

GENDER DIFFERENCES IN UPPER LIMB JOINTS CONTRIBUTIONS DURING A LIFTING TASK

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INTRODUCTION

- Upper limb injuries have been associated with work factors (heavy lifting, repetitive movements, bad postures) but also with individual risk factors including **gender** [1].
- Indeed, while women are underrepresented in manual handling work, the prevalence of their upper extremity disorders is **greater** than in men [2].
- Sex-related differences in motor behavior, such as **work technique**, have been identified and may contribute to the increased risk of injuries among women.
- Differences in lower limb joint coordination pattern between men and women were found [3]. However, the sex-specific **contribution of the upper limb's joint** during a lifting task remains unknown.

OBJECTIVE

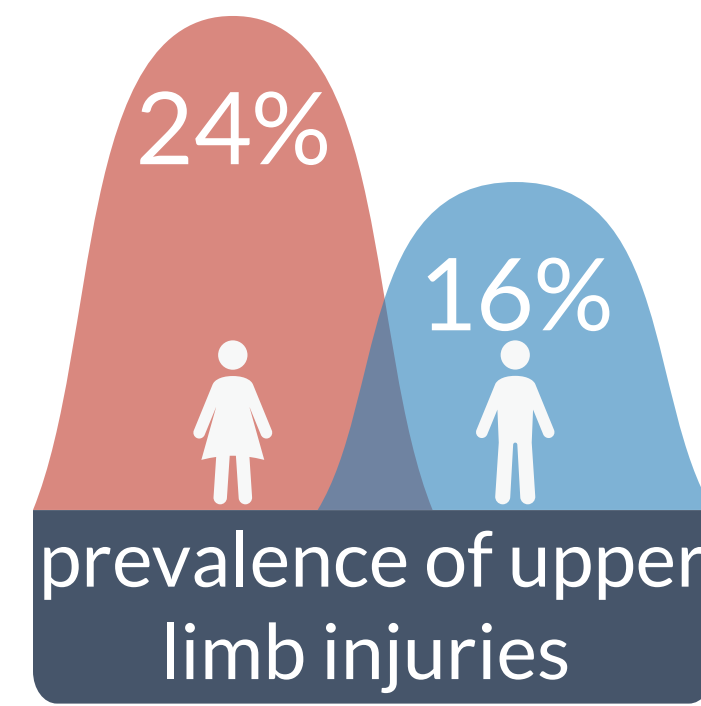
Investigate how the contribution of the upper limb joints differs between men and women.

HYPOTHESIS

Women use a different upper limb joint contribution strategy to perform a lifting task.

APPLICATIONS

Understand the reasons behind the higher prevalence of upper extremity injuries in women.



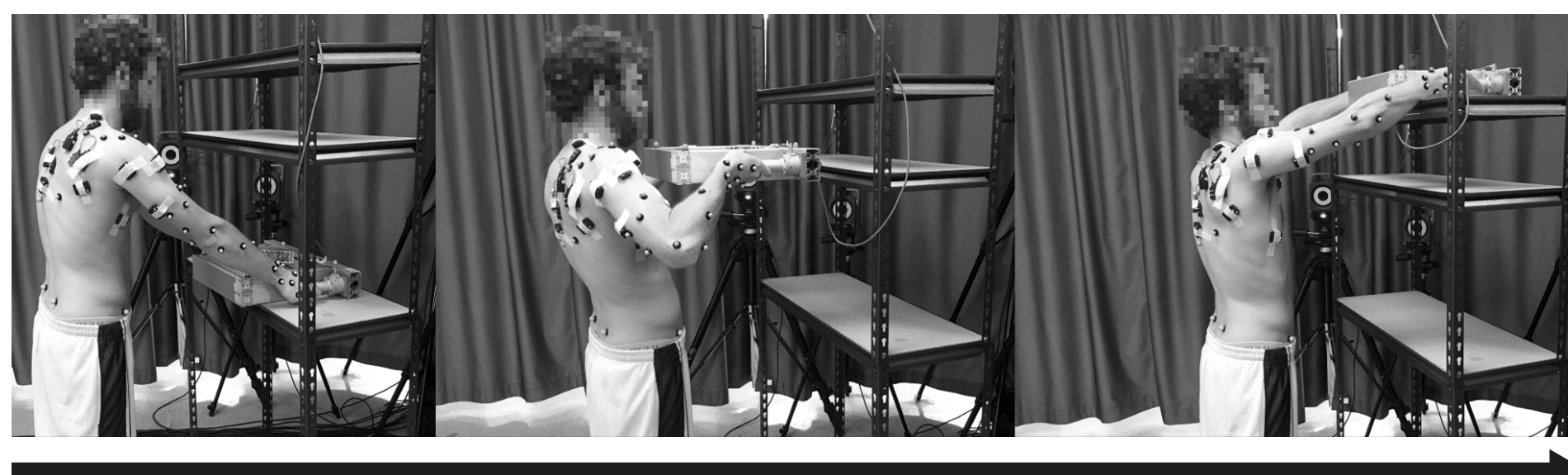
METHODS

Population

asymptomatic participants:		27 WOMEN	27 MEN
age (year)		21.4±1.8	25.6±5.7
weight (kg)		61.4±7.9	74.6±10.8
height (cm)		167.8±6.7	178.6±7.3

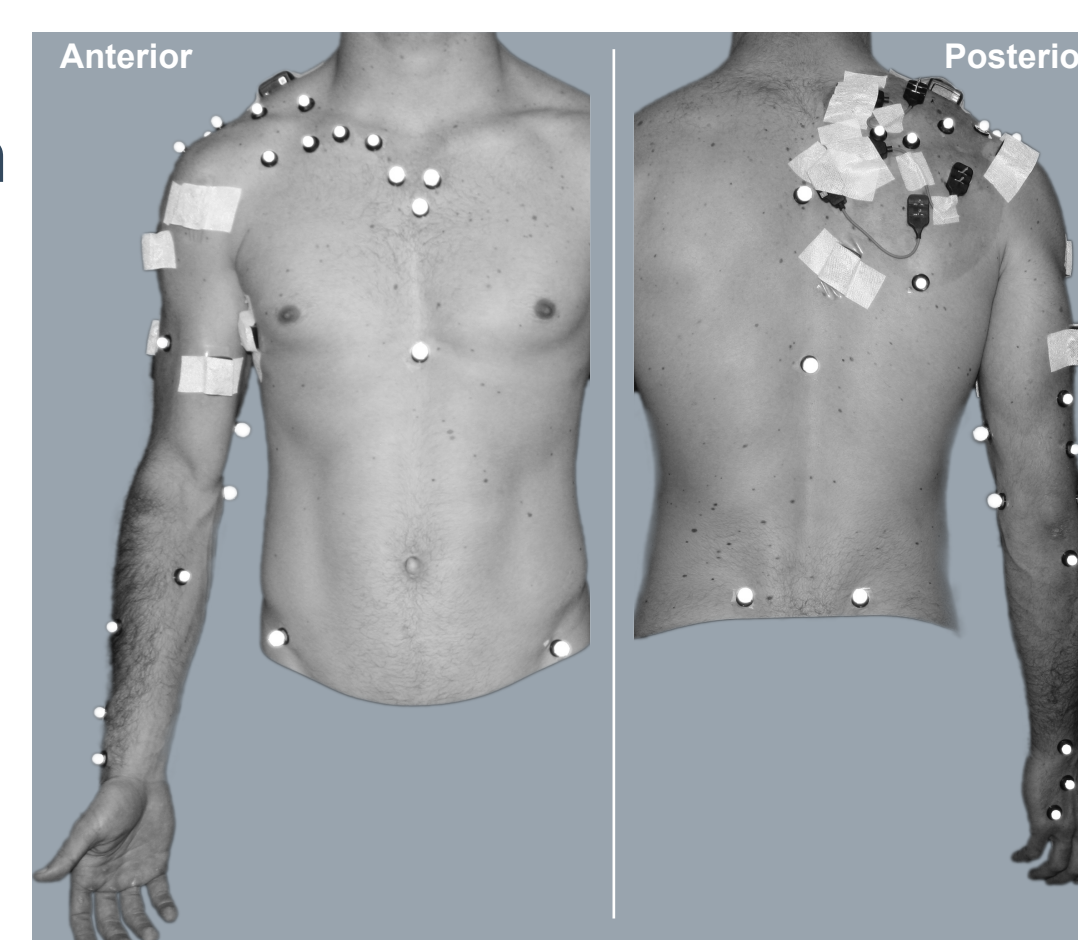
Task

- Participants moved a box between two adjustable shelves located at **hip** (0%) and **eye level** (100%).
- The mass of the box was set at **6** and **12 kg** (maximum acceptable mass for 90% of male and female respectively).



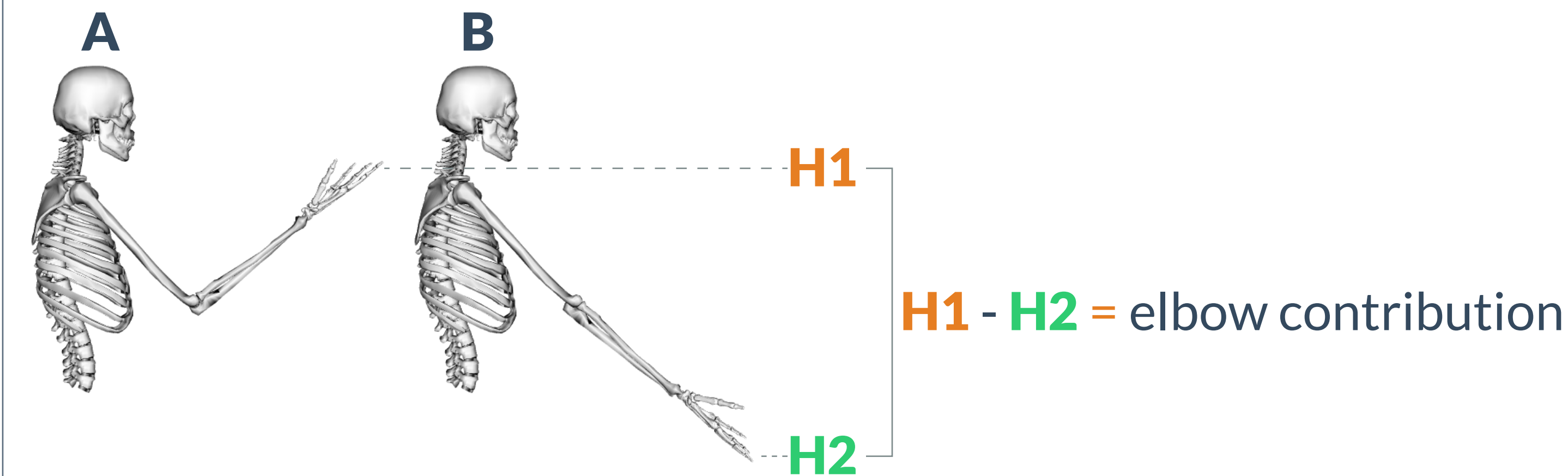
Kinematic

- Kinematics of the upper limb was recorded with VICON cameras and a 43 markers set.
- A 25 degree-of-freedom kinematic model was constructed.



Joint contribution

- Lifting technique were quantified at all times of the task through the **joint contribution** to the box height.



Joint contribution refers to the difference between the height during normal movement (A) and the height after the joint is reset to its reference orientation (B)

- Joint contributions were computed in 3D on the following groups of joints:

- pelvis-trunk (PE/TR)
- sternoclavicular-acromioclavicular (SC/AC)
- glenohumeral (GH)
- wrist-elbow (WR/EL)

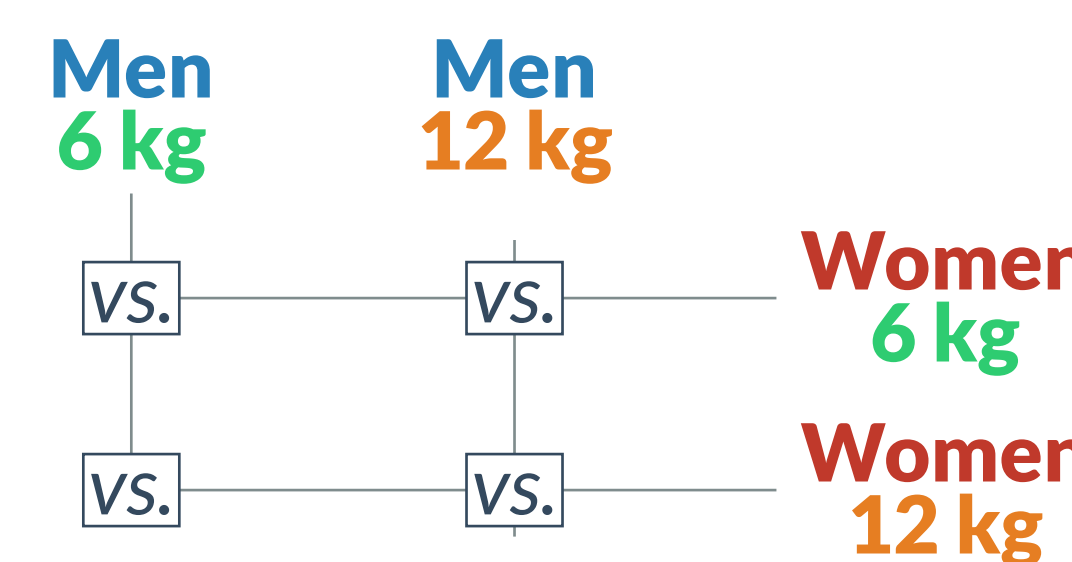
Statistics

- Contributions of men's and women's joints were compared using **statistical parametric mapping**.
- 2- ways ANOVA (**sex ~ mass**, with repeated measures on mass) on each group of joints.

POST HOC Mass-related

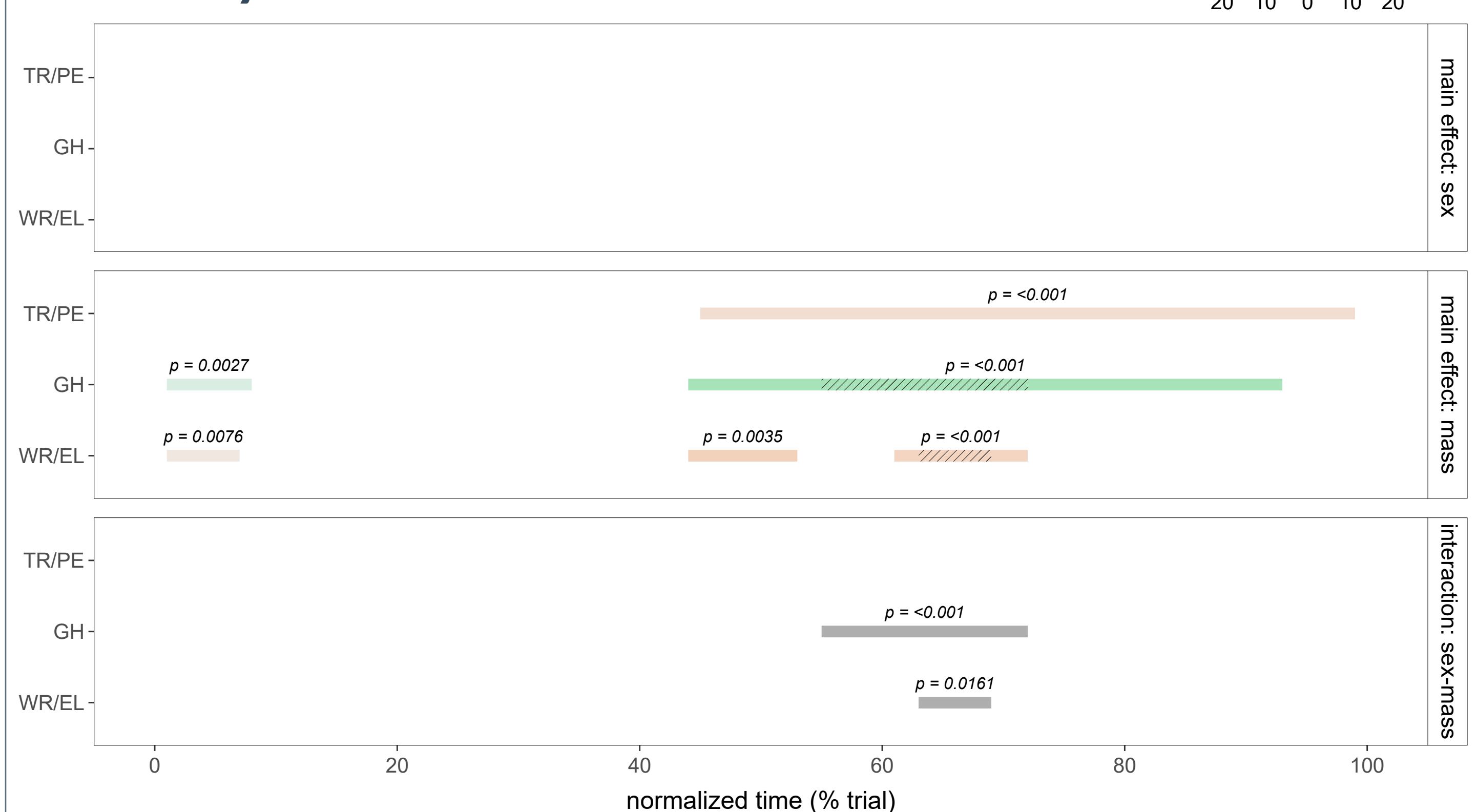


POST HOC Sex-related

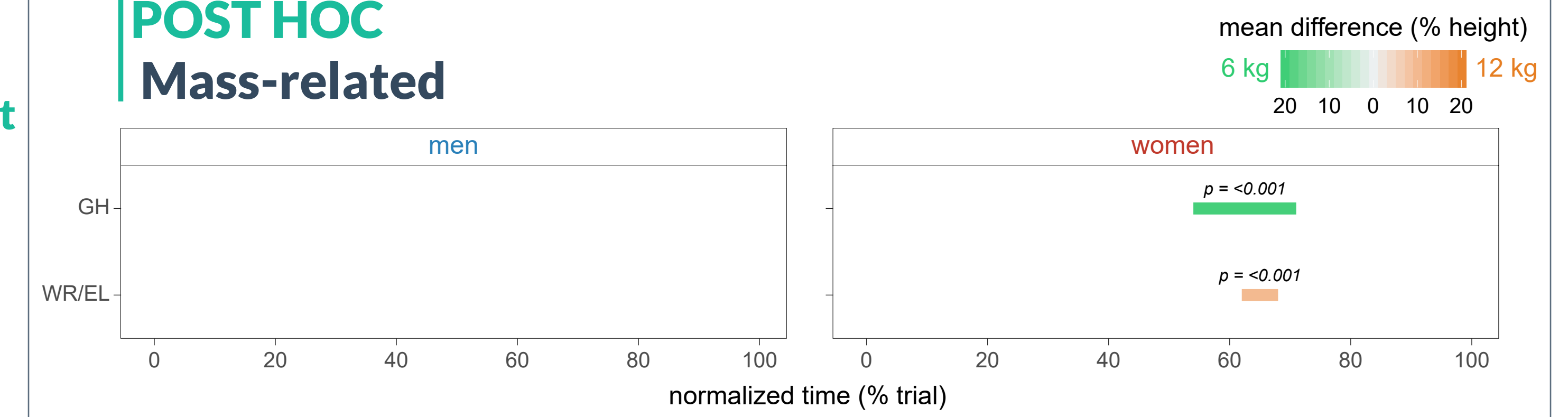


RESULTS

ANOVA 2-ways



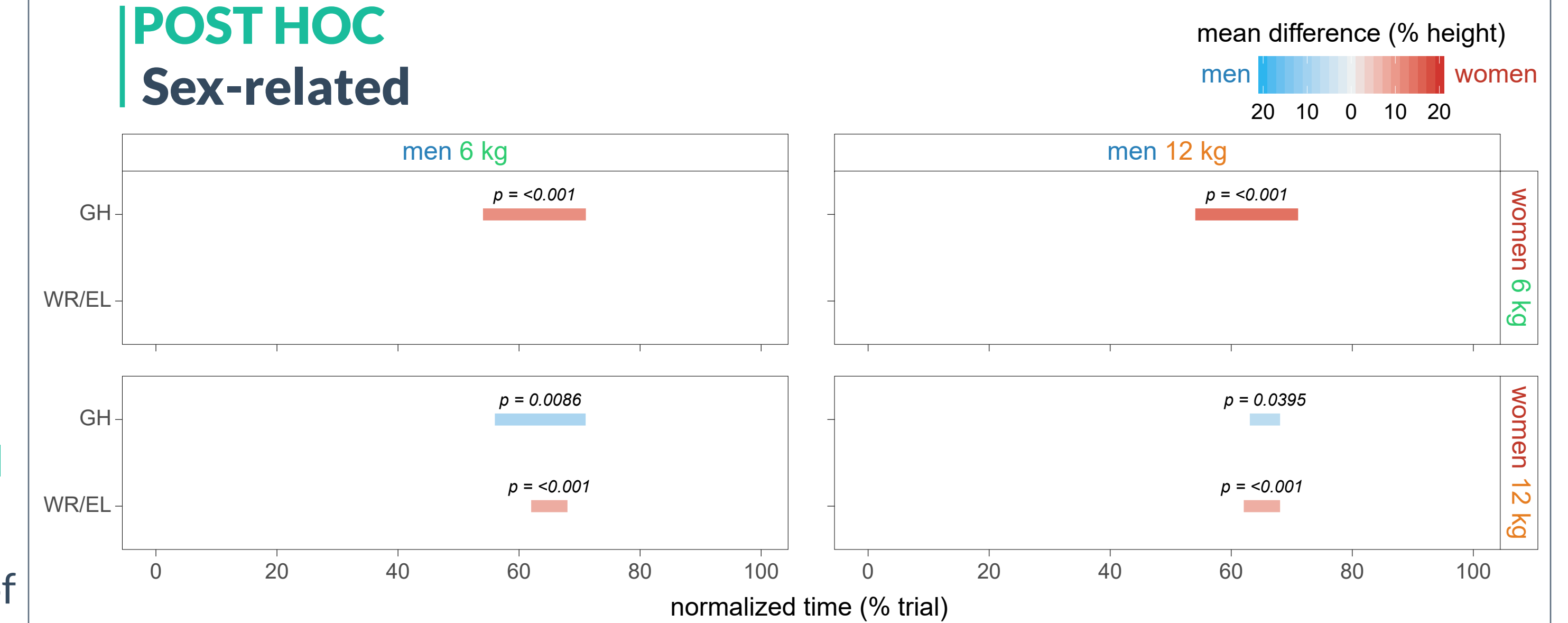
POST HOC Mass-related



- Mass-related comparisons demonstrate that **women are more affected** by a change from 6 to 12 kg:

- women may be more influenced by the 6 kg variation because it represents a **higher fraction** of their maximal force
- **kinematic adaptations** may occur when efforts are closer to maximal capacity.

POST HOC Sex-related



- Sex-related differences seem to be influenced by the **mass lifted by women**:

- when women lift a **6 kg** box, they use more their glenohumeral joint than men.
- when women lift a **12 kg** box, men use more their glenohumeral joint and women compensate with their wrist and elbow.

CONCLUSION

- Joint contribution has enabled the evaluation of **workers' lifting technique** and kinematic strategies.
- Our result support the perspective of a **sex-specific joint contribution strategy**.
- All the differences occur when arms are at **shoulder level and above**.
- overhead position is considered as the leading cause of shoulder injuries [4].
- In addition to working longer times in overhead position [5], we showed that women reach this position with a **different technique** than men.
- In addition to sex-related differences in trunk and lower-limb coordination when a box is lifted from the floor [3], we showed differences in upper-limb contribution when a box is handled above shoulder level.
- The implications of such results argue for a careful consideration of sex during ergonomic interventions, but also during research studies focusing on the upper limb.

REFERENCES

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