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Brain-muscle loop" in the fragility of older persons: from pathophysiology to new organizing models

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DOI 10.1007/s40520-017-0729-4 **PMID** 28233284

Abstract

BACKGROUND: The imperative action of the geriatric medicine is to prevent disability in older persons. Many epidemiological studies have been conducted in the last decades for improving knowledge of the aging process and their interactions with age-related diseases, especially for the identification of the relationship between sarcopenia and loss of mobility. Factors influencing muscle integrity can be classified into six main physiologic subsystems, but the central nervous system certainly plays a crucial role for maintaining muscle integrity in older persons. Recent data show that the reduced muscle strength and not muscle mass could be considered the core of the fragility in predicting changes of gait velocity and mobility and conferring a higher risk of mortality in older persons. Sarcopenia and cognitive decline could, therefore, produce slow gait velocity in older persons, with devastating effect and consequences. Perhaps the most notorious corollary is falling, which is often caused by an underlying gait problem. Injuries caused by accidental falls range from relatively innocent bruises to major fractures or head trauma. Another important consequence is reduced mobility, which leads to loss of independence. This immobility is often compounded by a fear of falling, which further immobilises patients and affects their quality of life and physical performance. **HYPOTHESIS:** When we search the association between brain pathology and muscle function in older persons, we amazingly find that established composite measure of physical frailty is associated with brain pathology. Sarcopenia, which produces muscle dysfunction, slow gait velocity and cognitive decline, could share a strong bidirectional relationship, and this suggests the coexistence of both cognitive and motor dysfunctions in older persons to characterize a new syndrome characterized by slow gait and cognitive complaints, the motoric-cognitive risk syndrome (MRC).

AIM: In this review, we want to emphasize the relationship between memory complaints with muscle function integrating cognitive and physical evaluation, even with amyloid PET study, to identify older patients at high risk of cognitive and physical decline.

PDF Y Endnote Y

A smartphone application suite for assessing mobility

Madhushri P, Dzhagaryan AA, Jovanov E, Milenkovic A, Madhushri P, Dzhagaryan AA, Jovanov E, Milenkovic A, Dzhagaryan AA, Madhushri P, Jovanov E, Milenkovic A.

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Abstract

Modern smartphones integrate a growing number of inertial and environmental sensors that can enable the development of new mobile health applications. In this paper we introduce a suite of smartphone applications for assessing mobility in elderly population. The suite currently includes applications that automate and quantify the following standardized medical tests for assessing mobility: Timed-Up-and-Go (TUG), 30 Seconds Chair Stand Test (30SCS), and a 4-stage Balance Test (4SBT). For each smartphone application we describe its functionality and a list of parameters extracted by processing signals from smartphone's inertial sensors. The paper shows the results from studies conducted on geriatric patients for TUG tests and from studies conducted in the laboratory on healthy subjects for 30SCS and 4SBT tests.

PDF Y Endnote Y

Commentary: working toward a multi-program strategy in fall prevention

Ory MG, Towne SD, Howell D, Quinn C, Eblen KJ, Swierc SM, Smith ML.

Front. Public Health 2017; 5: e14.

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Comment On: *Front Public Health* 2015;2:254.

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Abstract [Abstract unavailable]

PDF Y Endnote Y

Comparison of nine instruments to calculate anticholinergic load in a large cohort of older outpatients: association with cognitive and functional decline, falls, and use of laxatives

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Am. J. Geriatr. Psychiatry 2017; ePub(ePub): ePub.

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Abstract

OBJECTIVE: A patient's risk for anticholinergic adverse effects is frequently estimated by instruments evaluating the drugs included in his medication profile. It remains unknown, however, which characteristics should be included in such an assessment instrument aiming to reliably predict adverse anticholinergic outcomes.

DESIGN: Cross-sectional study.

SETTING: ESTHER cohort (Germany).

PARTICIPANTS: Home-dwelling participants (N = 2,761) aged between 60 and 87 years.

MEASUREMENTS: The association between anticholinergic load calculated with nine different instruments and four anticholinergic adverse outcomes was investigated in univariate and multivariate analyses. Therefore, linear models complemented with Kendall's tau rank correlation coefficients (τ) were applied for continuous outcomes and generalized linear models were used to derive odds ratios (ORs) with 95% confidence intervals (CIs) for binary endpoints.

RESULTS: Based on the respective identification criteria for anticholinergic drugs, the nine instruments identified between 245 (9%) and 866 (31%) anticholinergic drug users (mean age \pm SD: 73 ± 6 years; Mini-Mental State Examination [MMSE] score: 28.3 ± 2.07 ; Barthel Index: 97.1 ± 7.5 ; 291 reporting falls; 29 taking laxatives [surrogate for constipation]). In the multivariate analysis, only two instruments indicated a significant association between anticholinergic load and all four outcomes. The instrument considering the prescribed dose showed the strongest association with MMSE scores ($\tau = -0.10$), falls (OR: 2.30; 95% CI: 1.50-3.52), and the use of laxatives (OR: 3.11; 95% CI: 1.04-9.36).

CONCLUSIONS: Instruments most reliably predicted anticholinergic adverse events if they were either based on the drugs' serum anticholinergic activity and the suggestions of clinician experts or considered the actual prescribed dose.

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Data set of healthy old people assessed for three walking conditions using accelerometric and opto-electronic methods

Gillain S, Boutaayamou M, Dardenne N, Schwartz C, Demonceau M, Gerontitis C, Depierreux F, Salmon E, Garraux G, Bruyère O, Brûls O, Croisier JL, Petermans

J. Aging Clin. Exp. Res. 2017; ePub(ePub): ePub.

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DOI 10.1007/s40520-017-0730-y **PMID** 28247211

Abstract

BACKGROUND: Gait patterns of healthy aging are needed to allow a comparison with pathological situations. However, little data is available.

OBJECTIVE: To present gait pattern of healthy older specially selected to be "healthy walkers".

METHOD: Fifty-seven older people benefited from a geriatric assessment including clinical and functional evaluations to include only those without gait disorders. Gait data were simultaneously recorded using a tri-axial accelerometer placed on the waist and four 3D position markers placed on the feet at the level of the heel and the toe. Volunteers walked at comfortable self-selected speed (CW), fast self-selected speed (FW), and finally in dual task walking condition (DTW). The extracted gait parameters were: gait speed, stride length, stride frequency, regularity and symmetry, swing, stance and double support time and ratio and minimum toe clearance. Gait speed and stride length were normalized to the right leg length.

RESULTS: Fifty-seven older people with a mean age of 69.7 ± 4.2 years old (range from 65 to 82 years) were included. Data were analyzed according to the gender and according to the age (<70 or ≥ 70 years old). After normalization to leg length, the main significant differences were shown for stride length and minimum toe clearance in CW, FW and in DTW that were shorter in women. The regularity in FW was significantly lower among older volunteers.

CONCLUSIONS: This work provides a data set considering 14 gait parameters obtained from 57 healthy old people strictly selected and assessed for three walking conditions and shows that GS, SL

and MTC have to be related to the gender. The age-related impact on gait performances appears reduced in this cohort.

PDF Y Endnote Y

Does Nordic Walking restore the temporal organization of gait variability in Parkinson's disease?

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J. Neuroengineering Rehabil. 2017; 14(1): 17.

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(Copyright © 2017, BioMed Central)

DOI 10.1186/s12984-017-0226-1 **PMID** 28222810

Abstract

BACKGROUND: Gait disorders of Parkinson's disease (PD) are characterized by the breakdown of the temporal organization of stride duration variability that was tightly associated to dynamic instability in PD. Activating the upper body during walking, Nordic Walking (NW) may be used as an external cueing to improve spatiotemporal parameters of gait, such as stride length or gait variability, in PD. The aim of this study was to evaluate the beneficial effects of NW on temporal organization of gait variability and spatiotemporal gait variables in PD.

METHODS: Fourteen mild to moderate PD participants and ten age-matched healthy subjects performed 2 × 12 min overground walking sessions (with and without pole in a randomized order) at a comfortable speed. Gait speed, cadence, step length and temporal organization (i.e. long-range autocorrelations; LRA) of stride duration variability were studied on 512 consecutive gait cycles using a unidimensional accelerometer placed on the malleola of the most affected side in PD patients and of the dominant side in healthy controls. The presence of LRA was determined using the Rescaled Range Analysis (Hurst exponent) and the Power Spectral Density (α exponent). To assess NW and disease influences on gait, paired t-tests, Z-score and a two-way (pathological condition x walking condition) ANOVA repeated measure were used.

RESULTS: Leading to significant improvement of LRA, NW enhances step length and reduces gait cadence without any change in gait speed in PD. Interestingly, LRA and step length collected from the NW session are similar to that of the healthy population.

CONCLUSION: This cross-sectional controlled study demonstrates that NW may constitute a powerful way to struggle against the randomness of PD gait and the typical gait hypokinesia. Involving a voluntary intersegmental coordination, such improvement could also be due to the upper body rhythmic movements acting as rhythmical external cue to bypass their defective basal ganglia circuitries. **ETHICS COMMITTEE'S REFERENCE NUMBER:** B403201318916 **TRIAL REGISTRATION:** NCT02419768.

PDF Y Endnote Y

Dual-task does not increase slip and fall risk in healthy young and older adults during walking

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Appl. Bionics Biomech. 2017; 2017: e1014784.

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DOI 10.1155/2017/1014784 **PMID** 28255224

Abstract

Dual-task tests can identify gait characteristics peculiar to fallers and nonfallers. Understanding the relationship between gait performance and dual-task related cognitive-motor interference is important for fall prevention. Dual-task adapted changes in gait instability/variability can adversely affect fall risks. Although implicated, it is unclear if healthy participants' fall risks are modified by dual-task walking conditions. Seven healthy young and seven healthy older adults were randomly assigned to normal walking and dual-task walking sessions with a slip perturbation. In the dual-task session, the participants walked and simultaneously counted backwards from a randomly provided number. The results indicate that the gait changes in dual-task walking have no destabilizing effect on gait and slip responses in healthy individuals. We also found that, during dual-tasking, healthy individuals adopted cautious gait mode (CGM) strategy that is characterized by reduced walking speed, shorter step length, increased step width, and reduced heel contact velocity and is likely to be an adaptation to minimize attentional demand and decrease slip and fall risk during limited available attentional resources. Exploring interactions between gait variability and cognitive functions while walking may lead to designing appropriate fall interventions among healthy and patient population with fall risk.

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Effectiveness of a multicomponent exercise program in the attenuation of frailty in long-term nursing home residents: study protocol for a randomized clinical controlled trial

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BMC Geriatr. 2017; 17(1): e60.

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(Copyright © 2017, BioMed Central)

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Abstract

BACKGROUND: There is increasing evidence suggesting that cognition and physical frailty interact within a cycle of decline associated with aging which has been called cognitive frailty. Exercise programs have demonstrated to be an effective tool to prevent functional and cognitive decline during aging, but little is known about their potential to restore or maintain functionality in individuals that require long-term nursing care. Besides, WHO has recently highlighted the importance of introducing systematic musculoskeletal health programs for older people living in residential care, as they represent a particularly vulnerable group for the development of noncommunicable diseases.

METHODS: This is a multicentre randomized controlled trial. 114 participants will be randomly allocated to a usual care group or to an intervention group. Inclusion criteria are as follows: ≥ 70 years, ≥ 50 on the Barthel Index, ≥ 20 on MEC-35 who are capable to stand up and walk independently for 10 m. Subjects in the intervention group will add to the activities scheduled for the control group the participation in a 6 months long multicomponent exercise program designed to improve strength, balance and walking retraining. Study assessments will be conducted at baseline and at 3 and 6 months. The primary outcome is change in function assessed by Short Physical Performance Battery and secondary outcomes include other measurements to assess all together the condition of frailty, which includes functionality, sedentary behaviors, cognitive and emotional status and biological markers. The present study has been approved by the Committee on

Ethics in Research of the University of the Basque Country (Humans Committee Code M10/2016/105; Biological Samples Committee Code M30/2016/106).

DISCUSSION: Results from this research will show if ageing related functional and cognitive deterioration can be effectively prevented by physical exercise in institutionalized elders. It is expected that the results of this research will guide clinical practice in nursing home settings, so that clinicians and policymakers can provide more evidence-based practice for the management of institutionalized elder people. **TRIAL REGISTRATION:** The protocol has been registered under the Australian and New Zealand Clinical Trials Registry (ANZCTR) with the identifier: ACTRN12616001044415.

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Erratum to: Can augmented feedback facilitate learning a reactive balance task among older adults?

Mansfield A, Aqui A, Fraser JE, Rajachandrakumar R, Lakhani B, Patterson KK.

Exp. Brain Res. 2017; ePub(ePub): ePub.

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Abstract [Abstract unavailable]

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Fall detection algorithms for real-world falls harvested from lumbar sensors in the elderly population: a machine learning approach

Bourke AK, Klenk J, Schwickert L, Aminian K, Ihlen EA, Mellone S, Helbostad JL, Chiari L, Becker C, Bourke AK, Klenk J, Schwickert L, Aminian K, Ihlen EA, Mellone S, Helbostad JL, Chiari L, Becker C, Chiari L, Schwickert L, Aminian K, Becker C, Helbostad JL, Klenk J, Bourke AK, Mellone S, Ihlen EA. *Conf. Proc. IEEE Eng. Med. Biol. Soc.* 2016; 2016: 3712-3715.

(Copyright © 2016, IEEE (Institute of Electrical and Electronics Engineers))

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Abstract

Automatic fall detection will promote independent living and reduce the consequences of falls in the elderly by ensuring people can confidently live safely at home for longer. In laboratory studies inertial sensor technology has been shown capable of distinguishing falls from normal activities. However less than 7% of fall-detection algorithm studies have used fall data recorded from elderly people in real life. The FARSEEING project has compiled a database of real life falls from elderly people, to gain new knowledge about fall events and to develop fall detection algorithms to combat the problems associated with falls. We have extracted 12 different kinematic, temporal and kinetic related features from a data-set of 89 real-world falls and 368 activities of daily living. Using the extracted features we applied machine learning techniques and produced a selection of algorithms based on different feature combinations. The best algorithm employs 10 different features and produced a sensitivity of 0.88 and a specificity of 0.87 in classifying falls correctly.

This algorithm can be used distinguish real-world falls from normal activities of daily living in a sensor consisting of a tri-axial accelerometer and tri-axial gyroscope located at L5.

PDF Y Endnote Y

Fall preventive exercise with or without behavior change support for community-dwelling older adults: a randomized controlled trial with short-term follow-up

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J. Geriatr. Phys. Ther. 2017; ePub(ePub): ePub.

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(Copyright © 2017, American Physical Therapy Association)

DOI 10.1519/JPT.000000000000129 **PMI** 8244890

Abstract

BACKGROUND AND PURPOSE: In Western countries, falls and fall-related injuries are a well-known threat to health in the aging population. Studies indicate that regular exercise improves strength and balance and can therefore decrease the incidence of falls and fall-related injuries. The challenge, however, is to provide exercise programs that are safe, effective, and attractive to the older population. The aim of this study was to investigate the short-term effect of a home-based exercise program with or without motivational interviewing (MI) compared with standard care on physical performance, fall self-efficacy, balance, activity level, handgrip strength, adherence to the exercise, and fall frequency.

METHOD: A total of 175 older adults participated in this randomized controlled study. They were randomly allocated for the Otago Exercise Program (OEP) (n = 61), OEP combined with MI (n = 58), or a control group (n = 56). The participants' mean age was 83 years. The recruitment period was from October 2012 to May 2015. Measurements of physical performance, fall self-efficacy, balance, activity level, handgrip strength, adherence to the exercise, and fall frequency were done before and 12 weeks after randomization.

RESULTS AND DISCUSSION: A total of 161 participants were followed up, and there were no significant differences between groups after a period of 12 weeks of regular exercise. Within the OEP + MI group, physical performance, fall self-efficacy, physical activity level, and handgrip strength improved significantly; likewise, improved physical performance and fall self-efficacy were found in the control group. A corresponding difference did not occur in the OEP group. Adherence to the exercise was generally high in both exercise groups.

CONCLUSION: In the short-term perspective, there were no benefits of an exercise program with or without MI regarding physical performance, fall self-efficacy, activity level, handgrip strength, adherence to the exercise, and fall frequency in comparison to a control group. However, some small effects occurred within the OEP + MI group, indicating that there may be some possible value in behavioral change support combined with exercise in older adults that requires further evaluation in both short- and long-term studies.

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Fall risk factors analysis based on sample entropy of plantar kinematic signal during stance phase

Liang S, Jia H, Li Z, Li H, Gao X, Ma Z, Ma Y, Zhao G, Shengyun Liang, Huiyu Jia, Zilong Li, Huiqi Li, Xing Gao, Zuchang Ma, Yingnan Ma, Guoru Zhao, Liang S, Li H, Jia H, Gao X, Ma Z, Zhao G, Ma Y, Li Z.
Conf. Proc. IEEE Eng. Med. Biol. Soc. 2016; 2016: 4832-4836.

(Copyright © 2016, IEEE (Institute of Electrical and Electronics Engineers))

DOI 10.1109/EMBC.2016.7591809 **PMID** 28227594

Abstract

Falls are a multi-causal phenomenon with a complex interaction. The aim of our research is to study the effect of multiple variables for potential risk of falls and construct an elderly fall risk assessment model based on demographics data and gait characteristics. A total of 101 subjects, whom belong to Malianwa Street, aged above 50 years old and participated in questionnaire survey. Participants were classified into three groups (high, medium and low risk group) according to the score of elderly fall risk assessment scale. In addition, the data of ground reaction force (GRF) and ground reaction moment (GRM) was record when they performed walking at comfortable state. The demographic variables, sample entropy of GRF and GRM, and impulse difference of bilateral foot were considered as potential explanatory variables of risk assessment model. Firstly, we investigated whether different groups could present difference in every variable. Statistical differences were found for the following variables: age ($p=2.28e-05$); impulse difference ($p=0.02036$); sample entropy of GRF in vertical direction ($p=0.0144$); sample entropy of GRM in anterior-posterior direction ($p=0.0387$). Finally, the multiple regression analysis results indicated that age, impulse difference and sample entropy of resultant GRM could identify individuals who had different levels of fall risk. Therefore, those results could potentially be useful in the fall risk assessment and monitor the state of physical function in elderly population.

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Fall risk probability estimation based on supervised feature learning using public fall datasets

Koshmak GA, Linden M, Loutfi A, Koshmak GA, Linden M, Loutfi A, Koshmak GA, Linden M.
Conf. Proc. IEEE Eng. Med. Biol. Soc. 2016; 2016: 752-755.

(Copyright © 2016, IEEE (Institute of Electrical and Electronics Engineers))

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Abstract

Risk of falling is considered among major threats for elderly population and therefore started to play an important role in modern healthcare. With recent development of sensor technology, the number of studies dedicated to reliable fall detection system has increased drastically. However, there is still a lack of universal approach regarding the evaluation of developed algorithms. In the following study we make an attempt to find publicly available fall datasets and analyze similarities among them using supervised learning. After performing similarity assessment based on multidimensional scaling we indicate the most representative feature vector corresponding to each specific dataset. This vector obtained from a real-life data is subsequently deployed to estimate fall risk probabilities for a statistical fall detection model. Finally, we conclude with some observations regarding the similarity assessment results and provide suggestions towards an efficient approach for evaluation of fall detection studies.

PDF Y Endnote Y

Feasibility of unobtrusive ambient sensors for fall detections in home environment

Zhang Q, Karunanithi M, Qing Zhang, Karunanithi M, Karunanithi M, Zhang Q.

Conf. Proc. IEEE Eng. Med. Biol. Soc. 2016; 2016: 566-569.

(Copyright © 2016, IEEE (Institute of Electrical and Electronics Engineers))

DOI 10.1109/EMBC.2016.7590765 **PMID** 28226561

Abstract

Falls are the leading threats of death, injury and hospital admissions of seniors. About one third of seniors fall every year. Real time fall detection is thus critical to support independent livings of seniors by getting timely interventions from carers/family members. Recent years along with the IoT booming, many wearable sensor based fall detection systems have been developed. However privacy concerns or simply forgot-to-wear make wearable sensors not very accepted by seniors in a home environment seeking long term monitoring solutions. This motivates the development of unobtrusive ambient fall detection system. In this paper, we reviewed studies in this area and categorised them into two types of approaches, namely active and passive. We also evaluated their feasibilities within five domains: obtrusiveness, power connectivity, affordability, complexity of installation and being tested in field trials. The evaluation results could be used as guidance in designing new unobtrusive ambient fall detection systems.

PDF Y Endnote Y

High-technology based gait assessment in frail people: associations between spatio-temporal and three-dimensional gait characteristics with frailty status across four different frailty measures

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J. Nutr. Health Aging 2017; 21(3): 346-353.

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(Copyright © 2017, Springer Science+Business Media)

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Abstract

OBJECTIVE: We analyzed associations between a battery of gait characteristics and frailty status across four different frailty instruments in old patients.

DESIGN: Cross-sectional study.

SETTING: Geriatric wards of a general hospital.

PARTICIPANTS: 123 hospitalized patients aged ≥ 65 years.

MEASUREMENTS: Spatio-temporal and three-dimensional gait characteristics were assessed by an electronic walkway and a shoe-mounted, inertial sensor-based mobile gait analysis system. Frailty status was assessed by the frailty phenotype (FP), Clinical Frailty Scale (CFS), frailty index (FI), and frailty index based on a comprehensive geriatric assessment (FI-CGA).

RESULTS: A reduction in walking speed (FP, FI, FI-CGA), stride length (FP, FI, FI-CGA), maximum toe clearance (FP, CFS, FI, FI-CGA), toe off angle (FP, CFS, FI, FI-CGA), heel strike angle (FI-CGA) and greater stride length variability (FP, CFS, FI, FI-CGA), stride time variability (FP, FI), double support time (FP, FI), and stride width (CFA, FI-CGA) were associated with frailty status across the four frailty instruments (all $P < 0.05$, respectively). Walking speed (FP, CFS, FI, FI-CGA), stride length (FP, CFS, FI, FI-CGA), maximum toe clearance (FP, CFS, FI, FI-CGA), toe off angle (FP, CFS, FI, FI-CGA), heel strike

angle (FP, FI), stride length variability (CFS, FI, FI-CGA), stride time variability (FI), double support time (FP), and stride width (FP, CFS, FI) were related with frailty severity across the four frailty instruments independent of age and sex (all P adjusted < 0.05, respectively).

CONCLUSIONS: Gait changes in frail patients include more than solely a reduction in walking speed.

PDF Y Endnote Y

Identifying frailty levels and associated factors in a population living in the context of poverty and social vulnerability

Zazzetta MS, Gomes GA, Orlandi FS, Gratão AC, Vasilceac FA, Gramani-Say K, Ponti MA, Castro PC, Pavarini SC, Menezes AL, Nascimento CM, Cominetti MR.

J. Frailty Aging 2017; 6(1): 29-32.

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(Copyright © 2017, Journal of frailty and aging)

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Abstract

This study aimed to investigate a vulnerable population living in the context of poverty in a Brazilian municipality, in order to identify the factors that are associated with frailty syndrome in elderly people. From the total population living in the area, a random sample of 363 community-dwelling people, 60 years and older, age and gender-stratified, was selected to participate in the research. After losses, a sample of 304 older adults was classified as non-frail, pre-frail and frail. According to the Fried frailty criteria, the prevalence was 12.2% for non-frail individuals, 60.5% pre-frail and 27.3% frail. The main factors associated with frailty in the studied sample were low level of physical activity (OR: 5.2, 95%CI: 2.5-11.0), the occurrence of two or more falls within 12 months (OR: 3.1, 95%CI: 1.4-7.1), mobility deficits (OR: 3.0, 95%CI: 1.5-5.8), and depressive symptoms (OR: 1.9, 95%CI: 1.1-3.7). This study identified the most important factors that must be evaluated to identify frailty syndrome in a socially vulnerable population in the context of poverty. The data should help to encourage effective strategies concerning public health policies for this population.

PDF N Endnote Y

Impact of maximal strength training on work efficiency and muscle fiber type in the elderly: Implications for physical function and fall prevention

Wang E, Nyberg SK, Hoff J, Zhao J, Leivseth G, Tørhaug T, Husby OS, Helgerud J, Richardson RS. *Exp. Gerontol.* 2017; ePub(ePub): ePub.

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Abstract

Although aging is typically associated with a decreased efficiency of locomotion, somewhat surprisingly, there is also a reduction in the proportion of less efficient fast-twitch Type II skeletal muscle fibers and subsequently a greater propensity for falls. Maximal strength training (MST), with an emphasis on velocity in the concentric phase, improves maximal strength, the rate of force

development (RFD), and work efficiency, but the impact on muscle morphology in the elderly is unknown. Therefore we evaluated force production, walking work efficiency, and muscle morphology in 11 old (72 ± 3 years) subjects before and after MST of the legs. Additionally, for reference, the MST-induced morphometric changes were compared with 7 old (74 ± 6 years) subjects who performed conventional strength training (CST), with focus on hypertrophy, as well as 13 young (24 ± 2 years) controls. As expected, MST in the old improved maximal strength (68%), RFD (48%), and work efficiency (12%), restoring each to a level similar to the young. However, of importance, these MST-induced functional changes were accompanied by a significant increase in the size (66%) and shift toward a larger percentage (56%) of Type II skeletal muscle fibers, mirroring the adaptations in the hypertrophy trained old subjects, with muscle composition now being similar to the young. In conclusion, MST can increase both work efficiency and Type II skeletal muscle fiber size and percentage in the elderly, supporting the potential role of MST as a countermeasure to maintain both physical function and fall prevention in this population.

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PDF Y Endnote Y

Implementation of fall prevention in residential care facilities: a systematic review of barriers and facilitators

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Int. J. Nurs. Stud. 2017; 70: 110-121.

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DOI 10.1016/j.ijnurstu.2017.02.002 **PMID** 28242505

Abstract

OBJECTIVES: To identify the barriers and facilitators for fall prevention implementation in residential care facilities.

DESIGN: Systematic review. Review registration number on PROSPERO: CRD42013004655. **DATA**

SOURCES: Two independent reviewers systematically searched five databases (i.e. MEDLINE, EMBASE, CINAHL, PsycINFO, and Web of Science) and the reference lists of relevant articles.

REVIEW METHODS: This systematic review was conducted in line with the Center for Reviews and Dissemination Handbook and reported according to the PRISMA guideline. Only original research focusing on determinants of fall prevention implementation in residential care facilities was included. We used the Mixed Method Appraisal Tool for quality appraisal. Thematic analysis was performed for qualitative data; quantitative data were analyzed descriptively. To synthesize the results, we used the framework of Grol and colleagues that describes six healthcare levels wherein implementation barriers and facilitators can be identified.

RESULTS: We found eight relevant studies, identifying 44 determinants that influence implementation. Of these, 17 were facilitators and 27 were barriers. Results indicated that the social and organizational levels have the greatest number of influencing factors (9 and 14, respectively), whereas resident and economical/political levels have the least (3 and 4, respectively). The most cited facilitators were good communication and facility equipment availability, while staff feeling overwhelmed, helpless, frustrated and concerned about their ability to control fall management,

staffing issues, limited knowledge and skills (i.e., general clinical skill deficiencies, poor fall management skills or lack of computer skills); and poor communication were the most cited barriers.

CONCLUSION: Successful implementation of fall prevention depends on many factors across different healthcare levels. The focus of implementation interventions, however, should be on modifiable barriers and facilitators such as communication, knowledge, and skills. Effective fall prevention must consist of multifactorial interventions that target each resident's fall risk profile, and should be tailored to overcome context-specific barriers and put into action the identified facilitators.

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PDF Y Endnote Y

Increased number of community-living older adults attending an emergency department with falls and fractures: North Dublin experience

Fan CW, Duggan J, Rodger D, Brazil E, McCarthy F.

Ir. J. Med. Sci. 2017; ePub(ePub): ePub.

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(Copyright © 2017, General Publications)

DOI 10.1007/s11845-017-1587-y **PMID** 28238199

Abstract

BACKGROUND: The number of attendances to emergency department (ED) due to falls and fractures increases as the population ages. The community-based falls prevention strategy may reduce the number of falls requiring medical attention.

AIM: Our aim was to determine the changes over time in community-living older adults on the number of attendances to an urban ED over a 5 year period.

METHODS: Community-living adults aged ≥ 65 years from a catchment attending with falls and fractures to an ED in 2010 and 2014 were identified through an electronic patient record. The age, gender and patient-related outcome (admit, discharge with and without follow-up, died in department) were collected. Patient-related outcome was compared by age group.

RESULTS: There were 477 and 772 attendances with falls and fractures in 2010 and 2014, respectively. Between 3 and 7% were repeat attendees. Compared with 2010, in 2014, there were more women attendees; the proportion of patients aged ≥ 80 years were higher, more likely to be admitted and discharged without follow-up. Patients aged 85+ were six times more likely to require admission compared with under 75's.

CONCLUSION: With the rapidly ageing population in North Dublin, there is an urgent need to prioritise comprehensive assessment and provide a coordinated falls programme when older adults present to ED to reduce the risk of future falls and injuries.

PDF Y Endnote Y

Introducing a psychological postural threat alters gait and balance parameters among young participants but not among most older participants

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Abstract

The fear of falling can be manipulated by introducing a postural threat (e.g., an elevated support surface) during stance and gait. Under these conditions, balance parameters are altered in both young and elderly individuals. This study aimed to dissociate the physical and psychological aspects of the threat and show the impact of a verbal warning cue of imminent perturbation during gait among young and elderly healthy participants. Ten young subjects (29.4 ± 3.9 years) and ten subjects aged over 65 years (72.9 ± 3.5) participated in the study. Spatiotemporal and balance parameters were quantified during eight consecutive gait cycles using a motion analysis system and an instrumented treadmill. These parameters were compared twice in the control trial and before/after a verbal warning cue of imminent perturbation during gait ("postural threat") in perturbation trials and between groups using repeated measure ANOVAs.

RESULTS: The verbal cue yielded reduced step length ($p = 0.008$), increased step width ($p = 0.049$), advanced relative position of the center of mass ($p = 0.016$), increased stabilizing force ($p = 0.003$), and decreased destabilizing force ($p = 0.002$). This warning effect was not observed in the older participant group analyses but was found for three participants based on individual data analyses. The warning effect in younger participants was not specific to impending perturbation conditions. Most gait and balance parameters were altered in the older group ($p < 0.05$) versus the younger group in each condition, regardless of the warning cue. A psychological threat affects gait and balance similarly to a physical threat among young participants but not among most older participants.

PDF Y Endnote Y

Low-power operation of a barometric pressure sensor for use in an automatic fall detector

Lu W, Wang C, Stevens MC, Redmond SJ, Lovell NH, Wei Lu, Changhong Wang, Stevens MC, Redmond SJ, Lovell NH, Wang C, Lovell NH, Lu W, Redmond SJ, Stevens MC.

Conf. Proc. IEEE Eng. Med. Biol. Soc. 2016; 2016: 2010-2013.

(Copyright © 2016, IEEE (Institute of Electrical and Electronics Engineers))

DOI 10.1109/EMBC.2016.7591120 PMID 28226913

Abstract

The use of a barometric pressure sensor in a wearable fall detector has been shown to improve the detection accuracy by determining the altitude change associated with the fall event. However, the barometer is a high-power-consuming sensor. This paper proposes a fall detection approach using a hermetically sealed and waterproof enclosure incorporating a small window covered by a semi-permeable membrane (SPM) to delay the equilibrium of internal and external pressures. This feature can be utilized to limit the time the barometer is powered but still capturing critical pressure information to discriminate fall and non-fall events. The proposed fall detection system is evaluated with an existing data set of simulated fall and activities of daily living in which the barometric pressure data are delayed using a mathematical model of the enclosure and SPM assembly. Also, a benchtop test is performed to estimate the power and battery life. The proposed fall detection system achieves 94.0% sensitivity and 90.0% specificity with an estimated battery life of 995.7 days.

PDF Y Endnote Y

Out-of-hospital triage of older adults with head injury: a retrospective study of the effect of adding "anticoagulation or antiplatelet medication use" as a criterion

Nishijima DK, Gaona SD, Waechter T, Maloney R, Bair T, Blitz A, Elms AR, Farrales RD, Howard C, Montoya J, Bell JM, Faul M, Vinson DR, Garzon H, Holmes JF, Ballard DW.

Ann. Emerg. Med. 2017; ePub(ePub): ePub.

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(Copyright © 2017, American College of Emergency Physicians, Publisher Elsevier Publishing)

DOI 10.1016/j.annemergmed.2016.12.018 **PMID** 28238499

Abstract

STUDY OBJECTIVE: Field triage guidelines recommend that emergency medical services (EMS) providers consider transport of head-injured older adults with anticoagulation use to trauma centers. However, the triage patterns and the incidence of intracranial hemorrhage or neurosurgery in these patients are unknown. Our objective is to describe the characteristics and outcomes of older adults with head trauma who are transported by EMS, particularly for patients who do not meet physiologic, anatomic, or mechanism-of-injury (steps 1 to 3) field triage criteria but are receiving anticoagulant or antiplatelet medications.

METHODS: This was a retrospective study at 5 EMS agencies and 11 hospitals (4 trauma centers, 7 nontrauma centers). Patients aged 55 years or older with head trauma who were transported by EMS were included. The primary outcome was the presence of intracranial hemorrhage. The secondary outcome was a composite measure of in-hospital death or neurosurgery.

RESULTS: Of the 2,110 patients included, 131 (6%) had intracranial hemorrhage and 41 (2%) had in-hospital death or neurosurgery. There were 162 patients (8%) with steps 1 to 3 criteria. Of the remaining 1,948 patients without steps 1 to 3 criteria, 566 (29%) had anticoagulant or antiplatelet use. Of these patients, 52 (9%) had traumatic intracranial hemorrhage and 15 (3%) died or had neurosurgery. The sensitivity (adjusted for clustering by EMS agency) of steps 1 to 3 criteria was 19.8% (26/131; 95% confidence interval [CI] 5.5% to 51.2%) for identifying traumatic intracranial hemorrhage and 34.1% (14/41; 95% CI 9.9% to 70.1%) for death or neurosurgery. The additional criterion of anticoagulant or antiplatelet use improved the sensitivity for intracranial hemorrhage (78/131; 59.5%; 95% CI 42.9% to 74.2%) and death or neurosurgery (29/41; 70.7%; 95% CI 61.0% to 78.9%).

CONCLUSION: Relatively few patients met steps 1 to 3 triage criteria. For individuals who did not have steps 1 to 3 criteria, nearly 30% had anticoagulant or antiplatelet use. A relatively high proportion of these patients had intracranial hemorrhage, but a much smaller proportion died or had neurosurgery during hospitalization. Use of steps 1 to 3 triage criteria alone is not sufficient in identifying intracranial hemorrhage and death or neurosurgery in this patient population. The additional criterion of anticoagulant or antiplatelet use improves the sensitivity of the instrument, with only a modest decrease in specificity.

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Predictors of posttraumatic stress symptoms and association with fear of falling after hip fracture

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J. Am. Geriatr. Soc. 2017; ePub(ePub): ePub.

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(Copyright © 2017, John Wiley and Sons)

DOI 10.1111/jgs.14771 **PMID** 28240778

Abstract

OBJECTIVES: To determine whether fall-related hip fracture, alone or in the presence of Fear of Falling, is likely to induce PTSD in an elderly population.

DESIGN: A longitudinal prospective study of patients admitted for hip fracture.

SETTING: Eight St. Louis, Missouri, area hospitals.

PARTICIPANTS: Individuals aged 60 and older admitted for surgical hip fracture repair after a fall (N = 456).

MEASUREMENTS: Rates of partial and full posttraumatic stress disorder (pPTSD and fPTSD) were compared with rates of FoF. PTSD and FoF were assessed 4 and 12 weeks after surgery. Baseline characteristics including depression, stress, pain, cognitive functioning, and anesthesia type were also analyzed as potential predictors of PTSD symptoms 12 weeks after surgery.

RESULTS: No participants met criteria for fPTSD at 4 or 12 weeks, and rates of pPTSD were low 12 weeks after surgery (7.4%), in contrast to high rates of FoF symptoms at the same time point (58.5%). Higher ratings of stress and depressive symptoms at baseline were associated with higher levels of PTSD symptoms 12 weeks after surgery.

CONCLUSIONS: Hip fracture, despite its considerable morbidity, does not induce fPTSD and infrequently induces pPTSD. Individuals with higher rates of stress and depressive symptoms after hip fracture repair may be more likely to develop PTSD symptoms.

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PDF Y Endnote Y

Prevalence of sarcopenia in community-dwelling Chilean elders according to an adapted version of the European Working Group on Sarcopenia in Older People (EWGSOP) criteria

Lera L, Albala C, Sánchez H, Angel B, Hormazabal MJ, Marquez C, Arroyo P.

J. Frailty Aging 2017; 6(1): 12-17.

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(Copyright © 2017, Journal of frailty and aging)

DOI 10.14283/jfa.2016.117 **PMID** 28244552

Abstract

BACKGROUND: Sarcopenia is the progressive loss of mass and skeletal muscle strength and has serious consequences on older people's health. The Chilean older population has a high life-expectancy, but the prevalence of functional dependence is also high.

OBJECTIVE: To determine the prevalence of sarcopenia in Chilean older adults and its relationship with age, gender, and body mass index (BMI).

DESIGN: Cross-sectional study.

SETTING: Community.

PARTICIPANTS: 1,006 non-disabled, community-dwelling subjects aged 60 years or older living in Santiago.

MEASUREMENTS: Anthropometric measurements, handgrip strength, physical performance tests, and dual-energy-x-ray-absorptiometry (DXA) scan were performed. Sarcopenia was defined using

the algorithm of the European Working Group on Sarcopenia in Older People (EWGSOP). Muscle mass was measured with DXA scan; skeletal muscle mass index (SMI) and hand dynamometry were defined with cut-off points obtained for the Chilean population. For a 3m walking speed we used the cut-off point of the EWGSOP definition. Nutritional status and obesity were defined according to World Health Organization standards. Association between sarcopenia and age, gender, BMI and lean/fat mass ratio was estimated by logistic regression models.

RESULTS: The prevalence of sarcopenia was 19.1% (95%CI: 16.8%-21.8%), similar in men and women. There was an increasing trend of sarcopenia by age group and a decreasing trend with nutritional status. After logistic regression, sarcopenia was positively associated with age (OR=1.10; 95%CI:1.06-1.15) and falls (OR=1.83; 95%CI:1.07-3.15) and negatively associated with overweight (OR=0.31; 95%CI:0.16-0.59), obesity (OR=0.02; 95%CI:0.004-0.11), lean mass/fat mass ratio (OR=0.69; 95%CI:0.48-0.997), knee height (OR=0.78; 95%CI:0.68-0.89) and calf circumference (OR=0.87; 95%CI:0.77-0.97).

CONCLUSIONS: The total prevalence of sarcopenia was 19.1% increasing with age reaching 39.6% in people of 80 or more years of age. A negative association of sarcopenia with overweight, obesity and lean/fat mass ratio was observed. Although the high prevalence of obesity (35.9%), only 2% of obese people were sarcopenic.

PDF Y Endnote Y

Principal component analysis can decrease neural networks performance for incipient falls detection: a preliminary study with hands and feet accelerations

Artoni F, Martelli D, Monaco V, Micera S, Artoni F, Martelli D, Monaco V, Micera S.

Conf. Proc. IEEE Eng. Med. Biol. Soc. 2016; 2016: 6194-6197.

(Copyright © 2016, IEEE (Institute of Electrical and Electronics Engineers))

DOI 10.1109/EMBC.2016.7592143 **PMID** 28227925

Abstract

Fall-related accidents constitute a major problem for elderly people and a burden to the health-care national system. It is therefore important to design devices (e.g., accelerometers) and machine learning algorithms able to recognize incipient falls as quickly and reliably as possible. Blind source separation (BSS) methods are often used as a preprocessing step before classification, however the effects of BSS on classification performance are not well understood. The aim of this work is to preliminarily characterize the effect that two methods, namely Principal and Independent Component Analysis (PCA and ICA) and their combined use have on the performance of a neural network in detecting incipient falls. We used the feet and arms 3D kinematics of subjects while managing unexpected perturbations during walking.

RESULTS show that PCA needs to be used carefully as depending on the initial dataset, the PCA might lump variance together thus impairing the performance of an artificial neural networks (ANN) classifier. The use of PCA with 85% residual variance threshold significantly decreased the classifier performance, which was restored with a subsequent ICA (PCA + ICA). The results suggest that BSS techniques, though linear, might have an adverse effect on nonlinear classifiers such as ANN that might be dependent on the initial dataset redundancy.

PDF Y Endnote Y

Redefining the association between old age and poor outcomes after trauma: the impact of frailty syndrome

Joseph B, Orouji Jokar T, Hassan A, Azim A, Mohler MJ, Kulvatunyou N, Siddiqi S, Phelan H, Fain M, Rhee P.

J. Trauma Acute Care Surg. 2017; 82(3): 575-581.

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DOI 10.1097/TA.0000000000001329 **PMID** 28225741

Abstract

BACKGROUND: Frailty syndrome (FS) is a well-established predictor of outcomes in geriatric patients. The aim of this study was to quantify the prevalence of FS in geriatric trauma patients and to determine its association with trauma readmissions, repeat falls, and mortality at 6 months.

METHODS: we performed a 2-year (2012-2013) prospective cohort analysis of all consecutive geriatric (age, ≥ 65 years) trauma patients. FS was assessed using a Trauma-Specific Frailty Index (TSFI). Patients were stratified into: nonfrail, $TSFI \leq 0.12$; prefrail, $TSFI = 0.1$ to 0.27 ; and frail, $TSFI > 0.27$. Patient follow-up occurred at 6 months to assess outcomes. Regression analysis was performed to assess independent associations between TSFI and outcomes.

RESULTS: Three hundred fifty patients were enrolled. Frail patients were more likely to develop in-hospital complications (nonfrail, 12%; prefrail, 17.4%; and frail, 33.4%; $p = 0.02$) and an adverse discharge disposition compared with nonfrail and prefrail (nonfrail, 8%; prefrail, 18%; and frail, 47%; $p = 0.001$). Six-month follow-up was recorded in 80% of the patients. Compared with nonfrail patients, frail patients were more likely to have had a trauma-related readmission (odds ratio [OR], 1.4; 95% confidence interval [CI], 1.2-3.6) and/or repeated falls (OR, 1.6; 95%CI, 1.1-2.5) over the 6-month period. Overall 6-month mortality was 2.8% ($n = 10$), and frail elderly patients were more likely to have died (OR, 1.1; 95% CI, 1.04-4.7) compared with nonfrail patients.

CONCLUSION: Over a third of geriatric trauma patients had FS. TSFI provides a practical and accurate assessment tool for identifying elderly trauma patients who are at increased risk of both short-term and long-term outcomes. Early focused intervention in frail geriatric patients is warranted to improve long-term outcomes. **LEVEL OF EVIDENCE:** Prognostic study, level II.

PDF N Endnote Y

Relationship between fear of falling and perceived difficulty with grocery shopping

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J. Frailty Aging 2017; 6(1): 33-36.

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(Copyright © 2017, Journal of frailty and aging)

DOI 10.14283/jfa.2016.115 **PMID** 28244556

Abstract

Fear of falling is associated with self-imposed restrictions of basic and instrumental activities of daily living (ADL/IADL), leading greater risk for functional decline and falls. The inability to independently grocery shop, a food-related IADL, negatively affects nutritional status and survival among seniors. Thus, this study examined the relationship between the fear of falling and difficulty with grocery shopping among seniors (n=98, mean age=82, 83% female), taking into account their functional capacity. Demographic profile, eating problems, physical fitness (mobility, balance, endurance, leg strength), and fear of falling (balance confidence, falls efficacy) were measured. Fifty-six percent of participants reported difficulty with grocery shopping. Those who reported difficulty had significantly lower scores for dynamic balance, balance confidence and fall efficacy compared to those who did not. This study revealed a relationship between the fear of falling and perceived difficulty with grocery shopping. Interventions should address fear of falling among the frail seniors.

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Relationship between magnitude of applied torque in pre-swing phase and gait change for prevention of trip in elderly people

Miyake T, Tsukune M, Kobayashi Y, Sugano S, Fujie MG, Miyake T, Tsukune M, Kobayashi Y, Sugano S, Fujie MG, Sugano S, Miyake T, Fujie MG, Kobayashi Y, Tsukune M.

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(Copyright © 2016, IEEE (Institute of Electrical and Electronics Engineers))

DOI 10.1109/EMBC.2016.7592133 **PMID** 8227915

Abstract

Elderly people are at risk of tripping because of their narrow range of articular motion. To avoid tripping, gait training that improves their range of articular motion would be beneficial. In this study we propose a gait-training robot that applies a torque during the pre-swing phase to achieve this goal. We investigated the relationship between magnitude of applied torque and change in the range of knee-articular motion while walking before and after the application of this torque. We developed a wearable robot and carried out an experiment on human participants in which a motor pulls a string embedded on the robotic frame, applying torque in the pre-swing phase for a period of 20 [s]. Before and after applying torque the participant walked normally for 15 [s] without interference from the robot. We found that knee flexion angle increased after applying the torque if the torque was within the range of approximately 6-8 [Nm]. Therefore, we were able to verify that a new range of knee articular motion can be learned through application of torque.

PDF Y Endnote Y

Screening for frailty and sarcopenia among older persons in medical outpatient clinics and its associations with healthcare burden

Tan LF, Lim ZY, Choe R, Seetharaman S, Merchant R.

J. Am. Med. Dir. Assoc. 2017; ePub(ePub): ePub.

Affiliation: Division of Geriatric Medicine, National University Hospital, Singapore.

(Copyright © 2017, Lippincott Williams and Wilkins)

DOI 10.1016/j.jamda.2017.01.004 **PMID** 28242192

Abstract

OBJECTIVES: With an aging population and increase in multimorbidity, the importance of screening for frailty and sarcopenia has become a public health priority. Several tools to do so exist. This study aimed to examine whether the SARC-F and Edmonton frail screening tools are useful in clinical

practice to identify at-risk patients for negative health outcomes who would benefit from intervention.

DESIGN: This is a cross-sectional study of patients attending medical specialist outpatient clinics at the National University Hospital, Singapore from May 2015 to February 2016.

MEASUREMENTS: Frailty and sarcopenia were identified using the Edmonton Frail Scale and SARC-F questionnaires, respectively. Other clinically relevant data including basic demographics, presence of caregiver, number of follow-ups, medications and hospital readmissions in the past 1 year, Charlson comorbidity index, and modified Barthel index were collected from chart review.

RESULTS: A total of 115 patients 65 years old and older were screened. Of the sample, 44.3% (n = 51) of patients were sarcopenic, whereas 27.0% (n = 31) were classified as frail; 23.5% (n = 27) were both frail and sarcopenic; and 87.1% of frail patients were sarcopenic, whereas 47.1% of sarcopenic patients were frail. Sarcopenia and frailty were associated with a higher Charlson comorbidity index, higher likelihood of requiring a caregiver, more medical specialty follow-ups, polypharmacy, more than 2 hospital admissions within a year, a higher number of falls and falls with serious consequences. This affected their perceived health status with 50.0% of robust patients rating their health excellent compared with 19.6% of sarcopenic patients (P < .001), 9.7% of frail patients (P < .001) and sarcopenic and frail patients scoring the lowest with 3.7% (P < .001).

CONCLUSIONS: The prevalence of frailty and sarcopenia among older adults attending medical outpatient clinic is high. Both syndromes are predictors of recurrent hospital admissions, polypharmacy, multiple medical clinic appointments, higher rate of falls, and falls with serious consequences. Early identification of older adults at risk of adverse health outcomes would aid in instituting timely intervention to reduce healthcare burden and improve quality of life.

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PDF Y Endnote Y

Tailored education program using home floor plans for falls prevention in discharged older patients: A pilot randomized controlled trial

Ueda T, Higuchi Y, Imaoka M, Todo E, Kitagawa T, Ando S.

Arch. Gerontol. Geriatr. 2017; 71: 9-13.

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(Copyright © 2017, Elsevier Publishing)

DOI 10.1016/j.archger.2017.02.010 **PMID** 28242580

Abstract

OBJECTIVE: To investigate the effect of a tailored education program using home floor plans on falls prevention in discharged older patients.

DESIGN: A single-center, parallel, pragmatic, pilot randomized controlled trial with equal allocation to the intervention and control groups.

SETTING: Discharged hospital patients were followed-up in their home settings.

PARTICIPANTS: All discharged orthopedic patients aged ≥65 years who experienced ≥1 fall(s) in the past year (n=60).

INTERVENTIONS: Both groups received standard care (exercises) and the intervention group also received a tailored education program for falls prevention using home floor plans.

MEASUREMENTS: Falls and near-falls at the participants' homes using a 1-month fall calendar during the 1-month period after discharge. The evaluators were blinded at the baseline assessment.

RESULTS: Nine participants were withdrawn from the study, leaving 51 of 60 (85%) participants for the final analyses. No falls occurred in the intervention group (n=25) during follow-up. However, 2 participants (7.7%) fell in the control group (n=26). Near-falls were reported by 7 participants (28.0%) in the intervention group and 13 participants (50.0%) in the control group. The intervention group had 75% less near-falls compared with the control group, as assessed using a Cox proportional hazards model (hazard ratio, 0.25; 95% confidence interval, 0.09-0.75).

CONCLUSIONS: The tailored education program using home floor plans at the hospital was effective for reducing falls and near-falls among discharged orthopedic patients. Registration of clinical trials:

This study was registered with the Research Ethics Committee of University Hospital Medical Information Network (UMIN) Center (000018201).

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PDF Y Endnote Y

Testing non-wearable fall detection methods in the homes of older adults

Skubic M, Harris BH, Stone E, Ho KC, Su BY, Rantz M, Skubic M, Harris BH, Stone E, Ho KC, Bo-Yu Su, Rantz M, Stone E, Su BY, Harris BH, Skubic M, Rantz M, Ho KC.

Conf. Proc. IEEE Eng. Med. Biol. Soc. 2016; 2016: 557-560.

(Copyright © 2016, IEEE (Institute of Electrical and Electronics Engineers))

DOI 10.1109/EMBC.2016.7590763 **PMID** 28226559

Abstract

In this paper, we describe two longitudinal studies in which fall detection sensor technology was tested in the homes of older adults. The first study tested Doppler radar, a two-webcam system, and a depth camera system in ten apartments for two years. This continuous data collection allowed us to investigate the real-world setting of target users and compare the advantages and limitations of each sensor modality. Based on this study, the depth camera was chosen for a current ongoing study in which depth camera systems have been installed in 94 additional older adult apartments. We include a discussion of the different sensor systems, the pros and cons of each, and results of the fall detection and false alarms in the older adult homes.

PDF Y Endnote Y

Toward a low-cost gait analysis system for clinical and free-living assessment

Ladha C, Del Din S, Nazarpour K, Hickey A, Morris R, Catt M, Rochester L, Godfrey A, Ladha C, Del Din S, Nazarpour K, Hickey A, Morris R, Catt M, Rochester L, Godfrey A, Morris R, Ladha C, Rochester L, Godfrey A, Hickey A, Del Din S, Nazarpour K, Catt M.

Conf. Proc. IEEE Eng. Med. Biol. Soc. 2016; 2016: 1874-1877.

(Copyright © 2016, IEEE (Institute of Electrical and Electronics Engineers))

DOI 10.1109/EMBC.2016.7591086 **PMID** 28226879

Abstract

Gait is an important clinical assessment tool since changes in gait may reflect changes in general health. Measurement of gait is a complex process which has been restricted to bespoke clinical facilities until recently. The use of inexpensive wearable technologies is an attractive alternative and offers the potential to assess gait in any environment. In this paper we present the development of a low cost analysis gait system built using entirely open source components. The system is used to

capture spatio-temporal gait characteristics derived from an existing conceptual model, sensitive to ageing and neurodegenerative pathology (e.g. Parkinson's disease). We demonstrate the system is suitable for use in a clinical unit and will lead to pragmatic use in a free-living (home) environment. The system consists of a wearable (tri-axial accelerometer and gyroscope) with a Raspberry Pi module for data storage and analysis. This forms ongoing work to develop gait as a low cost diagnostic in modern healthcare.

PDF Y Endnote Y

Transcranial doppler sonography reveals reductions in hemispheric asymmetry in healthy older adults during vigilance

Harwood AE, Greenwood PM, Shaw TH.

Front. Aging Neurosci. 2017; 9: e21.

Affiliation: ARCH Laboratory, Department of Psychology, George Mason University Fairfax, VA, USA. (Copyright © 2017, Frontiers Research Foundation)

DOI 10.3389/fnagi.2017.00021 **PMID** 28228722

Abstract

Given that older adults are remaining longer in the workforce, their ability to perform demanding cognitive tasks such as vigilance assignments needs to be thoroughly examined, especially since many vigilance assignments affect public safety (e.g., aviation, medicine and long distance driving). Previous research exploring the relation between aging and vigilance is conflicted, with some studies finding decreased vigilance performance in older adults but others finding no effect of age. We sought a better understanding of effects of age on vigilance by assessing neurophysiological change over the course of a vigil in young (aged 18-24) and healthy older (aged 66-77) adults. To measure temporal changes in cerebral blood flow, participants underwent functional transcranial doppler (fTCD) recording during a 1 h vigilance task. Based on research showing a compensatory effect of increased left hemisphere activation during vigilance in young adults and the "hemispheric asymmetry reduction in older adults" (HAROLD) model, we predicted that during vigilance our older adults would show greater left hemisphere activation but perform at a similar level compared to young adults. While cerebral blood flow velocity (CBFV) declined over time in both groups, only young adults showed the typical right-lateralized CBFV pattern. Older adults showed greater left hemisphere activation consistent with the HAROLD model. However, the increased left hemisphere activation did not appear to be compensatory as the older adults performed at a significantly lower level compared to young adults over the vigil.

FINDINGS are discussed in terms of the HAROLD model of healthy aging and the resource theory of vigilance.

PDF Y Endnote Y

Two-threshold energy based fall detection using a triaxial accelerometer

Sucerquia A, Lopez JD, Vargas F, Sucerquia A, Lopez JD, Vargas F, Sucerquia A, Vargas F, Lopez JD.

Conf. Proc. IEEE Eng. Med. Biol. Soc. 2016; 2016: 3101-3104.

(Copyright © 2016, IEEE (Institute of Electrical and Electronics Engineers))

DOI 10.1109/EMBC.2016.7591385 **PMID** 28227174

Abstract

Elderly fall detection based on accelerometers is an active research area. Nowadays authors are addressing specific problems such as failure rates and energy consumption, but in most cases their

strategies do not conciliate these objectives. In this paper we propose a double threshold based methodology with two novel detection features, a product between the sum vector magnitude and the signal magnitude area, and a normalization of the signal magnitude area over five 1 s windows. The methodology was validated using the public Mobifall dataset, and one developed for this work. It achieved 99 % of accuracy with Mobifall, and 97 % with the self-developed dataset. This methodology is based on an activity by activity analysis performed for determining which activities are prone to fail, as an alternative way of reducing detection failures.

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UHF wearable battery free sensor module for activity and falling detection

Dang NT, Tran TV, Chung WY, Nam Trung Dang, Thang Viet Tran, Wan-Young Chung, Tran TV, Chung WY, Dang NT.

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Abstract

Falling is one of the most serious medical and social problems in aging population. Therefore taking care of the elderly by detecting activity and falling for preventing and mitigating the injuries caused by falls needs to be concerned. This study proposes a wearable, wireless, battery free ultra-high frequency (UHF) smart sensor tag module for falling and activity detection. The proposed tag is powered by UHF RF wave from reader and read by a standard UHF Electronic Product Code (EPC) Class-1 Generation-2 reader. The battery free sensor module could improve the wearability of the wireless device. The combination of accelerometer signal and received signal strength indication (RSSI) from a reader in the passive smart sensor tag detect the activity and falling of the elderly very successfully. The fabricated smart sensor tag module has an operating range of up to 2.5m and conducting in real-time activity and falling detection.

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Unexplained absences and risk of death and injury among nursing home residents: a systematic review

Woolford MH, Weller C, Ibrahim JE.

J. Am. Med. Dir. Assoc. 2017; ePub(ePub): ePub.

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DOI 10.1016/j.jamda.2017.01.007 **PMID** 28242190

Abstract

BACKGROUND: Unexplained absence of nursing home (NH) residents is one of the most challenging issues related to the care of older people. The aim of this review was to examine the death and injury outcomes of unexplained absence of NH residents.

METHOD: We searched MEDLINE, CINAHL, EMBASE, PsycINFO, AgeLine, and Cochrane Library to identify qualitative and quantitative studies published in the English language. Data on death and injury were collated, and aggregate proportions were calculated where possible.

RESULTS: Nine studies were identified; most ($n = 6$) were conducted in the United States. Persons with dementia formed the study population in all studies. There were 1440 individual unexplained absences reported across the 9 studies. We calculated a rate of 82 deaths and 61 injuries per 1000 incidents of unexplained absence. Extreme temperatures were the most common cause of death. Most individuals left by foot, and were found within a 1-mile radius of place last seen in green vegetation and waterways.

CONCLUSION: This review provides valuable insight into death and injury outcomes. Further studies are recommended to improve understanding and prevent adverse outcomes.

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A Kalman filter to estimate altitude change during a fall

Stevens MC, Lu W, Wang C, Redmond SJ, Lovell NH, Stevens MC, Wei Lu, Changhong Wang, Redmond SJ, Lovell NH, Wang C, Lu W, Redmond SJ, Lovell NH, Stevens MC.

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(Copyright © 2016, IEEE (Institute of Electrical and Electronics Engineers))

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Abstract

Barometers have been incorporated into fall detectors in order to enhance the accuracy of fall detection algorithms, however they are power-hungry devices. We present an offline evaluation of a Kalman filter (KF) for estimating the pressure change during a fall that enables low-power operation of the barometer. The KF takes advantage of the fact that a semi-permeable air membrane on a waterproof fall detector enclosure causes a delay in the equilibrium between internal and external enclosure pressure, and this delay enables the barometer to be switched off until a free-fall is detected. We assessed the KF using data obtained from simulated falls and activities of daily living. The KF was able to differentiate between fall and non-fall activities, with the average measured pressure change during a fall of 8 Pa best determined using a delay in pressure equalization of 20 seconds. The KF detected a change in altitude faster than a simple moving average filter (MAF), reaching 66% of its final value before the MAF was able to initialize.

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Complementary mechanisms for upright balance during walking

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PLoS One 2017; 12(2): e0172215.

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Abstract

Lateral balance is a critical factor in keeping the human body upright during walking. Two important mechanisms for balance control are the stepping strategy, in which the foot placement is changed in the direction of a sensed fall to modulate how the gravitational force acts on the body, and the lateral ankle strategy, in which the body mass is actively accelerated by an ankle torque. Currently, there is minimal evidence about how these two strategies complement one another to achieve

upright balance during locomotion. We use Galvanic vestibular stimulation (GVS) to induce the sensation of a fall at heel-off during gait initiation. We found that young healthy adults respond to the illusory fall using both the lateral ankle strategy and the stepping strategy. The stance foot center of pressure (CoP) is shifted in the direction of the perceived fall by ≈ 2.5 mm, starting ≈ 247 ms after stimulus onset. The foot placement of the following step is shifted by ≈ 15 mm in the same direction. The temporal delay between these two mechanisms suggests that they independently contribute to upright balance during locomotion, potentially in a serially coordinated manner. Modeling results indicate that without the lateral ankle strategy, a much larger step width is required to maintain upright balance, suggesting that the small but early CoP shift induced by the lateral ankle strategy is critical for upright stability during locomotion. The relative importance of each mechanism and how neurological disorders may affect their implementation remain an open question.

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Gait stability, variability and complexity on inclined surfaces

Vieira MF, Rodrigues FB, de Sá E Souza GS, Magnani RM, Lehen GC, Campos NG, Andrade AO. *J. Biomech.* 2017; ePub(ePub): ePub.

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Abstract

This study evaluated the gait stability, variability, and complexity of healthy young adults on inclined surfaces. A total of 49 individuals walked on a treadmill at their preferred speed for 4min at inclinations of 6%, 8%, and 10% in upward (UP) and downward (DOWN) conditions, and in horizontal (0%) condition. Gait variability was assessed using average standard deviation trunk acceleration between strides (VAR), gait stability was assessed using margin of stability (MoS) and maximum Lyapunov exponent (λ_s), and gait complexity was assessed using sample entropy (SEn). Trunk variability (VAR) increased in the medial-lateral (ML), anterior-posterior, and vertical directions for all inclined conditions. The SEn values indicated that movement complexity decreased almost linearly from DOWN to UP conditions, reflecting changes in gait pattern with longer and slower steps as inclination increased. The DOWN conditions were associated with the highest variability and lowest stability in the MoS ML, but not in λ_s . Stability was lower in UP conditions, which exhibited the largest λ_s values. The overall results support the hypothesis that inclined surfaces decrease gait stability and alter gait variability, particularly in UP conditions.

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How does self-perceived unsteadiness influence balance and gait in people with diabetes?

Preliminary observations

Reeves ND, Brown SJ, Petrovic M, Boulton AJ, Vileikyte L.

Diabetes Care 2017; ePub(ePub): ePub.

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(Copyright © 2017, American Diabetes Association)

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Abstract [Abstract unavailable]

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Imminent fracture risk

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Osteoporos. Int. 2017; ePub(ePub): ePub.

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(Copyright © 2017, Springer Science+Business Media)

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Abstract

The clinical significance of osteoporosis is in the occurrence of fractures and re-fractures. The main risk factor of sustaining a fracture is a previous one, but a recent fracture is a better fracture risk factor than fracture history. The role of the recency of fracture has been shown for both vertebral and non-vertebral fracture risk. This imminent risk is explained by both bone-related factors (underlying osteoporosis) and fall-related factors (including those related to postfracture care). Such a short-term increased risk has been shown also in patients initiating corticosteroids and in frail osteoporotic subjects with central nervous system (CNS) diseases or drugs targeting CNS, and thus a high risk of falls. Patients with an imminent (i.e. 2 years) risk of fracture or refracture should be identified in priority in order to receive an immediate treatment and a program of fall prevention.

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Noninvasive EEG correlates of overground and stair walking

Brantley JA, Luu TP, Ozdemir R, Zhu F, Winslow AT, Huang H, Contreras-Vidal JL, Brantley JA, Luu TP, Ozdemir R, Zhu F, Winslow AT, Huang H, Contreras-Vidal JL, Zhu F, Ozdemir R, Brantley JA, Huang H, Winslow AT, Contreras-Vidal JL, Luu TP.

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Abstract

Automated walking intention detection remains a challenge in lower-limb neuroprosthetic systems. Here, we assess the feasibility of extracting motor intent from scalp electroencephalography (EEG). First, we evaluated the corticomuscular coherence between central EEG electrodes (C1, Cz, C2) and muscles of the shank and thigh during walking on level ground and stairs. Second, we trained decoders to predict the linear envelope of the surface electromyogram (EMG). We observed significant EEG-led corticomuscular coupling between electrodes and sEMG (tibialis anterior) in the high delta (3-4 Hz) and low theta (4-5 Hz) frequency bands during level walking, indicating efferent signaling from the cortex to peripheral motor neurons. The coherence was increased between EEG and vastus lateralis and tibialis anterior in the delta band (< 2 Hz) during stair ascent, indicating a task specific modulation in corticomuscular coupling. However, EMG was the leading signal for biceps femoris and gastrocnemius coherence during stair ascent, possibly representing afferent feedback loops from periphery to the motor cortex. Decoder validation showed that EEG signals contained information about the sEMG patterns during over ground walking, however, the accuracy of the predicted sEMG patterns decreased during the stair condition. Overall, these initial findings

support the feasibility of integrating sEMG and EEG into a hybrid decoder for volitional control of lower limb neuroprostheses.

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Online learning of gait models for calculation of gait parameters

Waugh JL, Trinh A, Mohammed RR, McIlroy WE, Kulic D, Waugh JL, Trinh A, Mohammed RR, McIlroy WE, Kulic D, Waugh JL, Kulic D, Trinh A, McIlroy WE, Mohammed RR.

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Abstract

This paper proposes a novel approach for gait analysis from wearable sensing, based on an adaptive periodic model of any gait signal. The proposed method learns a model of the gait cycle during online measurement, using a continuous representation that can adapt to inter and intra-personal variability by creating an individualized model. Once the algorithm has converged to the input signal, key gait events can be identified relative to the estimated gait phase; these events can then be used to calculate gait parameters. The approach is implemented and tested on a human motion dataset where heel impact and toe takeoff events are extracted with an average error of 0.04 cycles.

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