Mobility Performance and Foot Problems in Older People

Wai-ting Lo, Ka-lai Yeung, Pui-ling Li, Kit-lun Yick and Kam-ching Chan

Institute of Textiles and Clothing,

The Hong Kong Polytechnic University.

Background

- Feet are the foundation and basis of support for the entire body
- Function of feet: protect the lower extremities, the spine from damaging ground reaction forces and reduce or change leading misalignments or deformities
- Foot deformities and unsteadiness of gait are **common** issues amongst older people
- **80%** of the studied elderly people have at least one foot problem and/or various types of foot deformities. *(Lai et al., 2014)*

Background

- Foot deformity, pain and deterioration of the neuromuscular system are found with **increased age** and **degenerative process**, resulting in increased plantar pressure during walking, increased postural sway, poor balance control and ultimately higher risks of falling. *(Castro et al., 2010 & Lorimer et al., 2002)*
- For example, older people with moderate-to-severe hallux valgus and lesser toe deformities were at a greater risk of falling than older people without these deformities because of the reduction in toe flexor strength. *(Mickle et al., 2009)*

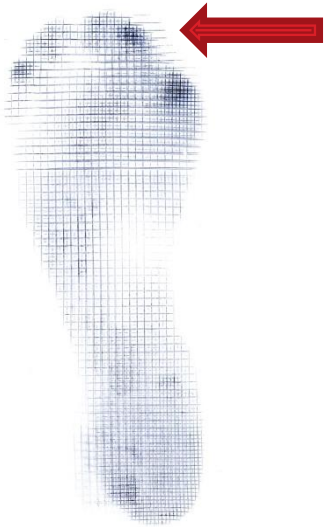


Figure 1: Elderly with hallux valgus and claw toe

Background

- Most clinical studies on foot deformities and related posture and balance assessments have only focused on the use of proper geriatric footwear for outdoor activities.
- Some authors showed that poorly fitting footwear or shoes **without adequate fixation** may **increase** the risk of trip-related **falls**.*(Sherrington et al., 2003 & Finlay, 1986)*
- **Open-toe slip-on mule slippers** with a single strap across the distal-dorsal foot are a popular type of indoor footwear, which **lacks of proper fixation**.

Background

- However, elderly people with foot problems may spend most of their time at home and many **fall incidents** actually occur **at home** when they are engaged in their normal daily activities, such as walking or changing positions during locomotion *(Hornbrook et*

- No previous investigations have been done on the balance performance of older people when indoor slippers are worn in relation to their foot degeneration and biomechanical changes.

Objectives

The aims of this study are to examine:

- Mobility performance of older people when they are walking in slippers (with less support and lack of proper fixation).
- Relationships between the foot sole morphology and mobility performance in older people

Methodology

Subjects: 52 elderly people

Location: Elderly residential care centre

- Demographic Description of Subjects:

	Women	Men
No. of Participants	47	7
Age	Mean :81.48 SD: 6.70	
BMI	Mean: 24.21 SD: 3.97	
Foot Size (European)	35 to 42 (Mean:38)	37 to 44.5 (Mean:40)

Methodology

Foot and balance assessments

- Foot deformity assessment
- Assessed by: Physiotherapist

Figure 2: Subject with hallux valgus, mallet, bunionette and flat foot

Figure 3: Subject with hallux valgus, claw toe, bunionette and overlapping toes

Methodology

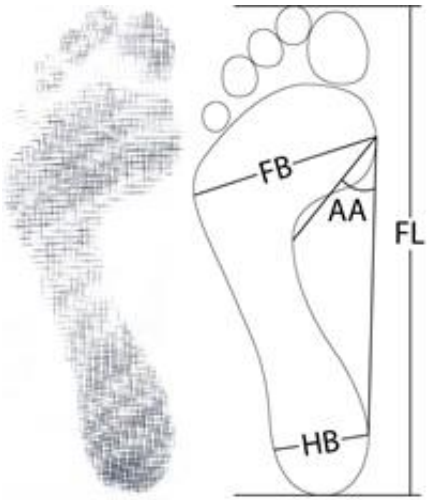
Foot and balance assessments

- **Static** footprint measurement
  - Podograph
  - Used to independently acquire the left and right footprints (Hemy et al., 2013)
  - Ink is applied to a paper-lined footplate in response to the pressure of a load-bearing foot

Methodology

Foot and balance assessments

- Footprint measurement
  - **Five** measurements are taken for analysis, including FB, AA, FL, HB and AI (Hemy et al., 2013)



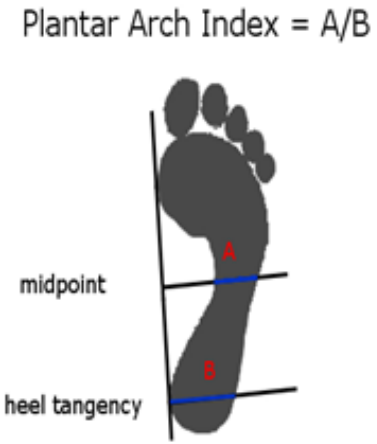


Figure 4. Footprint measurements:
foot length (FL), foot breadth (FB), heel breadth (HB), arch index (AI) and arch angle (AA)

Methodology

- Tinetti Performance-Oriented Mobility Assessment (POMA)

- A tool to measure **balance ability** in older people, which has sound reliability and validity *(Lin et al., 2002)*
- Comprises 16 items (including 9 balance-related items and 7 gait-related items)
- Assessed by: Physiotherapist
- Subjects were put on their **own slippers** (Hwang & Woo, 2012)

Methodology

- Tinetti Performance-Oriented Mobility Assessment (POMA)

- Assessment of balance and gait component
- Highest achievable score : **28** points
- Criterion: POMA score **> 24** points

  → Satisfactory mobility performance

  POMA score **< 17** points

  → Higher risk of falling

Results and Discussion

Foot Deformities

- Results:
- Only 11 subjects have a healthy foot
- 78.8% of the subjects have at least one foot deformity problem
- Common foot problems: Hallux valgus (51.9%) and Bunionettes (34.6%)

- Discussion:
- Incidences and patterns of foot deformities are very similar to the previous study of Hong Kong elderly people. *(Lai et al., 2014)*
- Those finding are also similar to that of Thailand elderly, which 87 % of subjects had foot problems and 45.5 % had hallux valgus. *(Chaiwanichsiri et al., 2009)*

Results and Discussion

Footprint measurements

- Men have a higher AI and lower AA than Women
- Prevalence of pes cavus (high arches) is equally found in both genders

Table 1 Descriptive statistics for footprint measurements (cm)				
	Male (n=7)		Female (n=45)	
	Range	Mean (SD)	Range	Mean (SD)
Foot length (FL)	21.40-26.10	23.31 (1.23)	19.60-24.80	21.48 (1.04)
Foot breadth (FB)	5.60-10.20	8.92 (0.85)	7.20-9.60	8.41 (0.51)
Heel breadth (HB)	3.80-5.80	5.11 (0.49)	4.10-7.60	4.99 (0.48)
Arch index (AI)	0.43-1.20	**0.75** (0.18)	0.25-1.30	**0.69** (0.20)
Arch angle (AA)	10.00-33.50	**26.93** (6.78)	6.00-42.00	**30.72** (6.54)

Results and Discussion

Footprint measurements

- Different from previous reports that women tend to develop pes planus (flat foot) and hallux valgus, while men will still maintain a normal and high arch *(Chaiwanichsiri et al., 2009)*
- No significant correlation between BMI and the AI. However, this findings was different from the previous study that a positive correlation found between the BMI and the AI in overweight and obese subjects. Obese women were presented flatter feet while obese men presented more pronated feet. *(Aurichio et al., 2011)*
- Significant adverse correlation between AA and AI ($r=-0.65$, $p<0.05$)

Results and Discussion

POMA Score

Table 2. Tinetti POMA Test (Mean Scores)			
	Male	**Female**	**Overall (SD)**
Balance POMA (0-16)	15.14 (0.90)	15.16 (1.35)	15.2 (1.28)
Gait POMA (0-12)	11.14 (1.21)	11.58 (0.89)	11.5 (0.93)
Tinetti POMA (0-28)	26.29 (1.70)	26.73 (1.78)	26.7 (1.74)
Risk of Falling (Tinetti POMA)			
High (0-17)	0 (0%)	0 (0%)	0 (0%)
Medium (18-24)	1 (12.5%)	7 (15.6%)	8 (15.4%)
Low (25-28)	6 (87.5%)	38 (84.4%)	44 (84.6%)

For medium risk of fallers, percentage of female subjects (15.6%) is slightly higher than that of the male subjects (12.5%)

Results and Discussion

POMA Score

- Discussion:
  - No significant difference between the male and female subjects in both balance and gait performance. This finding is similar to the previous study in Korean elderly that similar POMA mean scores were found in gender. But it found significant difference by sex. *(Ko et al., 2009)*
  - Only arch angle is significantly correlated to the POMA score associated with mobility performance and risk of falling ($r=0.226$, $p<0.05$). This may be because a significant correlation between arch angle and arch height *(Cureton et al., 1935)*. Low and high-arched feet increase the risk of injury and are also associated with insufficient or excessive stiffness, respectively. *(Faria et al., 2010)*

Conclusion

- Foot deformities such as hallux valgus, bunionettes, etc. are commonly found amongst Hong Kong elderly people
- Prevalence of arch deformities with ageing is similar in both genders
- **85%** of the subjects perform well in the mobility assessments and no gender difference
- Only arch angle is associated with mobility performance in older people with the use of slip-on mule slippers
- These findings could enhance our understanding of foot deformities and mobility performance, and provide information on the safety of footwear worn at home by older people

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Thank You
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