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Assessing balance abilities of healthy adults on an outdoor fitness and leasure trail

Böni AC[1,2], Singh NB[1], Taylor WR[1], Ravi DK[1].
[1]Institute for Biomechanics, ETH Zürich; [2]Health Department, Bern University of applied Sciences

1. Introduction

Impaired balance increases the **risk of falling** [Avin et al. 2015], which is the **leading cause of injuries** in the European Union [EuroSafe 2016].

Clinical and laboratory assessments may not capture risk of falling in an outdoor scenario [Handelzalts et al. 2020].

Objective

Feasability of assessing balance abilities of healthy adults on an outdoor fitness trail using wearables

Vision

Instrumentalizing outdoor fitness trails to identify fall risks in adults

2. Methods

Included were **healthy** adults between the **age 18-30 and 50-70**.

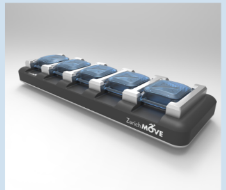
Participants were instructed to **walk (~2.3km)** through an outdoor fitness trail and to execute **7 different dynamic balance exercises.**

Pelvis Inertial Measurement Unit data were filtered and manually segmented before **smoothness, intensity, and stability** parameters were calculated. [Angelini et al. 2019]

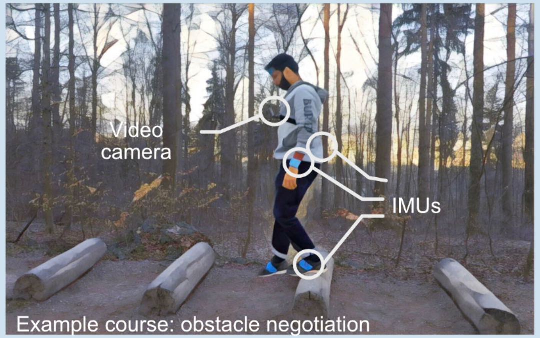
Effects of age-group and exercises were statistically tested with n-way anova, significance was set at 0.05.

3. Materials

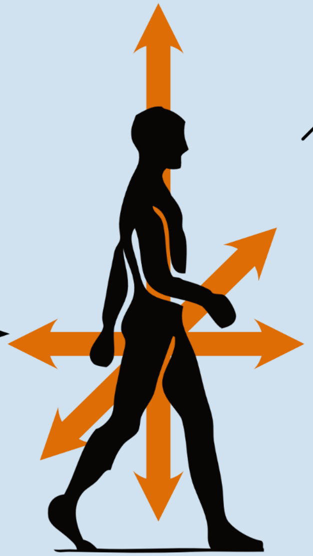
Outdoor fitness trail



Inertial Measurement Units (IMUs)



Outdoor balance assessment and training system



Anterior-Poster (AP), Medio-Lateral (ML), Vertical (V)

Smoothness (RMS Jerk)

Intensity (RMS Acc)

Stability (RMS Acc / RMS Mag)

RMS = root mean squared, Acc = Acceleration, Mag = Accerleration magnitude all axes

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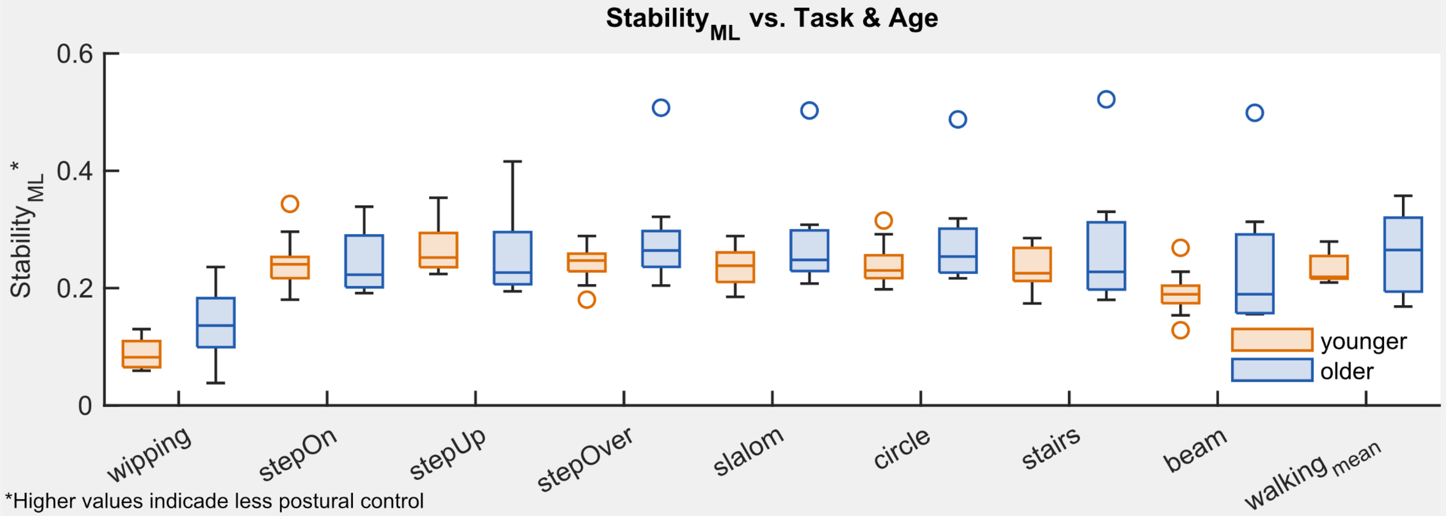
4. Results

After two **exlusions**, **19** participants were included (**older 8, younger 11, 68% female**). The **mean age** of the groups were **60±5** and **27±3 years**.

Significant effects of **age** and **task** on **Intensity** and **Stability**, with no significant interactions.

Smoothness was **significantly influenced** by **task** but **not** by **age.**

Effects	Tasks P-Value (AP,ML,V)	Age P-Value (AP,ML,V)
Smoothness	<.001, <.001, <.001	0.97, 0.37, 0.64
Intensity	<.001, <.001, <.001	0.003, 0.001, <.001
Stability	<.001, <.001, <.001	<.001, <.001, <.001



*Higher values indicade less postural control

5. Discussion

Stability and Intensity on every axis **may detect balance differences** in age and task on an outdoor fitness trial.

The non-significant **effects** of age on **smoothness** could be explained by **the arrest intervals of jerk** [Hogan et al. 2009].

Limitations are the **uneven** age and sex **distribution** and **unaccounted environmental & exercise factors**.

Further **indepth analysis** is needed that allow a **prediction of overall balance ability** from wearable technologies.

6. Conclusion

- ***Balance abilities can be measured with wearable sensors on an oudoor fitness trail***
- ***Zurich Vitaparcours® provides a vivid research environment***

7. Aknowledgement

Special thanks to Barbara Baumann from radix®, who provided information and consent for Zurich Vitaparcours®.