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Letter to editor

Effects of Ramadan Fasting on Running Activity Profiles in Elite Soccer Players during an Official 90-Minute Match

Dear Editor-in-chief

During the holy month of Ramadan, Muslims worldwide refrain from eating or drinking from sunrise to sunset over a period of approximately 30 days. Research in adult and youth soccer players has shown that during and/or following Ramadan, performance in athletic and/or skill tests can be affected (Zerguini et al., 2007; Chtourou et al., 2011). Sleep loss (Maughan et al., 2012) and alterations in circadian rhythm can also occur (Drust et al., 2012) potentially affecting preparation, performance and recovery. However, to our knowledge, only one study has examined the effects of Ramadan fasting on athletic performance in match-play conditions in soccer players (Aziz et al., 2018) and no data exist in elite performers. A comparison of 2 simulated matches played by amateur players in both a fasted versus non-fasted state reported a 13% and 35% reduction in total and high-intensity distance covered in the fasted state with a negative impact already noticeable early in the match (Aziz et al., 2018).

In this study, an interesting opportunity arose to investigate running performance in official match-play in a cohort of elite outfield players belonging to a high-standard soccer team (French 3rd division, season 2018-2019) who were observing the Ramadan fast. Ramadan officially began in France on Monday 6th May 2019 and the match kicked-off at 20:45 on Thursday 9th May (result 1-1). As such, the match took place during the early part of Ramadan during which the largest changes in fitness parameters can occur (Maughan et al., 2012). Seven players (age: 26.0 ± 4.0 years, height: 1.78 ± 0.07 m, weight: 74.0 ± 8.3 kg, VO_{2max} : 59.5 ± 5.2 ml·kg⁻¹·min⁻¹) commenced play in a home League match in a fasted state of which 3 were substituted during the 2nd half. All had performed the Ramadan fast for >8 years. Performance was concomitantly examined in 5 non-fasting peers (age 28.4 ± 3.9 years, height: 1.81 ± 0.08 m, weight: 76.8 ± 8.2 kg, VO_{2max} : 58.0 ± 4.2 ml·kg⁻¹·min⁻¹ of which 3 players completed 90-minutes and 2 entered play as substitutes. Running activity data was unavailable for 1 substitute.

Prior to the match, the cohort had participated in usual low- to moderate-intensity training sessions on the Monday and Tuesday morning (start 10:15, 75-mins duration) and in a low-intensity session on the Wednesday afternoon (start 17:30, 60-mins duration). No information on dietary intake over the course of the week prior to the match was recorded. The habitual 30-min warm-up session was commenced 45-min before the start of the match. Data provided by the French Football Federation showed respective values for temperature and humidity of 13°C and 62% at the start of play. Darkness fell at 21:17 hours and therefore fasting players were allowed and encouraged to drink and eat ad libitum during the half-time pause.

Mineral water, a commercial isotonic energy drink (Powerade, The Coca Cola Company, USA), almond cake and dried fruit were freely available for consumption. No information on individual intakes at half-time was recorded although all fasted players confirmed post-match they had consumed at least the energy drink and water.

Running performance was measured using a Global Positioning System device (GPS) sampling at 10 HZ (Play-ertek, Catapult Innovations, Melbourne, Australia). Players wore the same GPS across the entire season in a harness secured in the upper back, under their jersey. Measures of running performance included the total distance (TD) and that covered at high-intensities (HIR, >19.8km/h). Data were adjusted to provide a minute-by-minute analysis of distances covered (distance ÷ time played). For players completing 90-mins, performance in the 1st versus 2nd half and across 15-min intervals was also compared. To enable objective comparisons of performance in the aforementioned match, running data for each participant were compared against mean values ('habitual' performance) obtained for all additional match participations across the season (range 6-28 observations). The team's formation (3-5-2 system) was unchanged across the course of play and generally remained the same over the entire competitive season. All data arose as a condition of routine player monitoring across the season.

Data are presented as means and standard deviations and percentage difference between mean values. Hedges corrected effect sizes (ES) were calculated to determine the practical meaningfulness of the differences in mean values. The magnitude of the ES was classified as trivial (<0.2), small (>0.2–0.6), moderate (>0.6–1.2), large (>1.2–2.0) and very large (>2.0–4.0).

Results presented in Table 1 showed that the four players commencing the match in a fasting state and completing 90-mins play only reported *trivial* changes (ES: <0.2) in both TD and HIR activity compared to their habitual performances. In contrast, the 3 non-fasted players completing 90-mins demonstrated *moderate* and *small* reductions in these measures compared to their habitual profile. These findings suggest that the present elite players coped 'physically' with commencing match-play in a fasted state yet differ to results reported in amateur players who recorded less running activity overall when performing in a fasted versus a non-fasted condition (Aziz et al., 2018). This discrepancy may be partly explained by substantial differences in ambient temperature which affect running performance; here 13°C versus ~30°. However, less running activity (ES for TD: -2.16 and HIR: -0.41) was performed in the 3 fasting players who were substituted in the 2nd half (2 attackers, 1 attacking midfielder) in comparison to their habitual performances suggesting that these participants did not cope as well physically. Alternatively,

Table 1. Mean values for running performance (metres per minute) observed in muslim soccer players commencing a match in a fasted condition and completing 90mins play (Fasting Match) versus that for other 90min matches started and completed in a non-fasted condition (Mean) and comparison with data in non-fasting players for the Fasting Match and the Mean for other matches.

Players (n=12)	Total distance run (metres/minute)				High-intensity distance run (metres/minute)			
	Fasting Match	Mean	% Difference	ES	Fasting Match	Mean	% Difference	ES
Fasting players completing 90mins (n=4)	107.3±17.2	109.9±13.1	-2.3	-0.14	11.1±5.6	10.1±4.6	+9.9	0.17
Fasting players substituted (n=3)	105.7±3.0	113.5±2.8	-6.9	-2.16	11.1±2.4	12.4±2.5	-10.1	-0.41
Non-fasting players completing 90mins (n=3)	99.5±5.1	104.1±4.9	-4.4	-0.73	6.5±2.2	8.0±3.2	-19.4	-0.46
Non-fasting substitute players (n=2)	112.8±7.0	104.5±3.3	+8.0	0.86	9.6±3.2	12.0±2.9	-20.2	-0.45

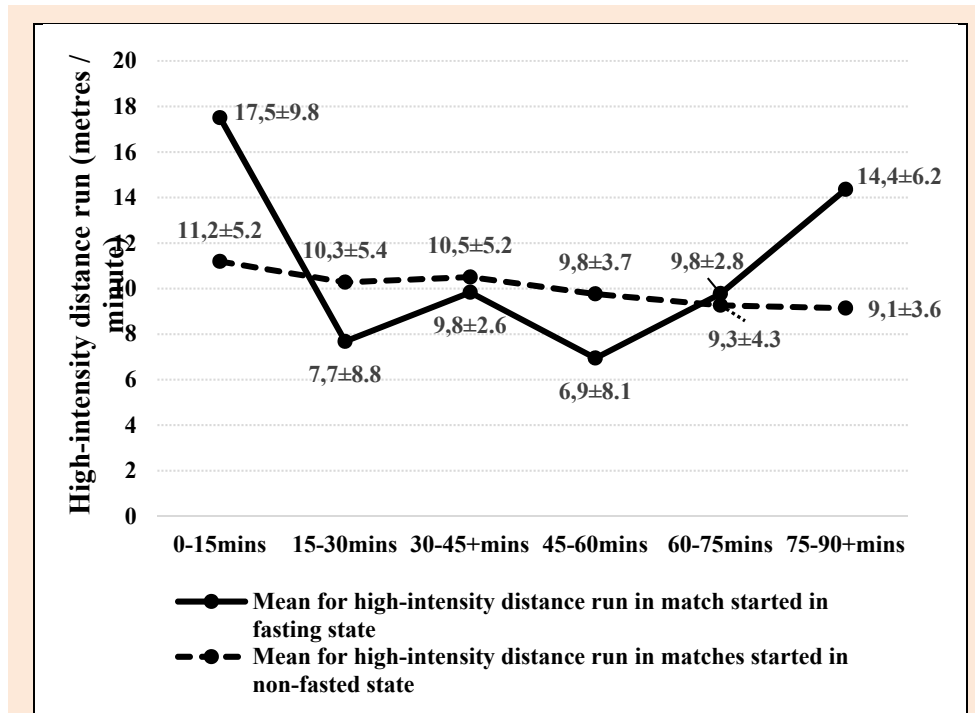


Figure 1. Mean values per 15-minute interval for high-intensity running (metres/minute) for 4 elite soccer players starting a match in a fasted condition and completing 90mins play compared to mean values recorded in matches started in a non-fasted condition and in which 90mins play was completed.

we can speculate that these substituted players initially adopted a pacing strategy (with the aim following the start of play to lower running activity in order to spare energy to respond to end of play running demands; Carling, 2013), a strategy which in the end was not completed due to their substitution between the 60th and 74th minutes of play.

Analysis of 1st versus 2nd half activity in the four fasting players completing 90-mins play showed only *trivial* declines in both 2nd half TD (107.4 ± 16.2 vs. 107.3 ± 18.5 , -0.1%, ES: -0.01) and HIR (11.6 ± 6.2 vs. 10.7 ± 5.1 , -7.9%, ES: -0.14) covered per minute. These reductions were lower in comparison to their habitual 1st versus 2nd half profile (TD: 112.5 ± 12.7 vs. 107.4 ± 13.5 , -4.6%, ES: -0.34 and HIR: 10.8 ± 5.3 vs. 9.5 ± 4.0 , -12.1%, ES: -0.24). While findings imply that the fasting players did not accumulate fatigue in the 2nd half, a reasonable explanation could be related to the substantially less total distance run per minute in the 1st half than that completed habitually (107.4 ± 16.2 vs 112.5 ± 12.7 , -4.5%, ES: -0.30). Indeed, research has shown that in certain circumstances elite soccer players reduce low-intensity activity early on to 'spare' energy for efforts for crucial intense actions as the match progresses (Carling & Bloomfield, 2009). Indeed, anecdotal evidence from informal discussions following the game

between the present authors and players indicated that they were aware of the potentially adverse effects of Ramadan fasting on physical performance and the importance to preserve energy over the course of play by pacing themselves where necessary. We can also speculate that the half-time nutritional intake and notably consumption of the commercial energy drink might have aided the players in maintaining 2nd half running performance. Indeed, the fasting players habitually did not always take on-board energy drinks at half-time which might in part explain the greater reduction in 2nd half activity in matches outside of the Ramadan period. Controlled research is warranted to test the impact of starting physiological status (e.g., blood glucose, muscle glycogen, hydration levels) and if possible subsequent in-game nutritional strategies in fasting versus non-fasting conditions.

In elite soccer match-play, there is a tendency for a peak in high-intensity activity in the first and a decline in the final 15-min periods of play (Carling, 2013). This trend is confirmed in figure 1 by the habitual performance observed in four players when starting matches in a non-fasted condition: 0-15min interval= 11.1 ± 5.2 m/min and 75-90+min interval= 9.1 ± 3.6 m/min. When HIR is analysed in the match completed after starting play in a fasted

state, the performance profile would suggest that players adopted a U-shaped type pacing profile (Abiss & Laursen, 2008; start strongly, progressively reduce efforts before progressively increasing activity in the latter stages) in an attempt to finish the match strongly. Interestingly, a similar pacing trend for HIR (data not shown) across 15-min intervals was also observed in the non-fasting players over the entire match. It is also reasonable to suggest that this running profile across match intervals was also associated with ball possession in addition to changes in scoreline. Indeed, the reference team's time in ball possession was at its lowest in the first 15-min interval (41% versus 49% for mean of all other 15-min intervals) hence the team's running activity was heavily dictated by the opposition during this period and it is positive that the team was able to respond to these demands (shown by greater than usual running activity) although a goal was conceded in the 12th minute. It is also positive that in 'chasing the game' both fasted (and non-fasted) players were able to increase their HIR during the final minutes of play resulting in the reference team equalising in stoppage time.

In summary, this study is to our knowledge the first to examine the impact of Ramadan fasting on running activity profiles in elite soccer players during an official 90-min soccer match. Results notably showed that players commencing play in a fasted state and completing 90mins generally coped physically which might partly be explained by nutritional intake during half-time and/or the adopting of a pacing strategy. Additional studies are nevertheless warranted using more controlled holistic experimental approaches and metrics (e.g., objective and subjective: physical/physiological/perceptual and technical) to improve understanding of the effects of Ramadan on performance particularly over consecutive matches. The inclusion of larger sample sizes (teams + matches) is also necessary to better account for the large natural variability inherent to match running performance.

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