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RESEARCH

EFFECT OF FOOT PROBLEMS ON FOOT FUNCTION IN ELDERLY MEN

ABSTRACT

Introduction: Foot problems have long been recognized as being common in older people, but few studies have adequately addressed the relationship between foot problems and functional disability. This study was conducted to determine how common foot problems of the elderly affect functionality of foot in elderly nursing home residents.

Materials and Method: Fifty three elderly men, who were residents of Maide Bolel Nursing Home in Eskisehir, were assessed and scored for presence of foot problems. The overall foot functions were evaluated with Foot Function Index (FFI) and a protocol based on subjective and objective criteria for pain and function of the hindfoot (HFS). The overall muscle strength of involved muscles was determined with manual muscle testing. Dynamic balance was evaluated with timed Up & Go (TUG) test. Furthermore, walking speed, pain severity and energy consumption were determined.

Results: According to our results, there was no correlation between foot problem scores and muscle strength, functional assessments, dynamic balance, energy consumption, pain severity and walking speed ($p>0.05$).

Conclusion: Although foot problems observed were less severe, they were relatively common in our sample. Therefore, informative, preventive and therapeutic interventions for foot problems in elderly people require further longitudinal investigations.

Key Words: Aged; Nursing homes; Foot diseases/epidemiology.

ARAŞTIRMA

YAŞLI ERKEKLERDE AYAK PROBLEMLERİNİN AYAK FONKSİYONLARI ÜZERİNE ETKİSİ

ÖZ

Giriş: Yaşlı bireylerde ayak problemlerinin yaygın olduğu bilinmektedir, ama ayak problemleri ve fonksiyonel yetersizlik arasındaki ilişkiyi araştıran az sayıda çalışma bulunmaktadır.

Gereç ve Yöntem: Eskişehir Maide Bolel Huzurevinde kalan 53 yaşlı erkeğin ayak problemleri belirlenerek puanlandı. Ayak fonksiyonları, Ayak Fonksiyon İndeksi (AFİ) ve arka ayağın fonksiyonu ve ağrıyı objektif ve subjektif kriterlere dayanarak değerlendiren bir protokol ile değerlendirildi. İlgili kasların toplam kas kuvvetleri manuel kas testi ile belirlendi. Dinamik denge, timed Up & Go (TUG) testi ile değerlendirildi. Ayrıca yürüme hızı, enerji tüketimi ve ağrı şiddeti belirlendi.

Bulgular: Çalışmamızda ayak problem skoru ile kas kuvveti, fonksiyenel değerlendirmeler, dinamik denge, enerji tüketimi, ağrı şiddeti ve yürüme hızı arasında herhangi bir ilişkiye rastlanmadı.

Sonuç: Çalışmamızda, şiddeti küçük olmakla birlikte ayak problemlerinin yaygın olduğu görüldü. Bu nedenle, yaşlı bireylerde ayak problemlerine yönelik, bilgilendirici, koruyucu ve tedaviye yönelik daha ileri çalışmaların yapılması gerektiğini düşünmekteyiz.

Anahtar Sözcükler: Yaşlılık; Huzurevleri; Ayak hastalıkları/epidemiyoloji.

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INTRODUCTION

Foot problems are common in elderly people (1,2). Epidemiological studies have shown that approximately 80% of elderly people have at least one structural and dermatological foot problem (3,4). Commonly reported problems include flat foot, hallux valgus, hammer toe, high arches, nail and skin pathologies, pain, swelling, infections and circulatory problems (5).

There are many factors which contribute to the development of foot problems in elderly people. Of primary concern are the age-related changes and the associated multiple chronic diseases which cause degenerative and trophic changes in the foot (6). These problems are rarely life-threatening, but they are associated with restricted joint movement, muscle weakness and footwear fitting difficulties, and as such are likely to impair mobility, can lead to impaired proprioception, skeletal problems, changes in gait and pain, and disability (7,8). Foot pain affects 20 to 30% of community-dwelling older people and is associated with decreased ability to perform activities of daily living, problems with balance and gait and increased risk of fall (2,9).

In spite of the high prevalence of foot problems and significant foot impairment in elderly people, foot problems often go unreported because many older people consider foot pain an inevitable consequence of ageing rather than a medical condition. Thus, the association between foot problems and impairment of foot function in elderly people are not well established (10).

The aim of the study was to determine whether structural foot problems, soft tissue problems, ankle weakness and foot pain were related to functional limitation or disabilities in elderly retirement home residents.

MATERIAL AND METHODS

This study was conducted to evaluate how foot problems such as pes planus, hallux valgus, claw toe, hammer toe, corns, nail problems commonly seen in elderly subjects affect the foot function of the elderly residents of Maide Bolel Nursing home in Eskişehir, Turkey.

Permission to conduct this study was obtained from the Turkish Social Services and Children Protection Agency (29.05.2008; confirmation # 100). Informed consent of the participants were obtained. Fifty three volunteers participated in the study. All participants were between 61 and 93 years of age and male. Data on disease history was collected by using an interview based technique. They had no known neurological, cardiovascular and musculoskeletal conditions likely to affect their balance or mobility and they had no difficulty in performing activities of daily living and had no cognitive problems. They were able to walk at least 50 m without assistance or using a device. The exclusion criteria included current pain, previous foot surgery, osteoarthritis affecting the foot, major medical conditions such as diabetes mellitus and rheumatoid arthritis.

Observational analysis, walking speed, energy consumption, functional assessment and dynamic balance tests were performed for each subject various times a day. All assessments were performed at once.

Subjects were examined individually. Height was measured in centimeters, weight in kilograms, and body mass index (BMI) was calculated as body weight/height?. Visual inspection and metric assessments were used for the diagnosis of foot problems including pes planus, pes cavus, hindfoot pronation, hallux valgus (angle ≥ 15º), bunion, metatarsophalangeal depression, claw toe, hammertoe, mallet toe, overlapping toes, corn, nail problems, edema and ulcer. The pes planus was established in bilateral stance by the position of navicula relative to the Feiss' line which extends to the metatarsophalangeal joint of the great toe (11,12). All assessments were made by a physical therapist with post-graduate experience.

Scoring system was devised according to presence and severity of deformity. Each problem was scored by using a score card. Aspects of the deformities were graded so that structural deformities were scored from one to three, as mild, moderate or severe. Furthermore, soft tissue problems were scored one or two, indicating presence or absence respectively. The severity of hallux valgus was documented as one point (angle ≥ 15º), two points (angle 30-45º) or three points (angle >45º). These scores were added up to obtain a total score for both feet, the so called foot problem score (FPS). The FPS ranged from 0 to 38.

The muscle strength for quadriceps femoris, hamstrings, tibialis anterior, tibialis posterior, gastrocnemius-soleus, peroneus longus and brevis, lumbricales, flexor hallucis longus and brevis, flexor digitorum longus and brevis, dorsal interossei, abductor hallucis, abductor digiti quinti, palmar interossei, adductor hallucis muscles were graded according to Lowett's manual muscle test (between 0 and 5) and were added to obtain a total score (0-110) (12).

Foot function was assessed with the Foot Function Index (FFI) system, comprising pain, disability and activity limitation subscales (13), an evaluation protocol and scoring system for pain and function of the hindfoot (14), dynamic balance and 10 meters walking speed.

The FFI is a questionnaire which was demonstrated to have high internal consistency and construct validity (13,15). FFI, both an anatomic and a disease-specific scale, measures pain, mobility and limitation as effects of foot complaints and problems of foot function. It consists of 23 items divided into 3 subscales: activity limitation (5 items), pain severity (9 items) and disability (9 items). The items are rated on a visual analog scale (VAS) composed of horizontal lines (10 cm). The respondent is asked to mark the horizontal line at the spot that best corresponds to the effect of the foot complaints in terms of activity limitations, pain and disability. To calculate the definitive scale scores, the item scores are summed and divided by the maximum possible number of questions. The scores range from 0 to 100; the higher score indicates more limitation, pain and disability. Pain severity was established using the pain subscale of FFI.

The evaluation protocol and scoring system for pain and function of the hindfoot (hindfoot function scale-HFS) comprises subjective criteria including pain, activities of daily living and work, sports, and recreational activities, difficulty in walking on various surfaces, walking distance, and use of walking aids; and objective criteria, including the range of motion of the subtalar joint and ankle and the presence of a limp. Total score was 100: the higher the score the better the function (14).

We evaluated walking speed in shod walking. The subjects were asked to wear comfortable walking shoes to assess the walking speed. The subjects were instructed to walk as fast as possible in a marked 10 meters walkway. A digital stopwatch was used to measure the time. In addition, heart beat per minute before and after the walking speed test was recorded to determine how much energy was consumed by each subject although the method provides limited approximation (16).

Dynamic balance was evaluated by using timed Up & Go test (TUG). This test was performed to measure how fast each subject was able to sit, stand and walk. Each subject was required to sit and get up and walk three meters and then return back to their chair to sit again (17).

For each test conducted, the results were recorded and analyzed using correlation analysis by SPSS. The findings will be discussed to determine whether foot problems affect the functionality of elderly men in Maide Bolel nursing home.

Statistical analyses were performed using Statistical Package for Social Sciences (SPSS) version 15.0. Analyses included percentages, calculation of means and related standard deviations (mean± SD). To evaluate the associations between the foot problem score, walking speed and energy consumption and muscle strength and dynamic balance and functional scales, Spearman correlation coefficient was used. Statistical significance was defined as a value of $p<0.05$.

RESULTS

Fifty three elderly men with an average age of 73.29 ± 7.08 years were interviewed and underwent foot examination in this study. The demographic characteristics and assessment results of the subjects are given in Table 1.

Table 1— Demographic Characteristics of the Participants

Characteristics	Min- Max	Mean	SD
Age (year)	61-93	73,79	7,08
Height (cm)	147-188	165,89	9,01
Weight (kg)	45-104,5	65,93	13,04
Body mass index (BMI)	16,7-37	24,04	4,52
Education (year)	0-11	3,26	2,94
Income (US Dolars)	0-450	189,47	163,37
Duration of stay in retirement home (year)	0,08-17	4,55	4,85
Foot Problem Score (FPS)	5-21	10,21	3,63
Pain severity (VAS)	0-83	13,76	21,91
Walking Speed (m/s)	0,46-1,85	1,09	0,36
Energy Consumption (EC)	0,01-0,48	0,10	0,10
Foot Function Index (FFI)	0-76	15,02	19,09
Hindfoot Function Scale (HFS)	23-100	80,35	16,64
Timed Up& Go Test (s)	5,05-17,23	9,38	2,55

Table 2— Distribution of deformities

n= 53	Bilateral		Unilateral	
	n	%	n	%
Pes planus	45	84.9	5	9.4
Hallux valgus	18	33.9	12	22.6
Claw/ hammer toe	14	26.4	4	7.5
Hindfoot pronation	3	5.6	6	11.3
Corn	4	7.5	2	3.7
Bunion	3	5.6	1	1.8
Overlapping toes	6	11.3	3	5.6
Nail problems	28	52.8	-	-
Edema	6	11.3	1	1.8
Transvers arch	44	83.0	1	1.8

All subjects reported at least one foot problem and exhibited a foot abnormality on inspection. The most common foot problem was pes planus which affected 94.3% of the sample. Of subjects with hallux valgus, 34 percent had bilateral, and 23% had unilateral hallux valgus (Table 2).

There was no correlation between FPS and muscle strength, FFI, HFS, walking speed, pain severity, timed Up & Go test and energy consumption (p>0.05) (Table 3).

We observed significant correlations between FFI and both timed Up & Go test (r = 0.33, p <0.05) and the evaluation protocol and scoring system for pain and function of the hindfoot (r = - 0.82, p<0.05), but no correlations were found between FFI and energy consumption, foot problem score, muscle strength and walking speed (p>0.05) (Table 4).

The fastest walking speed of our subjects was 1.09 ± 0.36 m/s. No correlation was found between walking speed and

Table 3— Correlations Between Foot Problem Scores (FPS) and Functional Evaluations

	Walking Speed (m/s)	Energy Consumption	TUG	FFI	HFS	Muscle Strength	Pain Severity
	r (p)	r (p)	r (p)	r (p)	r (p)	r (p)	r (p)
FPS	-0,05 (0,73)	-0,18 (0,19)	0,02 (0,88)	-0,01 (0,96)	-0,25 (0,07)	-0,24 (0,08)	0,08 (0,58)

r: Spearman correlation coefficient

Table 4— Correlation of Functional Assessment

	Walking Speed (m/s)	Energy Consumption (EC)	TUG	FFI	HFS	Muscle Strength
	r (p)	r (p)	r (p)	r (p)	r (p)	r (p)
WS (m/s)	-	-	-	-	-	
EC	-0,42(0,00)	-	-	-	-	
TUG (s)	-0,80(0,00)	0,34(0,01)	-	-	-	
FFI	-0,26(0,07)	0,11(0,42)	0,33(0,02)	-	-	
HFS	0,35(0,01)	-0,29(0,03)	-0,41(0,002)	-0,82(0,00)	-	
MS	0,27(0,05)	-0,15(0,27)	-0,15(0,28)	0,10(0,46)	-0,03(0,86)	-
Pain Severity	-0,26 (0,06)	-0,02 (0,89)	0,32 (0,02)	0,83 (0,00)	-0,69 (0,00)	-0,09 (0,52)

r: Spearman correlation coefficient
FFI: Foot Function Index, TUG: Timed-Up& Go
HFS: Hind Foot Function Score, MS: Muscle Strength

muscle strength, FPS and FFI ($p>0.05$). However, significant correlations were observed between walking speed and the evaluation protocol and scoring system for pain and function of the hindfoot ($r= 0.35$, $p<0.05$), timed Up & Go test ($r =-0.80$, $p<0.05$) and energy consumption ($r = -0.42$, $p<0.05$).

Timed Up & Go test evaluating dynamic balance correlated well with walking speed ($r = -0.80$, $p<0.05$), energy consumption ($r = 0.34$, $p<0.05$), FFI ($r = 0.33$, $p<0.05$) and the evaluation protocol and scoring system for pain and function of the hindfoot ($r = -0.41$, $p<0.05$). Also, meaningful relations were found between energy consumption and timed Up & Go test ($r =0.34$, $p<0.05$) and an evaluation protocol and scoring system for pain and function of the hindfoot ($r = -0.30$, $p<0.05$). Although pain severity correlated with FFI, TUG and HFS, there was no correlation between pain severity and walking speed and muscle strength ($p>0.05$).

DISCUSSION

Foot problems in elderly people are particularly important because of their direct relation to ambulation. They may have a significant influence on the quality of life causing pain, morbidity and functional disability. Although these problems have long been recognized as being common in elderly people, few studies have adequately addressed the relationship between foot impairment, gait abnormalities and reduced functional ability (2,8). Munro and Steele examined foot problems and the perception of foot problems as medical conditions in a sample of people aged 65 years and older who lived independently (18). Although 71% of the 128 respondents reported suffering from foot problems, only 39% had consulted medical personnel about their feet, and only 26% identified their foot pathologies as medical conditions. More females than males experienced foot problems and had visited medical personnel about their feet (18).

Many distinctive foot problems were reported in the literature. Scott et al. established that subjects aged 80.2 ± 5.7 years exhibited flatter/ more pronated feet, decreased range of motion at the ankle and first metatarsophalangeal joint, a higher prevalence of hallux valgus, lesser toe deformities, corn and calluses, reduced plantar tactile sensitivity at the lateral malleolus and 1st metatarsophalangeal joint, reduced ankle dorsiflexion strength in elderly participants compared to the young participants (19). In addition, the older participants demonstrated reduced magnitude of force and pressure under the heel, lateral forefoot and hallux, and spent a relatively longer period of stance phase loading the heel, midfoot and forefoot during gait. They concluded that these age-related differences could be largely explained by differences in step length and various foot characteristics, particularly foot posture and the severity of hallux valgus (19).

Different measures of functional outcomes were used in the literature. Menz and Lord used functional tests including stair ascent and stair descent, alternate stepping test and walking speed (2,5). Keysor et al. used a protocol including timed side-by-side, semitandem, and tandem balance tasks, timed repeated chair stands and a timed short walk test to examine functional limitation due to foot disorders (1). Badlissi et al. used the foot health function status scale including four questions addressing foot-related limitations and difficulties in work, activities, walking and climbing stairs within the previous week, and later he applied a timed walk test (7). We used foot related functional questionnaires (FFI, HFS), TUG and walking speed in this study as they were comprehensive and simple.

In the present study, the most common foot problems in elderly men were pes planus and nail and toe problems. All foot problems were scored and the scores were added up to obtain a total score for both feet, the so called foot problem score (FPS). There was no correlation between FPS and muscle strength, walking speed, pain severity and functional assessment scale in our subjects. In literature, different opinions were reported. Some authors have pointed out that even the smallest foot problems may lead to skeletal problems, impairment of proprioception, changes in walking pattern and slow walking speed. Furthermore, limitations of lower extremity functions are associated with pain, joint problems and muscle weakness (2,7,9). On the other hand, others have stated that foot disorders were not associated with chronic and severe foot pain, slow walking speed and functional outcomes or disability among older adults (1,20,21).

The fastest walking speed of our subjects in the current study was 1.09 ± 0.40 m/s. Walking speed was found to be associated with energy consumption, TUG and HFS, but not with pain severity, FFI and total muscle strength. Different studies were carried out for walking speed of elderly people and gait speed was found to be the strongest independent predictor of self-perceived physical function (20,22,23). However we found an inverse relation between energy consumption and walking speed and HFS; and a positive correlation between energy consumption and TUG test. We did not come across any article on assessment of correlation of energy consumption and foot disorders in the literature. For this reason we could not compare the results with literature values.

We did not find any association between foot problems and foot function. This may be due to inclusion of insufficient

number of subjects, the low foot problem scores obtained, and inadequate assessment of a few subjects who did not understand the functional questionnaires exactly. There are two basic limitations of our study. First, the subjects were wearing their own shoes which were not suitable, worn out and larger sized. Thus, functional assessment tests may be affected by inaccurate footwear. Secondly the tests were performed all at a time so the subjects may have been tired and may have completed the test in a longer time than they would normally do after a resting period. Furthermore, they hurried up to finish the questionnaire and they may have provided false information.

The management of foot problems in elderly people requires early recognition of their etiological factors, complaints, symptoms, physical signs, and the clinical manifestations of disease and degenerative changes. It is important to determine what can be done to maintain a good quality of life for the elderly. In addition, the treating team should aim for a supple, painless, plantigrade foot with adequate muscle balance and strength. We conclude that functional limitations and therapeutic interventions for foot problems require further longitudinal investigation to confirm and clarify the clinical implications of these results.

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References

1. Keysor JJ, Dunn JE, Link CL, Badlissi F, Felson DT. Are foot disorders associated with functional limitation and disability among comminity dwelling older adults? J Aging and Health 2005; 17(6): 734-52.
2. Menz HB, Lord SR. Foot pain impairs balance and functional ability in comminity –dwelling older people. Jam Podiatr Assoc 2001; 49(12):1651-6.
3. White EG, Mulley GP. Footcare for very elderly people: a community survey. Age Aging 1989 Jul;18(4) :276-8.
4. Barr ELM, Browning C, Lord SR, Menz HB, Kendig H. Foot and leg problems are important determinants of functional status in community dwelling older people. Dis and Rehabil 2005; 27(16): 917-23.
5. Menz HB, Lord SR. Foot problems, functional impairment, and falls in older people. J Am Podiatr Med Assoc 1999 Sep;89(9):458-67.
6. Helfand AE. Foot problems in older patients: a focused podogeriatric assessment study in ambulatory care. Jam Podiatr Assoc May –Jun; 94(3):293-304.
7. Badlissi F, Dunn JE, Link CL, Keysor JJ, McKinlay JB, Felson DT. Foot musculoskeletal disorders, pain and foot related functional limitation in older person. JAGS 2005; 53(6): 1029-33.
8. Menz HB, Pod B, Lord SR. The contribution of foot problems to mobility impairment and falls in community-dwelling older people. JAGS 2001; 49(12): 1651-6.
9. Menz HB, Tiedemann A, Kwan MMS, Plumb K, Lord SR. Foot pain in community-dwelling older people: an evaluation of The Manchester Foot Pain and Disability Index. Rheumatology 2006; 45: 863-7.
10. Tüzün C, Tikiz C. Yaşlılarda ayak problemleri. Turkish Journal of Geriatrics 2003; 6(4): 135-41.
11. Williams M, Worthingham C:Therapeutic Exercise For Body Alingment And Function. W.B. Saunders Company, London, 1957, p 27.
12. Coplan JA. Rotational motion of the knee: a comparision of normal and pronating subjects. JOSPT 1989;10(9):366-9.
13. Budiman-Mak E, Conrad KJ, Roach KE. The Foot Function İndex: a measure of foot pain and disability. Clin Epidemiol 1991; 44: 561-70.
14. Paley D, Hall H. Intra-Articular Fractures of the Calcaneus. J Bone Joint Surg 1993; 75A(3): 342-54.
15. Saag KG, Saltzman CL, Brown CK, et al. The foot function index for measuring rheumatoid arthritis pain: Evaluation side-to-side reliability. Foot& Ankle Int 1996, 17(8): 506-10.
16. Whittle MV. Energy Consumption, Gait Analysis: An Introduction. Butterworth H, editors. 1991, pp 48-55, 154.
17. Podsiadlo D, Richardson S. The timed " up& go": A test of basic functional mobility for frail elderly persons. J Am Geriatr Soc 1991; 39: 142-8.
18. Munro BJ, Steele JR: Foot-care awareness. A survey of persons aged 65 years and older. J Am Podiatr Med Assoc 1998 May;88(5):242-8.
19. Scott G, Menz HB, Newcombe L. Age Related Differences in Foot Structure and Function. Gait Posture 2007; 26(1): 68-75.
20. Kavlak Y, Simsek E, Erel S, Mutlu A, Bek N, Yakut Y, Uygur F. The impact of structural foot deformities in elderly. Fizyoterapi Rehabilitasyon 2006; 17(2): 84-8.
21. Leveille SG, Guralnik JM, Ferrucci L, Hirsch R, Hochberg MC. Foot pain and disability in older women. Am J Epidemiol 1998; 148(7): 657-65.
22. Cress ME, Schechtman KB, Mulrow CD, Fiatarone MA, Gerety MB, Buchner DM. Relationship between physical performance and self-perceived physical function. J Am Geriatr Soc 1995 Feb;43(2):93-101.
23. Bohannon RW. Comfortable and maximum walking speed of adults aged 20-79 years: reference values and determinants. Age Ageing 1997; 26(1):15-9.