



Tracking the impact of heat on physical activity: a global and regional analysis

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Introduction

The health benefits of regular engagement in exercise could be jeopardized as the climate warms and ambient conditions become unsafe for outdoor physical activity. The desire to engage in physical activity is significantly affected by the thermal environment, with warm ambient conditions corresponding to shortened duration of, or even complete disengagement from physical activity.



Regular physical activity carries numerous benefits for overall longevity, as well as cardiometabolic and mental health. It can be an important social activity as well!

Methods

Hourly temperature and relative humidity records from ERA5 were combined with gridded population data from NASA to determine the total number of hours per day from 1991 to 2021 in which outdoor exercise carried a 'high' risk of heat stress, per Sports Medicine Australia guidelines.

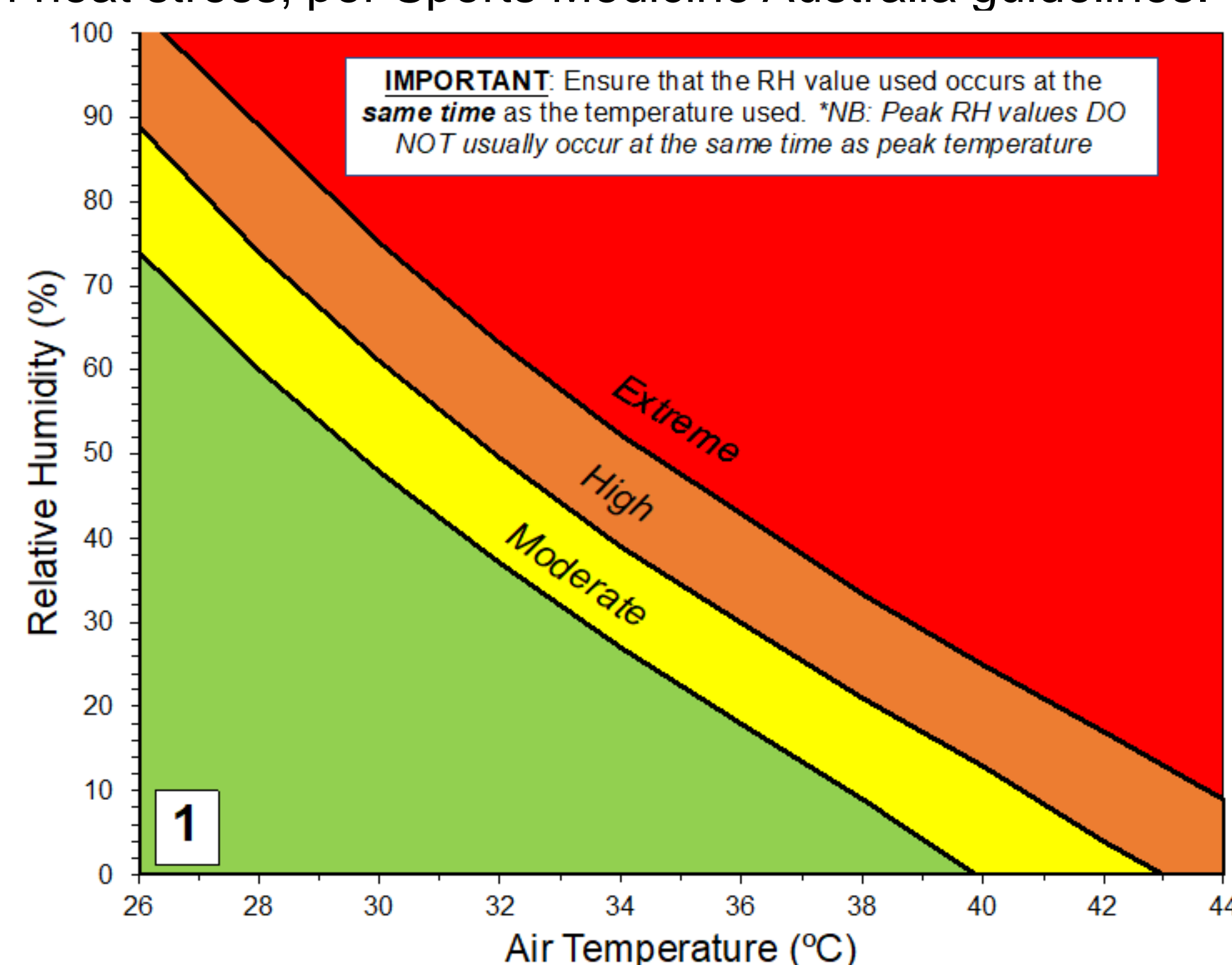


Figure 1 Risk function describing low, moderate, high, and extreme heat stress cutoffs, Sports Medicine Australia, 2021

Results

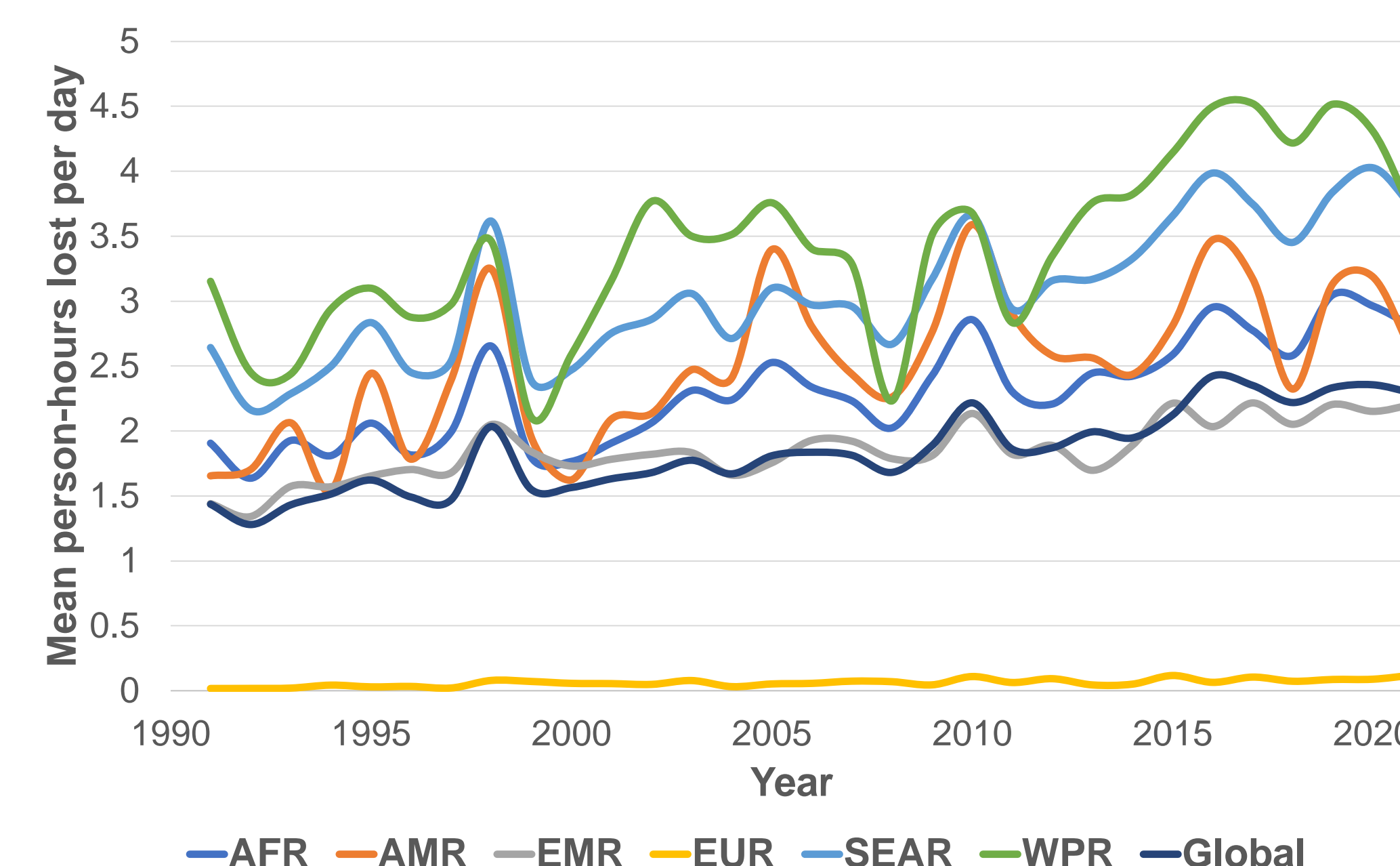


Figure 2 Mean lost hours per person per day, WHO regions and global, 1991-2021

The WHO **Western Pacific Region (WPR)** experienced the greatest loss of safe exercise hours in 1991 (3.15 person-hours/day), but was surpassed by the **South-East Asian Region (SEAR)** in 2021 (3.72 person-hours/day). The Eastern Mediterranean Region (EMR) closely followed global trends. The European Region (EUR) experienced the least amount of lost hours for each year of the study.

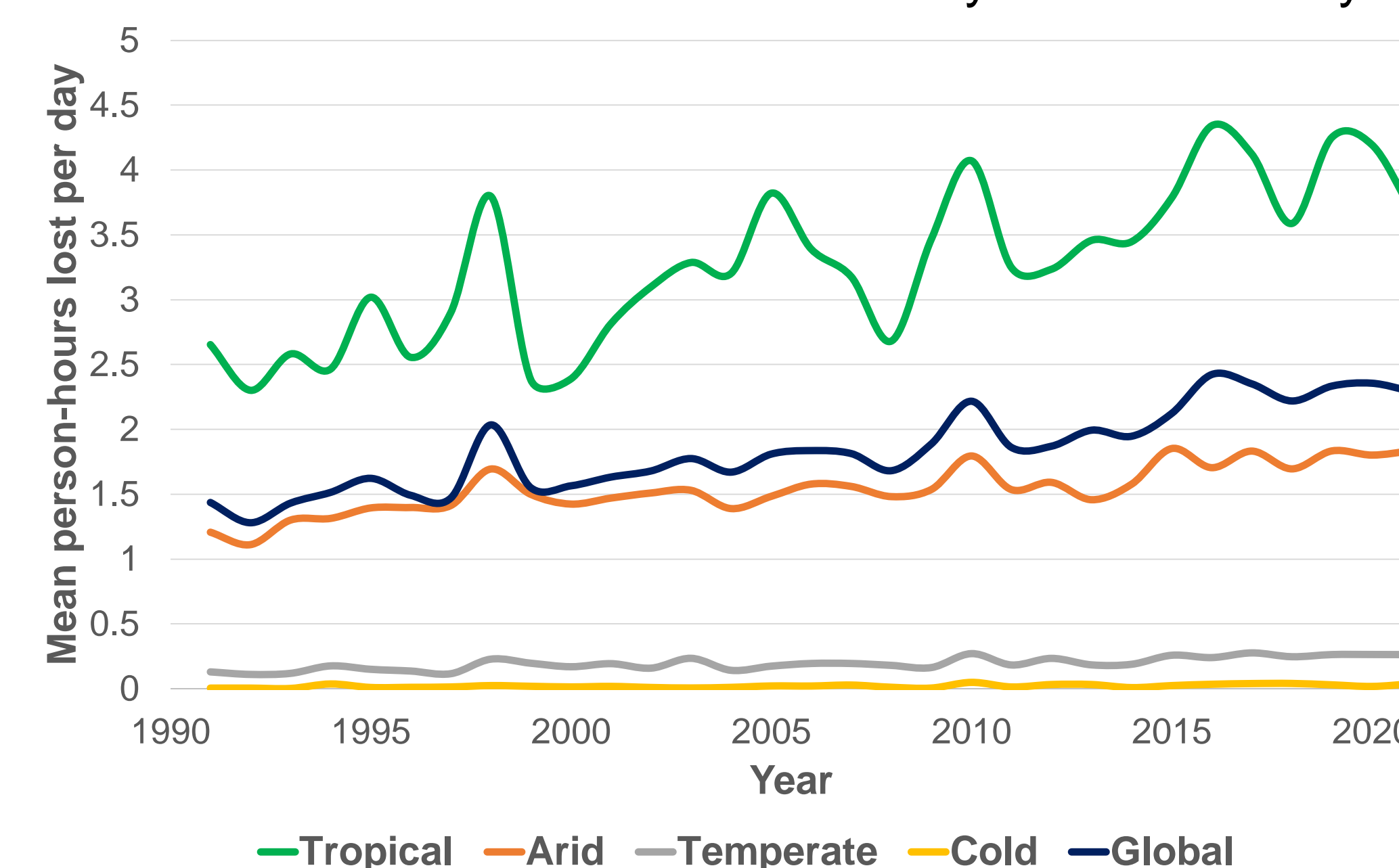


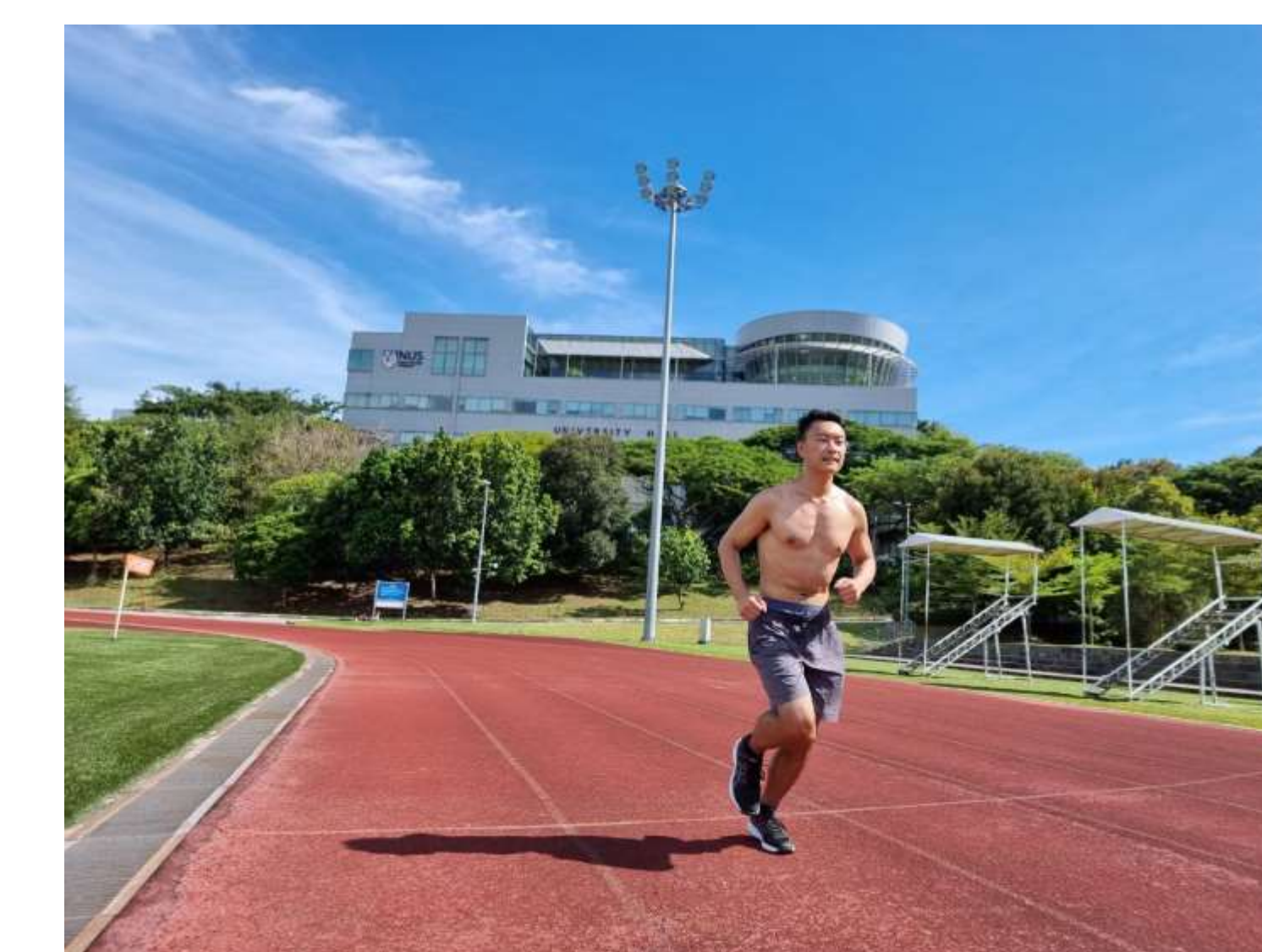
Figure 3 Mean lost hours per person per day, climate region and global, 1991-2021

The **tropical region** experienced the greatest loss of safe hours for each year of the study (2.65 person-hours/day in 1991; 3.69 person-hours/day in 2021). The arid region most closely followed global trends. As expected, the cold region experienced the least amount of lost hours for each year of the study, while the **temperate region** also experienced fewer lost hours than the global average.

Conclusions

Globally, the number of lost exercise hours increased from 1.44 person-hours/day in 1991 to 2.29 person-hours/day in 2021. There was a corresponding increase in lost hours in each WHO and climate region, but different regions followed vastly different trends. This indicates that the impact of climate change on humans' ability to safely exercise outdoors is not evenly distributed among the global population, with residents of tropical climate countries and countries in the Western Pacific and South-East Asian regions experiencing the greatest burden. **Such regional differences should be taken into account when designing potential interventions.**

While our analysis of lost exercise hours is evidence-based and highly innovative, it can still be further improved. Firstly, we did not consider potential loss of activity in unbearably cold conditions, **due to lack of available evidence of 'cold stress' safety thresholds.** This could have led to underestimation of lost hours in cold and temperate climate regions. Secondly, we did not consider the effect of heat acclimation in tropical populations, which could have allowed for safe exercise beyond the safety threshold we applied. **Future analyses will benefit from population studies eliciting country-level safe exercise thresholds.**



Phew! Outdoor exercise in Singapore, where daytime temperatures regularly exceed 30°C, can take some getting used to!

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