaviors, injuries, and demographics. Additional information was abstracted from patient medical record: comorbidities, medications, and discharge information. Data are presented descriptively. Forty-nine patients were interviewed: average age was 78 years; White (93.9%); female (53.1%); and most (63.3%) had fallen before. The most commonly reported fall factors and injuries included those occurring at home without agency services (65.0%), on hard flooring (51.1%), with laced shoes (44.2%), and with walkers (36.7%) and contained contusion/open wound of head (61.2%). Survey time was anecdotally estimated at 10-15 min. Preliminary data suggest that prevention efforts should emphasize on educating older adults to focus on ambulation, body position, and use of assistive devices in their daily activities. The development of a systematic and organized registry that documents scene data would inform public health agencies to develop fall prevention programs that promote older adult safety. Furthermore, it would provide a large sample size to test factor associations with injury severity.

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Falls and subjective well-being. Results of the population-based German Ageing Survey

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Abstract

PURPOSE: The aim of the current study was to determine the relationship between falling in the past 12 months and subjective well-being in a broader sense.

METHODS: Cross-sectional data were gathered from a representative sample of community-dwelling individuals in the second half of life (40 to 95 years; n=7808) in Germany. While life satisfaction was quantified using the Satisfaction with Life Scale (SWLS), positive and negative affect was measured using the Positive and Negative Affect Schedule (PANAS).

RESULTS: The prevalence of falling in the preceding 12 months was 17.6%. After controlling for sociodemographic factors, various lifestyle factors, self-rated health, and morbidity, multiple linear regression analysis revealed that falling in the past 12 months was associated with higher negative affect ($\beta=0.08$, $p<0.001$), lower positive affect ($\beta=-0.04$, $p<0.05$) as well as lower life satisfaction ($\beta=-0.12$, $p<0.001$).

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Falls in the aging population
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(Copyright © 2017, Elsevier Publishing)
DOI 10.1016/j.cger.2017.03.002 **PMID** 28689568
Abstract
The number of people living beyond 65 years of age is increasing rapidly, and they are at increased risk of falls. Falls-related injuries and hospitalizations are steadily increasing. Falls can lead to fear of falling, loss of independence, institutionalization, and death, inevitably posing a significant burden to the health care system. Therefore, screening of people at risk of falls and comprehensive assessment of older people at high risk of falls are critical steps toward prevention. This review evaluates the current knowledge relating to falls, with particular focus on rapid screening, assessment, and strategies to prevent falls in the community.
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Falls prevention activities among community-dwelling elderly in the Netherlands: a Delphi study
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(Copyright © 2017, Elsevier Publishing)
DOI 10.1016/j.injury.2017.06.022 **PMID** 28684078
Abstract
INTRODUCTION: This study aimed to provide an overview of the current falls prevention activities in community-dwelling elderly with an increased risk of falling in the Netherlands. Therefore, we determined: a) how health professionals detect community-dwelling elderly with an increased risk of falling; b) which falls prevention activities are used by health professionals and why; c) how elderly can be stimulated to participate in falls prevention programs; and d) how to finance falls prevention. METHODS: A two-round online Delphi study among health experts was conducted. The panel of experts (n=125) consisted of community physiotherapists, community nurses, general practitioners, occupational therapists and geriatricians, from all over the Netherlands. The median and Inter Quartile Deviation (IQD) were reported for the questions with 5-point Likert scales, ranging from 'least' (1) to 'most' (5).

RESULTS: Respectively 68% (n=85/125) and 58% (n=72/125) of the panel completely filled in the first and second round questionnaires. According to the panel, regular detection of fall risk of community-dwelling elderly with an increased risk of falling hardly takes place (median=2 [hardly]; IQD=1). Furthermore, these elderly are reluctant to participate in annual detection of fall risk (median=3 [reluctant]; IQD=1). According to 73% (n=37/51) of the panel, 0-40% of the elderly with an increased risk of falling are referred to exercise programs. In general, the panel indicated that structural follow-up is often lacking. Namely, after one month (n=21/43; 49%), three months (n=24/42; 57%), and six months (n=27/45; 60%) follow-up is never or hardly ever offered. Participation of elderly in falls prevention programs could be stimulated by a combination of measures. Should a combination of national health education, healthcare counseling, and removal of financial barriers be applied, 41-80% of the elderly is assumed to participate in falls prevention programs (n=47/64; 73%). None of the panel members indicated full financing of falls prevention by the elderly. A number of individuals are considered key in falls prevention activities, such as the general practitioner, physiotherapist, and informal caregiver.

CONCLUSION: This Delphi study showed clear directions for improving falls prevention activities and how to increase participation rates.

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How do community-dwelling persons with Alzheimer disease fall? Falls in the FINALEX Study

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Dement. Geriatr. Cogn. Dis. Extra 2017; 7(2): 195-203.

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Abstract

BACKGROUND: People with dementia are at high risk for falls. However, little is known of the features causing falls in Alzheimer disease (AD). Our aim was to investigate how participants with AD fall.

METHODS: In the FINALEX (Finnish Alzheimer Disease Exercise Trial) study, participants' (n = 194) falls were followed up for 1 year by diaries kept by their spouses.

RESULTS: The most common reason for falls (n = 355) was stumbling (n = 61). Of the falls, 123 led to injuries, 50 to emergency department visits, and 13 to fractures. The participants without falls (n = 103) were younger and had milder dementia than those with 1 (n = 34) or ≥2 falls (n = 57). Participants with a Mini Mental State Examination score of around 10 points were most prone to fall. In adjusted regression models, good nutritional status, good physical functioning, and use of antihypertensive medication (incident rate ratio [IRR] 0.68, 95% confidence interval [CI] 0.54-0.85) protected against falls, whereas fall history (IRR 2.71, 95% CI 2.13-3.44), osteoarthritis, diabetes mellitus, chronic obstructive pulmonary disease, higher number of drugs, drugs with anticholinergic properties, psychotropics, and opioids (IRR 4.27, 95% CI 2.92-6.24) were risk factors for falls.

CONCLUSIONS: Our study provides a detailed account on how and why people with AD fall, suggesting several risk and protective factors.

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Perspectives on the risks for older adults living independently

Abstract

Insight into risks concerning older adults living independently from their own perspective and their care provider's perspective is essential to address issues that may threaten their independent living. The most often mentioned perceived risks by older adults and their care providers in different regions in the Netherlands were: loneliness, falls, budget cuts in Dutch long-term care and not being able to call for help. The different perspectives of the respondents show a wide variety in risks, but also some similarities. The perspective of the frail older adults is required to gain insight into the priority of their perceived risks. An additional finding was the reluctance shown by the older adults to ask others in their social network for help.

RESULTS imply that possible preventive measures should not only focus on the medical or physical domain because older adults are likely to have other priorities to maintain self-reliance and live independently.

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Psychometric properties of the Swedish version of the Falls Efficacy Scale-International for older adults with osteoporosis, self-reported balance deficits and fear of falling

Abstract

PURPOSE: Investigate the psychometric properties of the Swedish version of the Falls Efficacy Scale-International (FES-I).

METHOD: Cross-sectional study. Community-dwelling older adults with self-reported balance deficits and fear of falling were recruited from an ongoing randomised controlled study to evaluate the psychometric properties of the FES-I using Rasch model analysis.

RESULTS: The Rasch model analysis revealed good category function, the questionnaire measured one dimension with an explained variance of 68.6% and item goodness-of-fit with mean square values (MnSq) 0.7-1.44. The item map showed that all items are spread over the scale, which indicates different difficulties in the items. Non-satisfactory person goodness-of-fit was shown with seven persons and showed person misfit according to both the MnSq-value and the z-value, 38 persons (40%) showed a person misfit when only following the threshold for MnSq.

CONCLUSIONS: The Swedish version of FES-I shows good psychometric properties with unidimensionality and item goodness-of-fit. Lower person goodness-of-fit was shown probably because of confounding factors that may influence the answers. The transformed values of the FES-I make it possible to use parametric statistics preferable for this population in future research.

Implications for rehabilitation The Falls Efficacy Scale-International (FES-I) shows good psychometric properties with unidimensionality, item goodness-of-fit and good item reliability, which means that FES-I is a valuable tool when measuring concerns about falling in an older population with osteoporosis and could be useful in clinical settings. Confounding factors such as pain, high number of falls, low fall self-efficacy, experience of previous falls, and vertigo may influence the answers and result in low person goodness-of-fit.

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Rapid depression assessment in geriatric patients

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Clin. Geriatr. Med. 2017; 33(3): 383-391.
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Abstract

Depression is common in geriatric patients, especially in those with multiple comorbidities and polypharmacy. Depression in older adults is often underdiagnosed and undertreated. Initial screening for depression can easily be accomplished in the waiting room. Yet the clinical interview still remains the gold standard for diagnosing geriatric depression. Key components of the clinical interview are observant watching of the patient for the subtle signs of depression. Clinical interview should be done with sensitivity to the importance of privacy. Illicit substances and medical conditions may significantly contribute. Suicide assessment should be done in a step wise manner. Copyright © 2017 Elsevier Inc. All rights reserved.

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Revisit, subsequent hospitalization, recurrent fall, and death within 6 months after a fall among elderly emergency department patients

Sri-On J, Tirrell GP, Bean JF, Lipsitz LA, Liu SW. Ann. Emerg. Med. 2017; ePub(ePub): ePub.
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Abstract

STUDY OBJECTIVE: We seek to describe the risk during 6 months and specific risk factors for recurrent falls, emergency department (ED) revisits, subsequent hospitalizations, and death within 6 months after a fall-related ED presentation.

METHODS: This was a secondary analysis of a retrospective cohort of elderly fall patients who presented to the ED from one urban teaching hospital. We included patients aged 65 years and older who had an ED fall visit in 2012. We examined the frequency and risk factors of adverse events (composite of recurrent falls, ED revisits, subsequent hospitalization, and death, selected a priori) at 6 months.

RESULTS: Our study included 350 older adults. Adverse events steadily increased, from 7.7% at 7 days, 21.4% at 30 days, and 50.3% at 6 months. Within 6 months, 22.6% of patients had at least one recurrent fall, 42.6% revisited the ED, 31.1% had subsequent hospitalizations, and 2.6% died. In multivariable logistic regression analysis, psychological or sedative drug use predicted recurrent falls,

ED revisits, subsequent hospitalizations, and adverse events.

CONCLUSION: More than half of fall patients had an adverse event within 6 months of presenting to the ED after a fall. The risk during 6 months of these adverse events increased with psychological or sedative drug use. Larger future studies should confirm this association and investigate methods to minimize recurrent falls through management of such medications.

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Sleep quality and its association with postural stability and fear of falling among Spanish postmenopausal women

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Abstract

OBJECTIVE: To analyze the association of sleep quality with postural balance, as measured with objective stabilometric parameters, and fear of falling (FoF), among Spanish postmenopausal women.

METHODS: In all, 250 women (60 ± 8 years) took part in this cross-sectional study. Sociodemographic and anthropometric data were collected, as well as information concerning history of falls and FoF. Anxiety and depression were assessed using the Hospital Anxiety and Depression Scale, and the Pittsburgh Sleep Quality Index was used to analyze sleep quality. Measurements of sway area (S), velocity (V), and mediolateral (RMSX) and anteroposterior (RMSY) displacements of the center of pressure were obtained with a resistive multisensor platform under both eyes-open (EO) and eyes-closed (EC) conditions to assess postural control. The independent associations of sleep quality with FoF and postural control were evaluated by multivariate linear and logistic regressions, respectively, adjusting for potential confounding variables.

RESULTS: SEO was independently associated (adjusted $R = 0.073$) with sleep duration ($P < 0.001$) and subjective sleep quality ($P = 0.001$), VEO (adjusted $R = 0.156$) with daytime dysfunction ($P = 0.006$) and sleep duration ($P = 0.013$), RMSXEO (adjusted $R = 0.118$) with subjective sleep quality ($P = 0.005$), and RMSYEO (adjusted $R = 0.166$) with sleep duration ($P = 0.001$) and daytime dysfunction ($P = 0.046$). Under EC condition, SEC (adjusted $R = 0.014$) was independently related with anxiety ($P = 0.034$), VEC (adjusted $R = 0.148$) with daytime dysfunction ($P = 0.002$) and sleep duration ($P = 0.024$), RMSXEC (adjusted $R = 0.134$) with subjective sleep quality ($P < 0.001$), and RMSYEC (adjusted $R = 0.128$) with sleep duration ($P = 0.013$) and daytime dysfunction ($P = 0.033$). Logistic regression showed that time since menopause ($P = 0.003$), body mass index ($P = 0.001$), and anxiety ($P < 0.001$), unlike sleep quality, were independently associated with FoF. The effect size of the model was medium (adjusted $R = 0.162$).

CONCLUSIONS: In Spanish postmenopausal women, sleep duration, subjective sleep quality, and daytime dysfunction were independent risk factors for worsened postural stability. FoF, anxiety,

time since menopause onset, and body mass index, unlike sleep quality, were independently associated with poor postural stability.

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Usability and acceptability by a younger and older user group regarding a mobile robot-supported gait rehabilitation system

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Abstract

PURPOSE: The aim of the study was to identify differences regarding usability, acceptability and barriers of usage of a robot-supported gait rehabilitation system between a younger and older group of patients with gait impairments.

METHOD: A mobile robot-supported gait rehabilitation prototype was tested on a group of geriatric patients aged 60 and above, and on a group of young patients aged 59 and below in a clinical setting during five therapy sessions. The involved therapists received 2 days training with the system and could test it profoundly. Data on usability, acceptability and barriers to system usage were collected with questionnaires and structured interviews with the patients.

RESULTS: The robotic system received overall moderate usability and good acceptability ratings, it was rated as clearly structured, practical and safe. Analyses identified a few barriers, such as time-intensive setup of the system or tight leg shells, which can be minimized with regular training and system adaptations. Differences between the two user groups could be revealed and will be used for future investigation.

CONCLUSION: This study showed the potential of the mobile robot-supported system for gait rehabilitation but also pointed out further need for action. Efficacy studies are the next step in the evaluation process.

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