Effect of Thirst Sensation on Heart Rate Variability during and after Exercise in the Heat, Independent of Hydration Status

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INTRODUCTION

Heart rate variability (HRV) is altered during exercise due to an imbalance between sympathetic and parasympathetic pathways, resulting in decreased HRV and increased heart rate (HR). Dehydration from exercising in the heat increases cardiovascular strain and modulates the autonomic nervous system. Thirst sensation may initiate when an individual is mildly dehydrated, but thirst perception on autonomic function during and after prolonged exercise in the heat is not yet understood.

PURPOSE

To investigate HRV response during and after exercise in the heat in response to thirst sensation, independent of hydration status.

METHODS

Twelve males (age: 29±12 years; body mass: 74.7±7.9 kg; height: 179.4±7.0 cm; maximal oxygen consumption [VO_{2max}]: 49.8±6.6 ml·kg^{-1}·min^{-1}) performed steady-state cycling at 55% wVO_{2max} for 90 minutes followed by a 12 km cycling time trial in the heat (ambient temperature: 34.9±0.6 °C; relative humidity: 30.3±0.9%; wind speed: 3.4 m×sec^{-1}) with two experimental conditions (thirsty [T] or non-thirsty [NT]) in random order. HRV was assessed before 90 min exercise (PRE) and after (MID), and following the time trial (POST) with electrocardiography. Thirst was measured every 5-minutes using a visual analog scale.

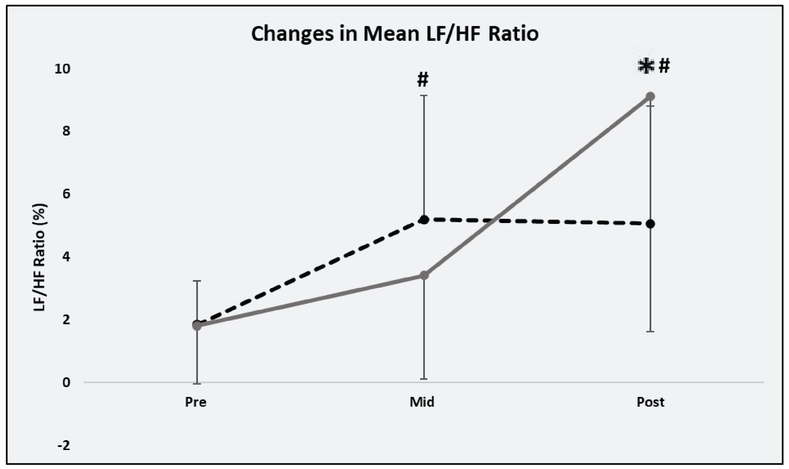
Statistical Analysis: Linear mixed effect models with random effects of the participant were used to determine the effects of thirst on HRV. Statistical significance was set at $p<0.05$.

Conditions

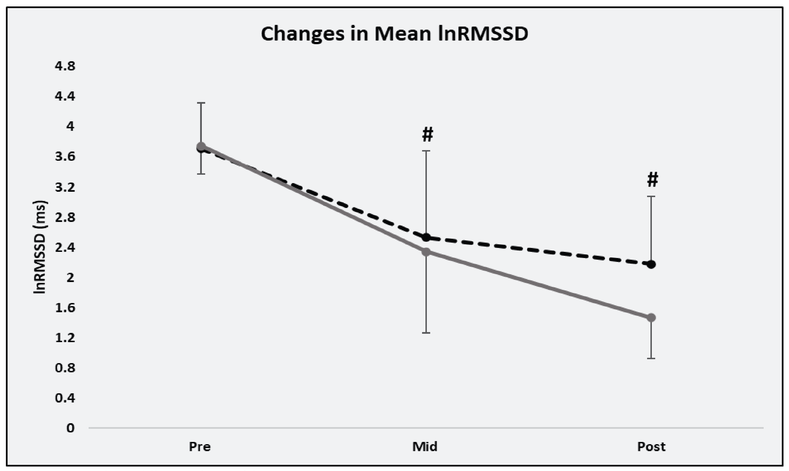
T — Infusion of 25ml of isotonic saline every 5 minutes via intravenous tube

NT — Drank 25mL of water every 5 minutes

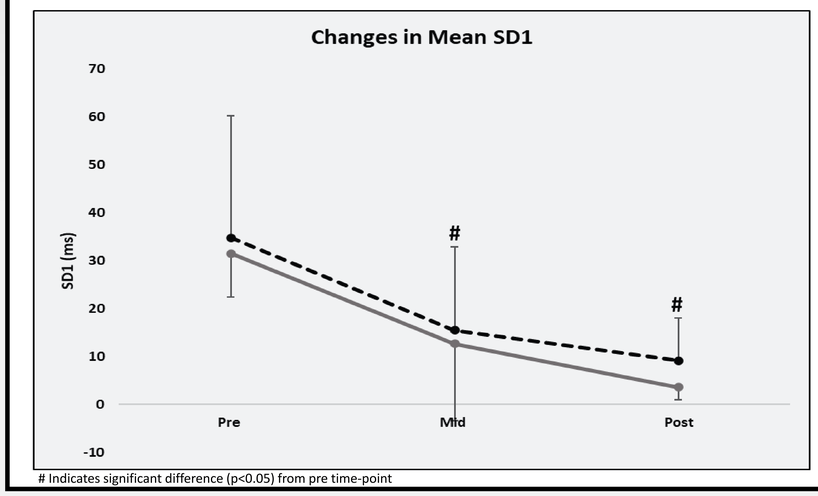
RESULTS



* Indicates significant interaction ($p<0.05$) between thirst sensation and heart rate variability measure.
\# Indicates significant difference ($p<0.05$) from pre time-point



\# Indicates significant difference ($p<0.05$) from pre time-point



\# Indicates significant difference ($p<0.05$) from pre time-point

RESULTS

Significant interaction of thirst sensation by time point of low frequency/high frequency ratio (LF/HF ratio) was determined. Bonferroni post hoc analyses revealed that T and NT experienced significantly different LF/HF ratio at POST (T; 9.11 ± 7.49%, NT; 5.07 ± 3.73%, $p<0.05$). No significant interactions were noted between thirst sensation and time point for other HRV variables, including root mean square of successive differences between normal heart beats (RMSSD), lnRMSSD, LF, HF, standard deviation of NN intervals (SDNN), standard deviation of Poincaré plot perpendicular to (SD1) and along (SD2) the line-of-identity ($p>0.05$).

——— = Thirsty (T)

- - - - - - - - - - = Non-Thirsty (NT)

CONCLUSION

These results demonstrated the significant differences between T and NT regarding the LF/HF ratio post-exercise in the heat. The LF/HF ratio is indicative of autonomic balance between sympathetic and parasympathetic domains, with an increased ratio indicating reduced parasympathetic activation. Thus, increased thirst sensation alone may increase sympathetic activation after exercising in the heat, independent of hydration status.

PRACTICAL APPLICATIONS

Exercising in the heat produces cardiovascular strain due to autonomic imbalance. However, low thirst sensation may attenuate this imbalance, specifically a reduced LF/HF ratio. Athletes and their support teams can structure planned drinking strategies to mitigate feelings of thirst, thereby reducing elevated sympathetic activity following exercise in the heat.

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