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Adaptations of prefrontal brain activity, executive functions, and gait in healthy elderly following exergame and balance training: a randomized-controlled study

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Front. Aging Neurosci. 2016; 8: e278.

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DOI 10.3389/fnagi.2016.00278 **PMID** 27932975

Abstract

During aging, the prefrontal cortex (PFC) undergoes age-dependent neuronal changes influencing cognitive and motor functions. Motor-learning interventions are hypothesized to ameliorate motor and cognitive deficits in older adults. Especially, video game-based physical exercise might have the potential to train motor in combination with cognitive abilities in older adults. The aim of this study was to compare conventional balance training with video game-based physical exercise, a so-called exergame, on the relative power (RP) of electroencephalographic (EEG) frequencies over the PFC, executive function (EF), and gait performance. Twenty-seven participants (mean age 79.2 ± 7.3 years) were randomly assigned to one of two groups. All participants completed 24 trainings including three times a 30 min session/week. The EEG measurements showed that theta RP significantly decreased in favor of the exergame group [L(14) = 6.23, p = 0.007]. Comparing pre- vs. post-test, EFs improved both within the exergame (working memory: z = -2.28, p = 0.021; divided attention auditory: z = -2.51, p = 0.009; divided attention visual: z = -2.06, p = 0.040; go/no-go: z = -2.55, p = 0.008; set-shifting: z = -2.90, p = 0.002) and within the balance group (set-shifting: z = -2.04, p = 0.042). Moreover, spatio-temporal gait parameters primarily improved within the exergame group under dual-task conditions (speed normal walking: z = -2.90, p = 0.002; speed fast walking: z = -2.97, p = 0.001; cadence normal walking: z = -2.97, p = 0.001; stride length fast walking: z = -2.69, p = 0.005) and within the balance group under single-task conditions (speed normal walking: z = -2.54, p = 0.009; speed fast walking: z = -1.98, p = 0.049; cadence normal walking: z = -2.79, p = 0.003). These results indicate that exergame training as well as balance training positively influence prefrontal cortex activity and/or function in varying proportion.

PDF Endnote

Analysis of a smartphone-based architecture with multiple mobility sensors for fall detection

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PLoS One 2016; 11(12): e0168069.

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DOI 10.1371/journal.pone.0168069 **PMID** 27930736

Abstract

During the last years, many research efforts have been devoted to the definition of Fall Detection Systems (FDSs) that benefit from the inherent computing, communication and sensing capabilities of smartphones. However, employing a smartphone as the unique sensor in a FDS application entails several disadvantages as long as an accurate characterization of the patient's mobility may force to transport this personal device on an unnatural position. This paper presents a smartphone-based architecture for the automatic detection of falls. The system incorporates a set of small sensing

motes that can communicate with the smartphone to help in the fall detection decision. The deployed architecture is systematically evaluated in a testbed with experimental users in order to determine the number and positions of the sensors that optimize the effectiveness of the FDS, as well as to assess the most convenient role of the smartphone in the architecture.
PDF Endnote

Are fear of movement, self-efficacy beliefs and fear of falling associated with levels of disability in people with osteoarthritis of the knee? A cross sectional study
Thompson DP, Moula K, Woby SR.
Musculoskeletal Care 2016; ePub(ePub): ePub.
Affiliation: Department of Research and Development, The Pennine Acute Hospitals NHS Trust, Trust Headquarters, North Manchester General Hospital, Crumpsall, Manchester, UK.

DOI 10.1002/msc.1167 **PMID** 27925419
Abstract
INTRODUCTION: Osteoarthritis of the knee (OAK) can result in significant disability and previous authors have suggested that cognitive and falls-related factors may be significant determinants of function. However, no previous studies have considered the relative influence of these factors when the effects of symptoms related to OAK are also considered. Additionally, it is plausible that falls-related factors exert a greater influence in patients who have previously fallen.
METHODS: Fifty-eight patients were recruited from an outpatient physiotherapy department. They completed measures of physical function, pain, stiffness, physical symptoms, fear avoidance, perceived consequences of falling, fear of falling and self-efficacy beliefs. Variables exhibiting significant correlations with disability were entered into a regression model. β Values were also calculated for the final model to allow the relative contribution of each variable to be established when all variables were considered. Sub-analysis was then performed using only data from patients who had previously fallen, to establish whether cognitive and falls-related factors exerted a stronger influence in this group.
RESULTS: Pain, stiffness and joint symptoms significantly explained 75% of the variance in disability. The cognitive and falls-related variables did not significantly explain any additional variance. Only pain and stiffness exhibited significant β values in the final model. Similar findings were observed in the sub-analysis with the participants who had previously fallen, with only pain and stiffness explaining significant variance (77%) or exhibiting significant β values.
DISCUSSION: The current findings suggested that cognitive and falls-related factors are not significantly related to disability in patients with OAK. By contrast, pain and stiffness were strongly associated with disability. This suggests that targeting cognitive and falls-related factors is unlikely significantly to improve outcome in these patients.

PDF Endnote

Association of lower extremity range of motion and muscle strength with physical performance of community-dwelling older women
Jung H, Yamasaki M.
J. Physiol. Anthropol. 2016; 35(1): e30.

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DOI 10.1186/s40101-016-0120-8 **PMID** 27931244
Abstract

BACKGROUND: Reduced lower extremity range of motion (ROM) and muscle strength are related to functional disability in older adults who cannot perform one or more activities of daily living (ADL) independently. The purpose of this study was to determine which factors of seven lower extremity ROMs and two muscle strengths play dominant roles in the physical performance of community-dwelling older women.

METHODS: Ninety-five community-dwelling older women (mean age ± SD, 70.7 ± 4.7 years; age range, 65-83 years) were enrolled in this study. Seven lower extremity ROMs (hip flexion, hip extension, knee flexion, internal and external hip rotation, ankle dorsiflexion, and ankle plantar flexion) and two muscle strengths (knee extension and flexion) were measured. Physical performance tests, including functional reach test (FRT), 5 m gait test, four square step test (FSST), timed up and go test (TUGT), and five times sit-to-stand test (FTSST) were performed.

RESULTS: Stepwise regression models for each of the physical performance tests revealed that hip extension ROM and knee flexion strength were important explanatory variables for FRT, FSST, and FTSST. Furthermore, ankle plantar flexion ROM and knee extension strength were significant explanatory variables for the 5 m gait test and TUGT. However, ankle dorsiflexion ROM was a significant explanatory variable for FRT alone. The amount of variance on stepwise multiple regression for the five physical performance tests ranged from 25 (FSST) to 47% (TUGT).

CONCLUSIONS: Hip extension, ankle dorsiflexion, and ankle plantar flexion ROMs, as well as knee extension and flexion strengths may play primary roles in the physical performance of community-dwelling older women. Further studies should assess whether specific intervention programs targeting older women may achieve improvements in lower extremity ROM and muscle strength, and thereby play an important role in the prevention of dependence on daily activities and loss of physical function, particularly focusing on hip extension, ankle dorsiflexion, and ankle plantar flexion ROMs as well as knee extension and flexion strength.
PDF Endnote

Balance and mobility training with or without concurrent cognitive training does not improve posture, but improves reaction time in healthy older adults

Jehu D, Paquet N, Lajoie Y.
Gait Posture 2016; 52: 227-232.
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DOI 10.1016/j.gaitpost.2016.12.006 **PMID** 27939652
Abstract

BACKGROUND AND AIMS: The purpose was to determine whether balance and mobility training (BMT) or balance and mobility plus cognitive training (BMT+C) would reduce postural sway and reaction time (RT) and maintain these improvements after a 12-week follow-up in healthy older adults.

METHODS: Participants were allocated to the BMT (n=15; age: 70.2±3.2), BMT+C (n=14;

age:68.7±5.5), or control group (n=13; age: 66.7±4.2). The BMT group trained one-on-one, 3×/wk for 12 weeks on a balance obstacle course. The BMT+C group trained one-on-one, 3×/week for 12 weeks on a balance obstacle course while completing cognitive tasks. Participants stood on a force plate for 30s in feet-apart (FA) and semi-tandem (ST) positions while completing simple RT and choice RT tasks at baseline, at the 12-week post-training, and at the 12-week follow-up. Participants were instructed to stand as still as possible while verbally responding as fast as possible to the auditory cues.
RESULTS: No group differences in center of pressure (COP) Area, COP Velocity, or Sample Entropy of the COP displacement were shown after the training or 12-week follow-up, but the BMT and BMT+C showed faster RT after training and maintained these improvements at the 12-week follow-up compared to the control group. No differences in postural sway or RT emerged between the BMT and BMT+C groups.
CONCLUSION: Both training groups improved RT after the interventions and sustained these improvements over 12 weeks, but showed no reductions in postural sway. Multi-task balance training likely results in reduced attention demand.

PDF Endnote

Brain activation in high-functioning older adults and falls: prospective cohort study
Verghese J, Wang C, Ayers E, Izzetoglu M, Holtzer R.
Neurology 2016; ePub(ePub): ePub.
Affiliation: From the Departments of Neurology (J.V., E.A., R.H.), Medicine (J.V.), and Epidemiology (C.W.), Albert Einstein College of Medicine; Ferkauf Graduate School of Psychology (R.H.), Yeshiva University, Bronx, NY; and Drexel University School of Biomedical Engineering (M.I.), Philadelphia, PA.

DOI 10.1212/WNL.0000000000003421 **PMID** 27927937
Abstract
OBJECTIVE: To determine whether brain activity over the prefrontal cortex measured in real time during walking predicts falls in high-functioning older adults.
METHOD: We examined166 older persons (mean age 75 years, 51% women) enrolled in a prospective aging study. High-functioning status defined as the absence of dementia or disability with normal gait diagnosed by study clinicians. The magnitude of task-related changes in oxygenated hemoglobin levels over the prefrontal cortex was measured with functional near-infrared spectroscopy during motor (walking at normal pace) and cognitive (reciting alternate letters of the alphabet) single tasks and a dual-task condition (walking while reciting alternate letters of the alphabet). Incident falls were prospectively assessed over a 50-month study period.
RESULTS: Over a mean follow-up of 33.9 ± 11.9 months, 116 falls occurred. Higher levels of prefrontal cortical activation during the dual-task walking condition predicted falls (hazard ratio adjusted for age, sex, education, medical illnesses and general mental status 1.32, 95% confidence interval 1.03-1.70). Neither behavioral outcomes (velocity or letter rate) on the dual task nor brain activation patterns on the single tasks (normal walk or talk alone) predicted falls in this high-functioning sample. The results remained robust after accounting for multiple confounders and for cognitive status, slow gait, previous falls, and frailty.

CONCLUSIONS: Prefrontal brain activity levels while performing a cognitively demanding walking condition predicted falls in high-functioning seniors. These findings implicate neurobiological processes early in the pathogenesis of falls.

PDF Endnote

Changes in physical activity, sedentary time, and risk of falling: the Women's Health Initiative Observational Study

Bea JW, Thomson CA, Wallace RB, Wu C, Seguin RA, Going SB, LaCroix A, Eaton C, Ockene JK, LaMonte MJ, Jackson R, Jerry Mysiw W, Wactawski-Wende
J. Prev. Med. 2016; ePub(ePub): ePub.
Affiliation: University at Buffalo, State University of New York, 410 Kimball Hall, Buffalo, NY 14214.

DOI 10.1016/j.ypmed.2016.11.025 **PMID** 27932054
Abstract

Falling significantly affects quality of life, morbidity, and mortality among older adults. We sought to evaluate the prospective association between sedentary time, physical activity, and falling among post-menopausal women aged 50-79 y recruited to the Women's Health Initiative Observational Study between 1993 and 1998 from 40 clinical centers across the United States. Baseline (B) and change in each of the following were evaluated at year 3 (Y3) and year 6 (Y6; baseline n=93,676; Y3 n=76,598; Y6 n=75,428): recreational physical activity (MET-h/wk), sitting, sleeping (min/d), and lean body mass by dual energy X-ray absorptiometry (subset N=6,475). Falls per year (0, 1, 2, ≥3) were assessed annually by self-report questionnaire and then dichotomized as ≤1and ≥2 falls/year. Logistic regression models were adjusted for demographics, body mass index, fall history, tobacco and alcohol use, medical conditions, and medications. Higher baseline activity was associated with greater risk of falling at Y6 (18%; p for trend <0.0001). Increasing sedentary time minimally decreased falling (1% Y3; 2% Y6; p<0.05). Increasing activity up to ≥ 9 MET-h/wk (OR: 1.12, 95%CI: 1.03-1.22) or maintaining ≥ 9 MET-h/wk (OR: 1.20, 95% CI: 1.13-1.29) increased falling at Y3 and Y6 (p for trend <0.001). Adding lean body mass to the models attenuated these relationships. Physically active lifestyles increased falling among post-menopausal women. Additional fall prevention strategies, such as balance and resistance training, should be evaluated to assist post-menopausal women in reaching or maintaining levels of aerobic activity known to prevent and manage several chronic diseases.

PDF Endnote

Comparison of older adults' visual perceptual skills, cognitive function, and fall efficacy according to fall risk in the elderly

Lee H, Park B, Yang Y.
J. Phys. Ther. Sci. 2016; 28(11): 3153-3157.
Affiliation: Department of Occupational Therapy, College of Biomedical Sciences and Engineering, Inje University, Republic of Korea.

DOI 10.1589/jpts.28.3153 **PMID**27942139
Abstract

PURPOSE: This research aims to identify the relationships among visual perceptual skills, cognitive functioning, and fall efficacy of older adults based on whether they are at risk for falls.
SUBJECTS AND METHODS: Subjects included 116 older adults over 65 years of age who use D Seniors Welfare Center and Y Senior Citizen Center in Busan Metropolitan City. All research subjects were classified based on balance maintenance ability evaluation and whether or not they had experienced falls more than once. Those with scores below the cut-off standard were selected as a group of older adults at risk for falls. An MVPT-3 test was used to assess visual perceptual skill, MMSE-KC, and MoCA-K tests to assess cognitive function, and the FES-K falls efficacy test to classify subjects as either at risk for falls or not.
RESULTS: After comparing scores for visual perceptual skills, cognitive functioning, and fall efficacy, subjects at risk for falls showed significantly lower scores than did those not at risk.
CONCLUSION: The study found that there are significant differences in balance ability, visual perceptual skill, cognitive functioning, and fall efficacy between older adults at risk for falls and those not at risk.
PDF Endnote

Danish register-based study on the association between specific antipsychotic drugs and fractures in elderly individuals
Torstensson M, Leth-Møller K, Andersson C, Torp-Pedersen C, Gislason GH, Holm EA.
Age Ageing 2016; ePub(ePub): ePub.
Affiliation: Department of Internal Medicine, Nykøbing Falster Hospital, Nykøbing Falster, Denmark.

DOI 10.1093/ageing/afw209 **PMID** 27932365
Abstract
BACKGROUND: antipsychotic drugs (APs) have been associated with falls and fractures in elderly individuals but limited knowledge on specific drugs exist.
OBJECTIVE: to investigate the association between individual APs and fractures in elderly persons.
DESIGN AND SETTING: nationwide register-based cohort study.
SUBJECTS: all Danish individuals aged ≥65 who had not been in treatment with any AP in the year before inclusion.
METHODS: incidence rate ratios (IRRs) of fractures of hip, pelvis or upper extremities during treatment with commonly used APs were assessed in multivariable Poisson models. Exposure was divided into time periods from initiation of treatment: 0-30 days, 31-365 days or >365 days.
RESULTS: one year prior to inclusion, 1,540,915 individuals ≥65 years had not received APs and of these 93,298 initiated treatment with APs. Mean follow-up was 9.6 years. During follow-up, 246,057 (16%) experienced a fracture. Associations were for all APs highest in the initial treatment period (0-30 days) with IRRs for risperidone 1.97 (95% CI: 1.70-2.28), olanzapine 2.31 (95% CI: 1.96-2.73), quetiapine 2.09 (95% CI: 1.73-2.52), zuclopenthixol 2.19 (95% CI: 1.82-2.63), chlorprothixen 1.62 (95% CI: 1.18-2.24), flupenthixol 1.43 (95% CI: 1.06-1.93), levomepromazine 1.19 (95% CI 0.86-1.66), haloperidol 2.98 (95% CI 2.57-3.45), compared with the background population.
CONCLUSIONS: use of APs is associated with fractures in elderly persons especially in the initial treatment period. If AP use in an elderly person is deemed necessary, individual falls prophylaxis should be considered.
PDF Endnote

Disentangling the health benefits of walking from increased exposure to falls in older people using remote gait monitoring and multi-dimensional analysis

Brodie MA, Okubo Y, Annegarn J, Wieching R, Lord SR, Delbaere K.

Physiol. Meas. 2016; 38(1): 45-62.

Affiliation: Neuroscience Research Australia, UNSW, Randwick, Sydney, Australia.

DOI 10.1088/1361-6579/38/1/45 **PMID** 27941237

Abstract

Falls and physical deconditioning are two major health problems for older people. Recent advances in remote physiological monitoring provide new opportunities to investigate why walking exercise, with its many health benefits, can both increase and decrease fall rates in older people. In this paper we combine remote wearable device monitoring of daily gait with non-linear multi-dimensional pattern recognition analysis; to disentangle the complex associations between walking, health and fall rates. One week of activities of daily living (ADL) were recorded with a wearable device in 96 independent living older people prior to completing 6 months of exergaming interventions. Using the wearable device data; the quantity, intensity, variability and distribution of daily walking patterns were assessed. At baseline, clinical assessments of health, falls, sensorimotor and physiological fall risks were completed. At 6 months, fall rates, sensorimotor and physiological fall risks were re-assessed. A non-linear multi-dimensional analysis was conducted to identify risk-groups according to their daily walking patterns. Four distinct risk-groups were identified: The Impaired (93% fallers), Restrained (8% fallers), Active (50% fallers) and Athletic (4% fallers). Walking was strongly associated with multiple health benefits and protective of falls for the top performing Athletic risk-group. However, in the middle of the spectrum, the Active risk-group, who were more active, younger and healthier were 6.25 times more likely to be fallers than their Restrained counterparts. Remote monitoring of daily walking patterns may provide a new way to distinguish Impaired people at risk of falling because of frailty from Active people at risk of falling from greater exposure to situations were falls could occur, but further validation is required. Wearable device risk-profiling could help in developing more personalised interventions for older people seeking the health benefits of walking without increasing their risk of falls.

PDF Endnote

Effects of elastic-band resistance exercise on balance, mobility and gait function, flexibility and fall efficacy in elderly people

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J. Phys. Ther. Sci. 2016; 28(11): 3189-3196.

Affiliation: Department of Physical Therapy, Sahmyook University, Republic of Korea.

DOI 10.1589/jpts.28.3189 **PMID**27942147

Abstract

PURPOSE: The purpose of this study was to analyze the effects of elastic-band resistance exercise on balance, gait function, flexibility and fall efficacy in the elderly people of rural community.
SUBJECTS AND METHODS: It is selected by 45 outpatients. They have come into the clinic continually to treat of physical therapy at least 1-2 times for a week. A group treated with both general physical therapy and elastic-band resistance exercise (23 patients), and the other group treated with only general physical therapy (22 patients). Elastic-band resistance exercise is composed of 8 movements

of lower extremity joints. It is performed for 30 minutes during 8 weeks by 3 times for a week. It is measured and recorded at the pre and post test that sit and reach test (SRT), functional reach test (FRT), timed up and go test (TUG) for every subjects by measurement equipments. And, subjects performed for the form of performance and question as its rated scale by Berg's balance scale (BBS), dynamic gait index (DGI), activities-specific balance confidence scale (ABC).
RESULTS: In the study, both the elastic-band exercise group and the general physical therapy group showed a significant improvement in balance, gait function, flexibility and fall efficacy. And the group with elastic-band resistance exercise showed more effectiveness than the contrast group in value of variation.
CONCLUSION: From this study, it was confirmed that elastic-band resistance exercise has influence on balance, gait function, flexibility and fall efficacy are working for agriculture of elderly people of rural community. Based on this result, elastic-band resistance exercise can be better instrument and easier to elderly people of rural community for the improvement in balance, gait function, flexibility and fall efficacy as it performing along with and reciprocal physical therapy.
PDF Endnote

Feasibility and cost-effectiveness of a multidisciplinary home-telehealth intervention programme to reduce falls among elderly discharged from hospital: study protocol for a randomized controlled trial

Giordano A, Bonometti GP, Vanoglio F, Paneroni M, Bernocchi P, Comini L, Giordano A.
BMC Geriatr. 2016; 16(1): e209.
Affiliation: Cardiac Rehabilitation Division, Salvatore Maugeri Foundation IRCCS, Institute of Lumezzane (Brescia), Brescia, Italy.

DOI 10.1186/s12877-016-0378-z **PMID** 27923343
Abstract
BACKGROUND: Fall incidents are the third cause of chronic disablement in elderly according to the World Health Organization (WHO). Recent meta-analyses shows that a multifactorial falls risk assessment and management programmes are effective in all older population studied. However, the application of these programmes may not be the same in all National health care setting and, consequently, needs to be evaluated by cost-effectiveness studies before to plan this intervention in regular care. In Italy structured collaboration between hospital staff and primary care is generally lacking and the role of Information and Communication Technologies (ICT) in a fall prevention programme at home has never been explored.
METHODS AND DESIGN: This will be a two-group randomised controlled trial aiming to evaluate the effects of a home-based intervention programme delivered by a multidisciplinary health team. The home tele-management programme, previously adopted in our Institute for chronic patients, will be proposed to elderly people affected by chronic diseases at high risk of falling at hospital discharge. The programme will involve the hospital staff and will be managed thanks to the collaboration between hospital and primary care setting. Patients will be followed for 6 months after hospital discharge. A nurse-tutor telephone support and tele-exercise will characterize the intervention programme. People in the control group will receive usual care. The main outcome measure of the study will be the percentage of patients sustaining a fall during the 6-months follow-up period. An economic evaluation will be performed from a societal perspective and will involve calculating cost-effectiveness and cost utility ratios.

DISCUSSION: To date, no adequately powered studies have investigated the effect of the Information and Communication Technologies (ICT) in a home fall prevention program. We aim the program will be feasible in terms of intensity and characteristics, but particularly in terms of patient and provider compliance. The results of the economic evaluation could provide information about the cost-effectiveness of the intervention and the effects on quality of life. In case of shown effectiveness and cost effectiveness, the program could be implemented into health services settings. TRIAL REGISTRATION: ClinicalTrials.gov (NCT02487589).
PDF Endnote

Improving nursing students' assessment of fall risk in community dwelling older adults
Patton SK.
Gerontol. Geriatr. Educ. 2016; ePub(ePub): ePub.
Affiliation: University of Arkansas.

DOI 10.1080/02701960.2016.1269007 **PMID** 27935435
Abstract
BACKGROUND: Nationally, approximately one-third of older adults fall each year. Falls and resulting injury result in decreased mobility, functional impairment, loss of independence, and increased mortality. Utilization of evidence based protocols by health care providers to identify older adults at risk of falling is limited and rates of participation by older adults in prevention activities is low. Because of nursing's increasing role in caring for older adults, development of fall prevention education for nursing students would result in increased awareness of the need for fall prevention in community dwelling older adults and increased access of older adults to falls risk assessment. There is a need to extend research to inform teaching and learning strategies for fall prevention.
METHOD: After pretesting, a convenience sample of 52 undergraduate nursing students and 22 graduate nursing students completed an online education program and performed a falls risk assessment on an older adult. After completing the clinical assignment, students completed a posttest and self-efficacy survey. Data were analyzed using multivariate statistical tests.
RESULTS: Results revealed an increase in knowledge and student self-reporting of efficacy of fall risk assessment skills for the older adult population.
CONCLUSION: This study suggests that nursing students acquired the necessary knowledge and self-efficacy for assessing fall risk of older adults through the combination of an online learning module and participating in actual fall risk assessment of an older adult.
PDF Endnote

Peripheral nerve blocks causing increased risk for fall and difficulty in ambulation for the hip and knee joint replacement patient
Crumley Aybar BL, Gillespie MJ, Gipson SF, Mullaney CE, Tommasino-Storz M.
J. Perianesth. Nurs. 2016; 31(6): 504-519.

DOI 10.1016/j.jopan.2015.01.017 **PMID** 27931702
Abstract
A systematic review of the literature was completed by the Evidence-Based Practice Group for the Patient population, Intervention/Issue, Comparison Intervention, Outcomes, Timing (PICOT) question: "Does the use of a peripheral nerve block increase the risk for falls and difficulty

ambulation in patients after lower extremity surgery through postoperative day 2?" A search of multiple databases using specified key terms resulted in 258 articles for total knee arthroplasty or total hip arthroplasty. These were reduced to 13 with exclusion criteria and became primary evidence. Numbers Needed to Harm and Numbers Needed to Treat (NNT) were calculated. Numbers Needed to Harm supported the PICOT question. Further research of postoperative falls and nursing interventions to reduce or prevent falls is suggested before creation of a Clinical Practice Guideline.

PDF Endnote

Reduction of falls and factors affecting falls a year after total knee arthroplasty in elderly patients with severe knee osteoarthritis

Tsonga T, Michalopoulou M, Kapetanakis S, Giovannopoulou E, Malliou P, Godolias G, Soucacos P.
Open Orthop. J. 2016; 10: 522-531.
Affiliation: Department of Orthopaedics, Amalia Fleming General Hospital, PC 15127, Melissia, Athens, Greece.

DOI 10.2174/1874325001610010522 **PMID** 27924167 **PMCID** PMC5109585
Abstract
BACKGROUND: Total Knee Arthroplasty (TKA) is a common surgical treatment for severe knee Osteoarthritis (OA), which generally improves pain, physical function, quality of life and possibly fall risk. Fall risk increases for older adults with severe knee OA; however it has not been studied extensively whether this parameter is improved after TKA.
OBJECTIVE: To investigate: a) the history and frequency of falls, including mechanism or causes of falls, injuries sustained from falls reported, activity during falling and location of falls and, b) the factors affecting falls, a year after TKA in elderly patients with severe knee OA. PATIENTS AND METHOD: An observational prospective longitudinal study of 68 patients (11 males and 57 females) was conducted. The frequency of falls was recorded every month after knee replacement for a year period. A year after the TKA patients completed self-administered questionnaires (SF-36, Womac, FOF, ABC, PASE) and were assessed in physical performance tests (TUG and BBS).
RESULTS: There was significant improvement in falls frequency ($p<0.001$), differentiation of falling status to the benefit of non fallers ($p<0.001$) and risk of serious injuries ($p<0.001$). The factors that affected falling status was history of falls ($p<0.0005$), fear of falls ($p<0.017$) and advanced age, marginally ($p<0.097$).
CONCLUSION: TKA generally improved a lot of aspects in patients' life. One of these was the reduction of fall risk, which always co-exists in this population and can cause devastating problems threatening the benefits of the procedure.
PDF Endnote

Should ReSPonD change falls prevention in Parkinson's disease?

Taylor JL, Sumakadas D.
J. R. Coll. Physicians Edinb. 2016; 46(2): 101-102.
Affiliation: D Sumukadas, Department of Medicine for the Elderly, Ninewells Hospital, Dundee, UK, E-mail d.sumukadas@nhs.net.

DOI 10.4997/JRCPE.2016.208 **PMID** 27929574
Abstract [Abstract unavailable]

Simplified tai chi program training versus traditional tai chi on the functional movement screening in older adults

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Evid. Based Complement. Alternat. Med. 2016; 2016: e5867810.
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DOI 10.1155/2016/5867810 **PMID** 27956920
Abstract
BACKGROUND: The present study aimed to evaluate and compare the effect of two different types of Tai Chi programs on the Functional Movement Screening (FMS) in older adults.
METHODS: Ninety older adults (65.5 ± 4.6 years old) who met the eligibility criteria were randomized into three different groups based on a ratio of 1 : 1 : 1: a traditional Tai Chi exercise (TTC), a simplified Tai Chi exercise (TCRT), or a control group (routine activity). The FMS consisted of the deep squat, hurdle step, in-line lunge, shoulder mobility, active straight leg rise, trunk stability push-up, and rotatory stability, which was used to measure physical function before the present study and after six months of Tai Chi interventions.
RESULTS: Seventy-nine participants completed the present study (control = 27, TTC = 23, and TCRT = 29). Significant improvement on the FMS tests between the baseline and after the six-month intervention was observed in both Tai Chi programs, whereas no significant improvement was observed in the control group. In addition, participants in the TCRT group demonstrated greater improvement than those in the TTC group.
CONCLUSIONS: The TCRT is more effective in improving the physical function in older adults when compared to the traditional Tai Chi modality, particularly for improving balance.

Trends in potentially inappropriate medication prescribing to nursing home patients: comparison of three cross-sectional studies

Halvorsen KH, Selbaek G, Ruths S.
Pharmacoepidemiol. Drug Saf. 2016; ePub(ePub): ePub.
Affiliation: Department of Global Public Health and Primary Care, University of Bergen, Bergen, Norway.

DOI 10.1002/pds.4142 **PMID** 27935150
Abstract
PURPOSE: The aim of this study was to examine trends in potentially inappropriate medication (PIM) prescribing in Norwegian nursing homes.
METHODS: Patients aged ≥70 years were included from three cross-sectional studies conducted in 1997, 2005 and 2011. PIMs were analyzed according to the Norwegian General Practice-Nursing Home criteria (NORGEP-NH), use of single substances to avoid, combinations to avoid, and deprescribing items. Associations between sample and use of PIMs were examined by logistic regression, adjusted for age, gender, and ward. We established Pearsons r for correlations between numbers of drugs and PIMs.

RESULTS: Altogether, 4373 patients (mean age 85.7 years, 73.5% women) were included. The mean overall number of drugs per patient increased from 4.7 in 1997 to 6.9 in 2011 ($p < 0.001$). Use of any single substances to avoid increased from 36.8% in 1997 to 39.5% in 2011 ($p = 0.002$), use of any combinations to avoid from 16.3% to 27.0% ($p < 0.001$), and use of any deprescribing items from 46.0% to 55.3% ($p < 0.001$). Use of codeine-analgesics, nonsteroidal anti-inflammatory drugs, tricyclic antidepressants, long-acting benzodiazepines, and first generation antihistamines decreased significantly, while use of short-acting benzodiazepines, z-hypnotics, statins, and anti-dementia drugs increased significantly. A moderate strong correlation was detected between number of drugs and the three above-mentioned PIM categories, $r = 0.34$, $r = 0.43$, $r = 0.37$, respectively (all $p < 0.001$).
CONCLUSIONS: Although several PIMs were less commonly prescribed in recent years, increased overall use of PIMs may suggests worsening of prescribing quality for nursing home patients in Norway.
PDF Endnote

Upper-extremity function predicts adverse health outcomes among older adults hospitalized for ground-level falls
Joseph B, Toosizadeh N, Orouji Jokar T, Heusser MR, Mohler J, Najafi B.
Gerontology 2016; ePub(ePub): ePub.
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DOI 10.1159/000453593 **PMID** 27941328
Abstract
BACKGROUND: Despite National Surgical Quality Improvement guidelines to integrate frailty into surgical elder assessments, a quick, accurate, and simple frailty assessment tool suitable for busy clinical settings is still not available. Recently, we have demonstrated that a simple upper-extremity function (UEF) test based on wearable sensors could identify frailty with high agreement with conventional assessments by testing 20-s repetitive elbow flexion and extension.
OBJECTIVE: We examined whether UEF parameters are sensitive for predicting adverse health outcomes in bedbound older adults admitted to hospital due to ground-level fall injuries. STUDY DESIGN: Frailty was assessed in 101 eligible older adults (age: 79 ± 9 years) admitted to a trauma setting using the UEF test at the time of admission. All participants were followed up for 2 months using phone calls and chart reviews. The measured health outcomes included (1) discharge disposition (favorable: discharge home or rehabilitation; unfavorable: discharge to skilled nursing facility or death), (2) hospital length of stay, (3) 30-day readmission, (4) 60-day readmission, and (5) 30-day prospective falls. Multivariate analyses were used to identify independent predictors of adverse health outcomes based on participants' demographic parameters (i.e., age, gender, and body mass index [BMI]) and UEF index.
RESULTS: Based on the UEF frailty status, 53 (52%) of the participants were frail and 48 (48%) were non-frail. Among all adverse health outcomes, age was only a significant predictor of 30-day prospective falls ($p = 0.023$). On the other hand, the UEF index was a significant predictor of all measured outcomes except hospital length of stay ($p < 0.010$). Among the UEF parameters, those indicating slowness, weakness, and exhaustion had the highest effect sizes to predict an unfavorable discharge disposition ($p < 0.010$; effect size = 0.65-0.92).

CONCLUSION: The results of this study suggest that a 20-s UEF test is practical in the trauma setting and could be used as a quick measure for predicting adverse events and outcomes among bedbound patients after discharge. Assessing frailty using UEF may assist in objective triage, treatment, and post-discharge decision-making with regard to geriatric trauma patients.

PDF Endnote

US and Dutch nurse experiences with fall prevention technology within nursing home environment and workflow: a qualitative study

Vandenberg AE, van Beijnum BJ, Overdevest VG, Capezuti E, Johnson TM.
Geriatr. Nurs. 2016; ePub(ePub): ePub.
Affiliation: Emory University, Department of Medicine, Division of General Medicine and Geriatrics, USA; Birmingham/Atlanta VA Geriatric Research Education and Clinical Center, USA.

DOI 10.1016/j.gerinurse.2016.11.005 **PMID** 27956058
Abstract

Falls remain a major geriatric problem, and the search for new solutions continues. We investigated how existing fall prevention technology was experienced within nursing home nurses' environment and workflow. Our NIH-funded study in an American nursing home was followed by a cultural learning exchange with a Dutch nursing home. We constructed two case reports from interview and observational data and compared the magnitude of falls, safety cultures, and technology characteristics and effectiveness. Falls were a high-magnitude problem at the US site, with a collectively vigilant safety culture attending to non-directional audible alarms; falls were a low-magnitude problem at the NL site which employed customizable, infrared sensors that directed text alerts to assigned staff members' mobile devices in patient-centered care culture. Across cases, 1) a coordinated communication system was essential in facilitating effective fall prevention alert response, and 2) nursing home safety culture is tightly associated with the chosen technological system.

PDF Endnote

A non linear scoring approach for evaluating balance: classification of elderly as fallers and non-fallers

Audiffren J, Bargiotas I, Vayatis N, Vidal PP, Ricard D.
PLoS One 2016; 11(12): e0167456.
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DOI 10.1371/journal.pone.0167456 **PMID** 27936060
Abstract

Almost one third of population 65 years-old and older faces at least one fall per year. An accurate evaluation of the risk of fall through simple and easy-to-use measurements is an important issue in current clinic. A common way to evaluate balance in posturography is through the recording of the centre-of-pressure (CoP) displacement (statokinesigram) with force platforms. A variety of indices have been proposed to differentiate fallers from non fallers. However, no agreement has been reached whether these analyses alone can explain sufficiently the complex synergies of postural

control. In this work, we study the statokinesigrams of 84 elderly subjects (80.3+- 6.4 years old), which had no impairment related to balance control. Each subject was recorded 25 seconds with eyes open and 25 seconds with eyes closed and information pertaining to the presence of problems of balance, such as fall, in the last six months, was collected. Five descriptors of the statokinesigrams were computed for each record, and a Ranking Forest algorithm was used to combine those features in order to evaluate each subject's balance with a score. A classical train-test split approach was used to evaluate the performance of the method through ROC analysis. ROC analysis showed that the performance of each descriptor separately was close to a random classifier (AUC between 0.49 and 0.54). On the other hand, the score obtained by our method reached an AUC of 0.75 on the test set, consistent over multiple train-test split. This non linear multi-dimensional approach seems appropriate in evaluating complex postural control.
PDF Endnote

Accidental falls in urgent and emergency care: results of the 2014 VIVA Survey
Ribeiro AP, Souza ER, Sousa CA, Freitas MG.
Cien. Saude Colet. 2016; 21(12): 3719-3727.
Affiliation: Coordenação Geral de Doenças e Agravos Não Transmissíveis e Promoção da Saúde, Departamento de Vigilância de Doenças e Agravos Não Transmissíveis e SVS, Ministério da Saúde. Brasília DF Brasil.

DOI 10.1590/1413-812320152112.18452016 **PMID** 27925113
Abstract
This cross-sectional study aimed to analyze the cases of falls in urgent and emergency care services of 24 Brazilian capitals and the Federal District participating in the 2014 VIVA Survey. We sought to describe the epidemiological profile of victims, characterizing the event and the severity of injuries it caused and to perform an association study. We calculated the simple and relative frequencies of variables and performed multivariate logistic regression analysis for complex sample data in order to verify associations between falls and selected variables. Fall victims profile results show a predominance of males, age groups 0-9years and 20-39 years and brown skin. Outcomes show that 56% fell from own height, public road was the most frequent place of falls and 92.7% of people receiving care for falls suffered some kind of injury, of which most common were bruises, sprain and strains, followed by cut/laceration. In the final model, we were able to associate fall with gender, age, education, disability and place of the event. The likelihood of falls at school is 14% higher than at home, but falls in recreation areas, public roads and other places are less likely than at home.
PDF Endnote

Analysis of a smartphone-based architecture with multiple mobility sensors for fall detection
Casilari E, Santoyo-Ramón JA, Cano-García JM.
PLoS One 2016; 11(12): e0168069.
Affiliation: Departamento de Tecnología Electrónica, Universidad de Málaga, Malaga, Spain.

DOI 10.1371/journal.pone.0168069 **PMID** 27930736
Abstract
During the last years, many research efforts have been devoted to the definition of Fall Detection Systems (FDSs) that benefit from the inherent computing, communication and sensing capabilities of

smartphones. However, employing a smartphone as the unique sensor in a FDS application entails several disadvantages as long as an accurate characterization of the patient's mobility may force to transport this personal device on an unnatural position. This paper presents a smartphone-based architecture for the automatic detection of falls. The system incorporates a set of small sensing motes that can communicate with the smartphone to help in the fall detection decision. The deployed architecture is systematically evaluated in a testbed with experimental users in order to determine the number and positions of the sensors that optimize the effectiveness of the FDS, as well as to assess the most convenient role of the smartphone in the architecture.
PDF Endnote

Assessment for benign paroxysmal positioning vertigo in medical patients admitted with falls in a district general hospital
Chancellor AM.
Clin. Med. (Lond.) 2016; 16(6): e607.
Affiliation: Tauranga Hospital, Tauranga, New Zealand.

DOI 10.7861/clinmedicine.16-6-607a **PMID** 27927836
Abstract [Abstract unavailable]

Effects of virtual reality training using Nintendo Wii and treadmill walking exercise on balance and walking for stroke patients
Bang YS, Son KH, Kim HJ.
J. Phys. Ther. Sci. 2016; 28(11): 3112-3115.
Affiliation: Department of Physical Therapy, Hanlyo University, Republic of Korea.

DOI 10.1589/jpts.28.3112 **PMID**27942130
Abstract
Purpose: The purpose of this study is to investigate the effects of virtual reality training using Nintendo Wii on balance and walking for stroke patients.
Subjects and Methods: Forty stroke patients with stroke were randomly divided into two exercise program groups: virtual reality training (n=20) and treadmill (n=20). The subjects underwent their 40-minute exercise program three times a week for eight weeks. Their balance and walking were measured before and after the complete program. We measured the left/right weight-bearing and the anterior/posterior weight-bearing for balance, as well as stance phase, swing phase, and cadence for walking.
Results: For balance, both groups showed significant differences in the left/right and anterior/posterior weight-bearing, with significant post-program differences between the groups. For walking, there were significant differences in the stance phase, swing phase, and cadence of the virtual reality training group.
Conclusion: The results of this study suggest that virtual reality training providing visual feedback may enable stroke patients to directly adjust their incorrect weight center and shift visually. Virtual reality training may be appropriate for patients who need improved balance and walking ability by inducing their interest for them to perform planned exercises on a consistent basis.
PDF Endnote

Falls prevention and balance rehabilitation in multiple sclerosis: a bi-centre randomised controlled trial

Cattaneo D, Rasova K, Gervasoni E, Dobrovodská G, Montesano A, Jonsdottir J.

Disabil. Rehabil. 2016; ePub(ePub): ePub.

Affiliation: LaRiCE Lab: Gait and Balance Disorders Laboratory , Don Gnocchi Foundation I.R.C.C.S , Milan , Italy.

DOI 10.1080/09638288.2016.1258089 **PMID** 27927030

Abstract

PURPOSE: People with Multiple Sclerosis (PwMS) have a high incidence of accidental falls that have a potentially detrimental effect on their daily life participation. The effect of balance specific rehabilitation on clinical balance measures and frequency of falls in PwMS was studied.

METHOD: A bi-centre randomised rater-blinded controlled trial. Participants in both groups received 20 treatment sessions. Participants in the intervention group received treatment aimed at improving balance and mobility. Participants in the control group received treatments to reduce limitations at activity and body function level. Primary measures were frequency of fallers (>1 fall in two months) and responders (>3 points improvement) at the Berg Balance Scale (BBS). Data was analysed according to an intention to treat approach.

RESULTS: One hundred and nineteen participants were randomised. Following treatment frequency of fallers was 22% in the intervention group and 23% in the control group, odds ratio (OR) and (confidence limits): 1.05 (0.41 to 2.77). Responders on the BBS were 28% in the intervention group and 33% in the control group, OR = 0.75 (0.30 to 1.91). At follow up ORs for fallers and responders at BBS were 0.98 (0.48 to 2.01) and 0.79 (0.26 to 2.42), respectively.

CONCLUSIONS: Twenty sessions 2-3 times/week of balance specific rehabilitation did not reduce fall frequency nor improve balance suggesting the need for more frequent and challenging interventions. Implications for Rehabilitation Programs for balance rehabilitation can improve balance but their effects in fall prevention are unclear. Twenty treatments sessions 2/3 times per week did not reduced frequency of falls in MS. The comparison with similar studies suggests that higher intensity of practice of highly challenging balance activities appears to be critical to maximizing effectiveness.

PDF Endnote

Mobility measures differentiate falls risk status in persons with multiple sclerosis: an exploratory study

Sebastião E, Learmonth YC, Motl RW.

NeuroRehabilitation 2016; ePub(ePub): ePub.

DOI 10.3233/NRE-161401 **PMID**27935560

Abstract

BACKGROUND: Falls are of great concern among persons with multiple sclerosis (MS).

OBJECTIVE: To examine differences in metrics of mobility, postural control, and cognition in persons with MS with distinct fall risk status; and to investigate predictors of fall risk group membership using discriminant analysis.

METHODS: Forty-seven persons with MS completed the Activities-Balance Confidence (ABC) Scale and underwent a battery of assessments of mobility, balance, and cognition. Participants further

wore an accelerometer for 7 days as an assessment of steps/day. Participants were allocated into fall risk groups based on ABC scale scores (increased fall risk (IFR); and normal fall risk (NFR)). We examined univariate differences between groups using ANOVA, and discriminant function analysis (DFA) identified the significant multivariate predictors of FR status.
RESULTS: After controlling for disability level, the IFR group had significantly ($p < 0.05$) worse scores in measures of mobility (i.e., MSWS-12, 6 MW, and steps/day) compared to the NFR group. DFA identified MSWS-12 and 6 MW scores as significant ($p < 0.05$) predictors of fall risk group membership. Those two variables collectively explained 55% of variance in fall risk grouping.
CONCLUSIONS: The findings suggest that mobility should be the focus of rehabilitation programs in persons with MS, especially for those at IFR.
PDF Endnote

Pioglitazone and risk for bone fracture: safety data from a randomized clinical trial
Viscoli CM, Inzucchi SE, Young LH, Insogna KL, Conwit R, Furie KL, Gorman M, Kelly MA, Lovejoy AM, Kernan WN.
J. Clin. Endocrinol. Metab. 2016; ePub(ePub): jc20163237.
Affiliation: Yale School of Medicine, New Haven, CT.

DOI 10.1210/jc.2016-3237 **PMID** 27935736
Abstract
CONTEXT: Pioglitazone reduces cardiovascular risk in non-diabetic patients after an ischemic stroke or transient ischemic attack (TIA) but is associated with increased risk for bone fracture.
OBJECTIVE: To characterize fractures associated with pioglitazone by location, mechanism, severity, timing, and sex. DESIGN, SETTING AND PATIENTS: Patients were 3876 non-diabetic participants in the Insulin Resistance Intervention after Stroke trial randomized to pioglitazone or placebo after an ischemic stroke or TIA and followed for a median of 4.8 years. Fractures were identified through quarterly interviews.
RESULTS: At 5 years, the increment in fracture risk between pioglitazone and placebo groups was 4.9% (13.6% vs. 8.8%; hazard ratio [HR], 1.53; 95% confidence interval [CI], 1.24-1.89). In each group, approximately 80% of fractures were low-energy (i.e., resulted from fall) and 45% were serious (i.e., required surgery or hospitalization). For serious fractures most likely to be related to pioglitazone (low-energy, non-pathological), the risk increment was 1.6% (4.7% vs. 3.1%; HR, 1.47; 95% CI, 1.03-2.09). Increased risk for any fracture was observed in men (9.4% vs. 5.2%; HR, 1.83; 95% CI, 1.36-2.48) and women (14.9% vs 11.6%; HR, 1.32; 95% CI, 0.98-1.78; interaction p-value = 0.13). No skeletal region was affected more than another.
CONCLUSIONS: Fractures affected 8.8% of placebo-treated patients within five years after an ischemic stroke or TIA. Pioglitazone increased the absolute fracture risk by 1.6%-4.9% and the relative risk by 47-60%, depending on fracture classification. Our analysis suggests that treatments to improve bone health and prevent falls may help optimize the risk/benefit ratio for pioglitazone.
PDF Endnote

Stride variability measures derived from wrist- and hip-worn accelerometers
Urbanek JK, Harezlak J, Glynn NW, Harris T, Crainiceanu C, Zipunnikov V.
Gait Posture 2016; 52: 217-223.

Affiliation: Department of Biostatistics, Johns Hopkins Bloomberg School of Public Health, 615 N. Wolfe Street, Baltimore, MD 21205, United States.

DOI 10.1016/j.gaitpost.2016.11.045 **PMID** 27936440
Abstract

Many epidemiological and clinical studies use accelerometry to objectively measure physical activity using the activity counts, vector magnitude, or number of steps. These measures use just a fraction of the information in the raw accelerometry data as they are typically summarized at the minute level. To address this problem, we define and estimate two measures of temporal stride-to-stride gait variability based on raw accelerometry data: Amplitude Deviation (AD) and Phase Deviation (PD). We explore the sensitivity of our approach to on-body placement of the accelerometer by comparing hip, left and right wrist placements. We illustrate the approach by estimating AD and PD in 46 elderly participants in the Developmental Epidemiologic Cohort Study (DECOS) who worn accelerometers during a 400m walk test. We also show that AD and PD have a statistically significant association with the gait speed and sit-to-stand test performance.

PDF Endnote

The effects of horse riding simulation exercise with blindfolding on healthy subjects' balance and gait

Cha HG, Lee BJ, Lee WH.
J. Phys. Ther. Sci. 2016; 28(11): 3165-3167.
Affiliation: Department of Physical Therapy, Sahmyook University, Republic of Korea.

DOI 10.1589/jpts.28.3165 **PMID** 27942142
Abstract

PURPOSE: The study was conducted to determine the effect of horse riding simulation combined with blindfolding on healthy individuals' balance and gait.

SUBJECTS AND METHODS: Thirty subjects were randomly divided into an experimental group (n=15) and a control group (n=15). The subjects in the experimental group covered their eyes using a blindfold, climbed onto a horse riding simulator, and performed the horse riding simulation exercise. The control group took part in the horse riding exercises without a blindfold. All of the subjects performed the 20 minutes long exercise once a day, five times a week, over a four-week period.

RESULTS: The experimental group showed significant improvement in static balance, dynamic balance, velocity, and cadence compared to pre-intervention measurements. In addition, the control group showed significant improvement in static balance, dynamic balance, single support, and cadence compared to pre-intervention measurements. Significant differences in post-training gains in static balance, dynamic balance, and cadence were observed between the experimental group and the control group.

CONCLUSION: Subjects that performed horse riding simulation exercise after blindfolding showed significant improvements in balance and cadence compared to the control group.
PDF Endnote

The epidemiology, prognosis, and trends of severe traumatic brain injury with presenting Glasgow Coma Scale of 3

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J. Crit. Care 2016; 38: 197-201.

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DOI 10.1016/j.jcrc.2016.11.034 **PMID** 27940095

Abstract

PURPOSE: To characterize trends and prognosis of severe traumatic brain injury (TBI).

METHODS: This 5-year multicenter retrospective study included patients with TBI and Glasgow Coma Scale of 3. We analyzed demographic and clinical characteristics and mortality using Pearson χ(2) tests, Cochran-Armitage trend tests, and stepwise logistic regression. Analyses were stratified by vehicular and fall etiologies; other etiologies were excluded (24%).

RESULTS: Included were 481 patients. Fall-related injuries increased 58% (P=.001) but vehicular etiology did not change (P=.63). The characteristics of the populations changed over time; with falls, the population became older and increasingly presented with normal vital signs, whereas with vehicular etiology, the population became younger, with more alcohol-related injury (P<.05 for all). Mortality from falls increased substantially from 25% to 63% (P<.001), whereas death from vehicular injures remained statistically unchanged but with a downward trend (50%-38%, P=.28). Predictors of mortality included injury severity and age at least 65 years for both groups. Additional variables that were prognostic were abnormal vital signs and subdural hematoma for vehicular injuries, and sex for fall injuries.

CONCLUSIONS: The epidemiology of severe TBI is changing. These epidemiologic data may be used for management and resource decisions, monitoring, and directing injury prevention measures.

PDF Endnote