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Is there an anthropometric bias in the heat tolerance test? Exploring heat intolerance further with a human conceptual heat balance approach.

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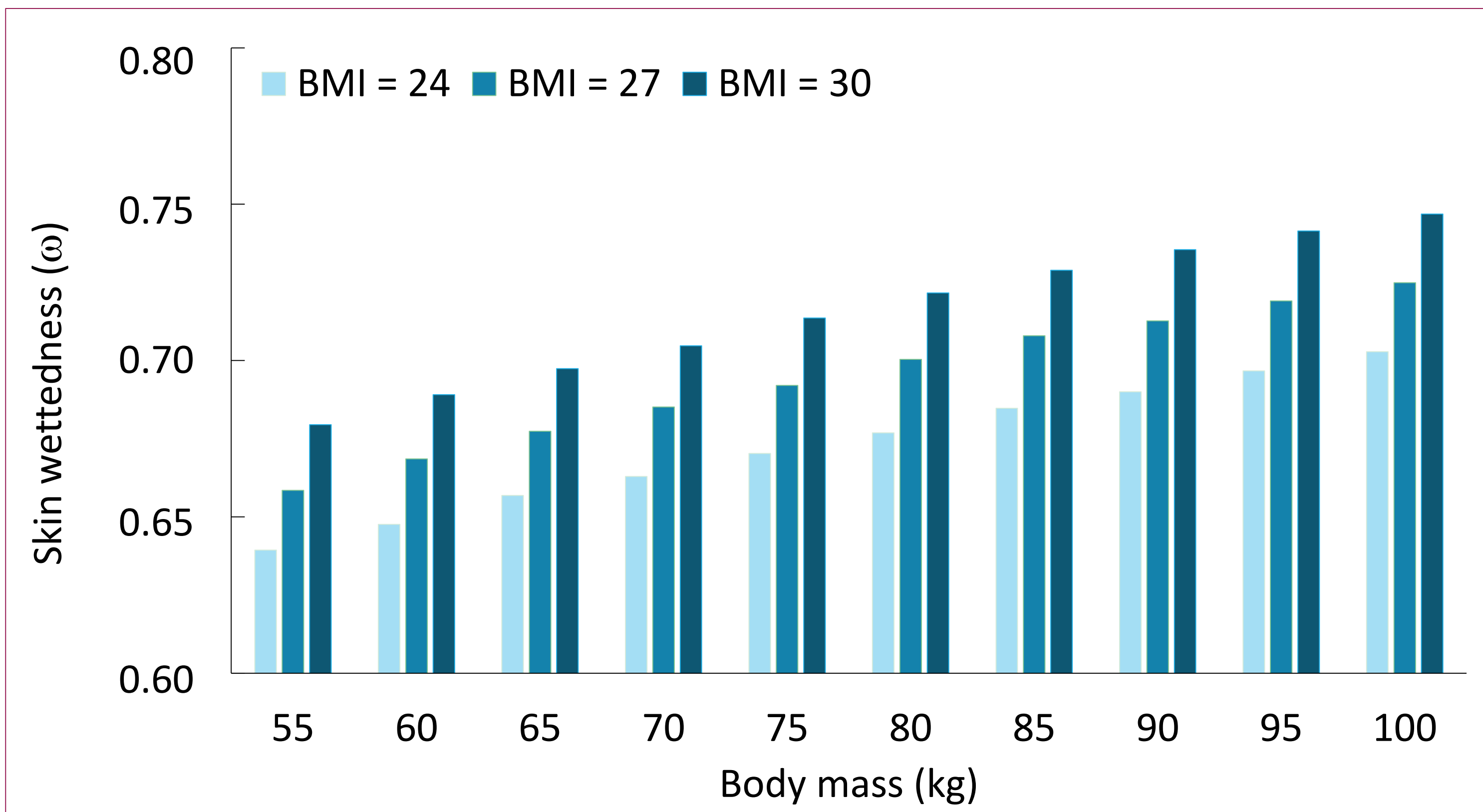
Introduction & objective

- **Heat intolerance** is defined as the inability to maintain a thermal balance whereas other individuals are able to do so under the same conditions.
- In the military, the **heat tolerance test (HTT)** developed by the Israeli Defense Force (Moran et al. 2004) is usually performed to classify individuals who have suffered exertional heat stroke, as heat tolerant or intolerant, prior to their **return to duty**.
- The study **conceptually** examined the HTT physiological compensability regardless of the **anthropometry** of the individuals. Then, the **sweat rates required to reach thermal balance** were estimated to go further into the interpretation of the HTT results.

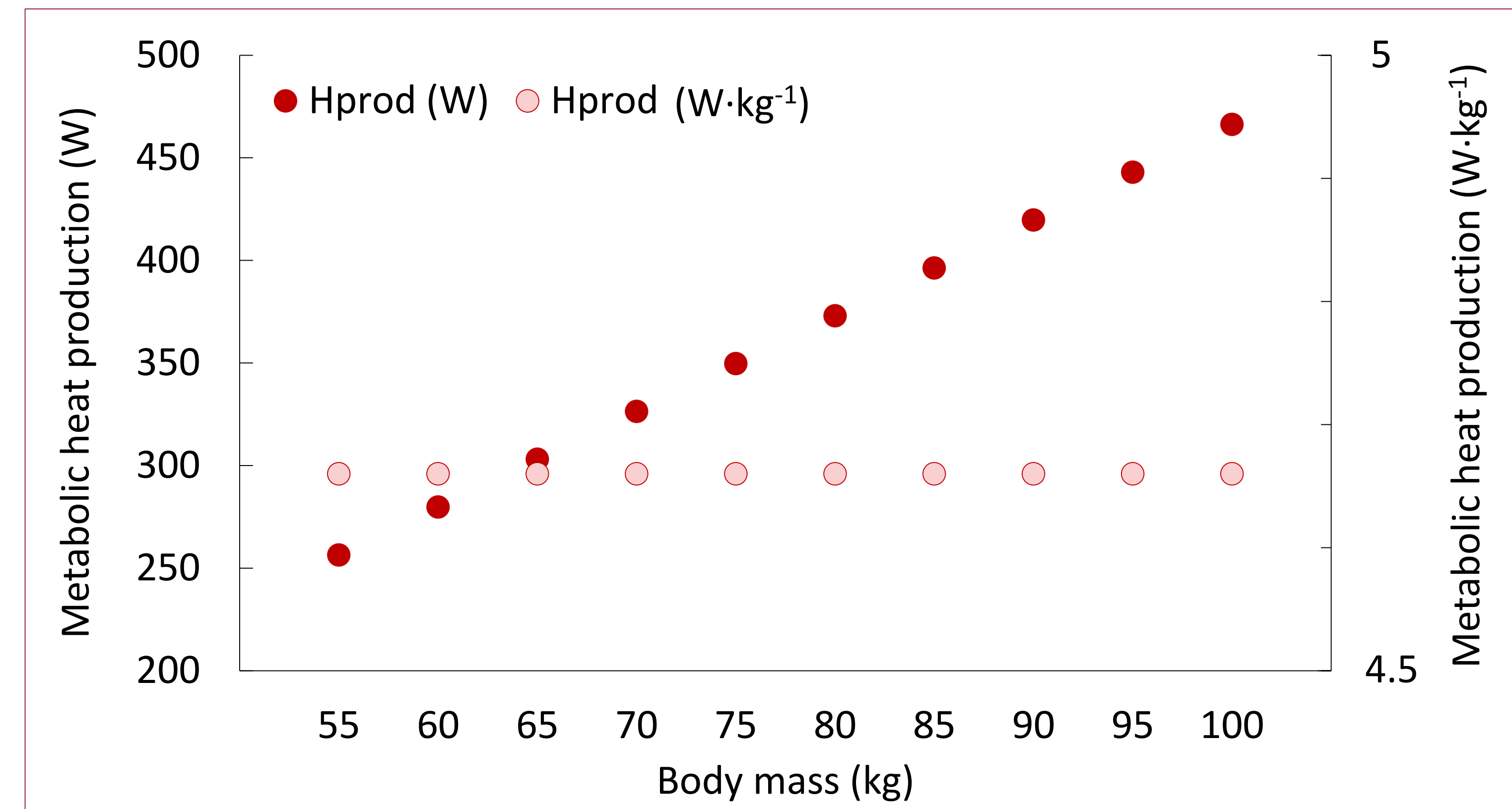
Materials & methods

- All the elements of the human heat balance equation were calculated based on HTT conditions (treadmill walking for 2 hours at 5 km·h⁻¹ with a 2% slope, at a temperature of 40°C and 40% relative humidity).
- Metabolic heat production during walking was predicted using the Lankford equation.
- Then, the evaporative requirements for heat balance, the maximum evaporative rate possible and the predicted sweat rate were estimated for different body mass and body mass index.

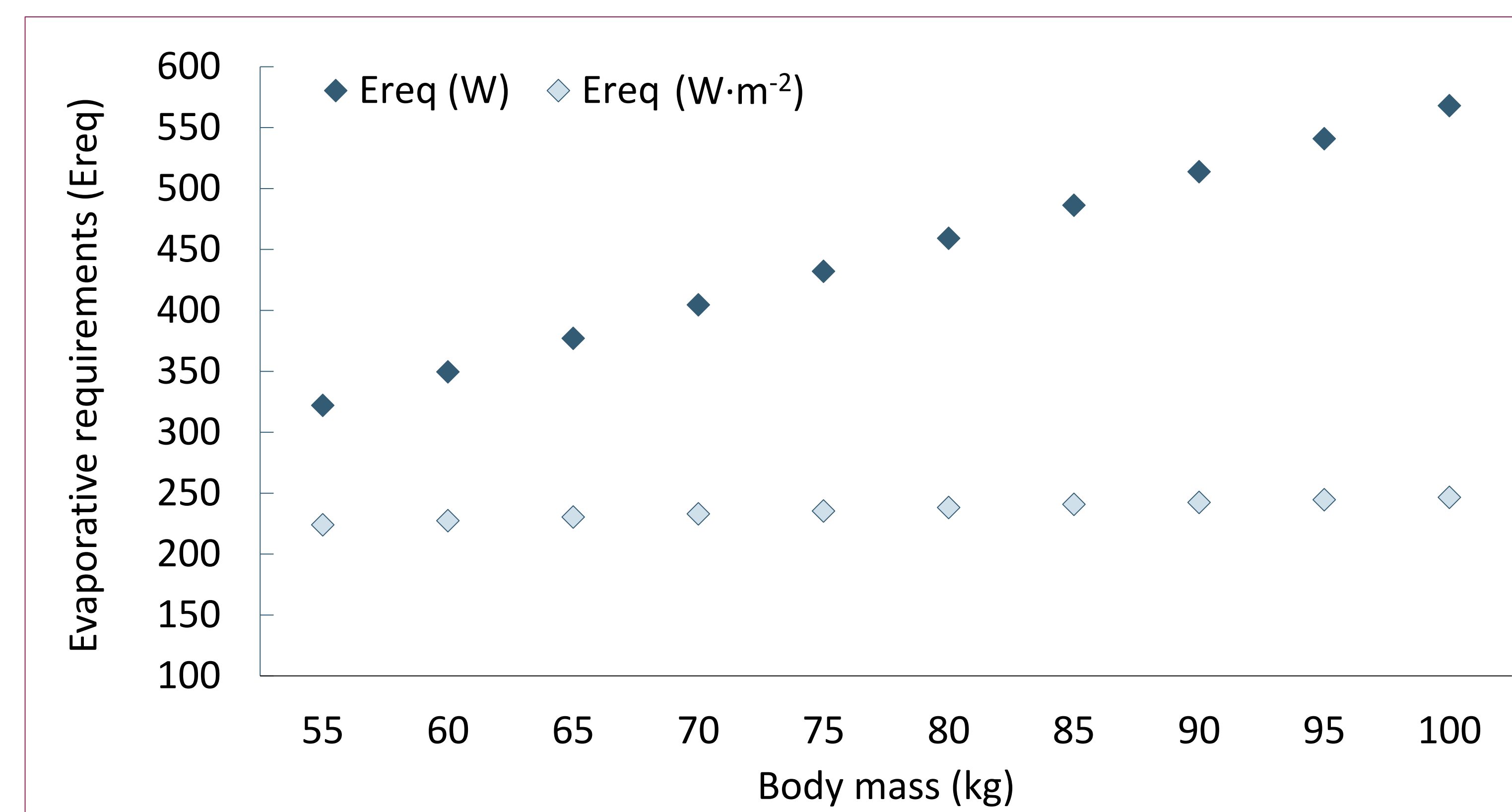
Results



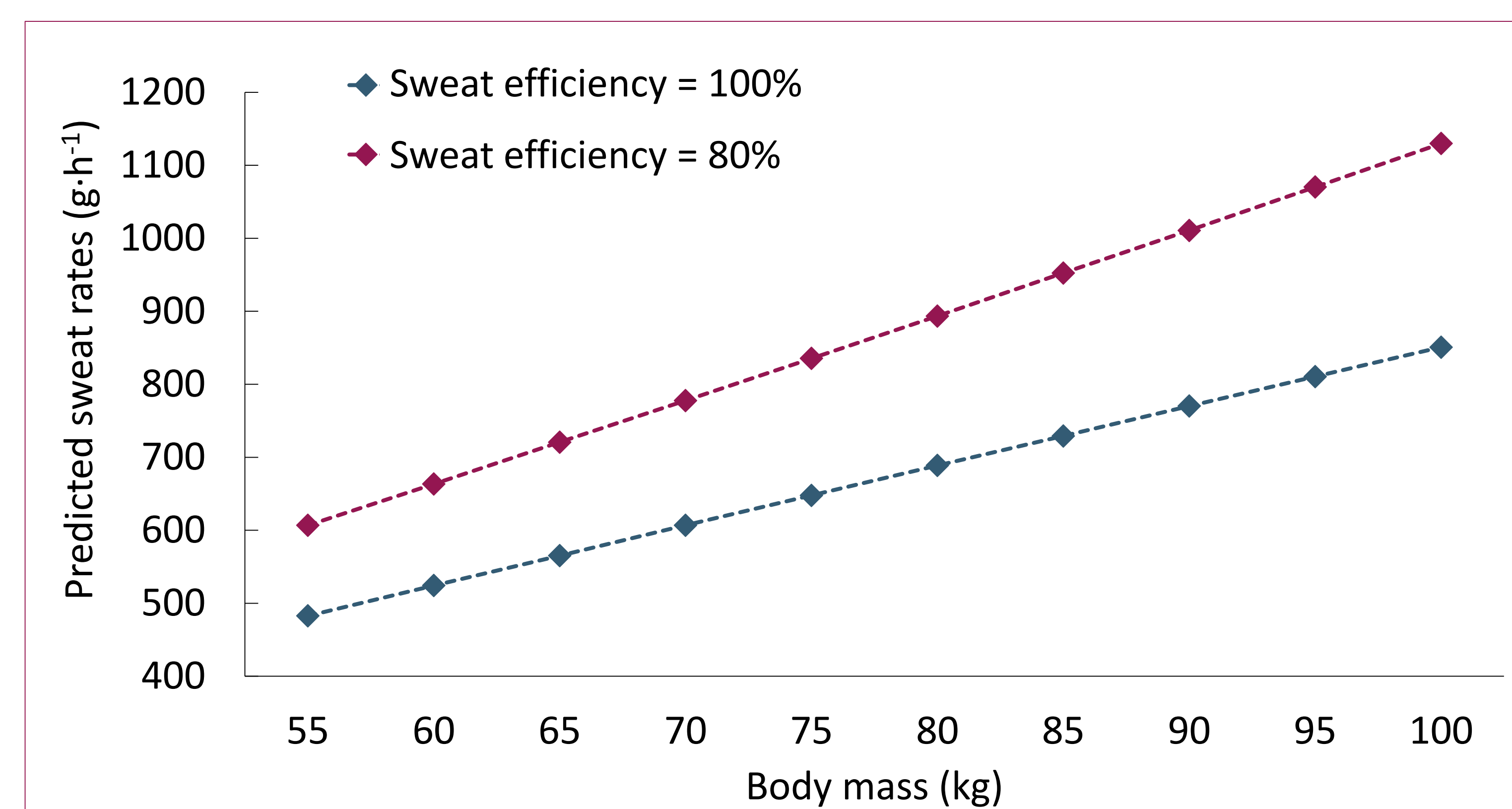
- Skin wettedness (ω) increased with both body mass and body mass index
- Skin wettedness also varied according to the surface area-to-mass ratio; if the ratio decreased then the wettedness increased.



- Metabolic heat production (Hprod) expressed in W but not in W·kg⁻¹ increased with body mass.



- Evaporative requirements (Ereq) expressed in W but not in W·m⁻² increased with body mass.



- Predicted sweat rates to reach thermal balance, when expressed in g·h⁻¹, increased with body mass.

Discussion & conclusion

Skin wettedness indicates that the HTT is theoretically **physiologically compensable regardless of individual anthropometry**, however **thermal strain increases with the body mass of the individuals**. Moreover, a skin wettedness greater than 0.7 indicates that participants must be **endurance trained** to reach thermal balance. Furthermore, based on metabolic heat production expressed relative to body mass, our results support the possibility of **comparing rectal temperature changes** during the HTT between individuals of **different body mass** (Cramer and Jay, 2014). Finally, predictions of the required sweat rates allow further interpretation of the HTT results and could help distinguish the organic intolerances from the temporary functional intolerances, depending on the size of the difference between measured and predicted sweat rates.

Military impact

Ultimately, the objective is to determine whether the heat intolerance revealed by the HTT is of **organic or functional origin**. Moreover, this data can be used as a support for decision-making regarding return to duty post exertional heat stroke.



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