

SafetyLit May 6th 2018

Association between the gait pattern characteristics of older people and their two-step test scores

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BMC Geriatr. 2018; 18(1): e101.

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DOI 10.1186/s12877-018-0784-5 **PMID** 29699495

Abstract

BACKGROUND: The Two-Step test is one of three official tests authorized by the Japanese Orthopedic Association to evaluate the risk of locomotive syndrome (a condition of reduced mobility caused by an impairment of the locomotive organs). It has been reported that the Two-Step test score has a good correlation with one's walking ability; however, its association with the gait pattern of older people during normal walking is still unknown. Therefore, this study aims to clarify the associations between the gait patterns of older people observed during normal walking and their Two-Step test scores.

METHODS: We analyzed the whole waveforms obtained from the lower-extremity joint angles and joint moments of 26 older people in various stages of locomotive syndrome using principal component analysis (PCA). The PCA was conducted using a 260 × 2424 input matrix constructed from the participants' time-normalized pelvic and right-lower-limb-joint angles along three axes (ten trials of 26 participants, 101 time points, 4 angles, 3 axes, and 2 variable types per trial).

RESULTS: The Pearson product-moment correlation coefficient between the scores of the principal component vectors (PCVs) and the scores of the Two-Step test revealed that only one PCV (PCV 2) among the 61 obtained relevant PCVs is significantly related to the score of the Two-Step test.

CONCLUSIONS: We therefore concluded that the joint angles and joint moments related to PCV 2- ankle plantar-flexion, ankle plantar-flexor moments during the late stance phase, ranges of motion and moments on the hip, knee, and ankle joints in the sagittal plane during the entire stance phase- are the motions associated with the Two-Step test.

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Awareness about falls and elderly people's exposure to household risk factors

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Cien. Saude Colet. 2018; 23(4): 1097-1104.

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DOI 10.1590/1413-81232018234.09252016 **PMID** 29694576

Abstract

OBJECTIVES: to describe the awareness about falls among elderly people living in their households in communities, to measure the other risks that they are exposed to in their homes and to evaluate the influence that knowledge on falling brings in the adoption of preventative measures.

METHOD: The FRAQ-Brazil questionnaire was used on 473 elderly people as well as a questionnaire on elderly people being exposed to 20 household risk factors. Associations between the variables

were analyzed using the chi-squared test with a confidence interval of 95%.

RESULTS: The age range was between 60 and 95 years with the average being 70.6 years. The majority of those interviewed were female (58.4%) who were earning 2 minimum wages (46.3%). The average amount of correct answers given with the use of the FRAQ-Brazil questionnaire was 19.5 out of 32 points and the elderly participants were, on average, exposed to 7.8 household risk factors. 180 of them stated that they had already received information on falls.

CONCLUSION: The majority of the elderly population displayed little knowledge on falls and were exposed to a variety of daily risk factors. Individuals who were more advanced in years and who had more knowledge on falls, were exposed to less household risk factors. This may well have been due to the adoption of preventative measures through changing domestic environment.

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Dual-task elderly gait of prospective fallers and non-fallers: a wearable-sensor based analysis

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Sensors (Basel) 2018; 18(4): s18041275.

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DOI 10.3390/s18041275 **PMID** 29690496

Abstract

Wearable sensors could facilitate point of care, clinically feasible assessments of dynamic stability and associated fall risk through an assessment of single-task (ST) and dual-task (DT) walking. This study investigated gait changes between ST and DT walking and between older adult prospective fallers and non-fallers. The results were compared to a study based on retrospective fall occurrence. Seventy-five individuals (75.2 ± 6.6 years; 47 non-fallers, 28 fallers; 6 month prospective fall occurrence) walked 7.62 m under ST and DT conditions while wearing pressure-sensing insoles and accelerometers at the head, pelvis, and on both shanks. DT-induced gait changes included changes in temporal measures, centre of pressure (CoP) path stance deviations and coefficient of variation, acceleration descriptive statistics, Fast Fourier Transform (FFT) first quartile, ratio of even to odd harmonics, and maximum Lyapunov exponent. Compared to non-fallers, prospective fallers had significantly lower DT anterior-posterior CoP path stance coefficient of variation, DT head anterior-posterior FFT first quartile, ST left shank medial-lateral FFT first quartile, and ST right shank superior maximum acceleration. DT-induced gait changes were consistent regardless of faller status or when the fall occurred (retrospective or prospective). Gait differences between fallers and non-fallers were dependent on retrospective or prospective faller identification.

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Examining the effects of an Otago-based home exercise program on falls and fall risks in an assisted living facility

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J. Geriatr. Phys. Ther. 2018; ePub(ePub): ePub.

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(Copyright © 2018, American Physical Therapy Association)

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Abstract

BACKGROUND AND PURPOSE: The Otago exercise program is a strengthening, balance, and walking program designed to decrease falls among community-dwelling older adults. Few studies have examined the effects of the Otago program in an assisted living environment. The purpose of the current study was to assess the effects of an Otago-based home exercise program in decreasing falls and the risk of falls among older adults living in an assisted living facility.

METHODS: A retrospective chart review of 30 individuals residing at either of 2 assisted living facilities in central Florida was undertaken. Participants had a mean age of 87 years, were at risk for falls as determined by the Tinetti Performance-Oriented Mobility Assessment (POMA), and were provided with an Otago-based intervention by home health physical therapy. The outcome measures were the number of falls in the previous year, the number of falls in the year following the intervention, and Tinetti POMA scores pre- and postintervention.

RESULTS AND DISCUSSION: The mean number of falls significantly decreased from 1.4 (0.9) to 0.5 (0.7) fall per person per year after home health physical therapy with the tailored Otago based-exercise intervention. The intervention resulted in a statistically significant improvement in Tinetti POMA scores from 11.8 (2.5) to 17.6 (3.8).

CONCLUSIONS: An Otago-based strengthening, balance, and walking home exercise program can potentially be used to decrease the number of falls and the risk of falling among older adults residing in an assisted living facility.

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Improving fall detection using an on-wrist wearable accelerometer

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Sensors (Basel) 2018; 18(5): s18051350.

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Abstract

Fall detection is a very important challenge that affects both elderly people and the carers. Improvements in fall detection would reduce the aid response time. This research focuses on a method for fall detection with a sensor placed on the wrist. Falls are detected using a published threshold-based solution, although a study on threshold tuning has been carried out. The feature extraction is extended in order to balance the dataset for the minority class. Alternative models have been analyzed to reduce the computational constraints so the solution can be embedded in smart-phones or smart wristbands. Several published datasets have been used in the Materials and Methods section. Although these datasets do not include data from real falls of elderly people, a complete comparison study of fall-related datasets shows statistical differences between the simulated falls and real falls from participants suffering from impairment diseases. Given the obtained results, the rule-based systems represent a promising research line as they perform similarly to neural networks, but with a reduced computational cost. Furthermore, support vector machines performed with a high specificity. However, further research to validate the proposal in

real on-line scenarios is needed. Furthermore, a slight improvement should be made to reduce the number of false alarms.

PDF Y Endnote Y

Issues in geriatric care: falls

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FP Essent. 2018; 468: 18-25.

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(Copyright © 2018, American Academy of Family Physicians)

DOI unavailable **PMID** 29714993

Abstract

One in three older adults falls each year. There are approximately 2.5 million falls among older adults treated in emergency departments. Falls account for 87% of all fractures in this age group. The biggest risk factor for falling is a history of falls. Other risk factors include frailty, sedative and anticholinergic drugs, polypharmacy, and a variety of medical conditions. Current recommendations are that all patients age 65 years and older should be asked about falls each year. Patients also can be screened for fall risk with a variety of approaches including questionnaires and the Timed Up & Go test. For patients who have fallen or are at risk, care should focus on correcting reversible home environmental factors that predispose to falls, minimizing the use of drugs with sedating properties, addressing vision conditions, recommending physical exercise (including balance, strength, and gait training), and managing postural hypotension as well as foot conditions and footwear. In addition, vitamin D and calcium supplementation should be considered. For patients needing anticoagulation for medical reasons, an assessment must balance fall risk (and thus bleeding from a fall) versus the risk of discontinuing anticoagulation (eg, sustaining an embolic stroke from atrial fibrillation). Written permission from the American Academy of Family Physicians is required for reproduction of this material in whole or in part in any form or medium.

PDF Not yet available Endnote Y

New horizons in fall prevention

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(Copyright © 2018, Oxford University Press)

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Abstract

Falls pose a major threat to the well-being and quality of life of older people. Falls can result in fractures and other injuries, disability and fear and can trigger a decline in physical function and loss of autonomy. This article synthesises recent published findings on fall risk and mobility assessments and fall prevention interventions and considers how this field of research may evolve in the future. Fall risk topics include the utility of remote monitoring using wearable sensors and recent work investigating brain activation and gait adaptability. New approaches for exercise for fall prevention

including dual-task training, cognitive-motor training with exergames and reactive step training are discussed. Additional fall prevention strategies considered include the prevention of falls in older people with dementia and Parkinson's disease, drugs for fall prevention and safe flooring for preventing fall-related injuries. The review discusses how these new initiatives and technologies have potential for effective fall prevention and improved quality of life. It concludes by emphasising the need for a continued focus on translation of evidence into practice including robust effectiveness evaluations of so that resources can be appropriately targeted into the future.

PDF Y Endnote Y

An analysis of trunk kinematics and gait parameters in people with stroke

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Afr. J. Disabil. 2018; 7: e310.

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DOI 10.4102/ajod.v7i0.310 **PMID** 29707514 **PMCID** PMC5913771

Abstract

BACKGROUND: Approximately two out of three people with stroke experience gait problems. Trunk movement control and symmetry is an important prerequisite for functional walking gait. Movement control, measured objectively as kinematics during walking gait, is rarely investigated.

OBJECTIVE: To describe the three-dimensional (3D) kinematics of the trunk during gait in people with stroke, including key spatiotemporal characteristics.

METHODOLOGY: A total of 17 adults with stroke who met the inclusion criteria were selected to participate in this cross-sectional pilot study. An eight-camera T-10 Vicon system with Nexus 1.8 software (Vicon Motion System Limited, Oxford, UK) was used to analyse the 3D kinematics of the trunk during self-selected walking speed. Trunk kinematics throughout the gait cycle and spatiotemporal parameters were extracted using custom-built scripts in MATLAB used at the Stellenbosch University Movement Analysis Laboratory. Stata Version 12.1 software was used to assess differences in trunk kinematics between the affected and unaffected sides during gait using the Sign test (statistical significance level $p < 0.05$).

RESULTS: Participants achieved functional gait speeds although they presented with asymmetrical trunk kinematics. During the full gait cycle, there were statistically significant differences of trunk motion between the affected and unaffected sides in the coronal plane ($p < 0.001$). There were statistically significant differences in the trunk kinematics between the affected side and unaffected sides at initial contact ($p < 0.001$) and foot off ($p < 0.049$) in the coronal plane as well as at initial contact ($p < 0.000$) and foot off ($p < 0.013$) in the transverse plane.

CONCLUSION: This pilot study found significant asymmetry in trunk motion between the affected and unaffected sides that varied across the gait cycle. This suggests the trunk may need to be targeted in clinical gait retraining post-stroke.

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Effect of noise stimulation below and above sensory threshold on postural sway during a mildly challenging balance task

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Gait Posture 2018; 63: 27-32.**Affiliation:** School of Public Health, Physiotherapy and Sport Science, University College Dublin, Belfield Campus, Dublin 4, Dublin, Ireland.

(Copyright © 2018, Elsevier Publishing)

DOI 10.1016/j.gaitpost.2018.04.031 **PMID** 29704801**Abstract**

BACKGROUND: Mechanical and electrical sub-sensory noise stimulation applied to the sensory receptors has been shown to improve performance during postural balance tasks. This improvement has been linked with the Stochastic Resonance (SR) phenomenon. It is not clear if noise levels above sensory threshold can also lead to a reduction in postural sway.

RESEARCH QUESTION: The aim of this study was to investigate the different effects of sub- and super-sensory electrical noise stimulation applied to the Tibialis Anterior muscle during several repetitions of a mildly challenging single-leg postural balance task.

METHODS: Fifteen healthy individuals participated in this study. Participants performed 25 repetitions of a balance tasks where they leaned forward and maintained a pre-determined position for 20 s. Each participant experienced 5 different stimulation levels (no-stimulation, 70%, 90%, 110% and 130% of their sensory threshold ST) for 5 times in a randomized order. Optimal stimulation (OS) was defined as the stimulation intensity minimizing the standard deviation of postural sway in the anteroposterior direction.

RESULTS: ~57% of the participants presented levels of OS below ST. We did not observe a clear SR-effect, characterized by a U-shaped relationship between the performance metric and the stimulation intensity. OS led to a selective improvement in all the anteroposterior posturographic parameters analyzed. Stimulation below ST led to an improvement in most of the balance features, while stimulation above ST led to an increase in postural sway. **SIGNIFICANCE:** Our results suggest that OS can be found both below and above ST although stimulation below ST appears to be more effective in reducing postural sway.

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PDF Y Endnote Y**Effect of pelvis impact angle on stresses at the femoral neck during falls**

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DOI 10.1016/j.jbiomech.2018.04.015 **PMID** 29691053**Abstract**

Improved understanding is required of how the mechanics of the fall affect hip fracture risk. We used a hip impact simulator to determine how peak stresses at the femoral neck were affected by pelvis impact angle, hip abductor muscle force, and use of a wearable hip protector. We simulated

falls from standing (2 m/s impact velocity) involving initial hip abductor muscle forces of 700 or 300 N. Trials were acquired for impact to the lateral aspect of the greater trochanter, and impact to the pelvis rotated 5°, 10° and 15° anteriorly (positive) or posteriorly (negative). Measures were acquired with and without a commercially available hip protector. During trials, we measured three-dimensional forces with a load cell at the femoral neck, and derived peak compressive and tensile stresses. Peak compressive stress increased 37% (5.91 versus 4.31 MPa; $p < 0.0005$) and peak tensile stress increased 209% (2.31 versus 0.75 MPa; $p < 0.0005$) when the pelvis impact angle changed from 15° anterior to -15° posterior. For lateral impacts, the peak tensile and compressive stresses averaged 73% and 8% lower, respectively, in the 700 N than 300 N muscle force condition, but the effect was reversed for anteriolateral or posteriolateral impacts. The attenuation in peak compressive stress from the hip protector was greatest for posteriolateral impacts (-15 to -5°; 36-41%), and least for anteriolateral (+15°; 10%). These results clarify the effects on hip fracture risk during a fall of pelvis impact angle and muscle forces, and should inform the design of improved hip protectors.

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PDF Y Endnote Y

Epidemiology and social costs of hip fracture

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Injury 2018; ePub(ePub): ePub.

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Abstract

Hip fracture is an important and debilitating condition in older people, particularly in women. The epidemiological data varies between countries, but it is globally estimated that hip fractures will affect around 18% of women and 6% of men. Although the age-standardised incidence is gradually falling in many countries, this is far outweighed by the ageing of the population. Thus, the global number of hip fractures is expected to increase from 1.26 million in 1990 to 4.5 million by the year 2050. The direct costs associated with this condition are enormous since it requires a long period of hospitalisation and subsequent rehabilitation. Furthermore, hip fracture is associated with the development of other negative consequences, such as disability, depression, and cardiovascular diseases, with additional costs for society. In this review, we show the most recent epidemiological data regarding hip fracture, indicating the well-known risk factors and conditions that seem relevant for determining this condition. A specific part is dedicated to the social costs due to hip fracture. Although the costs of hip fracture are probably comparable to other common diseases with a high hospitalisation rate (e.g. cardiovascular disease), the other social costs (due to onset of new co-morbidities, sarcopenia, poor quality of life, disability and mortality) are probably greater.

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Falls, mobility, and physical activity after spinal cord injury: an exploratory study using photo-elicitation interviewing

Musselman KE, Arnold C, Pujol C, Lynd K, Oosman S.

Spinal Cord Ser. Cases 2018; 4: 39.

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(Copyright © 2018, Nature Publishing Group)

DOI 10.1038/s41394-018-0072-9 **PMID** 29707239 **PMCID** PMC5919918

Abstract

STUDY DESIGN: Exploratory qualitative study using photo-elicitation interviews.

OBJECTIVES: To identify contributors to falls, as perceived by individuals with incomplete spinal cord injury, and describe the impact of perceived fall risk on mobility and physical activity. **SETTING:** Participants' home and community environments.

METHODS: Eight individuals with chronic motor incomplete spinal cord injury participated. Participants took photographs of situations that increased/decreased their risk of falling, or depicted how this risk impacted mobility and physical activity. Photographs were discussed in semi-structured interviews. Inductive thematic analysis was used to describe participants' perceptions and experiences.

RESULTS: Photo-elicitation interviews identified four themes: (1) Perceived challenges were primarily environmental with biological (e.g., reduced strength) and behavioral (e.g., risk-taking) factors also identified. (2) Impact of perceived fall risk included moving slowly, avoiding balance-provoking activities, and feelings of frustration and/or fear. (3) Prevent falls: learn through experience included strategies used to avoid falls, which were learnt experientially and consisted of changes to behavior. (4) Factors mitigating impact of perceived fall risk included character traits (i.e., perseverance, optimism) and a desire for independence.

CONCLUSIONS: Primarily environmental factors were perceived to contribute to fall risk and mainly behavioral strategies were adopted to mitigate the risk. **SPONSORSHIP:** Physiotherapy Foundation of Canada.

PDF Y Endnote Y**Immersive virtual reality to improve walking abilities in cerebral palsy: a pilot study**

Gagliardi C, Turconi AC, Biffi E, Maghini C, Marelli A, Cesareo A, Diella E, Panzeri D.

Ann. Biomed. Eng. 2018; ePub(ePub): ePub.

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DOI 10.1007/s10439-018-2039-1 **PMID** 29704186

Abstract

Immersive virtual reality (IVR) offers new possibilities to perform treatments in an ecological and interactive environment with multimodal online feedbacks. Sixteen school-aged children (mean age 11 ± 2.4 years) with Bilateral CP-diplegia, attending mainstream schools were recruited for a pilot study in a pre-post treatment experimental design. The intervention was focused on walking competences and endurance and performed by the Gait Real-time Analysis Interactive Lab (GRAIL), an innovative treadmill platform based on IVR. The participants underwent eighteen therapy

sessions in 4 weeks. Functional evaluations, instrumental measures including GAIT analysis and parental questionnaire were utilized to assess the treatment effects. Walking pattern (stride length left and right side, respectively $p = 0.001$ and 0.003 ; walking speed $p = 0.001$), endurance (6MWT, $p = 0.026$), gross motor abilities (GMFM-88, $p = 0.041$) and most kinematic and kinetic parameters significantly improved after the intervention. The changes were mainly predicted by age and cognitive abilities. The effect could have been due to the possibility of IVR to foster integration of motor/perceptual competences beyond the training of the walking ability, giving a chance of improvement also to older and already treated children.

PDF Y Endnote Y

Injuries associated with subdural hematoma: a study of the National Trauma Data Bank

Anandasivam NS, Russo GS, Samuel AM, Grant R, Bohl DD, Grauer JN.

Conn. Med. 2017; 81(4): 215-222.

(Copyright © 2017, Connecticut State Medical Society)

DOI unavailable PMID 29714406

Abstract

Of 92030 patients with subdural hematoma (SDH) in the National Trauma Data Bank (NTDB), 55729 had fall mechanisms of injury (61%), while 36301 had other traumatic mechanisms (nonfall, 39%). For nonfall mechanisms, the three associated injuries with the highest incidence were: skull fractures (43.3%), rib/sternum injuries (25.0%), and thoracic organ injuries (24.0%). For fall mechanisms, the three associated injuries with the highest incidence were: skull fractures (19.0%), spinal injuries (7.1%), and upper extremity fractures (6.8%). Mortality was associated with age and most studied associated injuries (odds ratios of up to 2.04). 'This study conveys an important clinical point: even though traditional teaching highlights the risk of noncontiguous spine fractures in patients with a known spine fracture, the risk of a noncontiguous spine fracture is higher when dealing with a patient with SDH. This is underscored by the fact that mortality is higher for SDH patients with other as associated injuries.

PDF N Endnote Y

The epidemiology of mild traumatic brain injury: the Trondheim MTBI follow-up study

Skandsen T, Einarsen CE, Normann I, Bjøralt S, Karlsen RH, McDonagh D, Nilsen TL, Akslen AN, Haberg AK, Vik A.

Scand. J. Trauma Resusc. Emerg. Med. 2018; 26(1): 34.

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(Copyright © 2018, Scandinavian Networking Group on Trauma and Emergency Management, Publisher Holtzbrinck Springer Nature Publishing Group)

DOI 10.1186/s13049-018-0495-0 PMID 29703222

Abstract

BACKGROUND: Mild traumatic brain injury (MTBI) is a frequent medical condition, and some patients report long-lasting problems after MTBI. In order to prevent MTBI, knowledge of the epidemiology is important and potential bias in studies should be explored. Aims of this study were to describe the epidemiological characteristics of MTBI in a Norwegian area and to evaluate the

representativeness of patients successfully enrolled in the Trondheim MTBI follow-up study. **METHODS:** During 81 weeks in 2014 and 2015, all persons aged 16-60 years, presenting with possible MTBI to the emergency department (ED) at St. Olavs Hospital, Trondheim University Hospital or to Trondheim municipal outpatient ED, were evaluated for participation in the follow-up study. Patients were identified by CT referrals and patient lists. Patients who were excluded or missed for enrolment in the follow-up study were recorded.

RESULTS: We identified 732 patients with MTBI. Median age was 28 years, and fall was the most common cause of injury. Fifty-three percent of injuries occurred during the weekend. Only 29% of MTBI patients were hospitalised. Study specific exclusion criteria were present in 23%. We enrolled 379 in the Trondheim MTBI follow-up study. In this cohort, Glasgow Coma Scale score was 15 at presentation in 73%; 45% of patients were injured under the influence of alcohol. Patients missed for inclusion were significantly more often outpatients, females, injured during the weekend, and suffering violent injuries, but differences between enrolled and not enrolled patients were small.

CONCLUSION: Two thirds of all patients with MTBI in the 16-60 age group were treated without hospital admission, patients were often young, and half of the patients presented during the weekend. Fall was the most common cause of injury, and patients were commonly injured under the influence of alcohol, which needs to be addressed when considering strategies for prevention. The Trondheim MTBI follow-up study comprised patients who were highly representative for the underlying epidemiology of MTBI.

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The relationship between physiological and perceived fall risk in people with multiple sclerosis: implications for assessment and management

Gunn H, Cameron M, Hoang P, Lord S, Shaw S, Freeman J.

Arch. Phys. Med. Rehabil. 2018; ePub(ePub): ePub.

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DOI 10.1016/j.apmr.2018.03.019 **PMID** 29698641

Abstract

OBJECTIVE: This study evaluated the relationship between physiological and perceived fall risk in people with MS.

DESIGN: Secondary analysis of data from prospective cohort studies undertaken in Australia, United Kingdom and the United States.

SETTING: Community

PARTICIPANTS: 416 ambulatory people with MS (age 51.5 ±12.0 years; 73% female; 62% relapsing-remitting MS; 13.7 ±9.9 years disease duration).

INTERVENTIONS: Not applicable

OUTCOME MEASURES: All participants completed measures of physiological (Physiological Profile Assessment (PPA)) and perceived (Falls Efficacy Scale-international (FESi)) fall risk and prospectively recorded falls for three months.

RESULTS: 155 (37%) of the participants were recurrent fallers (≥2 falls). Mean PPA and FESi scores were high (PPA 2.14±1.87, FESi 34.27±11.18). The PPA and the FESi independently predicted faller

classification in logistic regression, which indicated that the odds of being classified as a recurrent faller significantly increased with increasing scores (PPA Odds Ratio 1.30 (95%CI 1.17-1.46), FESi Odds Ratio 1.05 (95% CI 1.03-1.07)). Classification and regression tree analysis divided the sample into four groups based on cut-off values for the PPA: (1) low physiological/ low perceived risk (PPA <2.83, FESi <27.5), (2) low physiological/ high perceived risk (PPA <2.83, FESi >27.5), (3) high physiological/ low perceived risk (PPA >2.83, FESi <35.5), and (4) high physiological/ high perceived risk (PPA >2.83, FESi >35.5). Over 50% of participants had a disparity between perceived and physiological fall risk; most were in group 2. It is possible that physiological risk factors not detected by the PPA may also be influential.

CONCLUSION: This study highlights the importance of considering both physiological and perceived fall risk in MS, and that further research is needed to explore the complex inter-relationships of perceptual and physiological risk factors in this population. This study also supports the importance of developing behavioral and physical interventions which can be tailored to the individual's need.

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PDF Y Endnote Y

Validation of freezing-of-gait monitoring using smartphone

Kim HB, Lee HJ, Lee WW, Kim SK, Jeon HS, Park HY, Shin CW, Yi WJ, Jeon B, Park KS.

Telemed. J. E-Health 2018; ePub(ePub): ePub.

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DOI 10.1089/tmj.2017.0215 **PMID** 29708870

Abstract

BACKGROUND: Freezing of gait (FOG) is a commonly observed motor symptom for patients with Parkinson's disease (PD). The symptoms of FOG include reduced step lengths or motor blocks, even with an evident intention of walking. FOG should be monitored carefully because it not only lowers the patient's quality of life, but also significantly increases the risk of injury.

INTRODUCTION: In previous studies, patients had to wear several sensors on the body and another computing device was needed to run the FOG detection algorithm. Moreover, the features used in the algorithm were based on low-level and hand-crafted features. In this study, we propose a FOG detection system based on a smartphone, which can be placed in the patient's daily wear, with a novel convolutional neural network (CNN).

METHODS: The walking data of 32 PD patients were collected from the accelerometer and gyroscope embedded in the smartphone, located in the trouser pocket. The motion signals measured by the sensors were converted into the frequency domain and stacked into a 2D image for the CNN input. A specialized CNN model for FOG detection was determined through a validation process.

RESULTS: We compared our performances with the results acquired by the previously reported settings. The proposed architecture discriminated the freezing events from the normal activities with an average sensitivity of 93.8% and a specificity of 90.1%.

CONCLUSIONS: Using our methodology, the precise and continuous monitoring of freezing events with unconstrained sensing can assist patients in managing their chronic disease in daily life effectively.

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