

## Effects of Ramadan on the Diurnal Variations of Repeated-Sprint Performance

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**Purpose:** This study examined the effects of Ramadan on cycling repeated-sprint ability (RSA) and corresponding diurnal variations. **Methods:** Twelve active men performed an RSA test ( $5 \times 6\text{-s}$  maximal sprints interspersed with 24 s passive recovery) during morning and afternoon sessions 1 wk before Ramadan (BR), during the second (R2) and the fourth (R4) weeks of Ramadan, and 2 wk after Ramadan (AR). Maximal voluntary contraction was assessed before ( $\text{MVC}_{\text{pre}}$ ), immediately after ( $\text{MVC}_{\text{post}}$ ), and 5 min after the RSA test ( $\text{MVC}_{\text{post}5}$ ). Moreover, hematocrit, hemoglobin, and plasma sodium and potassium ( $\text{K}^+$ ) concentrations were measured at rest and after the RSA test and  $\text{MVC}_{\text{post}}$ . **Results:** Overall, peak power ( $P_{\text{peak}}$ ) during the RSA test decreased throughout the 5 sprints.  $P_{\text{peak}}$  measured in the first sprint and  $\text{MVC}_{\text{pre}}$  were lower during Ramadan than BR in the afternoon ( $P < .05$ ) and higher in the afternoon than the morning BR and AR ( $P < .05$ ). However, this diurnal rhythmicity was not found for the last 4 sprints'  $P_{\text{peak}}$ ,  $\text{MVC}_{\text{post}}$ , and  $\text{MVC}_{\text{post}5}$  in all testing periods. Furthermore, the last 4 sprints'  $P_{\text{peak}}$ ,  $\text{MVC}_{\text{post}}$ ,  $\text{MVC}_{\text{post}5}$ , and morning  $\text{MVC}_{\text{pre}}$  were not affected by Ramadan.  $[\text{K}^+]$  measured at rest and after the RSA test and  $\text{MVC}_{\text{post}}$  were higher during Ramadan than BR in the afternoon ( $P < .05$ ) and higher in the afternoon than the morning during Ramadan ( $P < .05$ ). **Conclusions:** Fatigability is higher in the afternoon during Ramadan, and, therefore, training and competition should be scheduled at the time of day when physical performance is less affected.

**Keywords:** fasting, time of day, RSA, MVC, hematological measurements

Ramadan is a holy month during which devout Muslims refrain from eating and drinking from sunrise to sunset, which may affect body mass and hematological indices.<sup>1</sup> Ramadan fasting has been associated with increased serum protein, albumin,<sup>2</sup> uric acid,<sup>3</sup> hemoglobin (Hb),<sup>4,5</sup> and hematocrit (Hct).<sup>2,5</sup> These changes have been attributed to decreased plasma volume subsequent to a reduction in fluid intake and may indicate hypohydration.<sup>6</sup> In most studies, changes in sleep habits and food and fluid intakes during Ramadan result in a decrease in some aspects of performances (eg, force and anaerobic capacity).<sup>4,7</sup> Nevertheless, the point at which the various components of performance in different sports are affected is not well established.<sup>8</sup> Also, the decline in muscle performance during Ramadan may associate to

central, as well as peripheral, factors. In this context, it has been demonstrated that during exercise, potassium ( $\text{K}^+$ ) is released from the intracellular to the extracellular space of human skeletal muscle and further into the bloodstream.<sup>9</sup> Accumulation of  $\text{K}^+$  in the muscle interstitium has been suggested to cause fatigue as the increase of extracellular  $\text{K}^+$  depolarizes the sarcolemma and consequently should reduce its excitability.<sup>10</sup>

Moreover, most of the studies investigating the effects of Ramadan on performance have not examined whether changes occur during the course of the day. This is important because performance is not constant throughout the daytime, showing rhythmicity, as do other physiological and biochemical variables.<sup>11</sup> In this context, aerobic and anaerobic performances display a diurnal rhythm, with higher values in the late afternoon than in the morning.<sup>12</sup> Among the few studies that have assessed the effect of time of day on diurnal performance variations during Ramadan, Souissi et al<sup>7</sup> found that anaerobic performances were unaffected in the morning but impaired in the evening during Ramadan. Those authors showed that the diurnal rhythm of short-term maximal performances is affected by Ramadan. However, more studies are required to determine the overall effects of time of day on physical performance during Ramadan.

Furthermore, tests of repeated-sprint ability (RSA) have been designed to replicate the demands of an intense

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