

# Effects of Slippers on Sit-to-Stand Transition in Older Women

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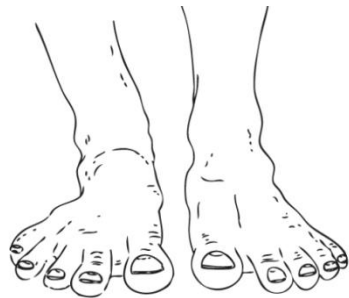
# Presentation outline

1. Introduction
2. Methods
3. Results
4. Conclusions
5. References
6. Q&A

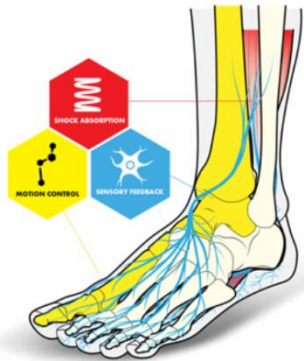
# 1. Introduction

# Introduction

## Common problems for many older people



Loss of sensation



Weakness of  
Somatosensory



Risk of falling



Improper footwear

# Introduction

- **Slips and trips** can be prevented by **shoe features**, including midsole material hardness, height of the heel collar and outer sole slip resistance. (*Hornbrook et al., 1991*)
- **Risk of falls** in old people is increased inside home when walking **barefoot** or in **socks**. (*Koepsell et al., 2004; Menz et al., 2006*)



Hornbrook et al. (1991). Falls among older persons: Antecedents and consequences. In R. Weindruch, E. Hadley, & M. Ory, *Reducing Frailty and Falls in Older Persons* (pp. 106-125). Springfield: Charles C Thomas.

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Menz et al. (2006). Footwear characteristics and risk of indoor and outdoor falls in older people. *Gerontology*, 52(3), 174-180.

# Introduction

- **Slips and trips** can be prevented by **shoe features**, including midsole material hardness, height of the heel collar and slip resistance.

Biomechanical studies on indoor footwear are scarce

(Knapik et al., 2004; Menz et al., 2006)



Hornbrook et al. (1991). Falls among older persons: Antecedents and consequences. In R. Weindruch, E. Hadley, & M. Ory, *Reducing Frailty and Falls in Older Persons* (pp. 106-125). Springfield: Charles C Thomas.

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# Introduction

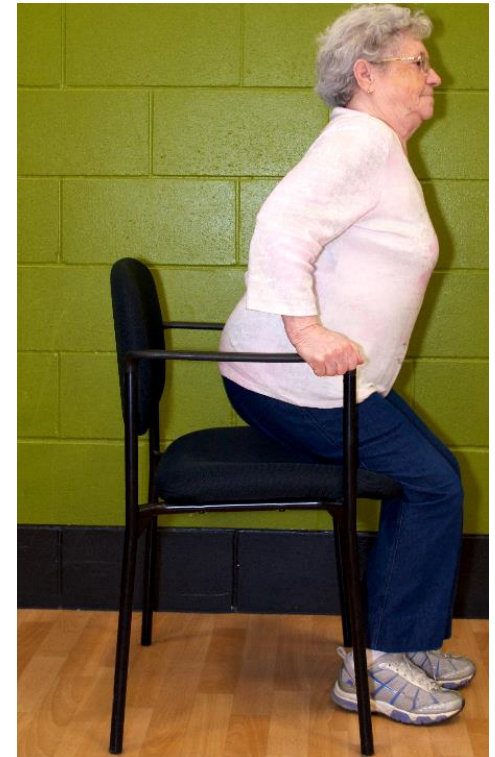
## Sit-to-stand

(fundamental and frequent motion)

- **Postural transition** and **coordination of muscle activity** to achieve postural stability.

*(Millington, et al., 1992; Ganea. Et al., 2011)*

- Important indicator of daily-life **functional independence** and **mobility**. *(Schenkman et al., 1991)*



Millington et al. (1992). Biomechanical analysis of the sit-to-stand motion in elderly persons. *Arch Phys Med Rehabil*, 73(July 1992):609-617.

Ganea et al. (2011). Multi-parametric evaluation of sit-to-stand and stand-to-sit transitions in elderly people. *Medical Engineering & Physics*, 33(2011):1086-1093.

Schenkman et al. (1990). Whole-body movements during rising to standing from sitting. *Physical Therapy*, 70(1990): 638-648.

# Introduction

Sit-to-stand  
(fundamental and frequent motion)

- Postural transition and coordination of

Visual observation to assess sit-stand transition balance

...ence and  
...y. (Schenkman et al., 1991)



Millington et al. (1992). Biomechanical analysis of the sit-to-stand motion in elderly persons. *Arch Phys Med Rehabil*, 73(July 1992):609-617.

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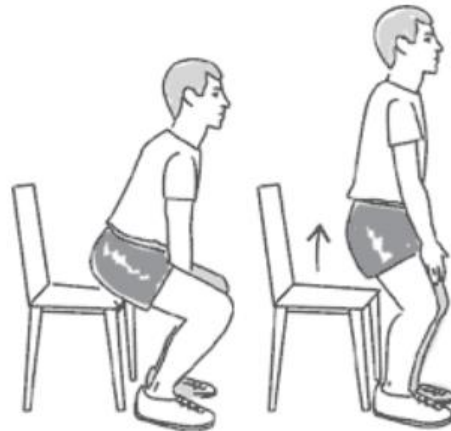
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# Introduction

Objective:

To **quantify** the subject's **postural stability in sit-to-stand transition** in response to barefoot and indoor slipper conditions



# 2. Methods

2.1 Participants

2.2 Footwear

2.3 Experimental protocol

2.4 Measure outcomes

# 2.1 Participants



- 10 healthy older females
- 60-67 years old
- BMI: 20.4-28.6
- Foot size: EU 35-38
- Without using walking aid
- Healthy feet

## 2.2 Footwear



### 1 Barefoot



### 2 Slipper

- Common indoor slipper style of local older woman
- **Open-toe** design
- A **strap** across the **dorsal** forefoot

## 2.3 Experimental protocol



① Positioned in an **armless** standard chair

② **Adjustable** seat height to position knee at  $90^\circ$  of flexion

③ Sat with their feet **shoulder width** apart

④ **Arms by the side** without touching their body



① Stand up, at the command “stand”



② **Stand still** for five seconds

③ **5 minutes** practice trial

④ **3 valid trials** of data

# 2.4 Measure outcomes

❖ Center of pressure (COP)

By Novel Pedar®

① COP excursion (mm)

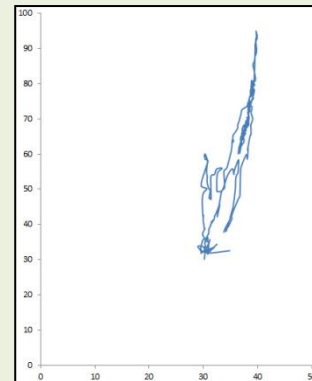
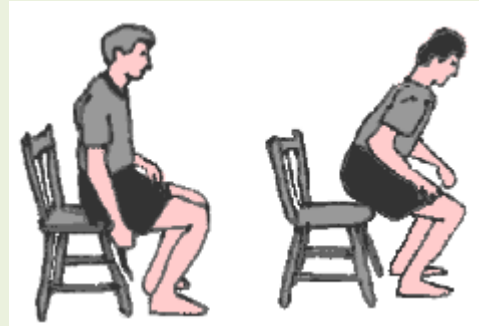


Antero-posterior (AP) range



Medio-lateral (ML) range

② COP sway length (mm) & mean COP velocity (mm/s)



# 3. Results and discussion

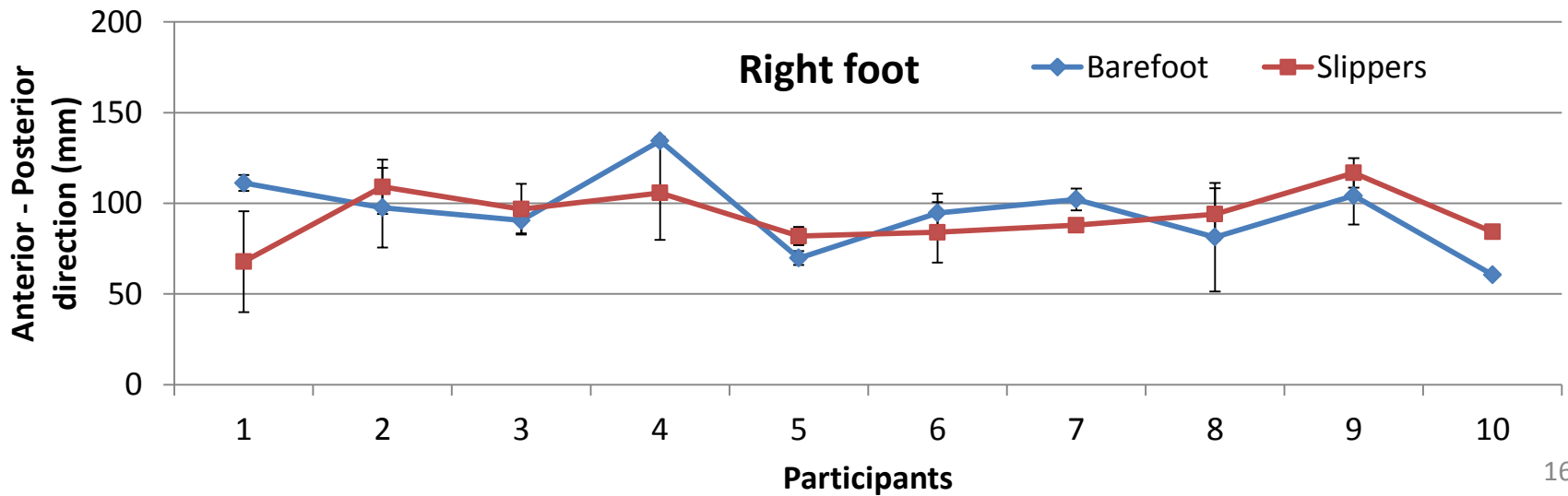
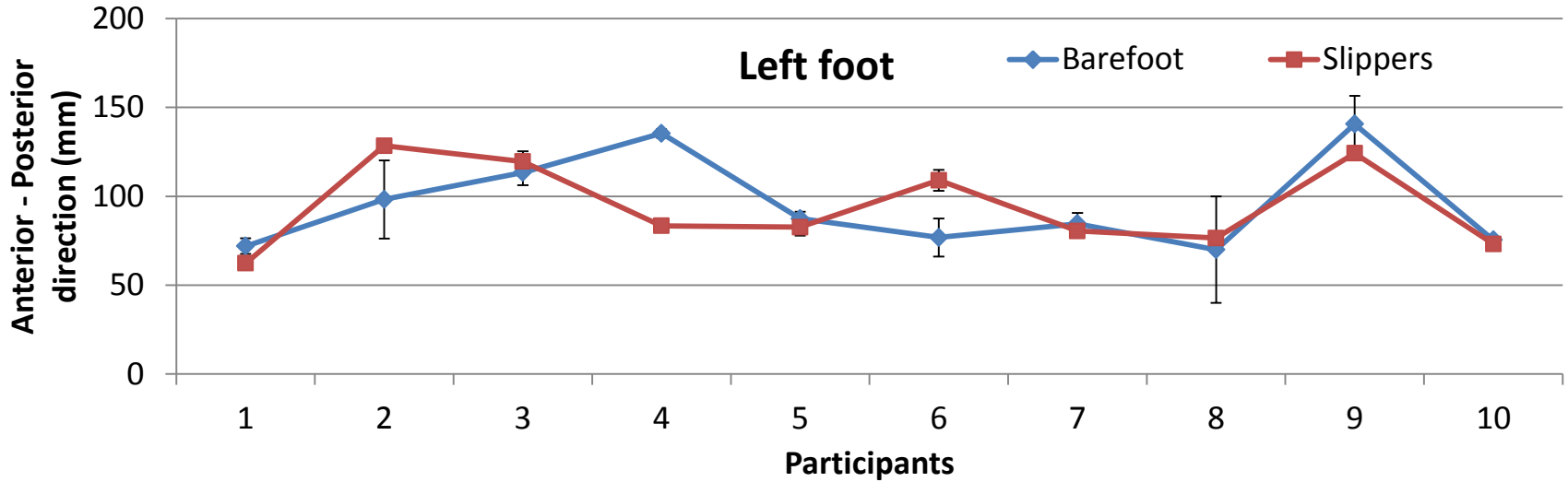
3.1 COP AP excursion

3.2 COP ML excursion

3.3 Sway length

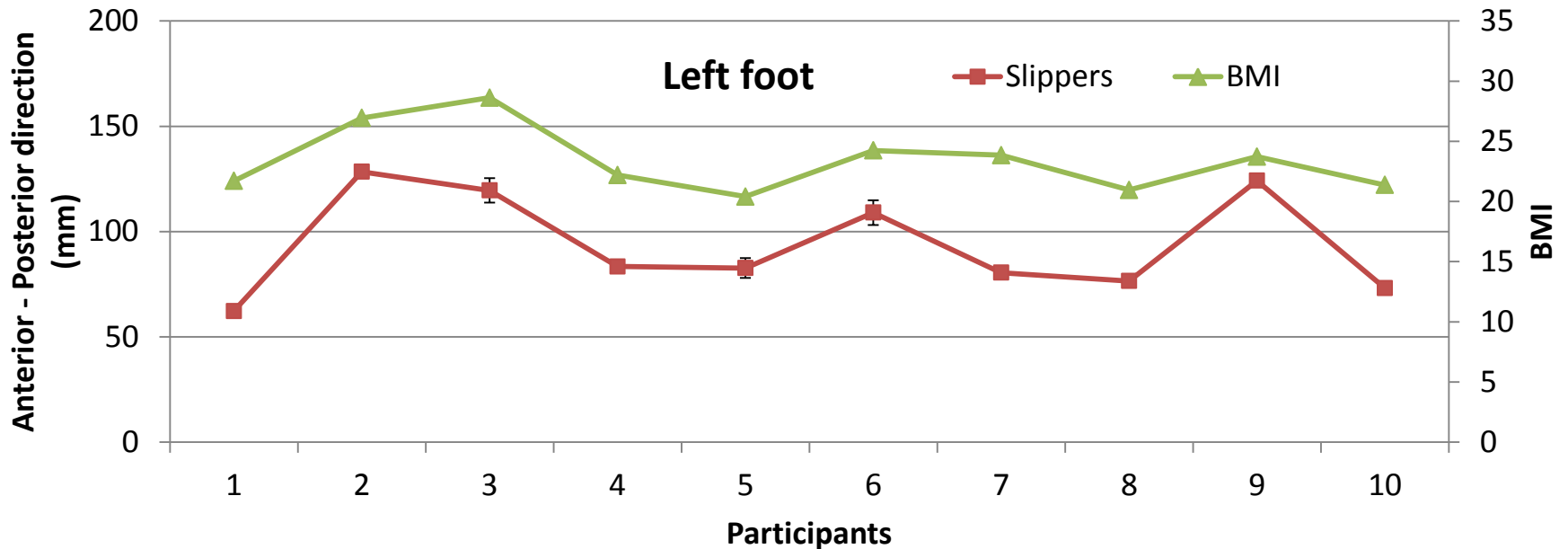
3.4 Mean velocity

# 3.1 COP AP excursion



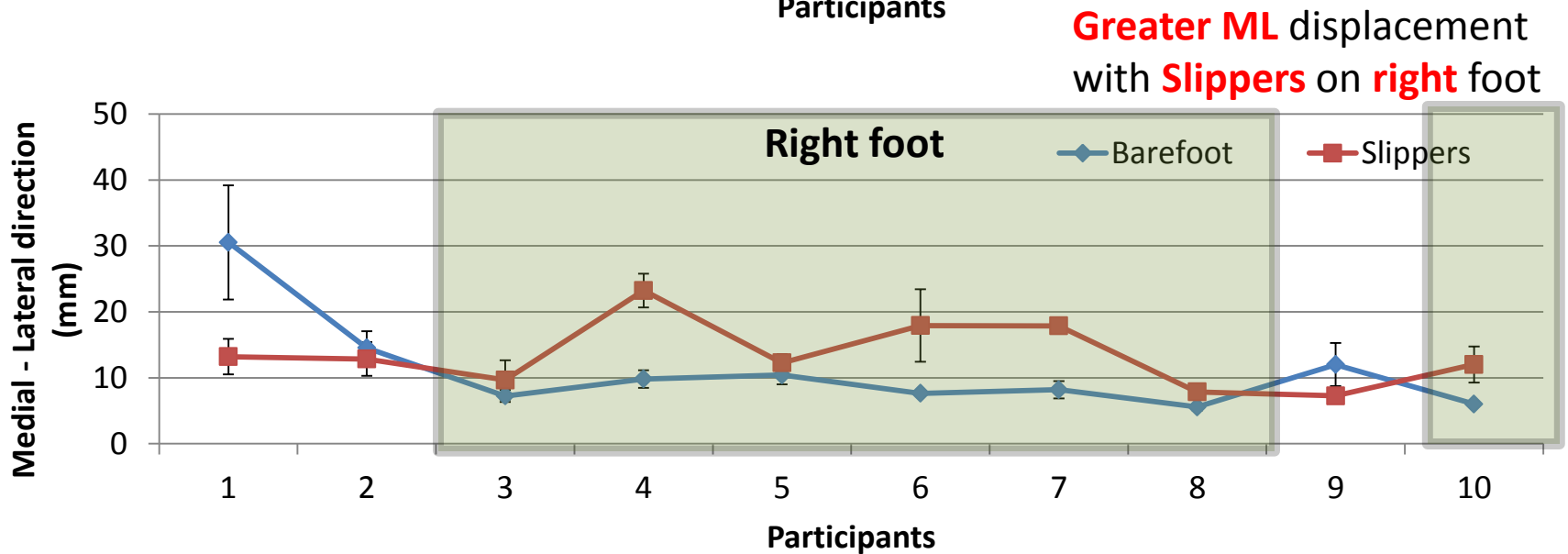
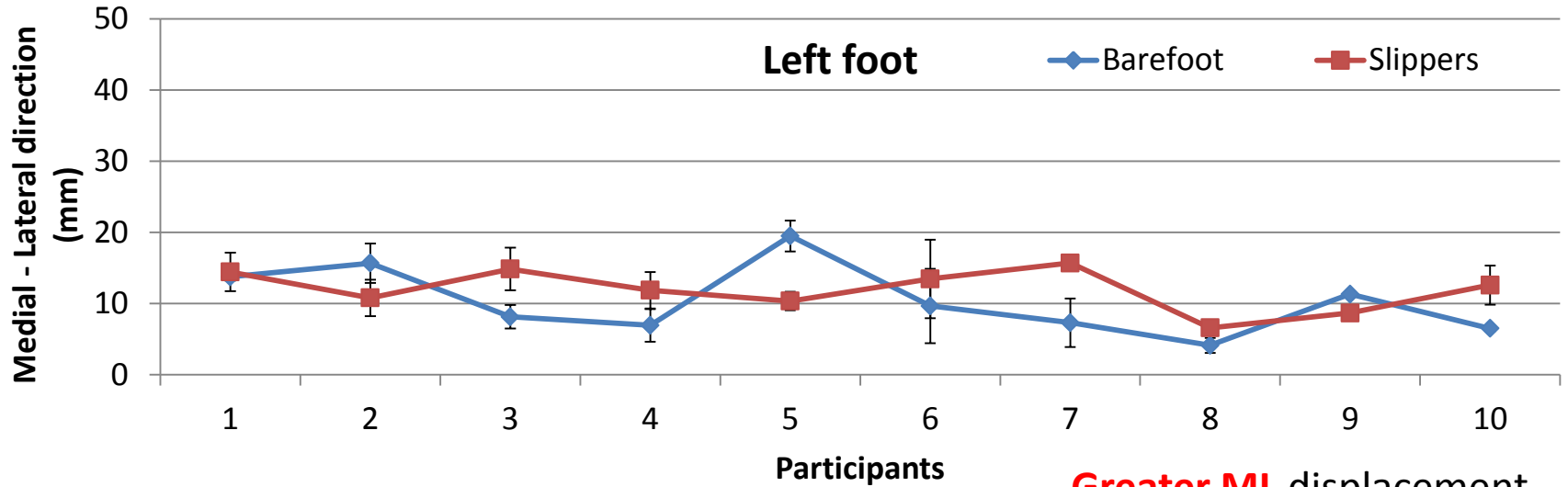


# 3.1 COP AP excursion

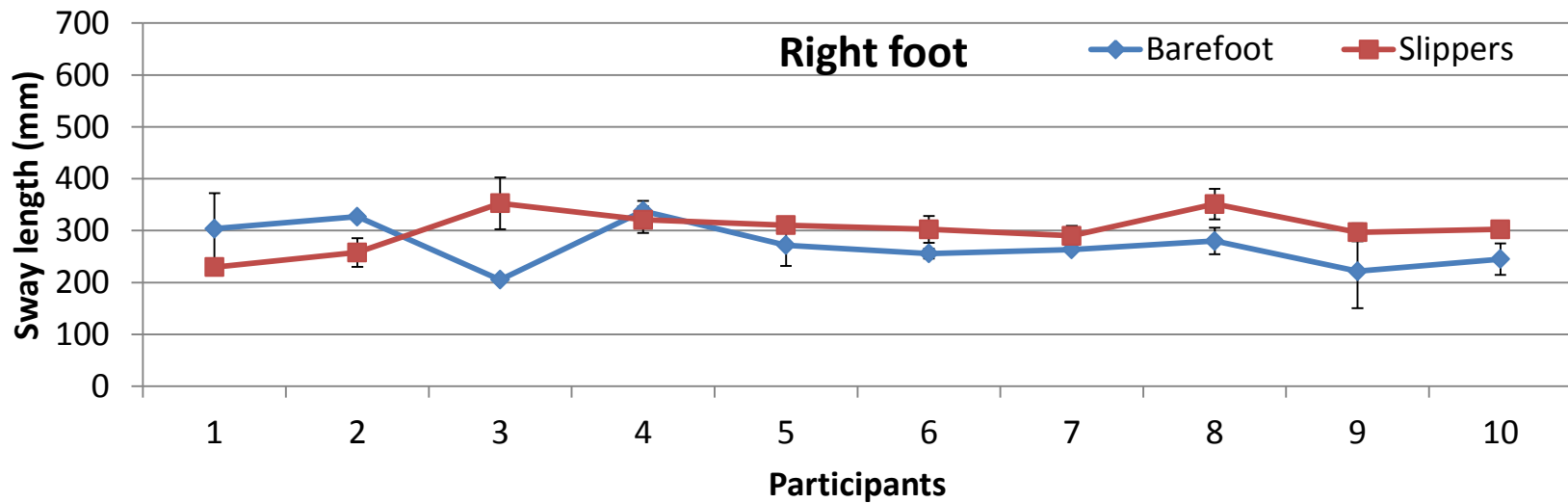
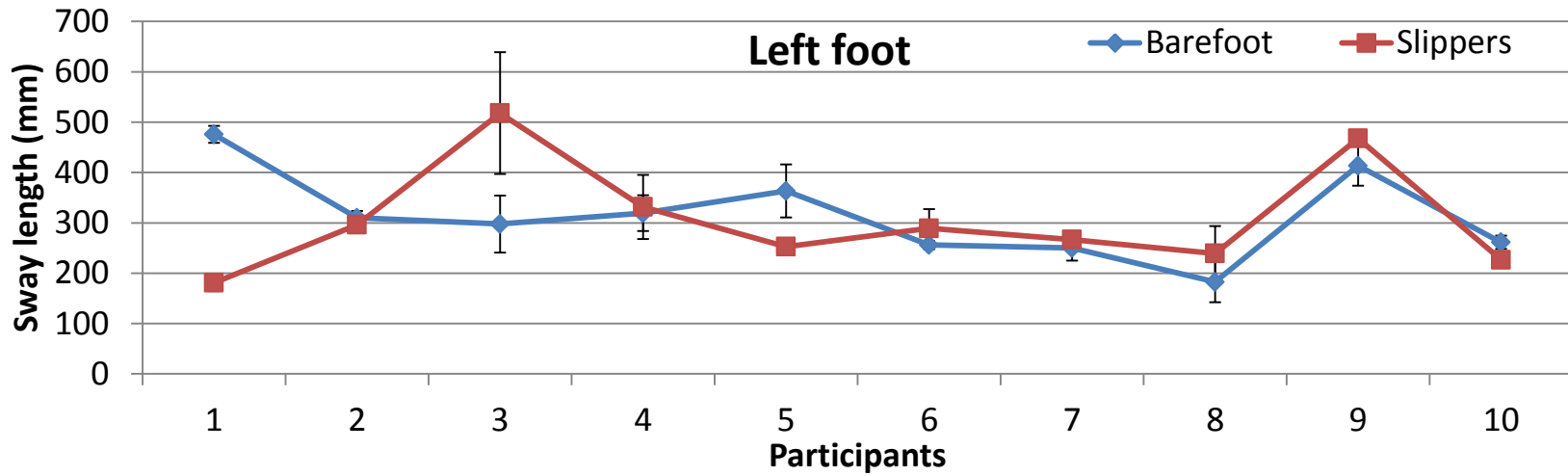


**Left side with slipper**  
**Higher BMI, greater AP displacement**  
 **$p < 0.05$**

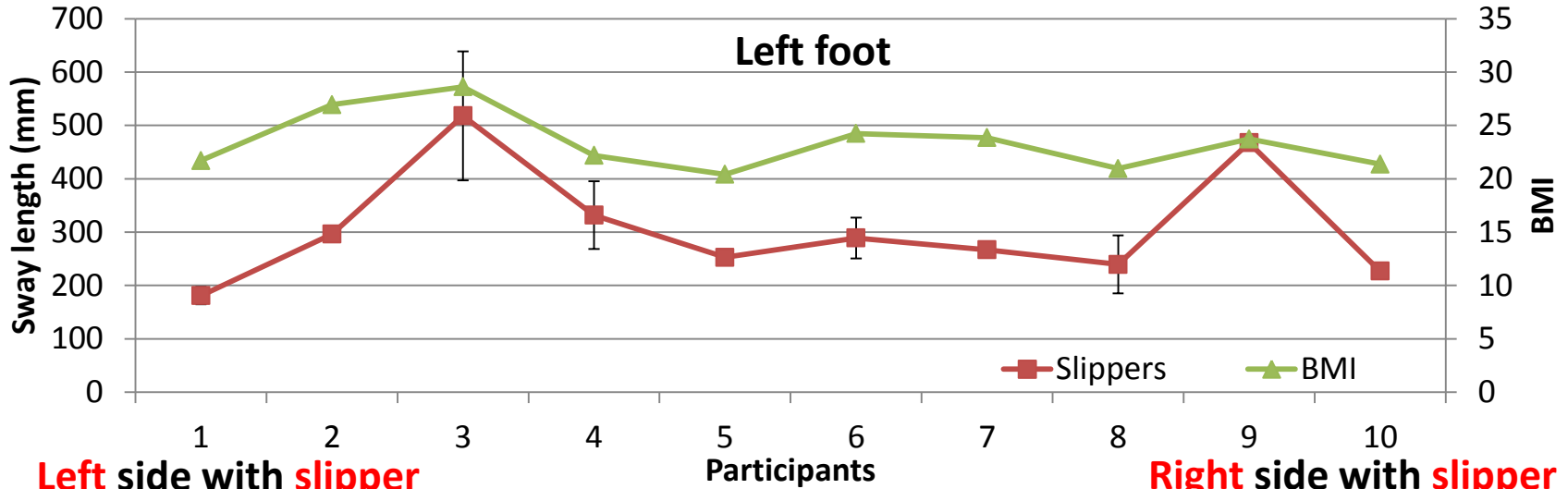
# 3.2 COP ML excursion



# 3.3 Sway length

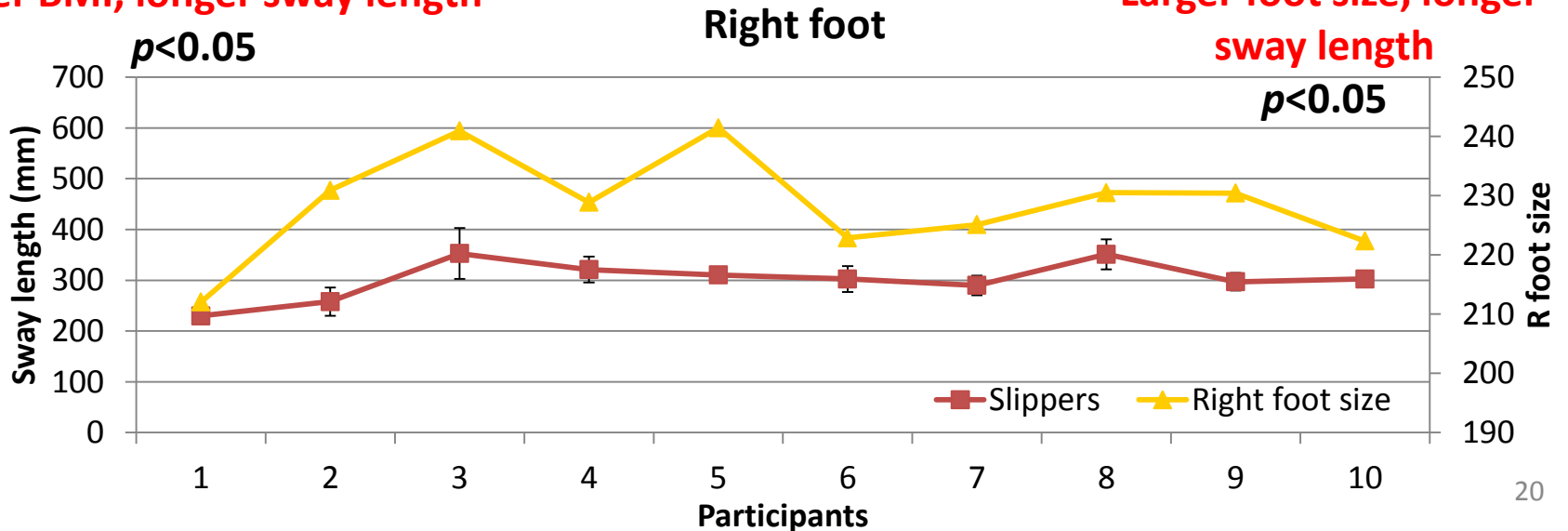


# 3.3 Sway length

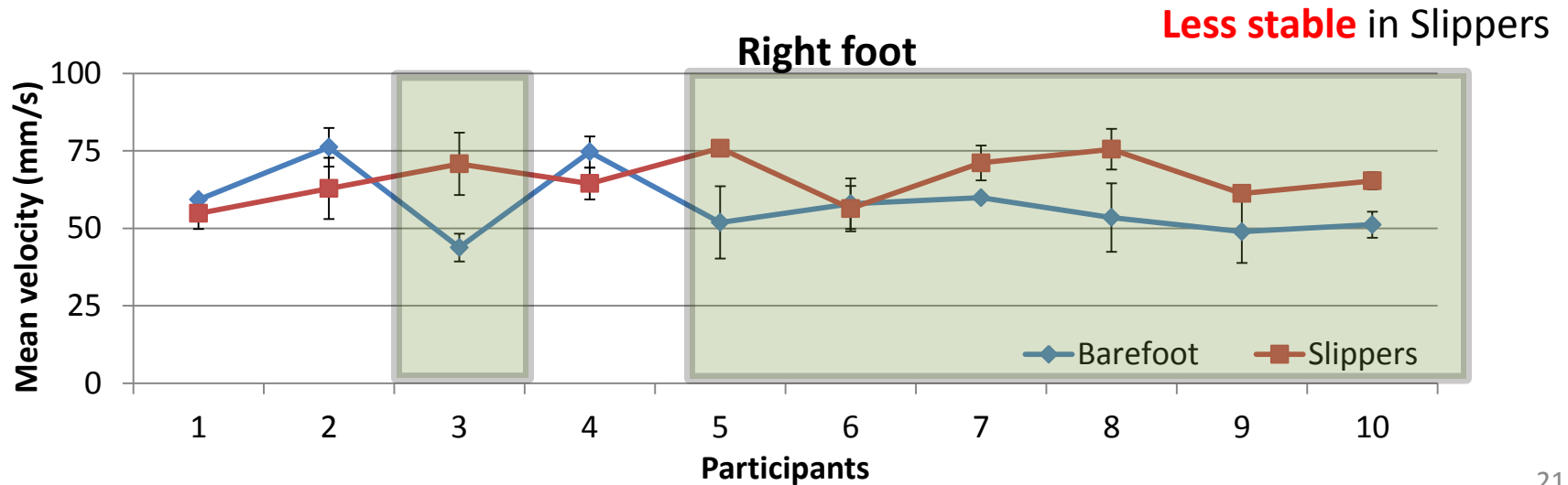
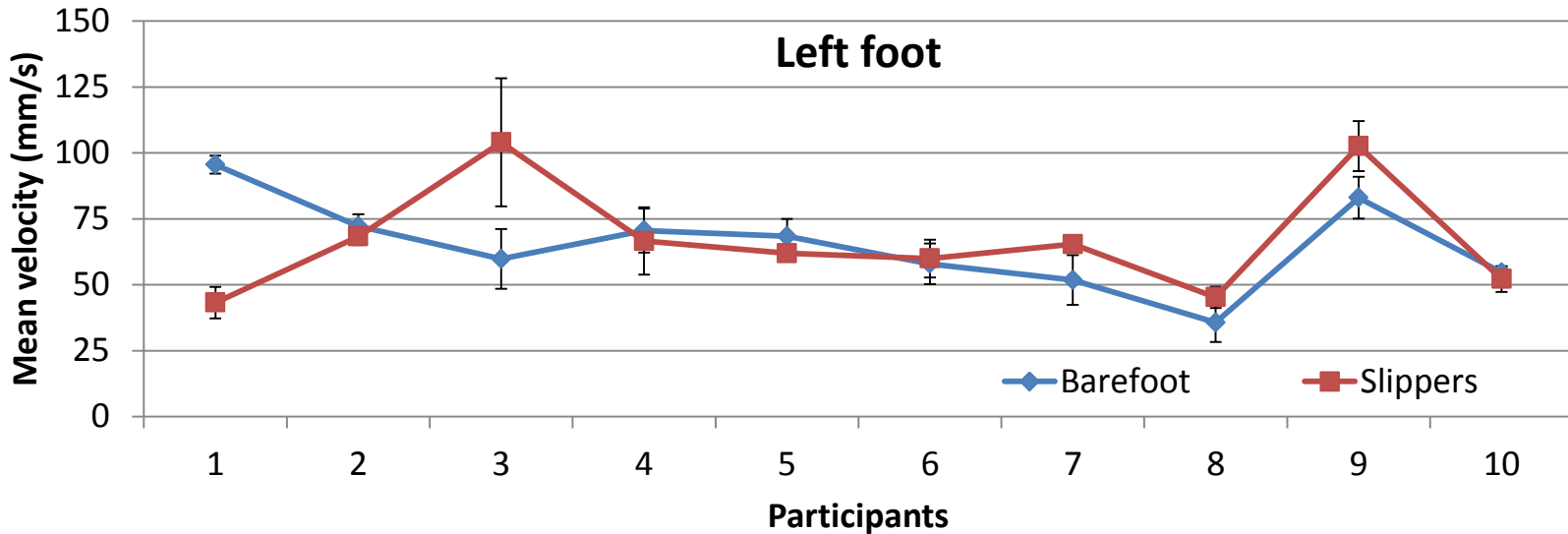


**Left side with slipper**  
**Higher BMI, longer sway length**

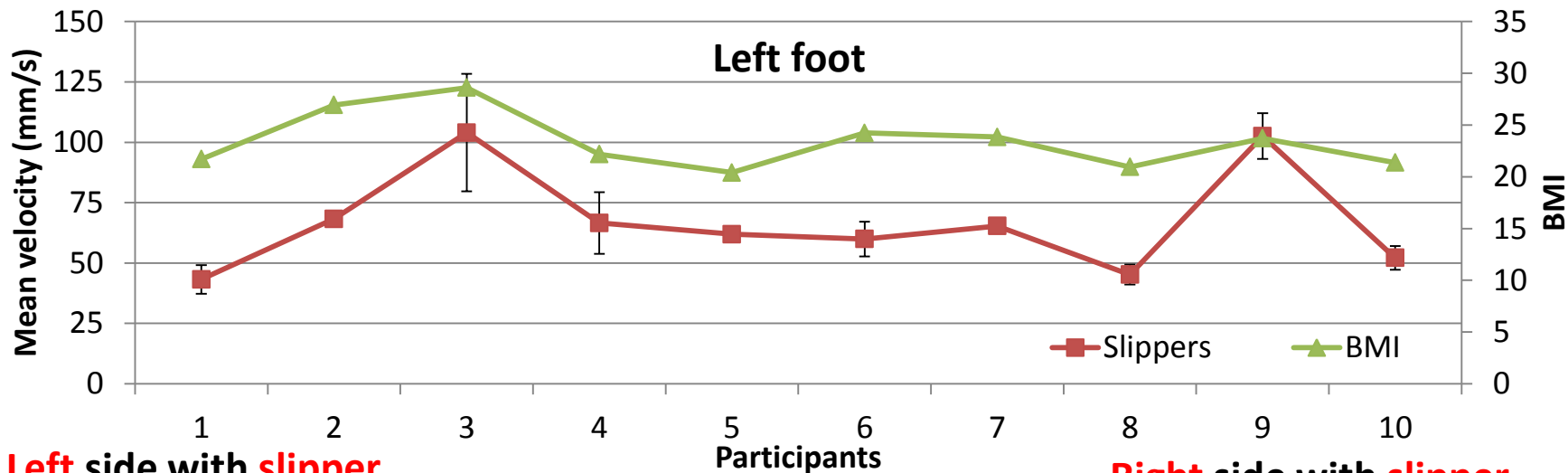
**Right side with slipper**  
**Larger foot size, longer sway length**



# 3.4 Mean velocity

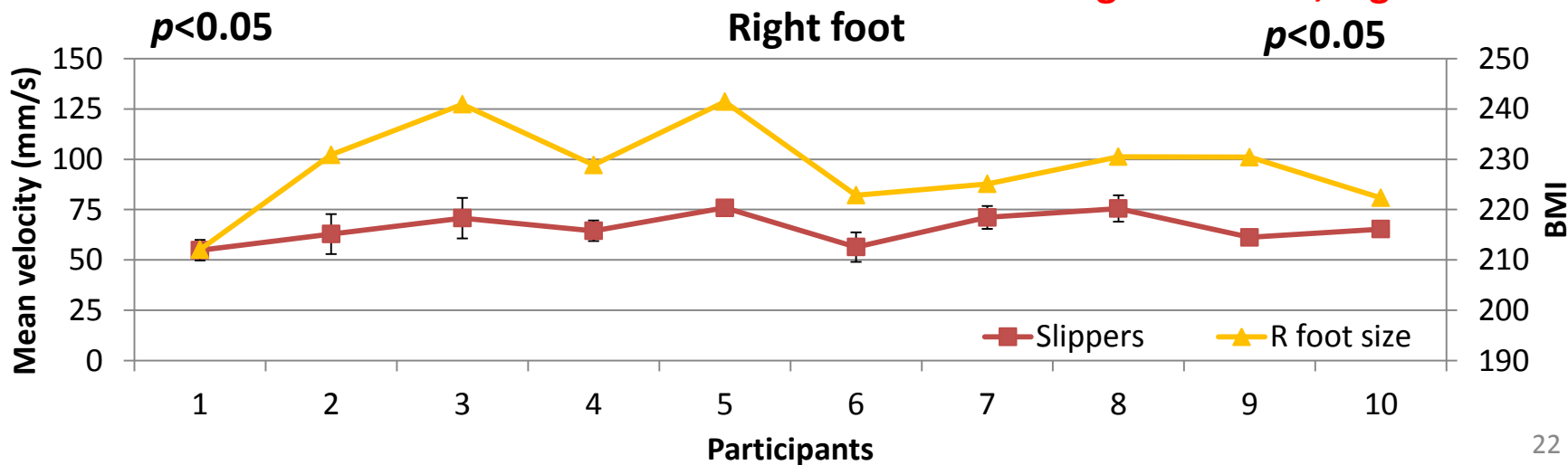


# 3.5 Mean velocity



**Left side with slipper**  
**Higher BMI, higher velocity**

**Right side with slipper**  
**larger foot size, higher velocity**



# 4. Conclusion

# 4. Conclusion and suggestion

- Slippers VS BF: **No significant difference** found in AP and ML direction, sway path and sway velocity.
- **Left** foot with slipper **positively correlated** with **BMI** in AP, sway length and velocity.
- Right foot with slipper **positively correlated** with **foot size**, sway length and velocity.
- Slippers **without fixation** on hindfoot **may not able** to **improve** postural stability during sit- stand movement.
- Indoor slippers **interventions/ design** associated with **improved postural stability** in older adults should be developed and investigated.



# Acknowledgment

- Departmental Grant of Institute of Textiles and Clothing, The Hong Kong Polytechnic University (PolyU G-UA1X).

# References

- [1]. Hornbrook, M., Wingfield, D., Stevens, V., Hollis, J., & Greenlick, M. (1991). Falls among older persons: Antecedents and consequences. In R. Weindruch, E. Hadley, & M. Ory, *Reducing Frailty and Falls in Older Persons* (pp. 106-125). Springfield: Charles C Thomas.
- [2]. Koepsell, T., Wolf, M., Buchner, D., Kukull, W., Lacroix, A., Tencer, A. (2004). Footwear style and risk of falls in older adults. *Journal of the American Geriatrics Society*, 52(9), 1495-1501. doi: 10.1111/j.1532-5415.2004.52412.x
- [3]. Menz, H., Morris, M., Lord, S. (2006). Footwear characteristics and risk of indoor and outdoor falls in older people. *Gerontology*, 52(3), 174-180. doi: 10.1159/000091827
- [4]. Millington, P.J., Myklebust, B.M., Shambes, G.M. (1992). Biomechanical analysis of the sit-to-stand motion in elderly persons. *Arch Phys Med Rehabi*, 73(July 1992):609-617.
- [5]. Ganea, R., Paraschiv-Ionescu, A., Bula, C., Rochat, S., Aminian, K. (2011). Multi-parametric evaluation of sit-to-stand and stand-to-sit transitions in elderly people. *Medical Engineering & Physics*, 33(2011):1086-1093.
- [6]. Schenkman, M., berger, R., Riley, P. Mann R., Hodge, W. (1990). Whole-body movements during rising to standing from sitting. *Physical Therapy*, 70(1990): 638-648.

END

Thank you for your kind attention



# TA muscle activation

Ready to stand



Standing still

