



UNIVERSITY OF TECHNOLOGY
IN THE EUROPEAN CAPITAL OF CULTURE
CHEMNITZ

Science & Cycling 2023

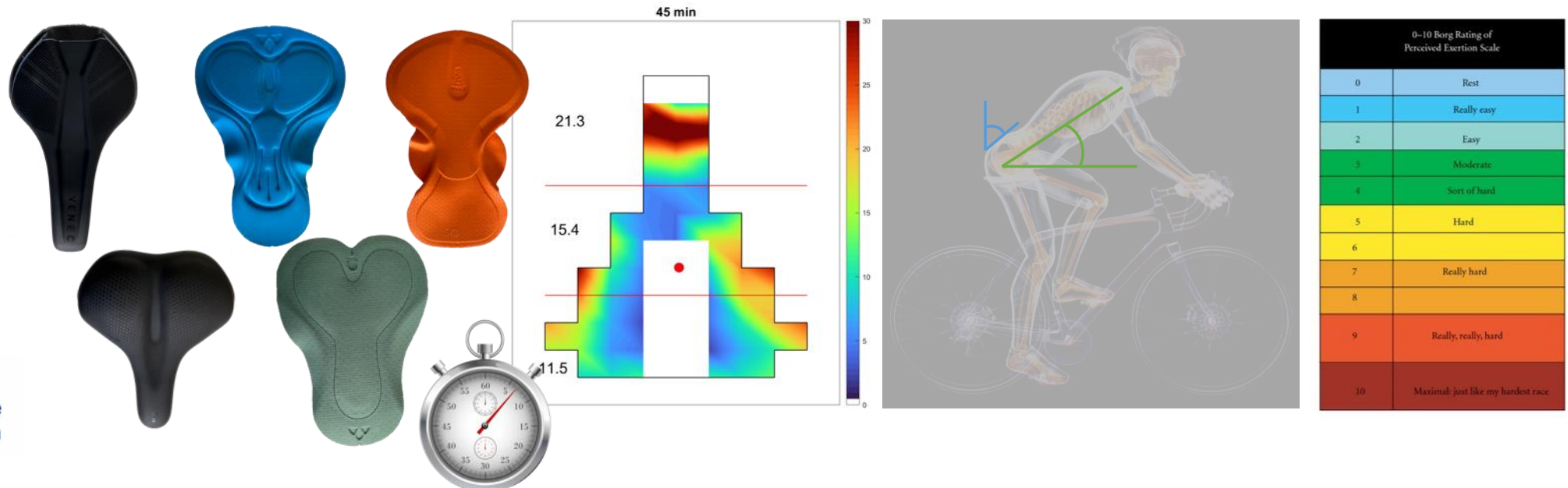
Stefan Schwanitz, Sophie Richter & Frank I. Michel



i-lab
LET'S DO FUTURE



Effects of test duration on pressure distribution, pelvic stability, and subjective perception in laboratory investigations for evaluating bicycle saddles and seat pads



Introduction

Background

- Seat pads provide support and comfort at the interface with the bicycle saddle
- Different saddle designs influence sitting posture and comfort during cycling

Bressel, E., & Larson, B. J. (2003). Bicycle seat designs and their effect on pelvic angle, trunk angle, and comfort. *Medicine and science in sports and exercise*, 35(2), 327-332

- Larsen et al. (2019) reported increased discomfort after one hour of cycling among professional female cyclists

Larsen, A., Hansen, E. A., & Madeleine, P. (2019). Effects of cycling shorts padding on perceived discomfort and saddle pressure distribution among female cyclists in laboratory conditions. *Journal of Sports Sciences*, 37(4), 431-438.



Introduction

Research question

How does the evaluation of seating systems in cycling, including seat pads and saddle designs, change over a ride time of up to 60 minutes for non-professional male and female cyclists?



Materials & Methods

Test design

- KICKR bike (Wahoo, Atlanta, United States) adjusted to match subject's anatomy and achieve a 50° trunk lean angle
- Cube Venec saddle (Pending System GmbH & Co. KG., Waldershof, Germany) in two widths
- Subjects wore their preferred cycling pants during the test
- Pedalling resistance set to 70% FTP, cadence of 80 rpm
- Duration 60 minutes while maintaining the position
- Data recorded at 3, 15, 30, 45, and 60 min of test duration



Materials & Methods







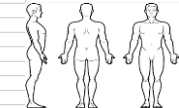
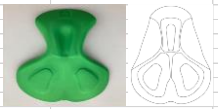
Participants



n=7
 age: 31.5 ± 4.1 years
 body weight: 61.7 ± 5.2 kg
 height: 167.3 ± 3.2 cm
 FTP: 195.3 ± 10.5 W



n=6
 age: 39.5 ± 8.2 years
 body weight: 80.5 ± 5.4 kg
 height: 181.8 ± 4.6 cm
 FTP: 281.6 ± 17.7 W

TRAINING DATA			
1. Your biking classification?	<input type="checkbox"/> Untrained <input type="checkbox"/> Recreationally trained <input type="checkbox"/> Trained <input type="checkbox"/> Well trained <input type="checkbox"/> Professional		
2. What kind of sport on a regular base?	1. _____ 2. _____ 3. _____		
3. Which cycling discipline?	<input type="checkbox"/> Trail <input type="checkbox"/> Roadbike <input type="checkbox"/> Enduro <input type="checkbox"/> Cross country <input type="checkbox"/> Gravel/Cydo cross <input type="checkbox"/> Day touring <input type="checkbox"/> Travel <input type="checkbox"/> I don't bike.		
4. Please fill accordingly.	<input type="checkbox"/> Trail <input type="checkbox"/> Roadbike <input type="checkbox"/> Enduro <input type="checkbox"/> Cross country <input type="checkbox"/> Gravel/Cydo cross <input type="checkbox"/> Day touring <input type="checkbox"/> Travel	Competition (yes/no)? _____ Years? _____ How often per month _____ Km/ride _____	
5. Which hand position do you prefer?	<input type="checkbox"/> Tops  <input type="checkbox"/> Hoods  <input type="checkbox"/> Drops 		
6. Preferred seating position?	<input type="checkbox"/> Upright (70-90°)  <input type="checkbox"/> Sporty (50-70°)  <input type="checkbox"/> Roadbike (30-50°) 		
7. What do you wear below the tights?	<input type="checkbox"/> Underwear <input type="checkbox"/> Nothing		
ANAMNESIS/INJURIES			
2. Have you experience any of these problems?	<input type="checkbox"/> Abrasion <input type="checkbox"/> Sit bone pain <input type="checkbox"/> Numbness <input type="checkbox"/> Saddle soreness/skin irritations <input type="checkbox"/> Other, please describe. _____		
<i>If yes on question 2:</i>			
3. When do you experience this problem? (eg. Discipline, weather, please describe)	_____		
4. Expected cause?	<input type="checkbox"/> Saddle <input type="checkbox"/> Seat pad <input type="checkbox"/> Seating position <input type="checkbox"/> Other: _____		
5. Mark in the figure the area of the problem			
			

Materials & Methods

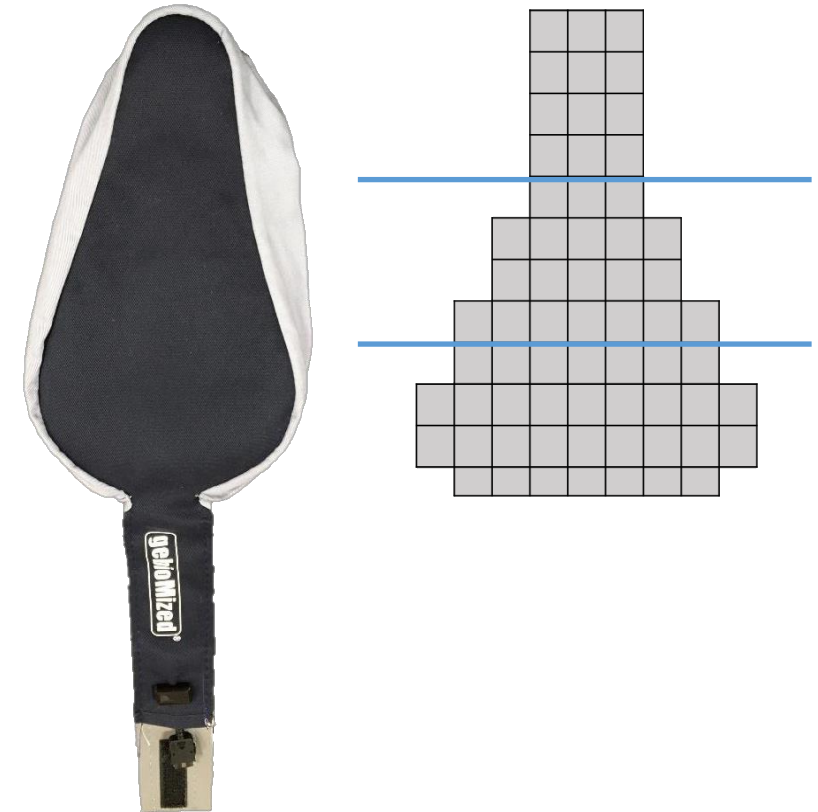
Pressure mapping

gebioMized system:

- 64 cells (8x8 mm each)
- 200 Hz
- 10 s recording time

Parameters:

- mean & peak pressure in 3 zones and overall
- centre of pressure range anterior-posterior & medial-lateral
- loaded area & total force (normalised to body weight)



Materials & Methods

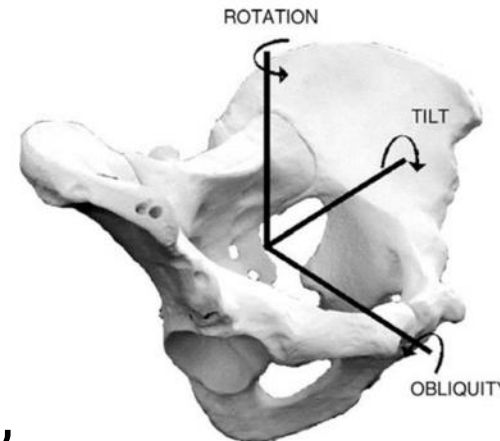
Kinematics of the pelvis

Myon inertial measurement unit (IMU)

- attached to the sacrum
- 256 Hz sampling frequency
- 10 s recording time
- on-board data processing outputs roll, pitch and yaw angle of the IMU

Parameters:

- mean pelvis tilt angle
- range of motion around all 3 axes



POTTER, J.J., J.L. SAUER, C.L. WEISSHAAR, D.G. THELEN und H.-L. PLOEG. Gender differences in bicycle saddle pressure distribution during seated cycling. *Medicine and science in sports and exercise*, 2008, 40(6), 1126-1134.

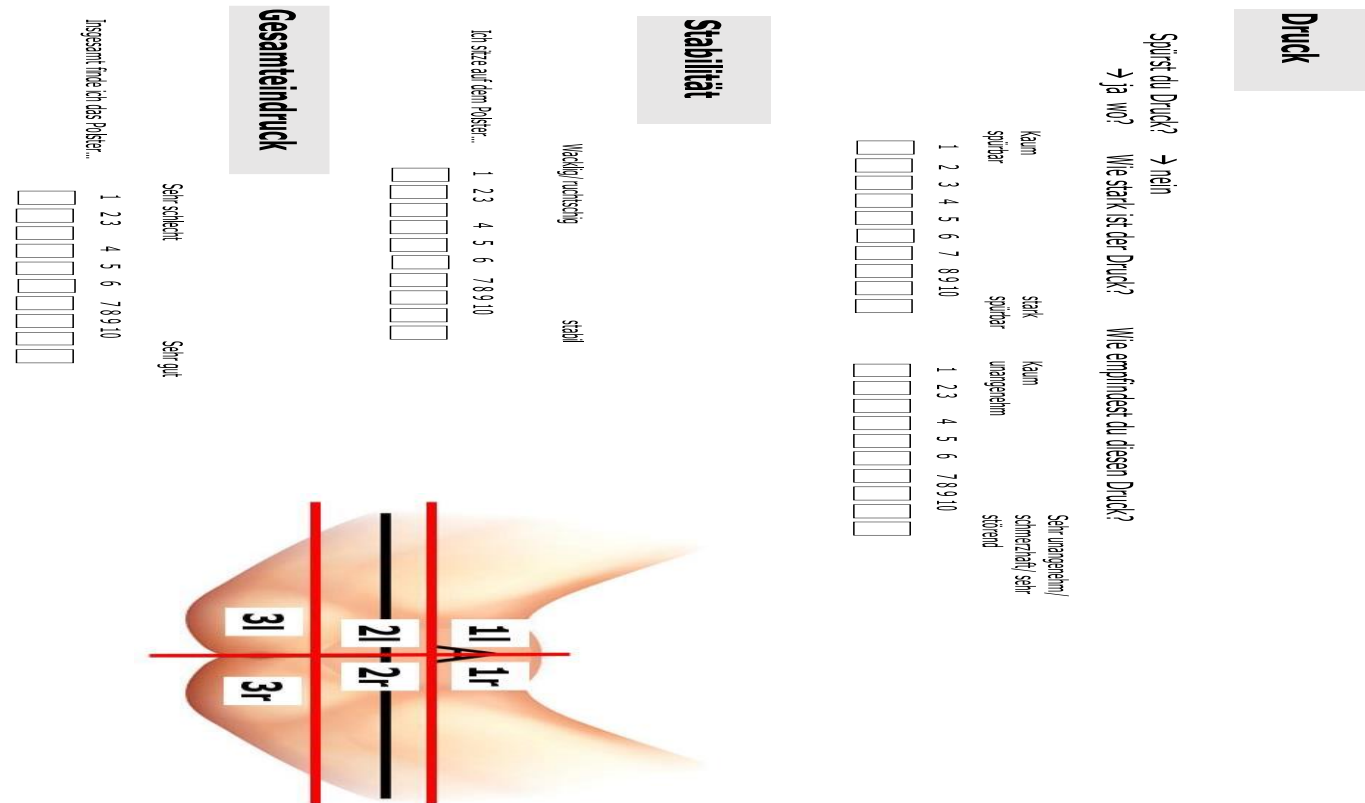


Materials & Methods

Subjective Evaluation

Parameters

- Localisation of the pressure area
- Pressure intensity
- Pressure sensation
- Stability
- Overall impression
- Rate of perceived exertion (BORG)



Materials & Methods

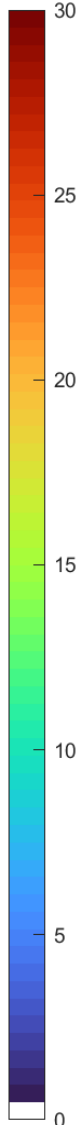
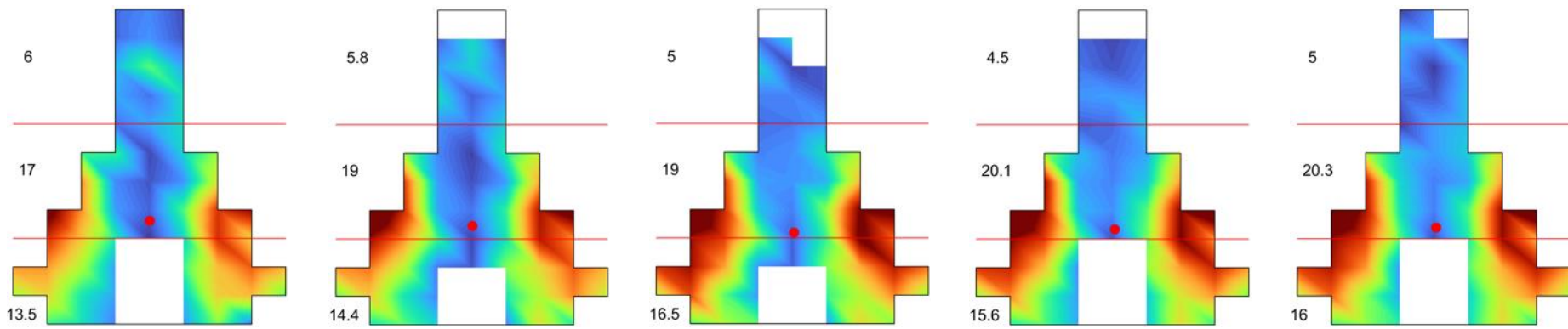
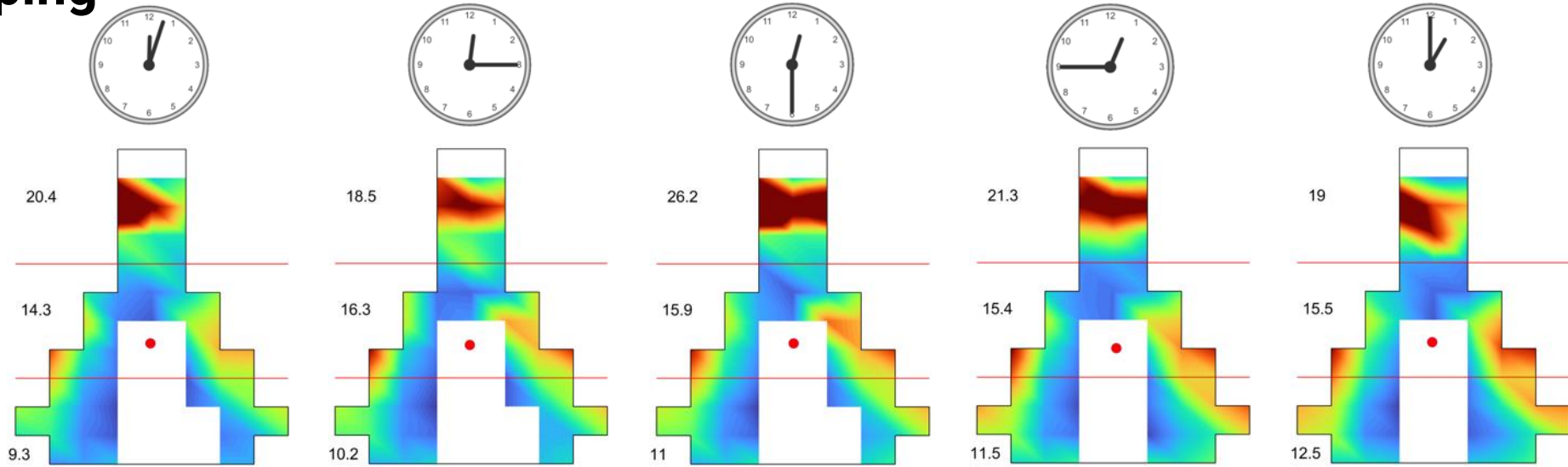
Data processing and statistics

- Time-series data were processed using Matlab (R2022b, The MathWorks Inc., Natick, United States).
- Statistical analysis was carried out with RStudio (version 1.3.1093, Posit PBC, Boston, United States).
 - Mann-Whitney-U-test for differences between females and males in terms of anthropometrics
 - Spearman's rank correlation coefficient ρ for correlations between test duration and pressure/ kinematic/ subjective variables
 - Friedman test & Bonferroni post-hoc test analysis for differences between time points



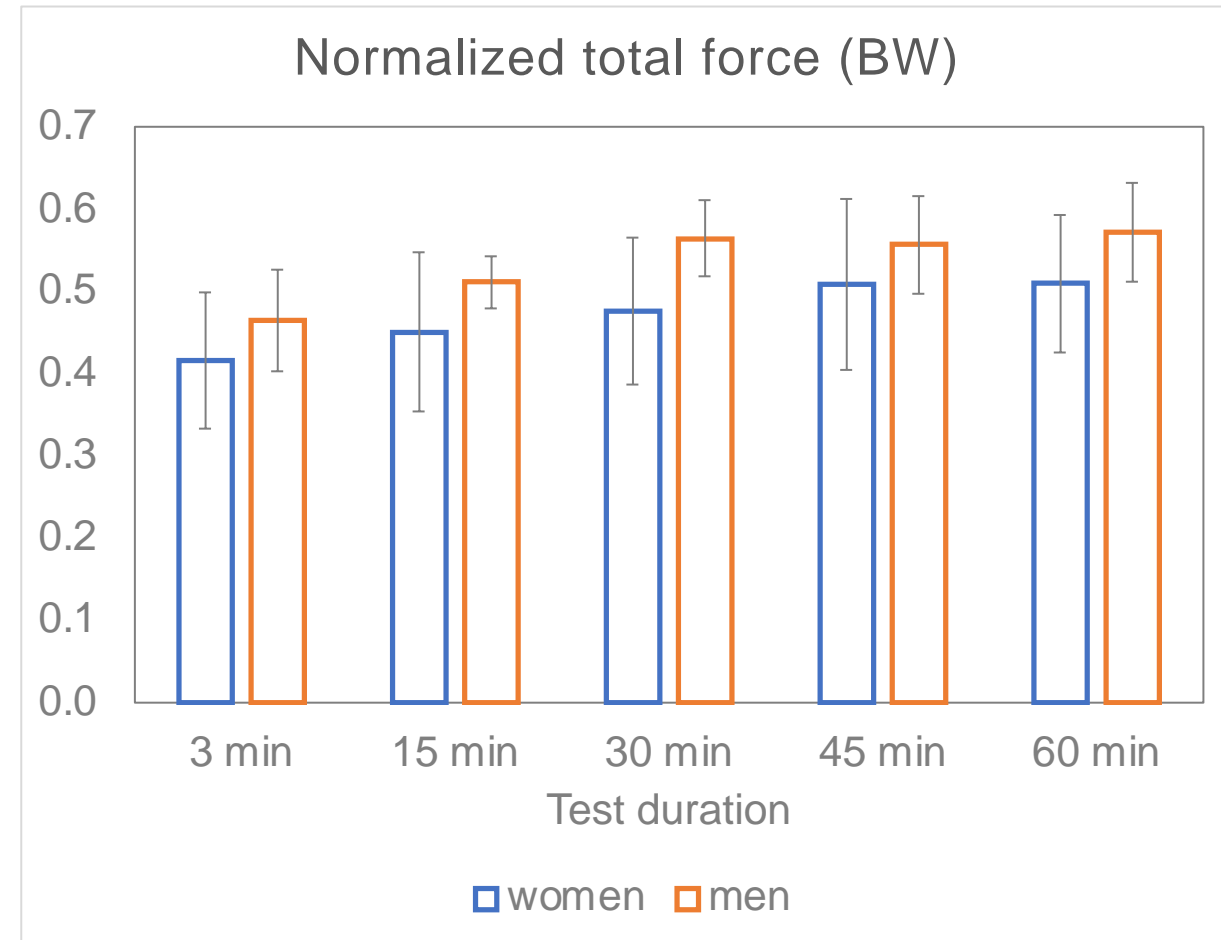
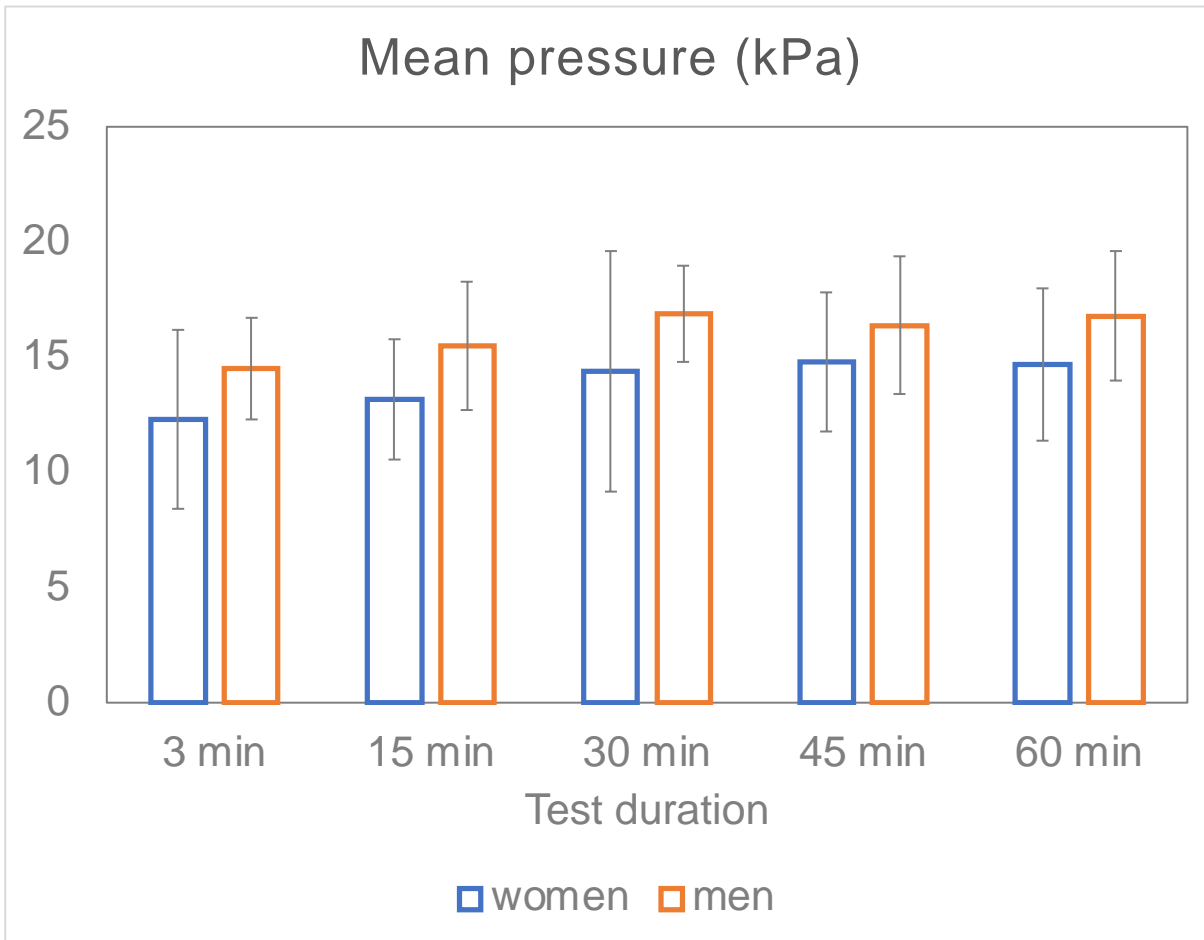
Results

Pressure mapping



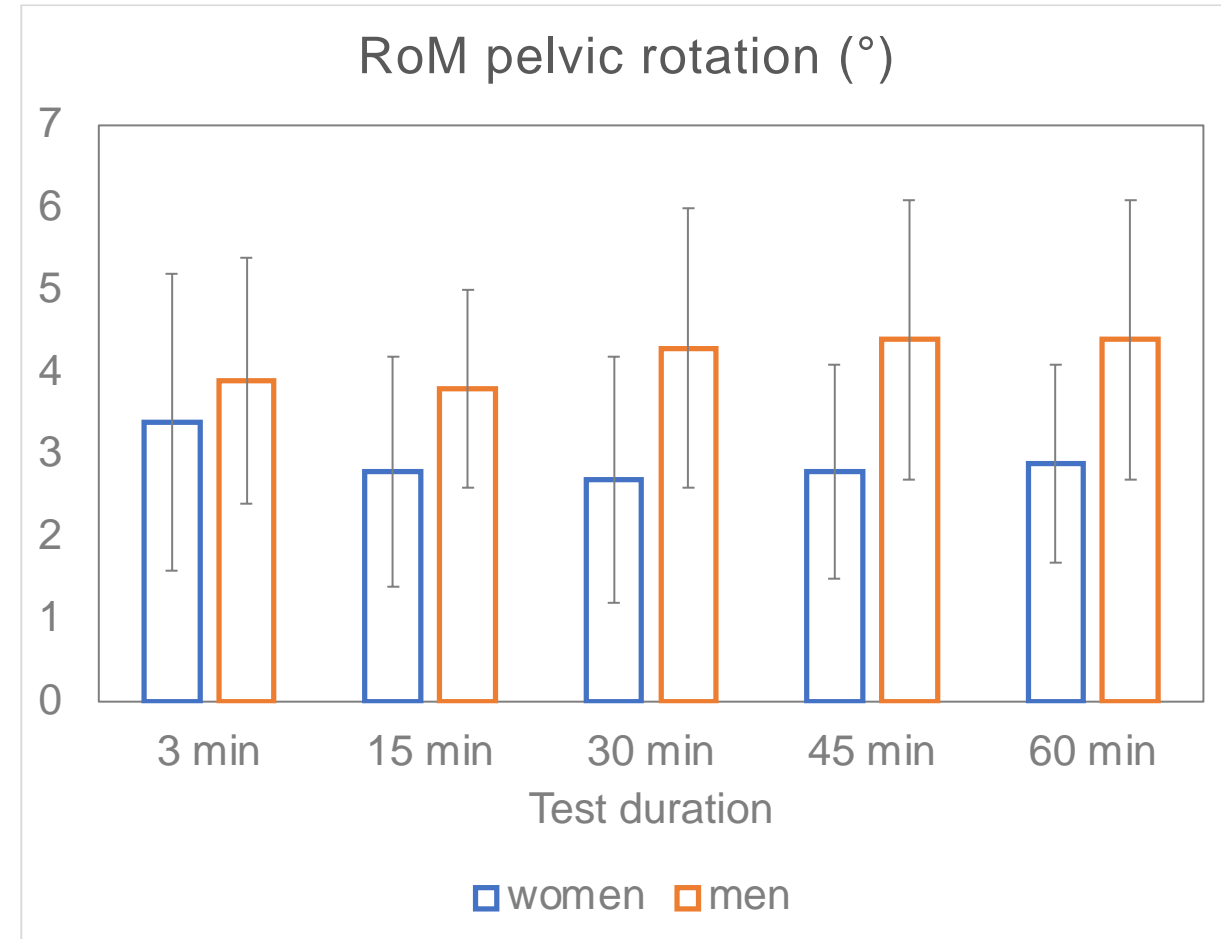
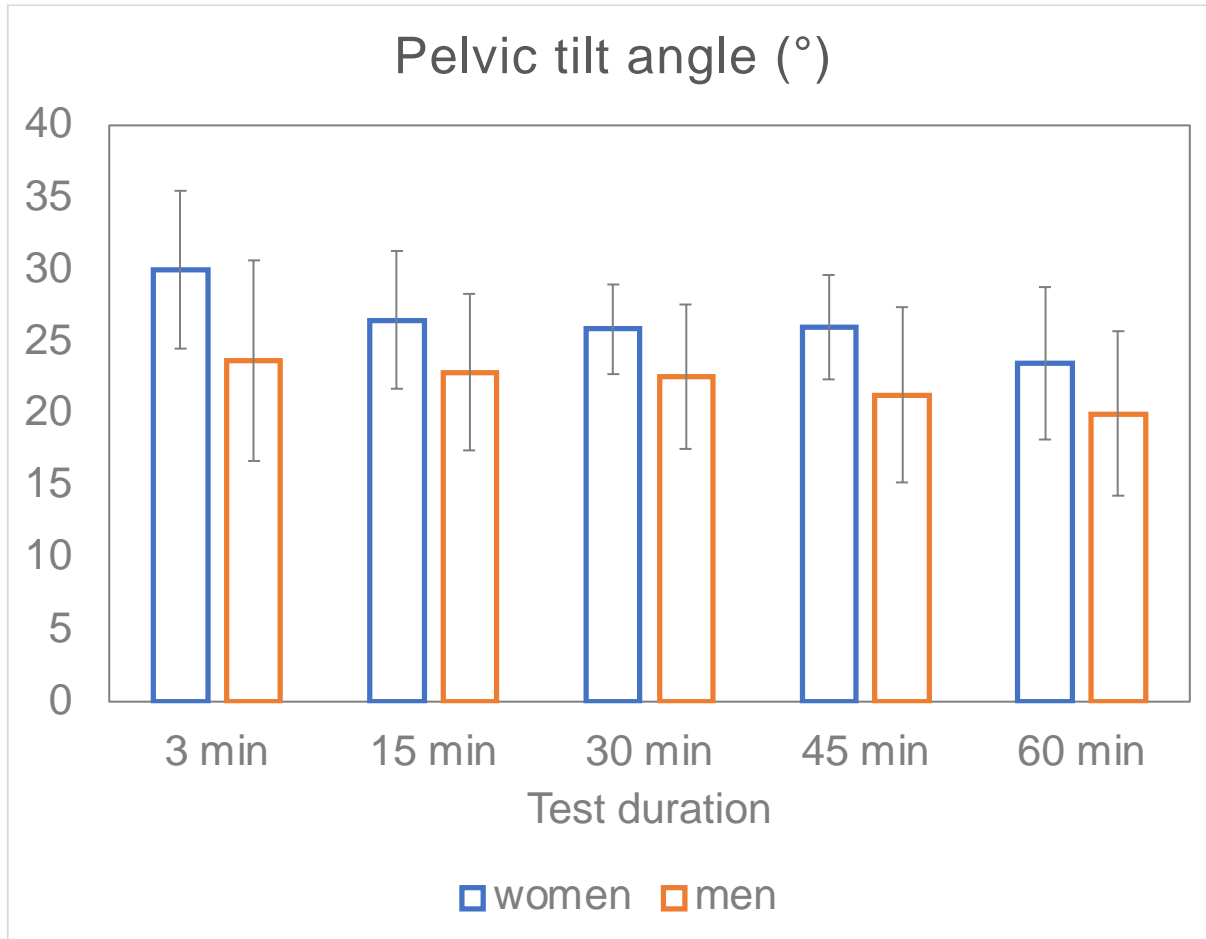
Results

Pressure mapping



Results

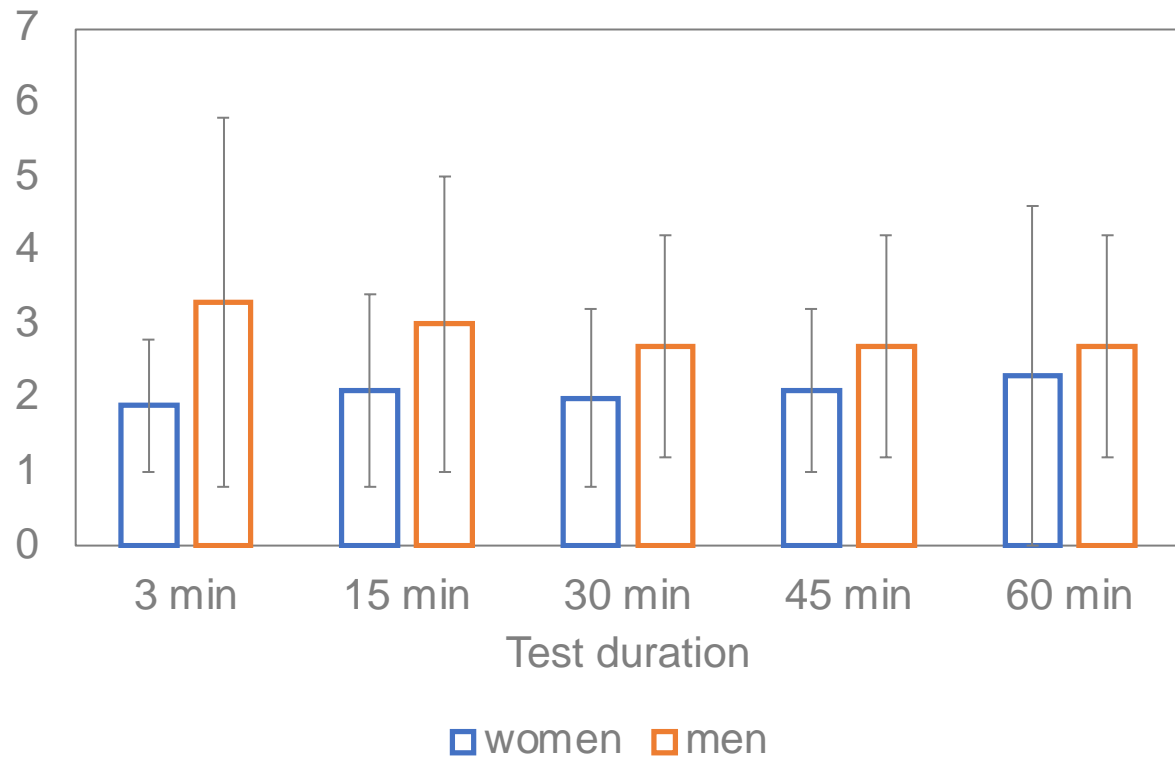
Kinematics of the pelvis



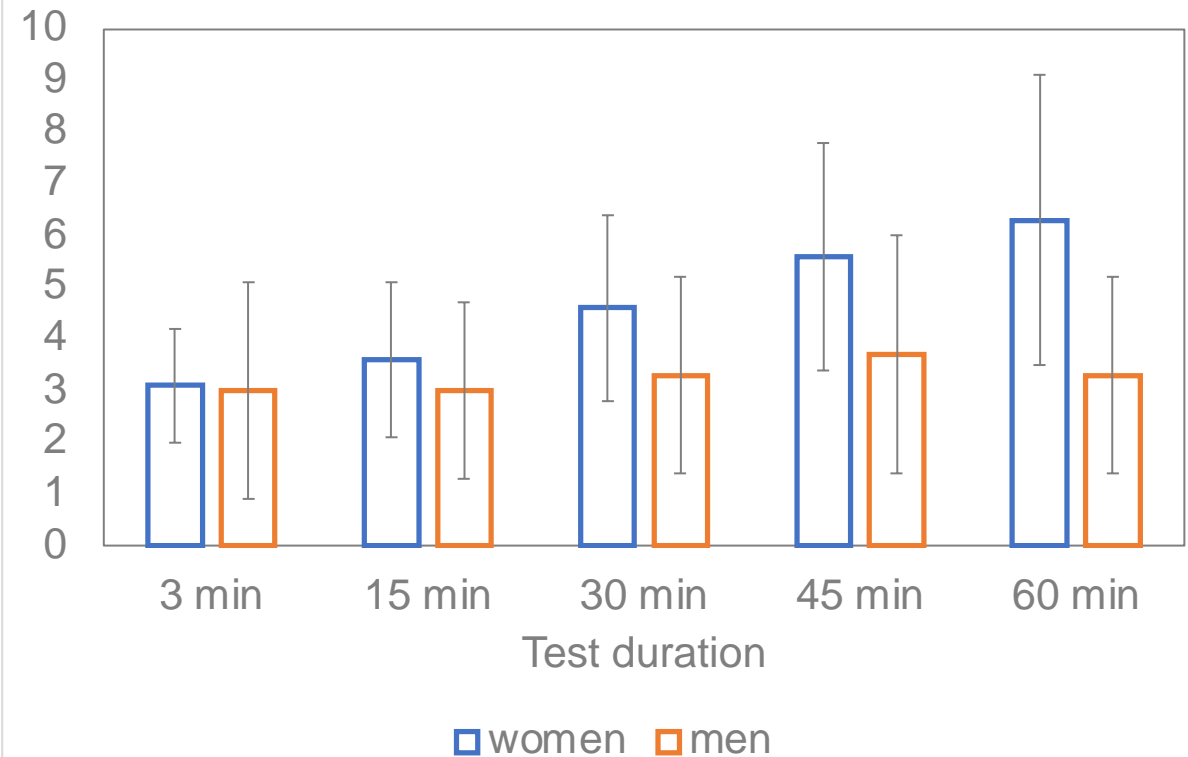
Results

Subjective Evaluation

Perceived stability of the seating position (1="stable"; 10 "wobbly")



Overall impression (1="very good"; 10 "very poor")



Discussion

Key findings

- weight shift towards the saddle & reduction of the pelvic tilt angle
- higher loading of the contact area buttock – seat pad – saddle
mean pressure values in agreement with the findings of Marcolin et al. (2015)
Marcolin, G., Petrone, N., Reggiani, C., Panizzolo, F. A., & Paoli, A. (2015). Biomechanical comparison of shorts with different pads: an insight into the perineum protection issue. *Medicine*, 94(29).
- increased pressure negatively perceived by female cyclists
consistent with the results of Larsen et al. (2019)
Larsen, A., Hansen, E. A., & Madeleine, P. (2019). Effects of cycling shorts padding on perceived discomfort and saddle pressure distribution among female cyclists in laboratory conditions. *Journal of Sports Sciences*, 37(4), 431-438.
- **test duration of 15 to max. 30 min. per condition recommended**



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