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Are toe weakness and deformity associated with falls in older people

Abstract

Hallux valgus and lesser toe deformities are highly prevalent foot problems in older adults, affecting up to 74% of this population. One suggested cause of these toe deformities is inadequate strength of the intrinsic flexor muscles of the toes [1]. Adequate toe flexor strength is essential to control body weight shifts, propel the body during gait and assist in shock absorption during repeated impacts. Furthermore, a previous study using a qualitative measure of toe flexor strength reported associations between poor toe flexor strength and poor performance in balance and functional tests in elderly people [2]. Of further concern, in a sample of retirement home dwellers, fallers were more likely to have severe hallux valgus and fail a clinical test of toe-flexor strength more often than non-fallers [3]. However, this association has not been investigated in community-dwelling older people or assessed using a quantitative method of toe flexor strength. Therefore, the purpose of this study was to determine whether toe flexor strength or the presence of hallux valgus or lesser toe deformities were associated with the risk of falling in older community dwelling adults.

Keywords

people, older, toe, falls, deformity, associated, weakness

Disciplines

Arts and Humanities | Life Sciences | Medicine and Health Sciences | Social and Behavioral Sciences

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ARE TOE WEAKNESS AND DEFORMITY ASSOCIATED WITH FALLS IN OLDER PEOPLE?

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INTRODUCTION

Hallux valgus and lesser toe deformities are highly prevalent foot problems in older adults, affecting up to 74% of this population. One suggested cause of these toe deformities is inadequate strength of the intrinsic flexor muscles of the toes [1]. Adequate toe flexor strength is essential to control body weight shifts, propel the body during gait and assist in shock absorption during repeated impacts. Furthermore, a previous study using a qualitative measure of toe flexor strength reported associations between poor toe flexor strength and poor performance in balance and functional tests in elderly people [2]. Of further concern, in a sample of retirement home dwellers, fallers were more likely to have severe hallux valgus and fail a clinical test of toe-flexor strength more often than non-fallers [3]. However, this association has not been investigated in community-dwelling older people or assessed using a quantitative method of toe flexor strength. Therefore, the purpose of this study was to determine whether toe flexor strength or the presence of hallux valgus or lesser toe deformities were associated with the risk of falling in older community dwelling adults.

METHODS

Three hundred and twelve older men and women aged between 60-90 years were randomly recruited to participate in the study. Each participant had their feet assessed by the Chief Investigator (KJM) for the presence of lesser toe deformities whilst hallux valgus severity was rated using the Manchester Scale [4].

Toe flexor strength was assessed while each subject stood on an emed AT-4 pressure platform (25 Hz; Novel^{gmbh}) under two conditions: a) using their hallux and toes 2-5, or b) using only their hallux. During each trial subjects were instructed to push down as hard as possible onto the platform. During each testing session, three trials were completed on both the left and right feet for each condition, with at least 30 s rest between consecutive trials on the same foot. The hallux and toes 2-5 were masked on the peak force print using Novel-ortho automask software. Peak force (kg) was then determined for each mask, under each condition using Novel-win multi-mask evaluation software, and then normalised to body weight (%BW).

Participants were followed prospectively to determine their falls incidence over 12 months. Independent t-tests then used to identify any significant differences in hallux and lesser toe strength between those participants who fell during the 12 months (n = 107) compared to non-fallers (n = 196). Chi-square tests were computed to determine whether the prevalence of foot problems differed significantly between the two groups ($p < 0.05$). A forward stepwise linear regression was used to determine which variables were independent predictors of falls.

RESULTS AND DISCUSSION

Non-fallers displayed significantly greater strength at both the hallux (14.83 ± 7.8 %BW) and toes 2-5 (10.82 ± 4.5 %BW) than the fallers (11.59 ± 6.92 ; 8.72 ± 4.67 %BW; $p < 0.01$). Individuals with severe hallux valgus had a significantly greater risk of falling than those with no hallux valgus (OR = 5.2; 95% CI = 1.6-17.4) and those who had lesser toe deformity were also at a greater risk of falling than those without deformity (OR = 2.0; 95% CI = 1.2-3.5).

A forward stepwise linear regression indicated that hallux strength and the presence of lesser toe deformities were the most important factors in predicting falls, whereby 63.9% of individuals could be correctly identified as fallers or non-fallers based on these two variables. Of particular importance, for every 1% BW increase in hallux strength the odds of sustaining a fall decreased by 6.7% ($p < 0.001$).

Interestingly, those participants with moderate-severe hallux valgus or lesser toe deformity had significantly lower strength at the hallux and lesser toes, respectively, compared to those without these foot problems ($p \leq 0.01$; see Figure 1). Whether inadequate strength of these toe flexor muscles has contributed to the toe deformities or whether the structural deviations have resulted in the intrinsic flexor muscles becoming less efficient biomechanically requires further investigation.

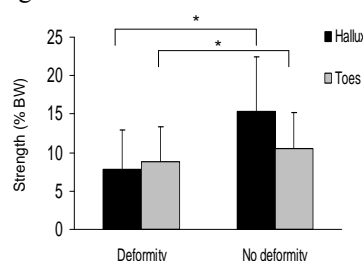


Figure 1: Hallux and lesser toe strength of individuals with and without hallux and lesser toe deformity.

CONCLUSIONS

Reduced toe flexor strength, particularly of the hallux, and the presence of toe deformities increase the risk of falling in older community dwelling adults. Interventions that increase the strength of the toe flexor muscles may be able to reduce the risk of falling. Similarly, identifying and providing treatment to those with toe deformities may also be beneficial in reducing the incidence of falls in community-dwelling older people.

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