



Evolution of Dietary Intake Between Before, During and After Ramadan Observance in Tunisian Physically Active Men: A Systematic Review

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Abstract

Objective: The present review was designed to systematize the literature on the evolution of dietary intake in Tunisian physically active subjects (i.e., physically active men and physical education students) between before, during and after Ramadan observance.

Evidence Acquisition: Two electronic databases, PubMed and Science direct, were searched using a comprehensive strategy. Studies published prior to August 2018 were included if they assessed dietary intake during Ramadan in Tunisian physically active subjects. A narrative synthesis of findings was conducted.

Results: Nine studies evaluated the dietary intake change between before, during and after Ramadan observance. Energy intake decreased in three studies and did not change in six studies. One study showed decreases in fat intake during Ramadan, two studies reported increases and six studies did not report significant changes. Protein intake decreased in three studies, increased in one study and did not change in five studies. Carbohydrate intake did not change in six studies and increased in three studies. Total water intake decreased in four studies and did not change in one study.

Conclusions: The literature does not support that Ramadan fasting had adverse effect on dietary intake.

Keywords: Fasting, Exercise, Sport Practice, Dietary, Food

1. Context

Ramadan (i.e., 29 to 30 days) intermittent fasting (i.e., from dawn to sunset) from eating, drinking, smoking, and certain other behaviors is a fundamental rule of Islam (1). The daytime fasting depends on the climatic conditions as Ramadan advances ~ 11 days each year and could, therefore, occur in all season (2). Likewise, daytime fasting is strongly influenced by the geographical location of Muslims (3) and could be, in some countries, longer than 18 h in summer. In other countries located at the poles, the duration of the fast could be longer, which represents a real challenge for the fasters. In this context, a previous study reported an increase in the risk of accidents during Ramadan due to changes in the lifestyle (4). This implies some loss of cognitive and/or physical performances (5-7), both of which are important elements of performance. Therefore, a good diet is essential to be in good health.

Every day, Muslims take two main meals called *Sahour* and *Iftar* (8). The requirement to eat only in a short period of time leads to a disturbed circadian rhythm and to sev-

eral changes in food intake timing (4). During Ramadan, changes are not only related to food intake timing, but the quantity and type of meals is different to that eaten in pre- or post-Ramadan (9, 10). In fact, a precious study showed that Ramadan is accompanied with higher lipid and protein intakes (11). Conversely, a decrease in carbohydrate consumption was observed during this month (11). Such dietary changes can in turn impact both the utilization and the storage of substrates, and entail to variations of body composition (1). Such a contradiction in the literature is probably due to different cultures in Islamic countries. In reality, variability of results depended on the region and conditions surrounding Ramadan fasting (12, 13). In this respect, many authors reported that the dietary intake during Ramadan remains substantially the same compared to the control period (i.e., before Ramadan) (14, 15). However, other studies have shown a decrease in daily calorie intake during Ramadan (16, 17). Amongst the changes affecting daily habits during Ramadan observance, we can distinctively observe either qualitatively or quantitatively dietetic-related changes.

Nowadays, no-previous study provided a systematic literature reviews on Ramadan intermittent fasting and subsequent effect on dietary intake in Tunisian physically active subjects. Systematic literature analysis provide a synthesis of the published results about a precise topic (e.g., dietary intake) from which conclusions could be drawn and decisions made by gathering data from different sources (18, 19). Therefore, the present review was designed to systematize the literature on the evolution of dietary intake in Tunisian physically active subjects between before, during and after Ramadan observance.

2. Evidence Acquisition

2.1. Protocol

Based on the guidelines of the preferred reporting items for systematic reviews and meta-analysis (PRISMA), this systematic review was prepared (20).

2.2. Eligibility Criteria

Single-group pre-post design and crossover design studies were included in the systematic review. All the included studies compared the outcomes before, during and after Ramadan intermittent fasting. All articles that assessed dietary intake and/or energy intake and/or carbohydrate intake and/or fat intake and/or protein intake were included.

Samples were required to consist of Tunisian physically active men, with a mean participant age of 18 years or older.

Only articles, written in English or French, published or accepted for publication in peer-reviewed journals were considered. No restrictions in terms of study design, setting or time frame were considered.

Articles that were strictly descriptive (i.e., review articles), conference proceedings, and articles carried on athletes or subject carrying diseases were excluded.

2.3. Information Sources and Search

Two electronic databases, PubMed and Science direct, were searched without any time limits or Filters. The last search was completed in August 25, 2018. The following combination of keywords was used when searching: [(Ramadan) OR (Ramadan fasting) OR (Ramadan observance) AND [(dietary intake) OR (energy intake)] AND [Tunisian].

Otherwise, to minimize the risk of missing important manuscripts, the reference lists of the selected studies were verified in addition to the related Google Scholar' citations from other journals. Specialists in the field were also contacted for possible upcoming studies. Also, target journals (i.e., Clinical Journal of Sport Medicine, International Journal of Sport Nutrition and Exercise Metabolism,

Asian Journal of Sports Medicine, Chronobiology International, Journal of the International Society of Sports Nutrition) were hand-searched for possible accepted studies in the field.

2.4. Study Selection

The method of studies selection is outlined in [Figure 1](#). Duplicate studies were removed from the first search results using EndNote.

Titles and abstracts of the selected studies were independently screened by two authors (Omar Boukhris and Khaled Trabelsi) for eligibility and resolved disagreements by consensus. Full texts of the selected manuscripts were subsequently screened for eligibility and disagreements once more resolved by consensus.

2.5. Data Collection Process

Using a pilot-tested extraction form, the two reviewers (Omar Boukhris and Khaled Trabelsi) independently collected data (i.e., including study characteristics (i.e., study design, methodology of dietary intake assessment), participant characteristics (i.e., age, number of participants, sex, and findings) and resolved disagreements by consensus.

3. Results

3.1. Study Selection

Nine studies were considered eligible for this systematic review.

3.2. Study Characteristics

Data of the nine selected studies are presented in [Table 1](#) in order of publication date. The included studies showed a range of study designs: All of subjects participating in the studies are men. Mean age of physically active undertaking training during Ramadan observance varied from 18 to 27 years. The total population size included in this review was 93.

3.3. Dietary Intake

A total of nine studies, published between 2007 and 2018, describing the change of dietary intake between before and during Ramadan observance for Tunisian physically active subjects are shown in [Table 1](#).

3.3.1. Energy Intake

Compared to pre- and post- Ramadan, six studies indicated that daily energy intakes remained similar during Ramadan (14, 21-25). However, three studies showed a decrease of energy intake (26-28).

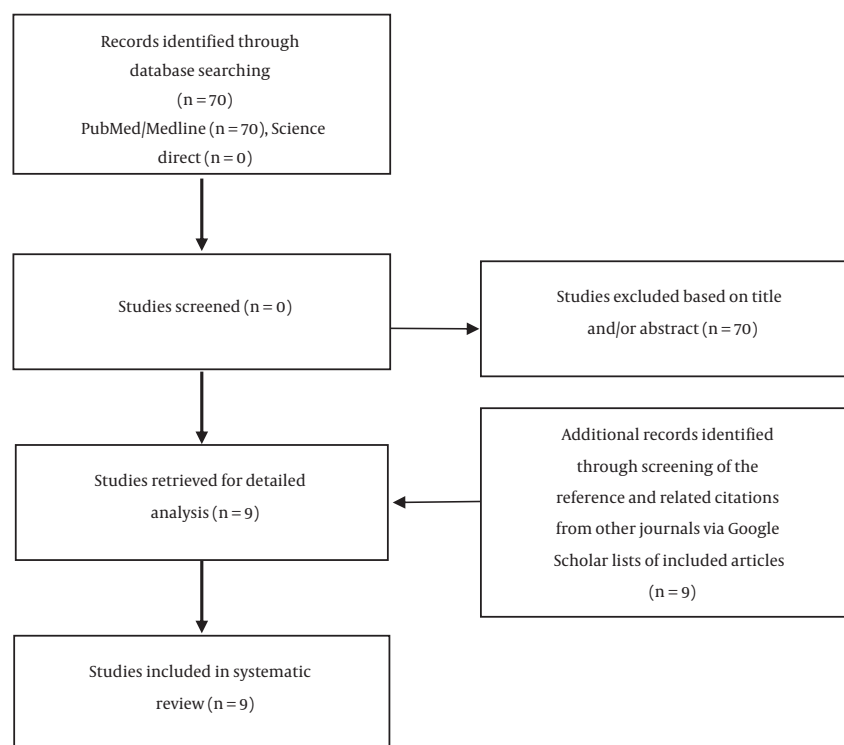


Figure 1. Flowchart of studies selection

3.3.2. Fat Intake

Six studies revealed no-changes during Ramadan in comparison to the control period (14, 21-24, 28). On the other hand, one study reported that the fat intake was lower during Ramadan than control periods (26). However, Trabelsi et al. (27) and Boukhris et al. (25) showed that the fat intake increased during the month of Ramadan.

3.3.3. Carbohydrate Intake

Three studies showed that carbohydrate intake decreased during Ramadan in comparison to control periods (21, 26, 27). However, six studies have reported the absence of change in carbohydrate intake between periods during and outside Ramadan (14, 22, 23, 25, 27, 28).

3.3.4. Protein Intake

Three studies observed increased protein ingestion during compared to before or after Ramadan (21, 23, 27). Conversely, one study showed a decrease in protein intake during Ramadan compared to control periods (26). However, the absence of change in protein consumption during Ramadan compared to control periods was reported by six studies (14, 22-25, 28).

3.3.5. Total Water Intake

Six studies assessed total water intake during Ramadan in physically active men. Trabelsi et al. (21, 22, 24, 27) reported a decrease in total water intake during in comparison to before Ramadan. However, Bouhleb et al. (28) reported that fluid intake did not change during Ramadan in comparison with control periods.

4. Discussion

This is the first systematic review, to the best of our knowledge, to investigate the evolution of dietary intake between before, during and after Ramadan intermittent fasting in Tunisian physically active subjects. It is worth noting that during Ramadan, peoples are faced with a change in the eating habit including food intake schedule since they have the opportunity to eat only during the night.

However, this does not mean that this change in eating time will induce a decrease in food intake because usually peoples try to have the same number of usual meals (i.e., two or three meals). Broadly, the effects of Ramadan intermittent fasting on dietary intake may be summarized as neutral. To maintain energy balance, some sedentary people still eat enough; however, others consume less food to

Table 1. Changes of Dietary Intake During Ramadan

Study	Subjects	Age	Gender	Training Program	Measures	Methods of Assessment	Findings
Souissi et al. (14)	12	22.6 ± 1.3	Male	-	One week before Ramadan; The second week of Ramadan; The fourth week of Ramadan; Two weeks after Ramadan	Dietary records during 3 days of each week of physical testing.	No change of dietary intake
Abdelmalek et al. (26)	9	22.1 ± 0.2	Male	-	The first week of Ramadan; The fourth week of Ramadan; Three weeks after Ramadan	Dietary records during 3 days of each week of physical testing.	Decrease of the mean energy and macro-nutrient intake during compared to after Ramadan
Trabelsi et al. (21)	10	26.6 ± 3.0	Male	Aerobic exercise (i.e., jogging and swimming) for recreational purposes for at least 3 times/week	Three days before Ramadan; The 15th day of Ramadan; The 29th day of Ramadan; 21 days after Ramadan	Dietary records (7 days before Ramadan and during 3 days of each week of Ramadan).	No-changes of energy and fat intake; protein intake increased during compared to before Ramadan; a significant decrease of carbohydrate intake was observed during compared to before Ramadan; total water intake decreased during compared to before Ramadan.
Trabelsi et al. (27)	12	23.8 ± 4	Male	Four two-hour training sessions each week	One day before the beginning of Ramadan; At the end of the first week of Ramadan; At the end of the fourth week of Ramadan	Dietary records (7 days before Ramadan and during 3 days of each week of Ramadan)	Compared to before and during Ramadan: The total daily energy intake was significantly lower; the fractional contribution of protein and fat to the daily diet was greater; the fractional contribution of carbohydrates to the daily diet was lower; total water intake was significantly higher.
Trabelsi et al. (22)	9	24 ± 3	Male	Bodybuilding (hypertrophic program) for recreational purposes at least three times/week	Two days before Ramadan; On the 29th day of Ramadan	Dietary records (7 days before Ramadan and during 3 days of each week of Ramadan).	No-changes of dietary intake; total water intake decreased during compared to before Ramadan.
Trabelsi et al. (23)	10	26.6 ± 3.0	Male	Aerobic training (continuous exercise) at least three times/week	Three days before Ramadan; The 15th day of Ramadan; The 29th day of Ramadan; 21 days after Ramadan	Dietary records (7 days before Ramadan and during 3 days of each week of Ramadan).	Energy, fat and carbohydrate intake did not change during compared to before Ramadan; protein consumption was significantly higher during the period between the beginning and Mid-Ramadan compared to before Ramadan; total water intake was significantly higher before than during Ramadan.
Bouhlel et al. (28)	10	21.8 ± 1.9	Male	They trained for 16 h/week (soccer, handball, basketball, volleyball, gymnastics, and athletics)	One week before Ramadan; At the end of the first week; During the fourth week of Ramadan	Dietary records (One week before Ramadan and during each day of Ramadan).	No change of protein, fat, carbohydrate and fluids intake; energy intake was lower during compared to before Ramadan.
Trabelsi et al. (24)	8	25 ± 3	Male	Bodybuilding (hypertrophic program) for recreational purposes at least three times/week	Two days before Ramadan; On the 29th day of Ramadan	Dietary records (7 days before Ramadan and during 3 days of each week of Ramadan).	No change of dietary intake; total water intake decreased during compared to before Ramadan.
Boukhris et al. (25)	13	21.2 ± 2.9	Male	They regularly practice physical exercise (e.g., jogging) for at least 3 hours per week	15 days before Ramadan; First ten days of Ramadan; Last ten days of Ramadan; 10 days after Ramadan; 20 days after Ramadan	Dietary records (7 days before Ramadan, during each day of Ramadan, 20 days after Ramadan) followed by an interview with a nutritionist.	No change of energy intake; fat intake increased during Ramadan in comparison with control periods; there was no-significant differences in the fractional contribution of protein intake; the fractional contribution of carbohydrate in percentage was significantly higher after 10 days of Ramadan compared to during and after 20 days of Ramadan.

overcome any sleep difficulties at night or for the exploitation of the opportunity of fasting to lose weight (29, 30). Additionally, it seems that with the proper coaching encouragement, an athlete, during the feed period of the day, could consume enough food and fluid to overcome the effect of the daytime fasting. Nevertheless, these statements could not be generalized due to differences (i) in people's desire to eat extra-food and/or (ii) in the training load during Ramadan.

In term of qualitative analysis of food, the composition of meals varies according to local eating habits (31). In the present review, six studies indicated that, in comparison to pre- and post-Ramadan, the daily energy intake was maintained during Ramadan (14, 21-25). However, other reports indicated, (i) in Saudi subjects, increases of total energy intake (32) or (ii) in Indian Muslims, decreases of daily energy intake (33). In the present systematic review, three studies showed a decrease of energy intake (26-28). Evidently, in Islamic countries, this contrariness is probably related to differences in food habits (11).

Concerning the fat intake, six studies revealed no-changes during Ramadan in comparison to control periods (14, 21-24, 28). On the other hand, one study reported that the fat intake was lower during Ramadan than control periods (26). However, two studies showed that the fat intake increased during the month of Ramadan (25, 27). An increase in lipid intake can lead to an increase in the consumption of saturated fatty acids, which could contribute to an increase of low density lipoprotein (LDL) cholesterol concentrations (34), and subsequently might lead to atherosclerosis.

Previous studies observed a high ingestion of protein during compared to before or after Ramadan (21, 23, 27). These findings could be explained by the large consumption of receipts based on meat, chicken and eggs during Ramadan (35). These results were in agreement with others studies which indicated the higher consumption of protein (32, 36). Indeed, most sports nutrition guidelines recommend an after training protein intake (37) could be better for recovery and adaptation process within the exercised muscles. Therefore, athletes who train during Ramadan are advised to change their training times to be in the early morning or the late evening (38). On the contrary, one study reported a decrease of protein intake during Ramadan compared to control periods (26). However, the most of studies have noticed no-changes on the consumption of protein during Ramadan in comparison with control periods (14, 22-25, 28).

Concerning the portion of carbohydrate, some studies demonstrated that the diet is characterized by a decrease in carbohydrate intake during Ramadan (21, 26, 27). Changes in foods compositions during the fasting month indicate a slight reduction in the carbohydrate contribu-

tion to energy intake, which may cause a decrease in blood glucose concentration toward the end of the day (39). Furthermore, a low carbohydrate diet may reduce the buffering capacity of the blood during intense muscular contractions (40). Therefore, it is recommended to ingest a low glycemic index at *Sahour* meal to prolong the release of sugars into the blood (41). However, six studies have noticed no-changes on the diet of carbohydrate between periods during and outside Ramadan (14, 22-25, 28).

Total water intake decreased in some studies (21-24, 27) and did not change in Bouhlel et al. (28). The decrease in water intake may induce a state of dehydration. This latter may negatively affect cognitive and physical performances (9, 42, 43). Therefore, physically active subjects practicing physical activity during Ramadan are advised to increase water intake (600 mL/h of fluid) during the hours of darkness (43).

The literature does not support the association of Ramadan fasting with any changes of dietary intake in Tunisian physically active subjects.

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