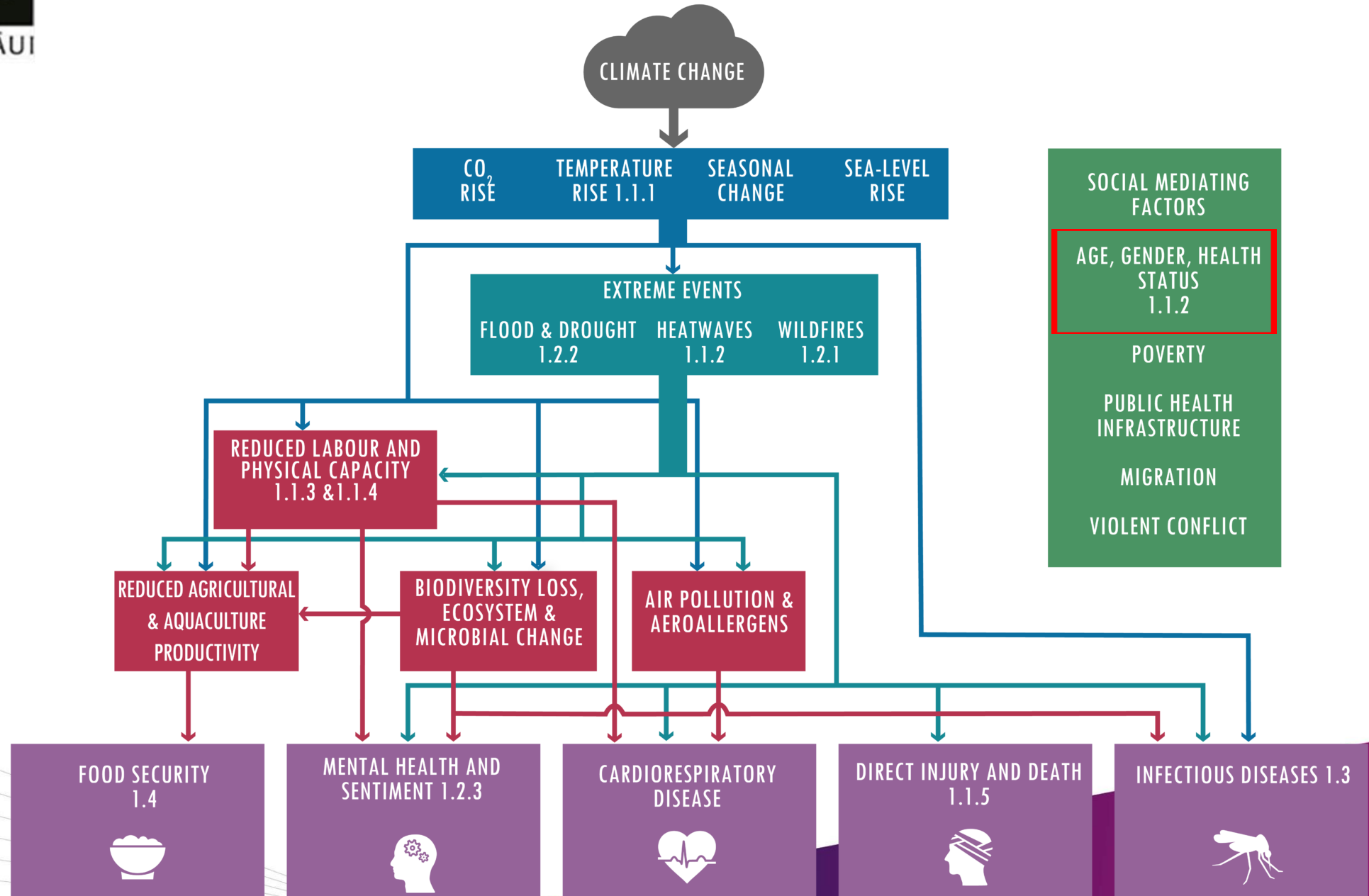


Hot water immersion to protect older people from heat injury in the time of climate change

Cole, E., Jackson, K., Donnan, K.J., Simpson, A.J. & Garrett, A.T.





Introduction



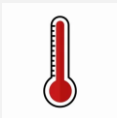
From 2005 to 2022, average increase in summer temperature three times the global mean (Romanello et al., 2023).



In Europe alone in the summer of 2022, an estimated 61672 heat-related excess deaths occurred (Ballester et al., 2023).



Individuals over 65 were classified as vulnerable to heat exposure (Chambers, 2020). 50+ (Kenney et al., 2014).



Training the body to adapt to higher temperatures can enhance thermoregulation and reduce the risk of heat-related illnesses (Ou et al., 2023).

Introduction



Hot water immersion (HWI) has emerged as a form of STHA that can aid the process of heat acclimation, offering a means of adaptation without the requirement of physical activity (An et al., 2019)



There are indications within literature that HWI among the elderly population could be a valuable approach for providing preventive protection during warm weather conditions (Waldock et al., 2021)



Further investigation is required to establish optimal frequency, intensity, and body placement within hot water conditions (Cole et al., 2023)

Aims

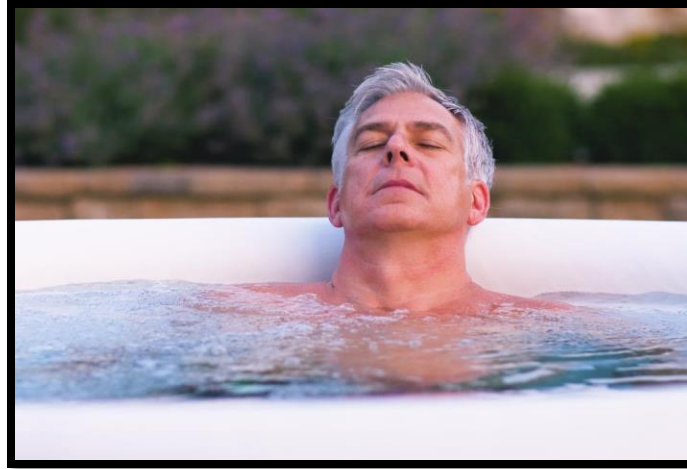
- To identify practical insights into more accessible heat acclimation techniques for a middle age population (45+ years)
- Comparing the effectiveness of an 'Arms Out' method, against an “Arms In” submersion protocol.

Methodology

- 9 participants (triathletes, fell runner and one endurance athlete)
- Age: 52years $\pm$ 6years
- Height: 176cm $\pm$ 8cm
- Weight: 76kg $\pm$ 13kg
- 2 females; 7 males
- Top 75th percentile of cardiovascular fitness according to six minute walk test (6MWT) (Bohannon, 2007; Ross et al., 2010)

Methodology

- Population: 45 yrs+
- Females and males
- Cross-over design
- Two days of hot water immersion (HWI)
- 6MWT prior to each HWI
- Forty-five minutes in a hot water tub each day (40 degrees C)
- Trial 1 – submersion of hot water up to base of neck with arms in
- Trial 2 – submersion of hot water up to the sternum with arms out



Methodology

Physiological

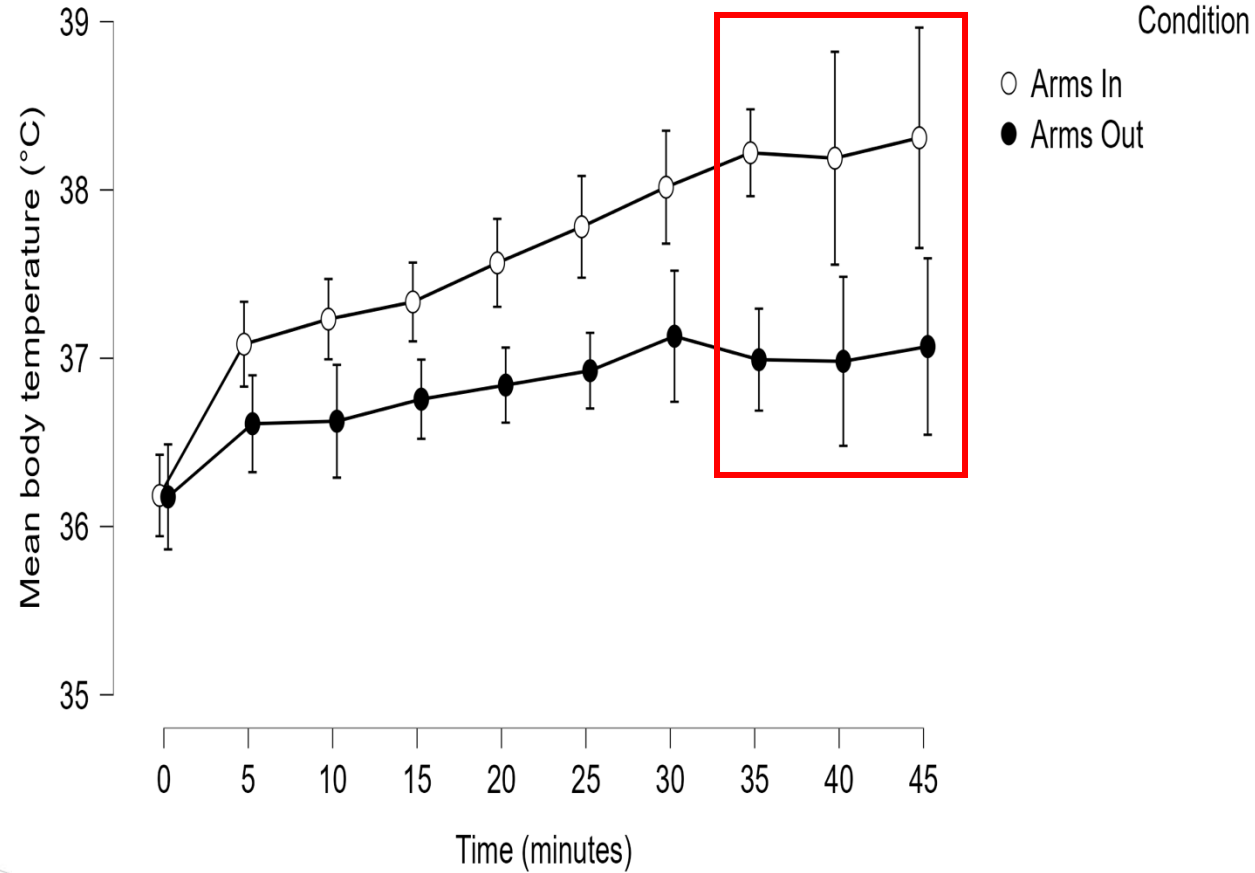
- Rectal temperature
- Mean skin temperature
- Mean body temperature
- Heart rate

Psychological

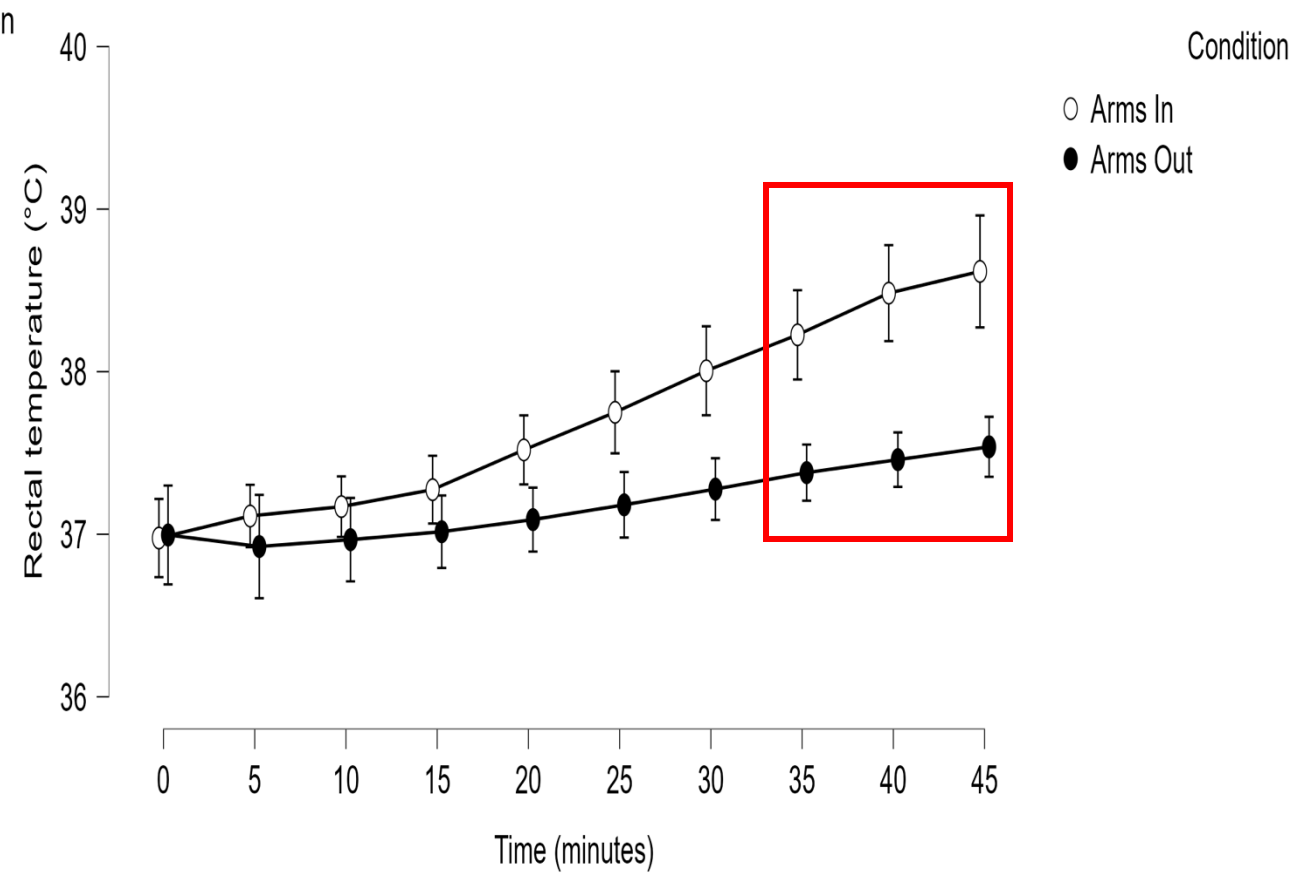
- Thermal comfort
- Thermal sensation
- Felt arousal
- Feeling scale
- Brunel mood scale questionnaire



Results

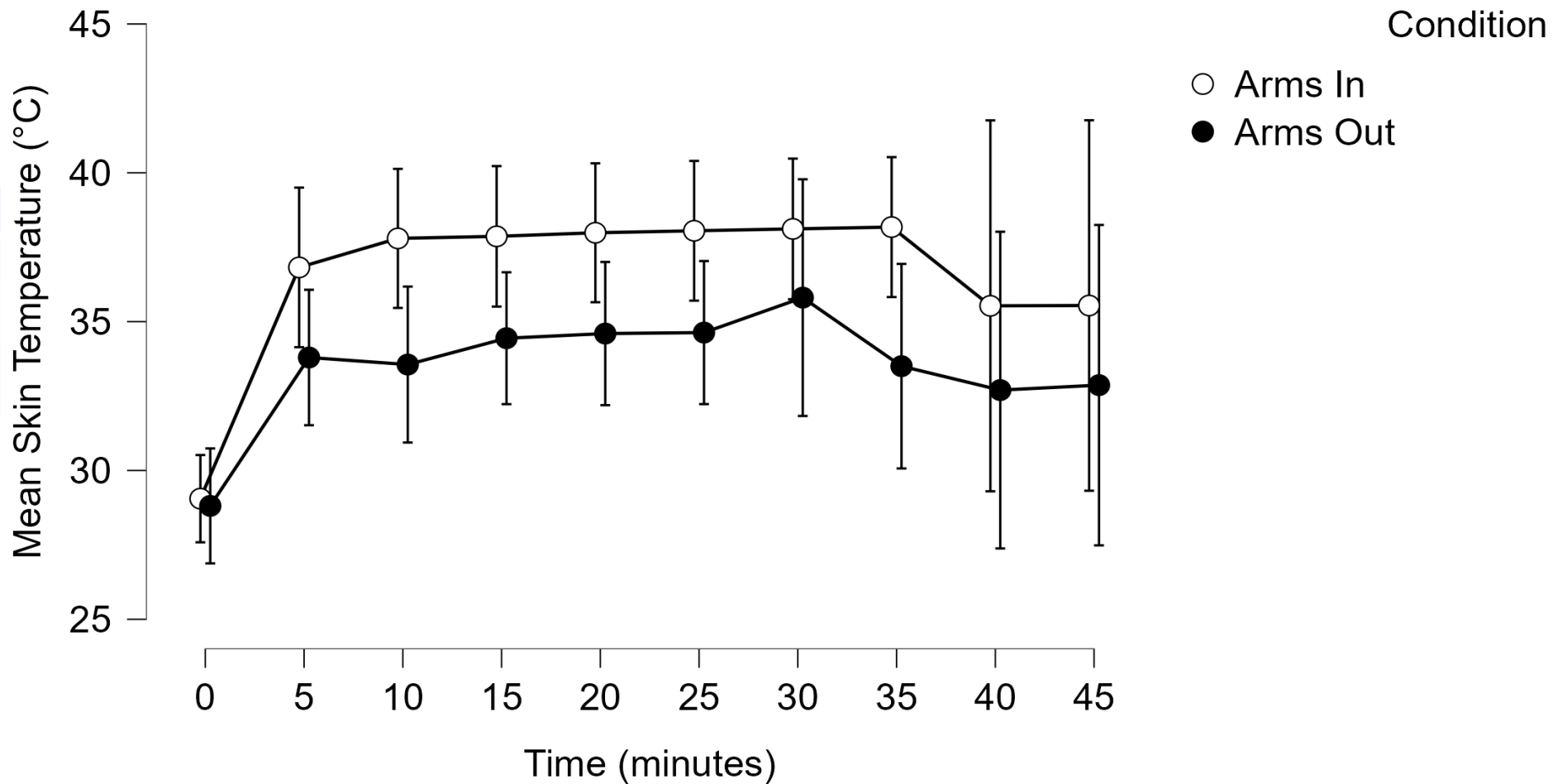


	<i>p</i>	<i>n</i> ²
Time	<.001	0.346
Condition	0.004	0.267
Time * Condition	<.001	0.060

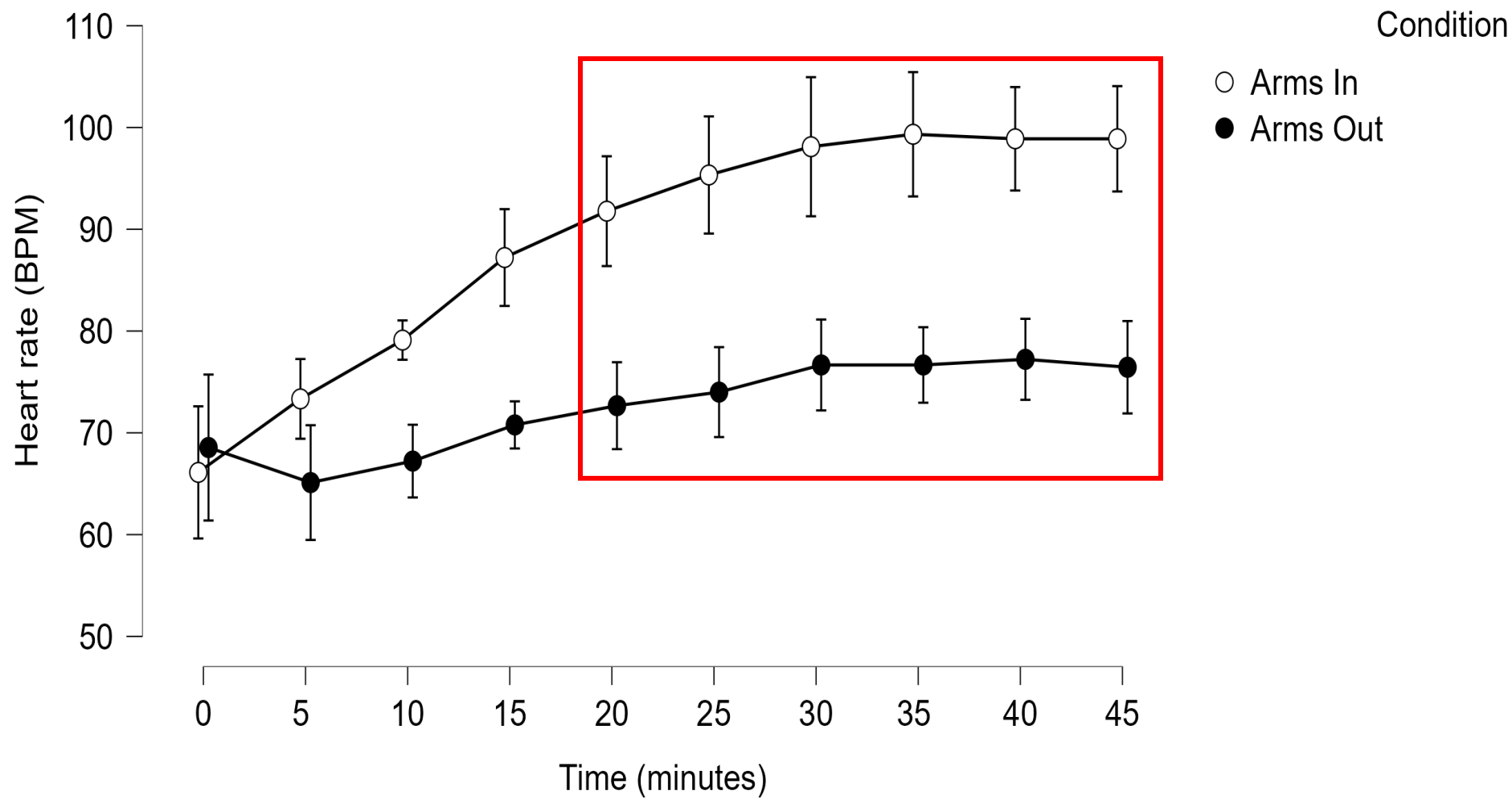


	<i>p</i>	<i>n</i> ²
Time	<.001	0.445
Condition	0.009	0.211
Time * Condition	<.001	0.097

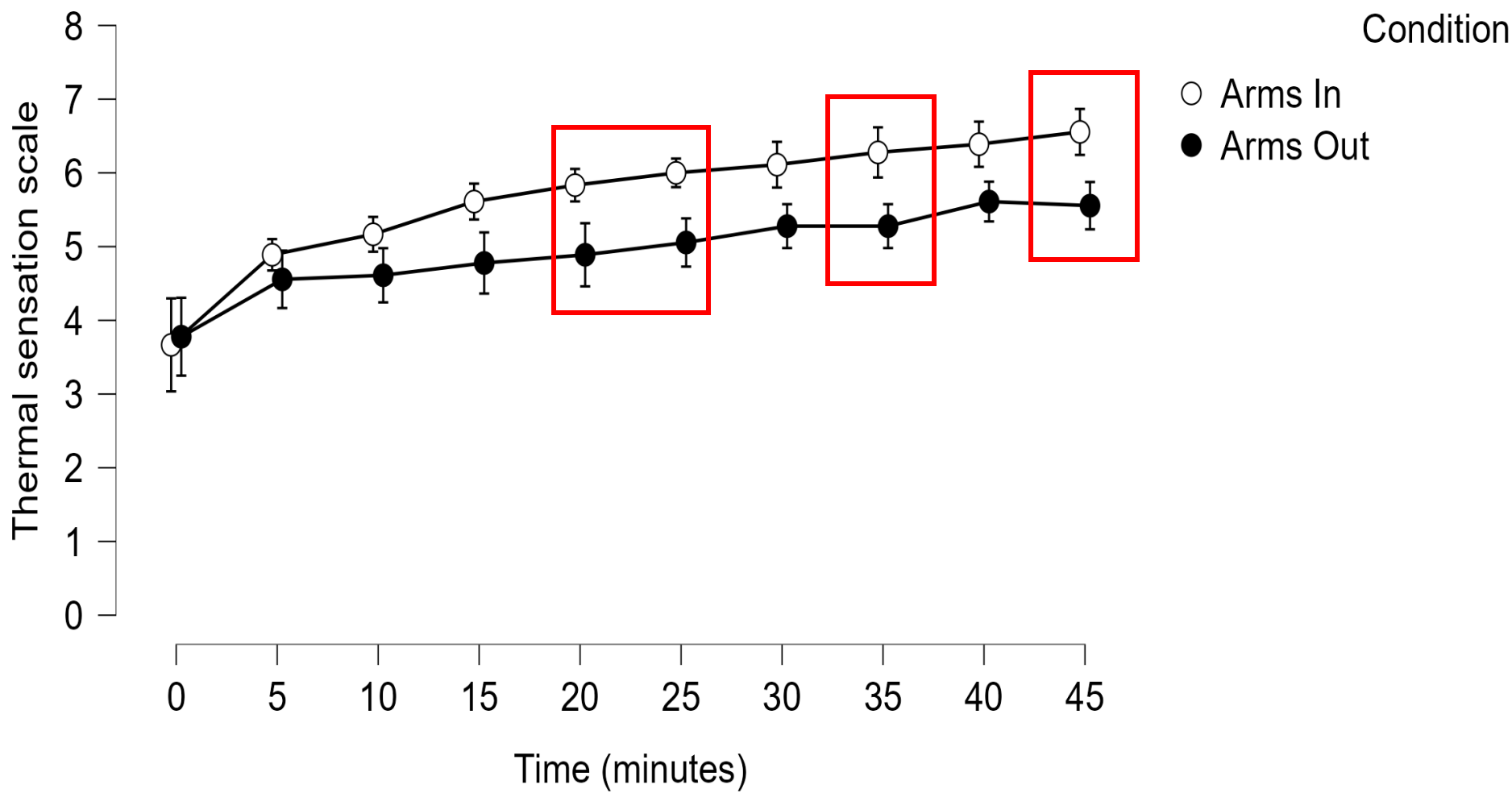
	<i>p</i>	<i>N</i> ²
Time	<.001	0.198
Condition	0.169	0.094
Time * Condition	0.857	0.013

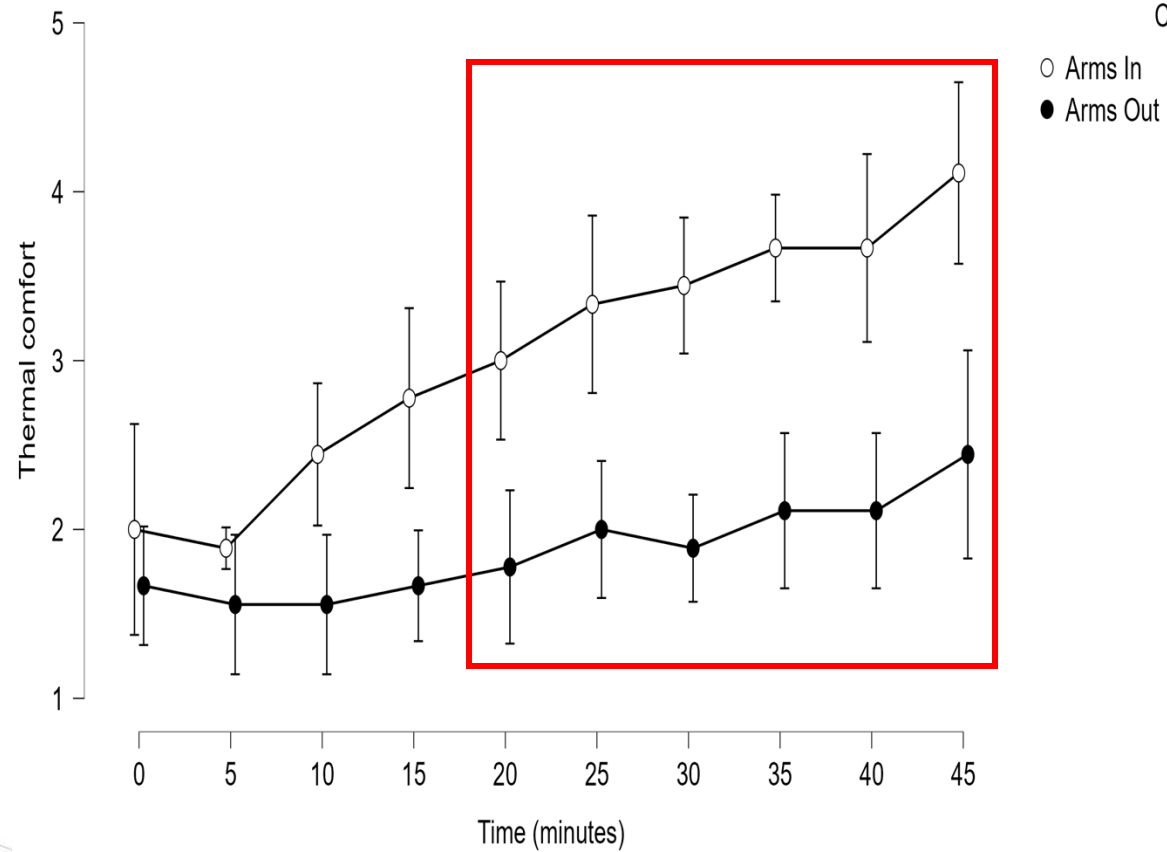


	<i>p</i>	<i>n</i> ²
Time	<.001	0.329
Condition	<.001	0.358
Time * Condition	<.001	0.071

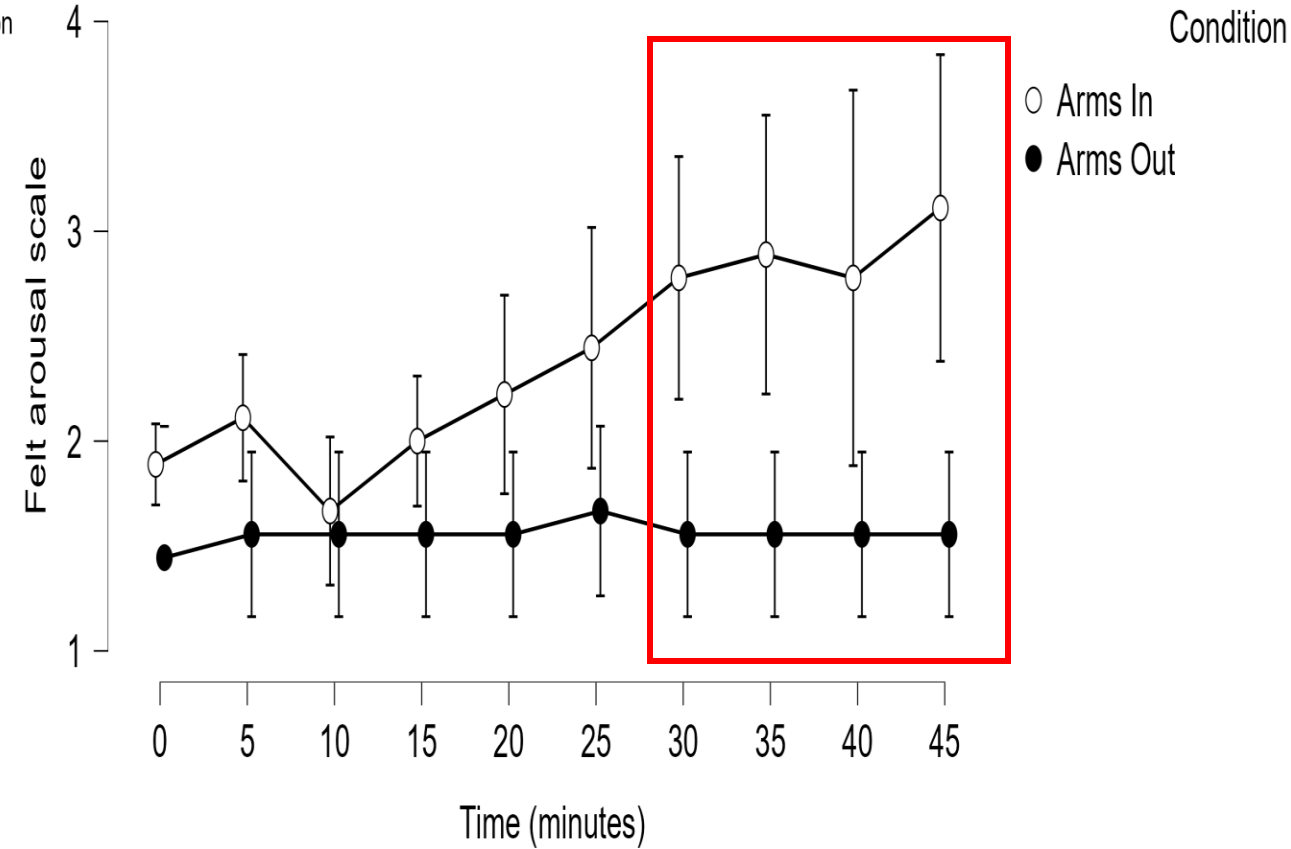


	<i>p</i>	<i>n</i> ²
Time	<.001	0.578
Condition	0.003	0.162
Time * Condition	<.001	0.037



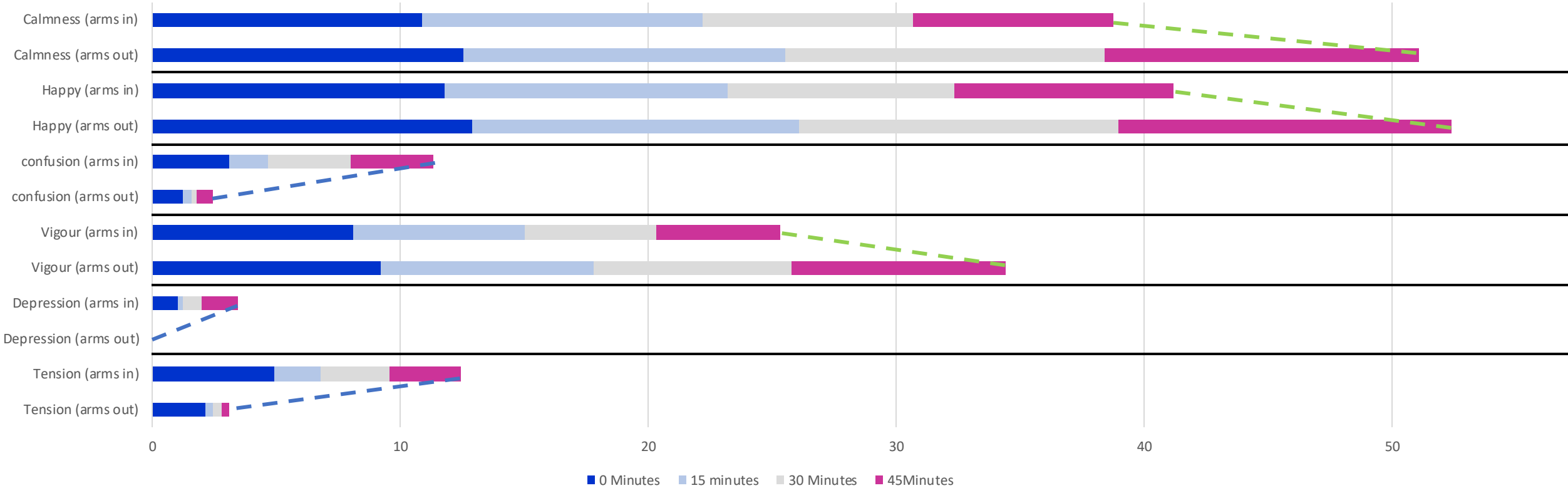


	<i>p</i>	<i>n</i> ²
Time	<.001	0.255
Condition	<.001	0.366
Time * Condition	<.001	0.060



	<i>p</i>	<i>n</i> ²
Time	<.001	0.090
Condition	0.029	0.279
Time * Condition	<.001	0.080

Brunel Mood Scale Questionnaire



	<i>Calmness</i>		<i>Happiness</i>		<i>Confusion</i>		<i>Vigour</i>		<i>Depression</i>		<i>Tension</i>	
	<i>p</i>	<i>n</i> ²	<i>p</i>	<i>n</i> ²	<i>p</i>	<i>n</i> ²	<i>p</i>	<i>n</i> ²	<i>p</i>	<i>n</i> ²	<i>p</i>	<i>n</i> ²
Time	0.017	0.233	0.005	0.254	0.185	0.046	0.008	0.115	0.296	0.042	0.002	0.158
Condition	0.003	0.115	0.015	0.158	0.006	0.257	0.040	0.233	0.046	0.162	0.020	0.254
Time * Condition	0.010	0.043	0.007	0.010	0.559	0.027	0.049	0.043	0.296	0.042	0.665	0.010

Conclusion

Arms in = more effective; Arms out = more tolerable

HWI interventions need to be more prescriptive to the participants who are undertaking it

Further research is necessary to dictate the protocol, frequency and length of HWI prescription

Recommendations to test HWI with an older population over a 5-day period to compare with existing STHA methods (Cole et al, 2023)

- An, J., Lee, I., & Yi, Y. (2019). The thermal effects of water immersion on health outcomes: an integrative review. *International journal of environmental research and public health*, 16(7), 1280.
- Ballester, J., Quijal-Zamorano, M., Méndez Turrubiates, R. F., Pegenaute, F., Herrmann, F. R., Robine, J. M., Basagaña, X., Tonne, C., Antó, J. M., & Achebak, H. (2023). Heat-related mortality in Europe during the summer of 2022. *Nature medicine*, 29(7), 1857-1866.
- Chambers, J. (2020). Global and cross-country analysis of exposure of vulnerable populations to heatwaves from 1980 to 2018. *Climatic Change*, 163(1), 539-558.
- **Cole, E., Donnan, K. J., Simpson, A. J., & Garrett, A. T. (2023). Short-term heat acclimation protocols for an aging population: Systematic review. *PLoS ONE*, 18(3). <https://doi.org/ARTN e028203810.1371/journal.pone.0282038>.**
- Ou, Y., Wang, F., Zhao, J., & Deng, Q. (2023). Risk of heatstroke in healthy elderly during heatwaves: a thermoregulatory modeling study. *Building and Environment*, 237, 110324.
- Romanello, M., Di Napoli, C., Green, C., Kennard, H., Lampard, P., Scamman, D., Walawender, M., Ali, Z., Ameli, N., & Ayeb-Karlsson, S. (2023). The 2023 report of the Lancet Countdown on health and climate change: the imperative for a health-centred response in a world facing irreversible harms. *The Lancet*, 402(10419), 2346-2394.
- Saghiv, M. S., Sagiv, M. S., Saghiv, M. S., & Sagiv, M. S. (2020). Cardiovascular Function. *Basic Exercise Physiology: Clinical and Laboratory Perspectives*, 285-369.
- Waldock, K. A., Gibson, O. R., Relf, R. L., Eichhorn, G., Hayes, M., Watt, P. W., & Maxwell, N. S. (2021). Exercise heat acclimation and post-exercise hot water immersion improve resting and exercise responses to heat stress in the elderly. *Journal of science and medicine in sport*.
- Zhao, Q., Guo, Y., Ye, T., Gasparrini, A., Tong, S., Overcenco, A., Urban, A., Schneider, A., Entezari, A., & Vicedo-Cabrera, A. M. (2021). Global, regional, and national burden of mortality associated with non-optimal ambient temperatures from 2000 to 2019: a three-stage modelling study. *The Lancet Planetary Health*, 5(7), e415-e425.

Hot water immersion to protect older people from heat injury in the time of climate change

Cole, E., Jackson, K., Donnan, K.J., Simpson, A.J. & Garrett, A.T.



Discussion

- Effectiveness vs tolerance?
- Everyone achieved 1°C above resting or 38.5°C Rectal core temperature during arms in trial.
- Participants were calmer, happier, less tense, less confused and more comfortable during arms out trial.
- Everyone completed the trial however there was one syncopal episode occurred post arms in control.

Who are we targeting this intervention at?

Are they likely to do it?

Difficulties of measuring core temperature easily, accurately and discreetly