The role of footwear in reducing falls in older people

Business, Industries

Study Objective

The role of footwear and foot characteristics has been extensively studied in older people to understand how these factors interact to induce falls, and further to endeavour to reduce fall as this has been classified as one of the more prevalent means of injury in older adults. Studies often focus on the interactions of footwear, foot mobility and flexation, and musculoskeletal disorders of the foot. Menant et al. (2008) systematically investigated the relationship between footwear characteristics, balance and stepping in older adults. They used specially designed footwear with contrasting features which included 6 different designs, a standard shoe, identically shaped soft and hard sole, a high heel-collar shoe, an elevated heel shoe, a bevelled heel shoe, a flared sole and a tread soled shoe, which were used to assess coordinated stability and choice stepping reaction times. In contrast, Menz et al. (2006) sought to determine the relationship between footwear characteristics and the risk of indoor and outdoor falls in older people. The study used only two shoe types that were supplied by the participants; these were a soft indoor shoe (slippers) and their normal outdoor shoes. The study explored the relationship between the footwear features and the frequency of falls in older adults by separately assessing indoor and outdoor falls.

Determining the correlation between musculoskeletal foot disorders, pain and functional stability is the most common form of fall study, perhaps because these relationships have less variation than shoe characteristics. Badlissi et al. (2005) investigated the relationship between musculoskeletal disorders of the foot (for example pes cavus, pes planus, claw toe, hammertoe, mallet toe, overlapping toes, hallux valgus/bunion, bunionette, and plantar fasciitis) and foot pain and functional limitation, measured on scales of 0-100 for foot pain while functional limitations were measured as walking times on a range of 0-4, to determine how foot pain mediated the relationship.

Menz et al. (2005) studied the comparative contribution of a number of foot and ankle features to performance on a range of balance and functional tests, building on previous work, to determine whether these tests could explain further variation in balance and functional performance after standard sensorimotor factors were measured. Spink et al. (2011) also investigated foot characteristics in older adults, determining the degree that foot and ankle strength, range of motion, posture, and deformity were related to performance, using tests that measured balance and functional ability.

Pain studies have also been used to assess falls. Mickle et al. (2010) determined if foot pain and plantar pressure were connected with falls in older people. The investigation focussed on the association of plantar pressures with foot pain in older adults and how foot pain or dynamic plantar pressures increase the risk of falls in this population, using ambulatory data from this group of community-dwelling older people. A follow-on study by Mickle et al. (2011) sought to establish whether disabling foot pain could be associated with functional foot characteristics, functional ability, andhealth-related quality of life (HRQOL) in retired adults. The principal objective was to determine whether disabling foot pain was connected with foot function quality, practical ability, and HRQOL in older adults, using two definitions (A: reduced ankle dorsiflexion and hallus flexor strength. B: reduced flexor strength of the lesser toes and increased foot reaction time and postural sway).

Outcome variables

The outcome variables for the footwear studies used similar measurements. Menant et al. (2008) measured a series of balance and stepping tests in the eight randomly presented shoe conditions. Maximum balance range and body sway measurements, coordinated stability and Choice-Stepping Reaction Time was assessed in each footwear style. In contrast, Menz (2006) measured footwear characteristics including shoe style, ? xation (buckle, velco etc.), heel height, counter height and width, critical tipping angle, sole rigidity and ? exion point, tread pattern, sole hardness and heel counter stiffness withrespectto specific incidence of fall.

Badlissi et al. (2005) measured foot disorders e. g pes cavus, pes planus, claw toe, hammertoe, mallet toe, overlapping toes, hallux valgus/bunion, bunionette, and plantar fasciitis against foot pain. Foot health was measured on a range of 0–100, and walk time was scored on a range of 0–4.

Spink (2011) measured foot and ankle strength by dynamometry, motion range, posture, deformity, and balance tests which measured postural sway, balance range extent, lateral steadiness, co-ordinated steadiness) Functional ability tests (alternate step, sit-to-stand, timed 6-m walk) were used to assess foot and ankle strength, whereas Menz (2005) tested foot and ankle characteristics (foot posture, range of motion, strength and deformity) against sensorimotor functions, which included vision, sensation, strength and reaction time, as well as balance and functional aptitude as measured using standing and leaning balance, stepping, sit to stand and walking speeds.

Mickle et al. (2010) classified participants into two categories (faller or non-faller) based on falls incidence over 12 months. Pain was calculated with the Manchester Foot Pain and Disability Index (MFPDI) that employs questions consisting of statements about the participant’s foot or foot pain. Finally, dynamic plantar pressures were measured during a walk over a pressure platform which was used to represent bare-foot dynamic foot function. Mickle et al. (2011) also employed MFPDI to establish foot pain. Foot function was characterised by foot reaction time, ankle dorsi? exion strength and ? exibility, hallux and lesser toe ? exor strength, and spatiotemporal gait parameters. Finally, volunteers performed postural sway tasks, those with disabling foot pain were classi? ed using original and conservative de? nitions from Short Form 36 Health Survey (SF-36). Pain-free was subsequently compared with individuals with pain following adjustments for gender and body mass index (BMI).

Participant/study selection

The participant study for these investigations was older adults of retirement age, without comparisons to younger adults. Badlissi et al. (2005) used a very large sample (n= 5784) of ethnically diverse adults aged 65 and older for their study into foot disorders. For the footwear studies, Menant et al. (2008) used 29 community-dwelling volunteers recruited from a research database aged ? 70 years with a mean age of 79. 1 (+/-3. 7) years of which 15 were females, while Menant et al. (2008) had the smallest cohort with only 29 community-dwelling volunteers with a mean age of 79. 1 (3. 7) years.

Menz et al. (2006) used 176 volunteers from a retirement village (56 men and 120 women), aged between 62–96 (mean age 80. 1, SD 6. 4). For the studies into foot characteristics Menz et al. (2005) used the same cohort as their previous study (n= 176), while Spink et al. (2011) employed a larger randomized cross-sectional study of people (n= 305) over 65 years, participants ranged between 65–93 years.

The pain studies by Mickle et al. (2010 and 2011) used the same participants of 312 community-dwelling people (154 female, 158 male) recruited from arbitrarily chosen federal electorates of New South Wales, Australia.

Inclusion/exclusion criteria

The exclusion criteria for all seven studies included that the participants were not bed or chair-bound; unable to ambulate household distances unaided (10m), unable to communicate in English (or Spanish (Badlissi et al. (2005)). Further exclusion criteria included neurodegenerative disorders and lower-limb amputation (Spink et al. (2011), Mickle et al. (2010 and 2011)). The ability to pass the Short Portable Mental Status Questionnaire was deemed necessary by Menz et al. (2005 and 2006) and Mickle et al. (2010 and 2011). While Mickle et al. (2010 and 2011) also stated that participants were required to arrange transport to testing venues; furthermore trials were discarded if obvious gait deviations or targeting of the pressure platform were detected.

Randomisation

Only studies into pain by Mickle et al. (2010 and 2011) used any form of randomisation in the choice of the study participants.

Baseline differences

Basline differences measured prior to studies being undertaken were performed by Menz et al. (2006) who assessed participants most-used indoor and outdoor footwear and the right shoe was characterised by a single examiner into 16 basic shoe categories.

Mickle et al. (2010 and 2011) used MFPDI to establish baseline foot pain and dynamic plantar pressures.

Interventions used

The studies into footwear (Menant et al. (2008) and Menz et al. (2006)) employed footwear interventions, however, while Menz et al. (2006) studies shoes types already owned by the participants, Menant et al. (2008) supplied specifically designed shoes for the study.

Demographics

Almost all studies used volunteers from community/retirement village volunteers, apart from Mickle et al. (2010 and 2011) who recruited study volunteers from arbitrarily chosen federal electorates of New South Wales, Australia. The age range was continuous after retirement age (60+ years) without bias towards gender, race or ethnicity. Other demographic characteristics included weight, height and BMI as well as foot and other medical conditions.

Time frame of study

Study time-frames ranged from 1 day to 1 week, while follow-up resulted in 1 year, however, only Menz et al. (2006) and Mickle et al. (2010) required 1 year.

Participant flow

(No data in any of the studies related to this topic)

Statistical analysis

Badlissi et al. (2005) employed logistic regression to acquire adjusted-odds ratios (95% con? dence intervals) to show interaction between foot musculoskeletal disorders and pain, with potential confounders adjustment. Subsequently, stepwise multiple linear regression was used to assess variance in walk tests and foot disorders were explained by the FHFS scale scores.

Menant et al. (2008) used repeated-measures ANOVA with simple contrasts for statistical analysis of the data, while Menz et al. (2006) assessed the differences in foot-wear characteristics and physiological falls risk factors between fallers and non-fallers using independent samples t-tests (for continuously scored variables) and dichotomous variables. Footwear variables with signi? cant difference between the two catagories were further assessed using logistic regression analysis with adjustment for confounders identi? ed by univariate analyses.

Menz et al (2005) applied descriptive statistics with multiple and step-wise regression. To define the relationship between foot and ankle characteristics, sensorimotor measures, balance and functional test performance scores, Pearson correlation coefficients (PCC) were used. Spink et al. (2011) also employed PCC to examine relationships between foot and ankle strength and range-of-motion measures and the balance and functional test performance scores and independent sample t-tests to measure difference in balance and functional test scores with Hierarchic stepwise multiple regression analysis.

Mickle et al. (2010) applied Chi-square values to establish frequency of foot pain differences between fallers and nonfallers. Independent t-tests was employed to establish signi? cant differences in peak pressure or pressure-time for the two groups and one-way analysis of covariance to ascertain signi? cance in peak plantar pressure or pressure-time integral data created by participant reports of foot pain and pain-free. Mickle et al. (2011) also used analysis of covariance tests to determine signi? cant differences in SF-36 scores, foot function, or postural sway variables in volunteers reporting foot pain or pain-free, while gender and BMI were input as covariates. Similarly, chi-square tests compared the frequency of responses between pain de? nitions.

Completeness of follow up

Of the seven studies investigated, only Menz et al. (2006) and Mickle et al. (2010) conducted follow up studies, which occurred one year later. The follow-up required participants to record falls over the 12 month period and comparisons were then made between ‘ fallers’ and ‘ non-fallers’.

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