Clinical Research on Foot & Ankle

Mini Review Open Access

Functional Competency of the Foot and Ankle in Older People

Kara Daniel*

Department of Surgery, Case Western Reserve University, USA

Abstract

Background: There are structural and functional changes in the foot and ankle as people age, and there is tentative evidence that foot issues affect balance and raise the risk of falling. We conducted a study to ascertain the relative contributions of various foot and ankle traits on performance on a variety of balance and functional tests in order to further examine this.

Methods: The foot and ankle characteristics, sensorimotor function, balance, and functional ability of 176 residents of a retirement community (56 men and 120 women, mean age 80.1 years, standard deviation 6.4 years) were tested. The foot and ankle characteristics included foot posture, range of motion, strength, and deformity (including tests of standing balance, leaning balance, stepping, sit-to-stand, and walking speed).

Results: In univariate analysis, a variety of foot and ankle traits as well as sensorimotor measurements were linked to success on the balance and functional tests. Ankle flexibility, plantar tactile sensitivity, and toe plantarflexor strength were repeatedly found through multiple regression analysis to be significant and independent predictors of balance and functional test performance, accounting for up to 59% of the variance in these test results.

Conclusions: Foot and ankle features, in particular ankle flexibility, plantar tactile sensitivity, and toe plantarflexor muscle strength, are significant independent predictors of balance and functional ability in older people. People may be able to move more freely and decrease their risk of falling if their plantar sensitivity is improved and their foot's flexibility and strength are increased.

Keywords: Functional test; Sensorimotor function; Foot posture; Deformity; Plantar tactile sensitivity

Introduction

Multiple sensory, motor, and integrative systems must interact in order to maintain balance and carry out useful tasks. These systems include peripheral feeling, strength, vision, vestibular function, and reaction speed. Age affects how well each of these variables functions [1]. Directly evaluating a person's physiological capabilities allows for the identification of deficits in one or more physiological domains and the estimation of how much they contribute to physical ability. The relative contributions of sensorimotor components to balance, functional ability, and risk of falling have all been examined in prior research using this method. However, this conceptual model does not take into account a number of variables. Particularly, it's likely that foot issues impair mobility in a way that is unrelated to the influence of these other conditions [2].

About 30% of older persons who live in the community report having foot issues, which are linked to slower walking speed, difficulties doing daily tasks, and a higher risk of falling. Although the negative impact of foot issues on mobility is widely acknowledged, the mechanism by which foot issues enhance the chance of falling has not been thoroughly investigated. The foot, which is the only point of contact with the ground when carrying out weight-bearing tasks, helps to maintain stability in two ways: (i) by giving the body mechanical support through the osteoligamentous architecture of the arch and the coordinated movement of the lower limb muscles; and (ii) by giving the body position information through plantar tactile mechanoreceptors. Deficits in foot posture, flexibility, strength, or sensibility are therefore likely to compromise this support function and make a person more susceptible to falling out of balance [3,4].

We have previously shown that performance on clinical tests of balance and functional ability was strongly and independently correlated with an overall assessment of foot impairment based on the observation of foot lesions and structural deformities. However, very little is known about how mobility may be impacted by foot posture, range of motion (ROM), feeling, and strength. There is some evidence that overly flat or strongly arched feet in healthy young people may affect standing balance, while older women have shown a significant link between ankle range of motion and balance [5-7].

This study built on earlier research to see if a wider range of foot characteristics tests are important predictors of balance and functional ability in an older group. We were particularly curious to find out if these assessments might account for additional variation in balance and functional performance after taking well-established sensorimotor factors into account.

Methods

The study sample included 176 residents in retirement communities with ages ranging from 62 to 96 (mean 80.1 years, standard deviation = 6.4) and 56 males and 120 women. Twenty-one people lived in serviced flats, and one hundred fifty-five people lived in independent living units. All meals were consumed in a communal dining area by residents of serviced flats, and employees kept their room's tidy [8]. However, each resident was responsible for dressing, bathing, and using the restroom on their own. If a resident's score on the Short Portable Mental Status Questionnaire was below seven or they were unable to

***Corresponding author:** Kara Daniel, Department of Surgery, Case Western Reserve University, USA, E-mail: kardaniel@edu.us

Received: 01-Aug-2022, Manuscript No: crfa-22-73031, **Editor assigned:** 02-Aug-2022, PreQC No: crfa-22-73031 (PQ), **Reviewed:** 16-Aug-2022, QC No: crfa-22-73031, **Revised:** 22-Aug-2022, Manuscript No: crfa-22-73031 (R), **Published:** 29-Aug-2022, DOI: 10.4172/2329-910X.1000362

Citation: Daniel K (2022) Functional Competency of the Foot and Ankle in Older People. Clin Res Foot Ankle, 10: 363.

ambulate within their home without assistance, they were declared ineligible for the study. 54% of participants were present. Data on the sexes and ages of nonresponders were available. Nonresponders shared the same gender (38% men) and age (80.1 years, standard deviation = 7.3) as participants. The study was authorised by the La Trobe University Human Studies Ethics Committee, and all participants gave their informed consent before participating [9].

Features of the Foot and Ankle

Five categories of foot and ankle characteristics foot posture, foot ROM, foot deformity and lesions, foot strength, and foot sensation were examined. The foot posture index, arch index, and navicular height were used to measure foot posture. Navicular height was divided by the length of the foot to account for variations in foot size. A modified weightbearing lunge test was used to evaluate ankle flexibility in degrees [10]. To lessen the demands on balance control throughout the test, participants rested their hands on a bench that was positioned next to them at waist height. Using a goniometer, the examiner evaluated the first metatarsophalangeal joint's (1st MPJ) range of motion while fully extending the hallux. The existence of hallux valgus, smaller toe abnormalities, corns, and calluses were recorded to assess foot deformity. Using the Manchester scale, the presence and severity of hallux valgus were assessed. By adding the ratings for the right and left foot, it was possible to calculate an overall indicator of hallux valgus severity. According to previously described standards, the presence of minor digital deformity, corns, and calluses was determined, and the total number of each of these abnormalities for both feet was recorded [11]. The paper grip test was used to measure the muscle strength of the hallux and lesser toes' plantarflexors. An aesthesiometer was used to assess the tactile sensitivity of the first MPJ using a two-alternative forced choice paradigm. Other sources have published the reliability coefficients for each of these tests when administered to elderly individuals [12].

Assessment of Sensorimotor Function

Four different aspects of sensorimotor function were evaluated: visual acuity, contrast sensitivity, tactile sensitivity of the lateral malleolus, strength (knee extension, ankle dorsiflexion), and finger-press reaction time. Other sources have reported on the apparatus, protocols, and test-retest reproducibility for these tests [13].

Functional assessment of balance

A sway metre that measures body displacements at the waist level was used to measure postural sway. Participants were tested while standing on the ground on a medium-density foam rubber surface with their eyes open. The maximum balance range test and coordinated stability tests were used to quantify leaning balance [14,15]. The sit-to-stand test, which measures how quickly a person can get up from a chair that is 43 cm high five times without using their arms, and walking speed over a distance of six metres were used to assess functional ability. Other sources have published the reliability coefficients for each of these tests when administered to elderly individuals. To counteract the impact of shoes, all testing were conducted barefoot. Prior to analysis, height was taken into account while calculating maximum balancing range, coordinated stability, and walking speed.

Statistical Analysis

Right-skewed distribution variables underwent log transformation. To investigate the connections between foot and ankle characteristics, sensorimotor measurements, balance test performance scores, and functional test performance scores, Pearson correlation coefficients were obtained. To examine for variations in balance and functional test results based on the results of the paper grip test, independent samples t tests were used. To ascertain their relative significance in explaining variance in each of the tests, all factors that were shown to be substantially linked with the balance and functional tests were subsequently included in a series of stepwise multiple regression analyses [16,17]. The model was then forced to include age to see if it could account for any further variation in the balancing and functioning test results. Only the most highly correlated variable from each domain was included as a potential predictor at the beginning of each block to avoid the inclusion of variables that might be misleading or unhelpful due to covariance among some independent variables. All variables put into the regression model's beta weights and signs were also checked to make sure they contributed significantly to the performance on the functional test. Following the inclusion of age into the model, the change in the amount of variance (R2) was evaluated. The standardised beta weights offered provide a sense of the relative weights assigned to the various metrics incorporated into the model for analysing the variation in balance and functional test scores. In order to evaluate the data, SPSS for Windows was used (SPSS, Inc., Chicago, IL).

Results

Descriptive Statistics

The study provides descriptive statistics for the measures of the foot and ankle, sensorimotor, balance, and functional tests.

Tests of balance and functional ability and foot and ankle features

Stydy demonstrates the correlations between the results of the functional and balance tests and the foot and ankle tests. Plantar tactile sensitivity, ankle flexibility, the existence of milder toe abnormalities, and the degree of hallux valgus were the foot and ankle features that consistently correlated with balance and functional test scores. With the exception of the hallux valgus, which was linked to mediolateral sway on the floor ($r = 0.158$, $p = .037$), all correlations were unaffected by dividing the sway values into anteroposterior and mediolateral components. Independent sample t tests showed that the balance and functional tests were worse for those who failed either of the two paper grip tests [18].

Associations between sensorimotor tests and balance and functional tests

Strength and response time tests showed the largest connections with functional performance, while the majority of sensorimotor measurements were correlated with balance ability.

Analyses of multiple regression

It was discovered that one or more of the foot and ankle test results were significant independent predictors of each test. In particular, it was discovered that ankle flexibility was a reliable predictor of every test, with the largest ß weights for the sit-to-stand, coordinated stability, alternative step test, and sway on the floor. Additionally, it was discovered that one of the two paper grip tests and the first MPJ's tactile sensitivity functioned as independent predictors of the balance and functional assessments. The addition of age explained additional variation in all tests, with the exception of coordinated stability [19].

Discussion

The results of this study show that the balance and functional capacity of older adults are greatly influenced by foot and ankle

characteristics. Ankle flexibility and toe plantarflexor muscle strength were consistently correlated with the leaning tests and functional measurements, but tactile sensitivity of the plantar surface of the foot and ankle flexibility were strongly correlated with postural sway. The relationship between plantar sensation and standing balance is in line with earlier findings that peripheral neuropathy patient's exhibit increased postural sway and healthy individual's exhibit impaired postural responses when sensory input is blocked, suggesting that plantar mechanoreceptors provide functionally significant information about body position. Similar to this, Endo and colleagues, who observed a substantial correlation between force plate assessments of toe plantarflexor strength and the anterior limit of the functional base of support, concur that the relationship between toe plantarflexor strength and maximal balance range. In the maintenance of balance in older adults, toe muscle function may be particularly crucial. Tanaka and colleagues' research demonstrates that older persons put more pressure on their toes when standing than younger people do, probably in an effort to heighten sensory input for balance maintenance.

The position of the feet was not found to be a predictor of balance or functional ability, in contrast to earlier studies in young people. Additionally, there was little correlation between the prevalence of corns and calluses and the functional assessments; however, this is most likely because these foot issues are so common in this age group. In univariate analyses, toe deformities (including hallux valgus) were significantly associated with balance and functional ability, which is consistent with our previous study; however, because this study also included ankle flexibility and toe strength, their relatively weaker associations prevented them from being included in the multivariate models.

It is acknowledged that a significant portion of the variance in the balance and functional measurements remains unexplained for despite the wide variety of potential variables included in the regression models. Between 11% and 24% of the variance in test performance was explained by the sway tests, which were pretty poorly predicted. Between 47% and 59% of the variance in the leaning balance and functional tests could be explained, but other variables including vestibular function and discomfort may have added more information. The foot and ankle measurements are helpful additions to the sensorimotor test battery utilised earlier, as shown by the various R2 values that compare favourably to past examinations of these functional measures.

The study's key predictors of foot and ankle problems may be modifiable. There is growing evidence that utilising insoles with elevated projections or vibrating pads may help elderly persons maintain their balance even if peripheral sensory loss is typically irreversible. Moreover, reducing the risk of falls in older persons may benefit from therapies aimed at enhancing ankle and first MPJ ROM and toe plantarflexor muscle strength. Stretching and water exercise regimens have been shown to increase ankle motion in older adults; however, the impact of increasing ankle flexibility on balance and the risk of falling has not yet been investigated. Similar to the previous example, preliminary research indicates that "grasping" exercises to strengthen toe muscles improve standing balance in seniors; it is unknown, though, whether this leads in a lower chance of falling.

Conclusion

Older people's balance and functional ability are significantly influenced by foot and ankle traits, particularly tactile sensitivity, ankle flexibility, and toe strength. Enhancing sensory data from the foot and including stretching and ankle and foot exercises in intervention trials to lower the risk of falling may be beneficial.

Acknowledgement

The entire study has well explained by the author.

Conflict of Interest

The author declares has no conflict of interest.

References

1. Lord SR, Ward JA (1994) Age-associated differences in sensori-motor function and balance in community-dwelling women. Age Ageing 23:452-460.
2. Benvenuti F, Ferrucci L, Guralnik JM, Gangemi S, Baroni A (1995) Foot pain and disability in older persons: an epidemiologic survey. J Am Geriatr Soc 43: 479-484.
3. Riccitelli ML (1966) Foot problems of the aged and infirm. J Am Geriatr Soc 14: 1058-1061.
4. Mickle KJ, Munro BJ, Lord SR, Menz HB, Steele JR (2011) Cross-sectional analysis of foot function, functional ability, and health-related quality of life in older people with disabling foot pain. Arthritis Care Res 63:1592-1598.
5. Menz HB, Barr ELM, Brown WJ (2011) Predictors and persistence of foot problems in women aged 70 years and over: a prospective study. Maturitas 68: 83-87.
6. Tinetti ME, Speechley M, Ginter SF (1988) Risk factors for falls among elderly persons living in the community. New Eng J Med 319:1701-1707.
7. Menz HB (2009) Utilisation of podiatry services in Australia under the Medicare Enhanced Primary Care Program, 2004-2008. J Foot Ankle Res 2: 30.
8. Garrow AP, Silman AJ, Macfarlane GJ (2004) The Cheshire Foot Pain and Disability Survey: a population survey assessing prevalence and associations. Pain 110: 378-384
9. Leveille SG, Bean J, Bandeen-Roche K, Jones R, Hochberg M, (2002) Musculoskeletal pain and risk of falls in older disabled women living in the community. J Am Geriatr Soc 50: 671-678.
10. Thoolen M, Ryan TJ, Bristow I (2000) A study of the skin of the sole of the foot using high-frequency ultrasonography and histology. Foot 10: 14-17.
11. Mickle KJ, Steele JR (2015) Obese older adults suffer foot pain and foot-related functional limitation. Gait Posture 42: 442-447.
12. Cobb SC, Tis LL, Johnson BF, Higbie EJ (2004) The effect of forefoot varus on postural stability. J Orthop Sports Phys Ther 34: 79-85.
13. Thomas SE, Dykes PJ, Marks R (1985) Plantar hyperkeratosis: a study of callosities and normal plantar skin. J Invest Dermatol 85:394-397.
14. Menz HB, Tiedemann A, Kwan MMS, Plumb K, Lord SR (2006) Foot pain in community-dwelling older people: an evaluation of the Manchester Foot Pain and Disability. Index Rheumatology 45: 863-867.
15. Pfieffer E (1975) A short portable mental status questionnaire for the assessment of organic brain deficit in elderly patients. J Am Geriatr Soc 23: 433-441.
16. Caselli MA, Levitz SJ, Clark N, Lazarus S, Velez Z, (1997) Comparison of Viscoped and Poron for painful submetatarsal hyperkeratotic lesions. J Am Podiatr Med Assoc 87: 6-10.
17. Leveille SG, Guralnik JM, Ferrucci L, Hirsch R, Simonsick E, et al. (1998) Foot pain and disability in older women Am J Epidemiol 148: 657-665.
18. Cavanagh PR, Rodgers MM (1987) The arch index: a useful measure from footprints. J Biomech 20: 547-551.
19. Kwan RL, Zheng YP, Cheing GL (2010) The effect of aging on the biomechanical properties of plantar soft tissues. Clin Biomech 25: 601-605.