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審査研究科	人間総合科学研究科		
学位論文題目	Foot characteristics and its association with balance in older adults （高齢者における足部の特性とバランス能力との 関係性）		
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論文の内容の要旨

（目的）

The primary aim of this thesis was to determine whether foot characteristics, which were foot deformity and static foot posture, associate with balance in independently-living older adults. As the foot and toes play crucial role in safe and efficient movement, it was hypothesized that foot deformity would be associated with poor balance. Furthermore, the association between balance and static foot posture, which in this study was arch height calculated using two different ways of measurements, was investigated. The secondary aim was identify gender differences in foot characteristics to design comfortable and efficient shoes in Japan which has large elderly population.

（対象と方法）

A total of 349 older adults participated in this study conducted in the Kasama City health center, Ibaraki, Japan. We assessed foot characteristics, using the recently launched 3D foot scanner by Dream GP Company, Japan. Balance tests and body mass index (BMI) of participants were measured and medical histories were gathered via face-to-face interviews.

（結果）

This doctoral thesis has 3 chapters.

In research theme 1 (Chapter IV) of this thesis, the first toe angle was considered as a foot characteristics and its association with physical performance and postural sway were investigated. There was significant positive correlation between the first toe angle and poor balance especially in women. Therefore, the first toe angle is an important determinant of balance in community-dwelling older people.

In research theme 2 (Chapter V) of this thesis, foot characteristics was considered as static foot posture and shape of the foot. We measured height of the arch in two different ways. The main objective of that chapter was to determine whether static foot posture and mobility with two different methods (navicular height & AHI) were independently associated with balance and postural sway in a large community sample of older adults after adjusting for the effects of medical factors using objective measures of balance status and the recently launched technology of 3D foot scanning. Results of this study provided intriguing findings on the associations between sitting arch height index (AHI) and balance in both genders. Arch rigidity index (ARI) is associated with postural sway and static balance in women and men, respectively. Moreover, sitting navicular height (NH) and foot mobility are associated with postural sway in women and with balance in men.

After it was confirmed that men and women results in chapter V were quite different, research theme 3 (Chapter VI), explored gender differences in foot characteristics. Furthermore, Chapter IV identified that there was significant positive correlation between first toe angle and poor balance especially in women. One suggested intervention for these individuals is to provide comfortable footwear. Therefore, the purpose of Chapter VI was to determine gender differences in foot characteristic in a large community sample of Japanese older adults using the recently launched technology of 3D foot scanning. The results indicated some differences between the anthropometric foot variables of older men and women. These differences most appear in instep height, instep girth, ball girth and navicular height.

(考察)

The first toe angle is an important determinant of balance in community-dwelling older people, especially women. The results in this study showed the important role that first metatarsophalangeal and the interphalangeal joints play in gait speed and balance.

Furthermore, our study provides intriguing findings on the associations between sitting AHI and balance and postural sway in both genders. ARI is associated with postural sway and static balance in women and men, respectively. Moreover, sitting NH and foot mobility are associated with postural sway in women and with balance in men. These findings suggested that among all those methods, sitting AHI might be better method for defining balance control in older adults.

In addition, the current study shows evidence of difference between some of the foot characteristics and shapes of older men and women. Gender differences in foot shape and characteristics should be considered when manufacturing shoes for Japanese older adults to accommodate the greater ball and instep girth, instep and navicular height of men's feet and greater first toe angle in women.

審査の結果の要旨

(批評)

本論文は、自立した生活を送る高齢者を対象として、足部形態とバランス能力との関連性について、性差を踏まえて明らかにした点で学術的な意義が高い。さらに、これらの知見は、転倒に対する高齢者自身への注意喚起につながるだけでなく、性差を踏まえた安全で快適な靴をデザインする上でも有用な情報として活用が期待される点も併せて高く評価された。

平成 27 年 1 月 6 日、学位論文審査委員会において、審査委員全員出席のもと論文について説明を求め、関連事項について質疑応答を行い、最終試験を行った。その結果、審査委員全員が合格と判定した。

よって、著者は博士（体育科学）の学位を受けるのに十分な資格を有するものと認める。