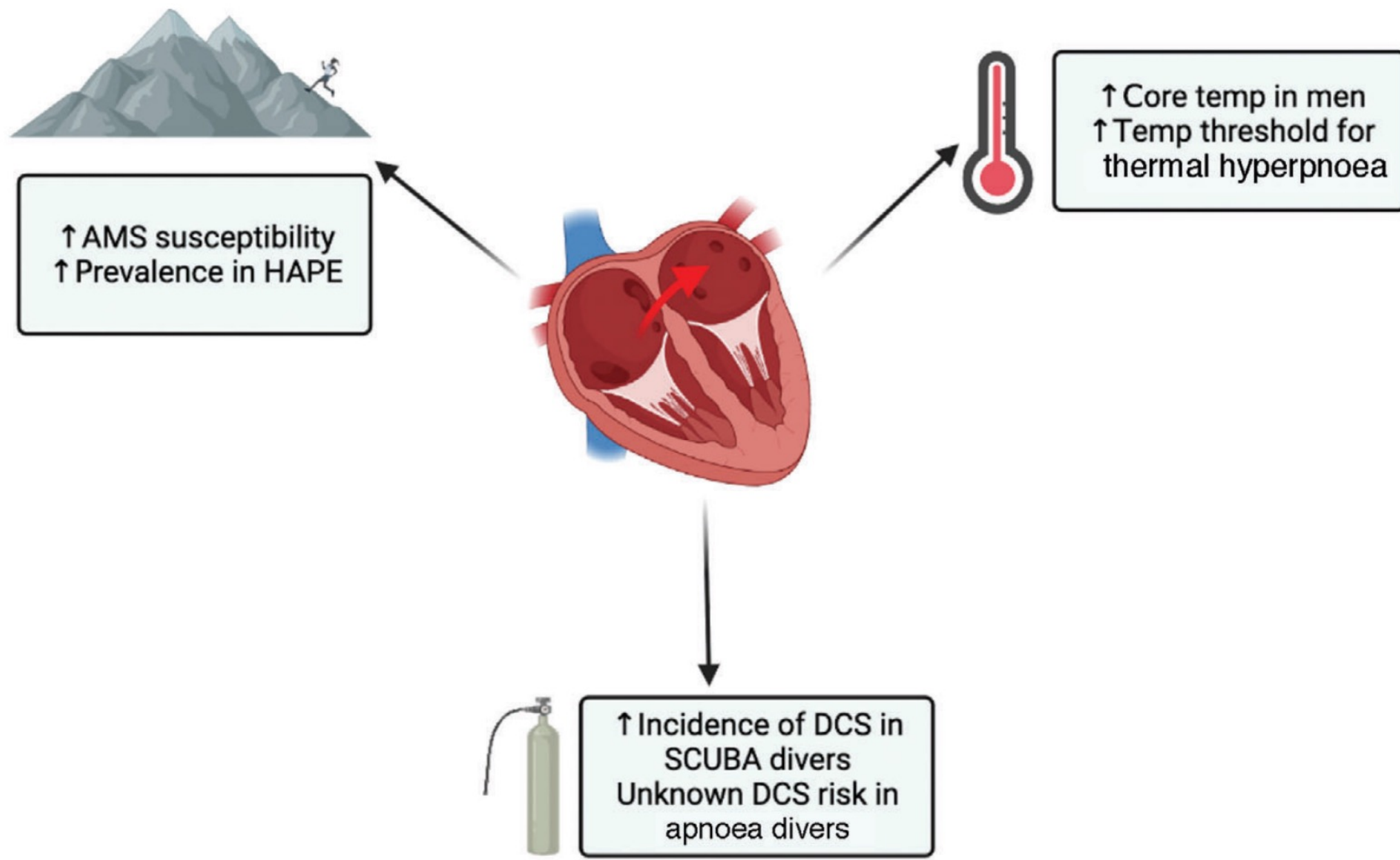


# INFLUENCE OF A PATENT FORAMEN OVALE ON THERMOREGULATORY RESPONSES DURING EXERCISE AT A FIXED HEAT PRODUCTION

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## INTRODUCTION



A patent foramen ovale (PFO) is a small hole between the atria of the heart that is present in 25-40% of the population.

Recently, data has shown that men with a PFO have higher esophageal temperatures at rest, during exercise, and during passive heating and cooling (hot tub/cold tub immersion)<sup>1,2</sup>.

The reasons for differences in core body temperature are unknown but may be due to differences in thermoregulatory mechanisms (skin blood flow, sweating), circulating inflammation (IL-6, MCP-1, etc), or metabolism/heat production in these situations.

## PURPOSE

To test whether:

1) A PFO influences the thermoregulatory and cardiovascular responses to a 60 min exercise bout at a fixed heat production (Hprod, 7 W/kg)

2) The differences in core temperature between PFO+ and PFO- men exist in multiple anatomical locations:

- Telemetric pill: gastrointestinal temperature
- Esophageal temperature: temperature of the blood in the heart



## METHODS

Study Design:

Visit 1:

- Lung function
- PFO screening

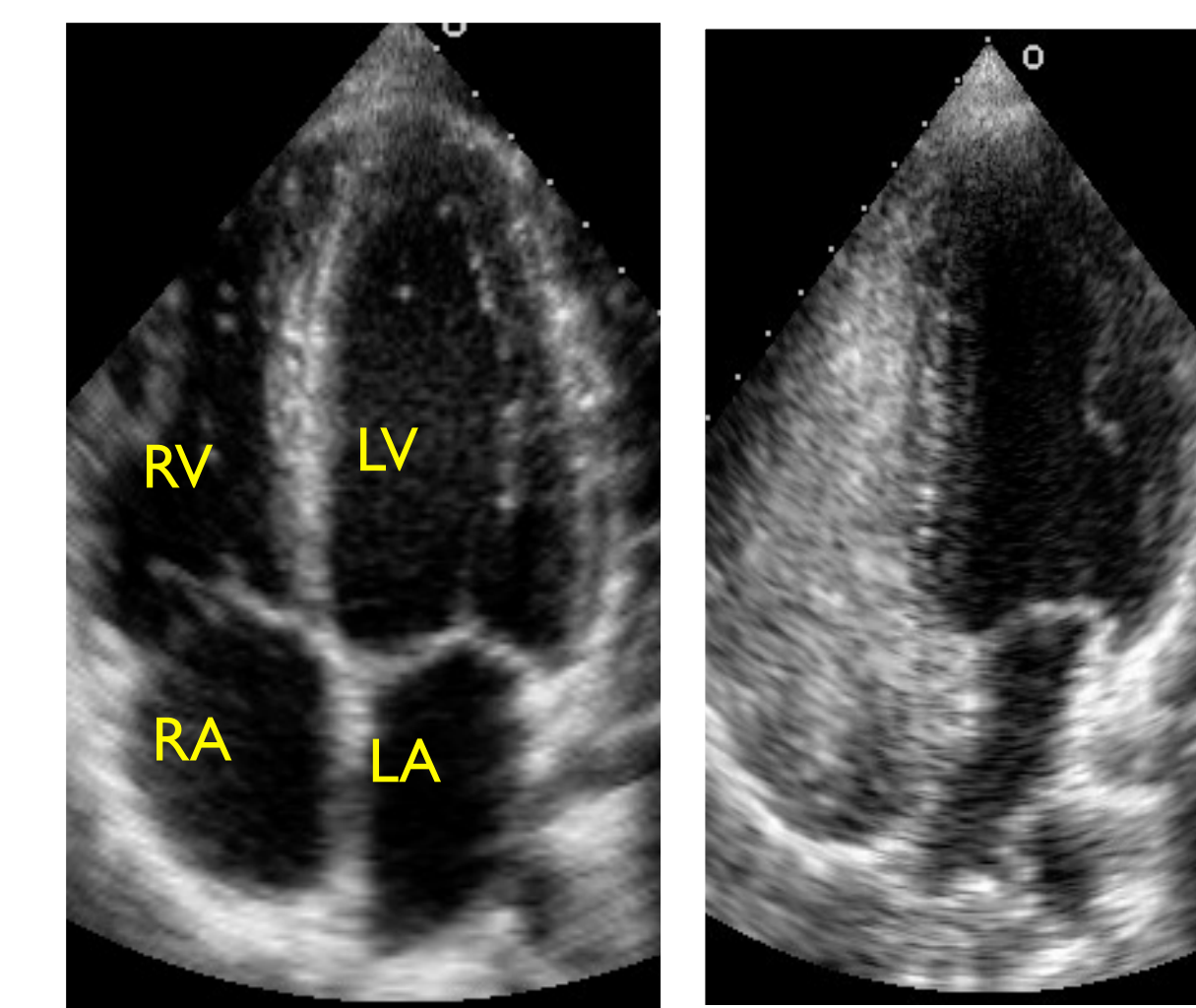
Visit 2: Hprod test/ maximal exercise test

- Subjects cycle at 4 workloads for 5 min each
- Collect metabolic data to calculate Hprod

Visit 3: 60 min exercise bout

- Pre-post body weight
- Urine specific gravity (hydration status)
- Core temperature (telemetric pill and esophageal probe)
- Skin temperature (skin thermistors)
- Respiratory Heat Loss:
  - Inspiratory air temperature & humidity
  - Expiratory air temperature & humidity
- Blood draws (inflammatory markers)

	PFO- (n = 10)	PFO+ (n = 11)
Ambient Temperature	22.2 ± 0.6	22.2 ± 0.5
Humidity (%)	41 ± 13	38 ± 10
Height (cm)	180 ± 5	180 ± 5
Weight (kg)	77.9 ± 6.1	77.7 ± 9.2
Heat Production (W/kg)	7.1 ± 0.3	7.1 ± 0.2
USG	1.016 ± 0.006	1.017 ± 0.005
Change in weight (kg)	-0.6 ± 0.2	-0.6 ± 0.2
% Change in weight	-0.6 ± 0.6	-0.7 ± 0.6



## RESULTS

Heart Rate

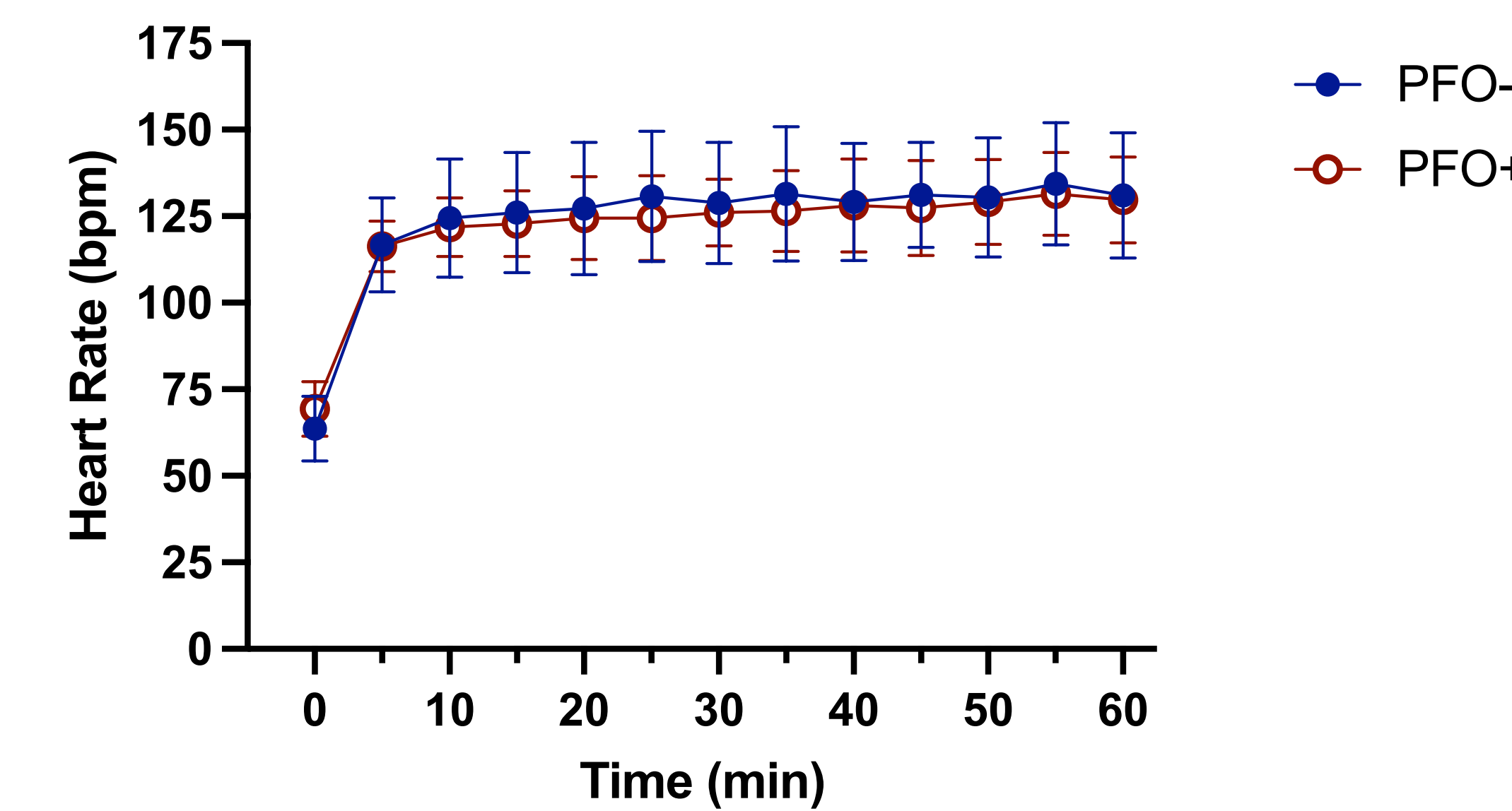


Figure 5. Heart rate at rest and during the 60 min of exercise.

## DISCUSSION & CONCLUSION

At rest and when exercising for 60 min at a fixed heat production (7 w/kg), PFO- men have higher T<sub>c</sub> as measured by telemetric pill.

No differences exist in T<sub>esoph</sub>, T<sub>skin</sub>, heart rate or respiratory heat loss between PFO+ and PFO- men at rest or during exercise.

Additionally, there were no differences in absolute or relative percent change in body weight pre-post exercise, indicating that there may be no differences in sweat rate between PFO+ and PFO- men.

The reason for the variability in core temperature differences seen in PFO+ and PFO- men among studies is unknown. It may be due to inter-individual variability, but the precise reasons remain to be determined.

## RESULTS

Core Temperature

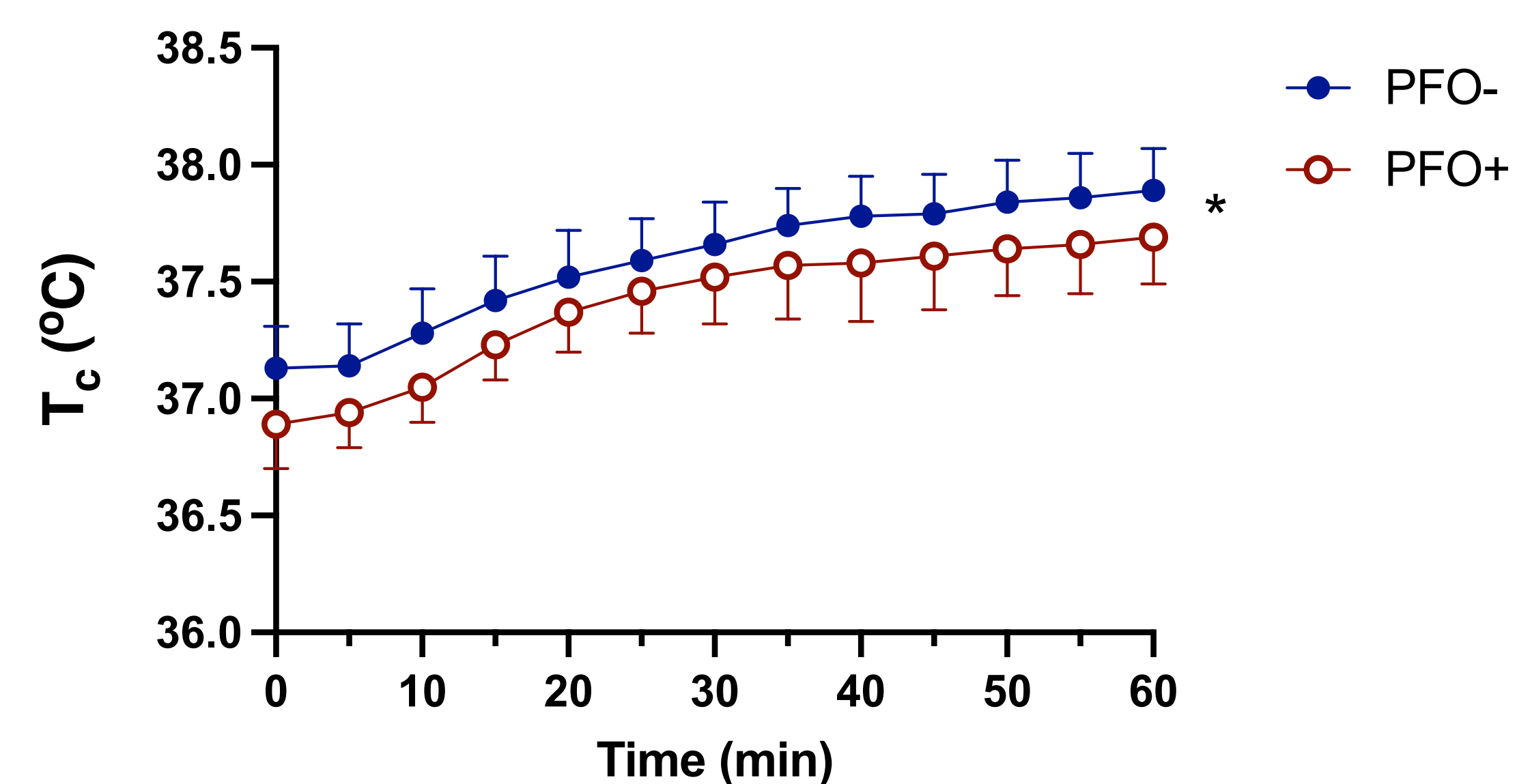


Figure 1. Core temperature at rest and during the 60 min of exercise. \* Main effect of PFO on T<sub>c</sub>

Skin Temperature

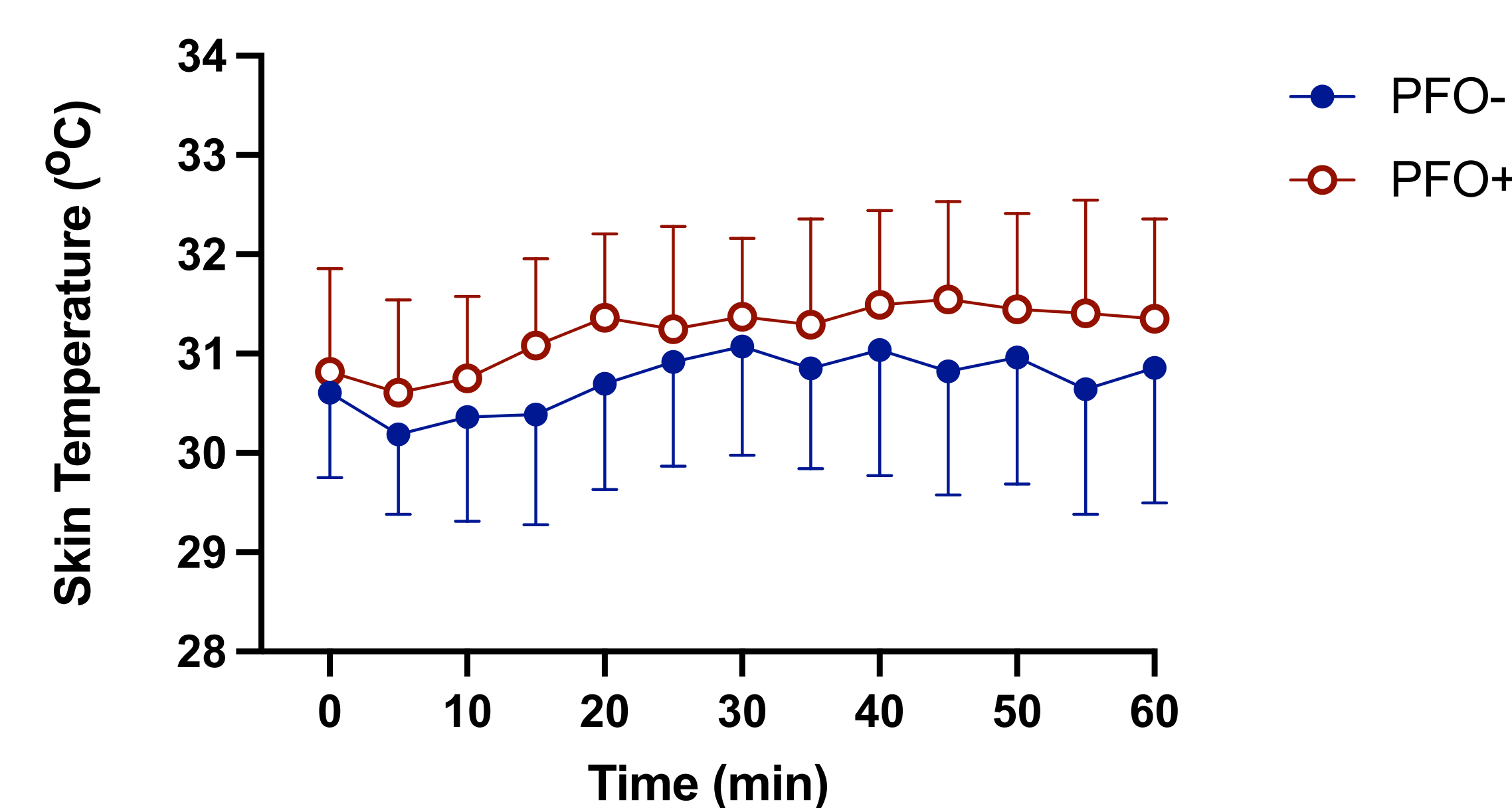


Figure 3. Skin temperature at rest and during the 60 min of exercise.

Esophageal Temperature

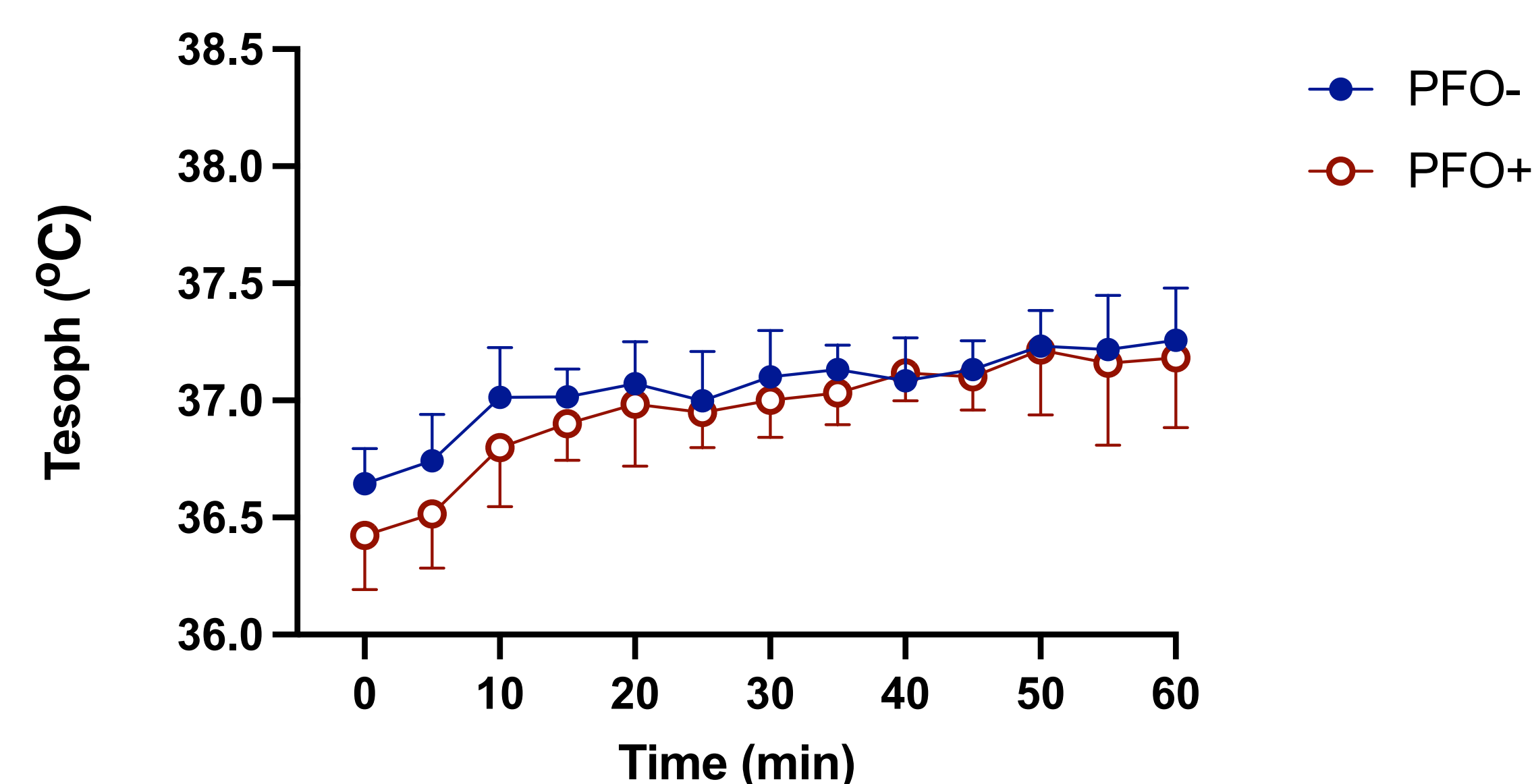


Figure 2. Esophageal temperature at rest and during the 60 min of exercise.

Total Respiratory Heat Loss

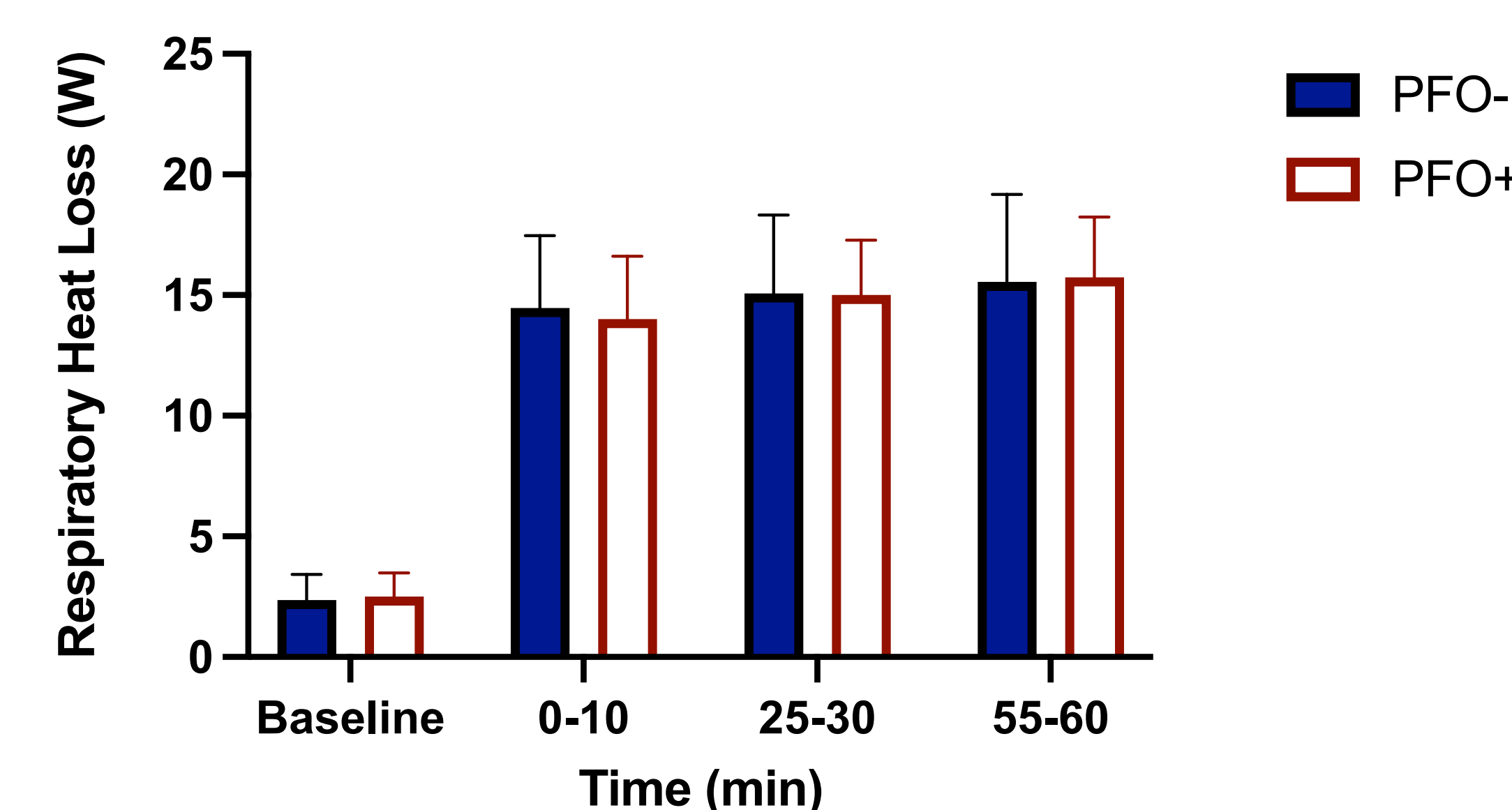


Figure 4. Respiratory heat loss at rest and during exercise.

## REFERENCES

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2. Davis JT, Ng CY, Hill SD, Padgett RC, Lovering AT. Higher oesophageal temperature at rest and during exercise in humans with patent foramen ovale. J Physiol. 2015;593(20):4615-30.