



# Effects of circadian rhythms on night-time swimming during the Olympics: will performance be affected? – A pilot study for Rio 2016

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## Introduction

Circadian rhythms (CRs), among other factors, have been shown to be crucial in sports performance. Unlike the usual timings for international events, the swimming competitions in the 2016 Olympics will be held between 22.00 and 00.30. This means that the CRs of the swimmers will be shifted by five-hours. The impact of CRs on sporting performance is already known (Cappert T, 1999). Therefore, the aim of this study was to analyse sleep quality (SQ), heart rate variability (HRV), heart rate recovery (HRR) and the total mood disturbance (TMD) index during a week of night-time training and the influence they have on the state of overreaching.

## Methods

Three male swimmers, who will be competing in the sprint races during the 2016 Olympics in Rio, were monitored during a week of night-time training sessions to correspond with the timings of their evening races during the Olympics' semi-finals and finals. Assessments of SQ, in which the ratio of total time in bed was calculated using actigraphy (Sensewear, Bodymedia USA), HRR, HRV (Minicardio, Hosand – Italy) and TMD were conducted five times during the whole simulation exercise with intervals of two days and once on the habituation day. All athletes answered a “morningness/eveningness” questionnaire in relation to the chronotype profile (REF). The CRs were made to shift by five hours, such that the athletes woke up at 11.00 and retired for the day at 02.00, while their nutritional intake was integrated with Tryptophan (an essential amino acid that is converted to serotonin, which in turn is converted to melatonin) in order to improve SQ. For each variable, a Univariate ANOVA with Time factor was used to compare the significant effects in-between sessions. When a significant F-value was found, least significant difference (LSD) was chosen as the *post-hoc* procedure. Meanwhile, a t-test was used to establish TMD on two occasions (at the beginning and at the end). The level of significance was fixed at  $p < 0.05$  using SPSS 15.0 Software.

## Results

The Univariate ANOVA showed that, for HRV, which was classified in terms of Very Low Frequency (VLF), Low Frequency (LF) or High Frequency (HF), SQ showed significant effects between each time period (T0-T1-T2-T3-T4):  $F=9.481$  and  $p=0.002$ ,  $F=6.603$  and  $p=0.007$ ,  $F=9.209$  and  $p=0.002$ ,  $F=19.189$  and  $p < 0.0001$ , respectively. Conversely, the Univariate ANOVA showed no significant effect on HRR, ( $F=0.817$  and  $p=0.542$ ). Finally, TMD was very low at the start ( $5.50 \pm 3.51$ ) respect  $81.00 \pm 18.90$  during the last session ( $p=0.031$ ).

## Discussion

The data suggest that training late at night impaired the physiological and psychological states of the athletes.

Increased sleep disturbance, fatigue and changes in autonomic functioning hinted at the onset of an overreached state.

The aim of this study was to investigate the effects of night-time training for swimmers that corresponded to the timings of events in which they were participating at the 2016 Olympics in Rio. In the current study, the main findings indicated that there are effects on HRV, SQ and TMD.

In conclusion, the time of day was shown to have a significant effect on the psychological and physiological variables observed in this study, thus indicating there are potential effects. More than two days under “late night” conditions can inhibit the performance of athletes, with a major impact on their “morningness” profile. In order to reduce such an impact, greater emphasis must be placed on identifying the nutritional and sleep needs of elite swimmers, in order to put together adequate recovery strategies that will help them train effectively to maximize performance outcomes.

## References

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