Effects of Ramadan fasting on body composition in athletes: a systematic review

Effets du jeûne du Ramadan sur la composition corporelle des sportifs : revue systématique

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RÉSUMÉ

Objectif: Au cours des dernières décennies, l'intérêt pour les effets du jeûne du Ramadan (JR) sur la santé et les performances sportives a considérablement augmenté. De plus, il est bien admis que la composition corporelle est une mesure cruciale en sport pour évaluer les programmes d'entraînement et optimiser la nutrition des sportifs. Cette revue systématique a été effectuée pour évaluer les effets du JR sur la composition corporelle des sportifs.

Sources de données: La recherche bibliographique a été réalisée dans les bases de données électroniques Web of Science et PubMed/MEDLINE jusqu'à mars 2019 en utilisant une combinaison de mots clés pertinents.

Critères d'éligibilité des études: Seules les études publiées en langue anglaise et évaluant les effets du JR sur les indicateurs de la composition corporelle chez les sportifs ont été retenues.

Évaluation des études: La qualité et la validité des études incluses ont été évaluées à l'aide de l'outil « QualSyst ».

Résultat: Les douze études retenues pour cette revue impliquent 183 participants (12 sportifs féminins et 171 sportifs masculins) de différentes disciplines sportives. L'analyse des études montre que l'indice de masse corporelle, la masse grasse et le pourcentage de graisse étaient généralement plus faibles pendant le Ramadan qu'avant le Ramadan, tandis que la masse maigre et l'eau corporelle totale étaient inchangées pendant le Ramadan.

Conclusion: Malgré l'importance de son contrôle auprès des sportifs, de nombreux aspects de la composition corporelle devraient être évalués de manière plus précise pendant le mois de Ramadan. D'autres études, notamment contrôlées et randomisées, sont nécessaires pour apprécier la magnitude des modifications de la composition corporelle chez les sportifs au cours du mois sacré.

Mots-clés

Religion, alimentation, activité physique, indice de masse corporelle

SUMMARY

Purpose: In recent decades, the interest for the effects of Ramadan fasting (RF) on health and athletic performance has substantially increased. Moreover, it is widely accepted that body composition is a crucial measure in sport settings to evaluate training programs and optimize nutrition for athletes. This systematic review was conducted to assess the effects of RF on body composition in athletes.

Data sources: An electronic database search was performed on the Web of Science and PubMed/MEDLINE databases from inception to March 2019 using a combination of relevant keywords.

Study eligibility criteria: RF-related measurements of any body composition indicators in athletes were considered. Only studies published in English language were included.

Study appraisal: The quality and validity of the included studies were assessed using "QualSyst".

Result: Twelve studies met the inclusion criteria for this review, which involved a total of 183 participants (12 female and 171 male athletes) of different sport disciplines. Collectively, the analyzed studies indicate that body mass index, body fat, and body fat percentage were generally lower during Ramadan compared to before Ramadan, while lean mass and total body water were unchanged during Ramadan.

Conclusion: Despite the importance of body composition control in sport and exercise settings, there are still many aspects of body composition that should be more thoroughly assessed in athletes during the month of Ramadan. More research, especially well-conducted randomized controlled trials, is needed to evaluate the magnitude of body composition changes in athletes during the holy month.

Key-words

Religion, diet, physical activity, body mass index

INTRODUCTION

Ramadan fasting (RF) is one among the five pillars of Islam. This practice involves a total abstinence from food and fluid intake from dawn to sunset for a full lunar month. The daily fasting hours depend on the geographical location and the season of the year. In summer, the longest fasting duration is observed in Greenland and the shortest in Chile (1). It is obvious that the month of Ramadan is accompanied with a displacement of meal timing to the hours of darkness. This change has been shown to be associated with a modified sleep pattern. In fact, nighttime sleep duration is generally decreased while daytime sleep duration is generally increased during Ramadan (2,3). All these changes may affect some physiological parameters including body composition (4).

Body composition refers to the relative percentage and distribution of fat and lean tissue (bone, muscles, organs, water) in the body. Its measurement is frequently carried out in the sport domain in order to evaluate training programs and optimize nutrition for athletes (5). Moreover, athletes regularly attempt to optimize body composition to meet the physical demands of their sports as many body composition indicators have been shown to correlate with determinants of physical performance such as speed, strength, and power (6). In this context, fat-free mass (7) as well as lean mass (7-9) were found to be linked to various indices of strength, power, and competition level. Similarly, body fat percentage is associated with sport performance as higher body fat negatively affects measures of speed and endurance, alongside sport-specific tasks like peak and average velocity (10). However, the measurement of body composition is generally liable to error (11). Its validity in athletes strongly depends on the methods used. There is no preferred method for quantifying body composition; this is rather determined by the context and subject characteristics (5).

Despite the importance of body composition quantification in sport and exercise settings, there are few studies investigating the impacts of RF on this variable in athletes. Likewise, it has been demonstrated that the absence of fluid ingestion during daytime fasting leads to a state of negative water balance called hypohydration (12). Fasting-induced hypohydration may have a greater impact on sport performance than the absence of food (13); it negatively affects physiological and cognitive functions, and consequently sport performance indices (13). Furthermore, acute food or fluid intake (14) as well as hydration status (15) affect the reliability of body composition measurements. For instance, the use of dual energy x-ray absorptiometry, a favored tool to determine body composition in athletes, for fat-free soft tissue mass assessment must ensure maintenance of euhydration state, as this measure was not reliable when the subjects were hypo-hydrated (16).

Given the importance of body composition control for athletes, and the physiological changes associated with RF, its measurement during the holy month seems crucial to manage any fasting-related perturbations. Therefore, the purpose of this systematic review was to focus on studies examining the effects of RF on body composition indicators in adult athletes.

METHODS

Protocol

This systematic review was performed following the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines where possible (17). The PRISMA statement is a useful framework aimed at helping authors improve the reporting of systematic reviews and meta-analyses.

Eligibility criteria

English-language original articles published or accepted for publication in refereed journals were reviewed. Parameters of interest were body composition indicators including body mass index (BMI), body fat percentage, fat mass, fat-free mass, lean mass, skinfold thickness, and total body water. This systematic review is focused only on studies including athletes as a recent meta-analysis (18) has reviewed the effects of RF on body mass and composition in healthy non-athlete adults. Due to the limited number of studies found, no restrictions were applied in terms of study design, country, or time frame. All included studies compared the parameters of interest's values obtained before and during Ramadan. Review articles, conference papers, and studies performed on physically active subjects or children and/or adolescents were excluded.

Search and information sources

A preliminary literature search was conducted for available systematic review that had reported the effects of RF on body composition in athletes. No systematic reviews were

found. Then, literature searches of the PubMed/MEDLINE and Web of Science databases were performed for all time periods up to March 10, 2019 using the following search terms: 'Player', 'Athlete', 'Sport', 'Fat mass', 'Body composition', and 'Fasting'. After selecting the eligible studies, the reference lists of the extracted publications were manually examined to identify additional references.

Study selection

The initial database created from the electronic searches was organized. Duplicate citations were eliminated using End-Note X9. Then, two reviewers (AA and HB) screened the articles by title and abstract review to record the relevant studies. Discordance was resolved by consensus. The new database was screened to include only the most important articles, and the full text of each citation was obtained and reviewed.

Data collection process

Data from the selected studies were recorded on a data extraction form. The following study characteristics were extracted: Description of study population (Sample, Age, and Country), Measurement season, Measurement periods, Measurement time points, Hours of fasting before testing, Body composition indicators, and RF effects.

Quality assessment

The quality and validity of each article included in this systematic review were assessed using the QualSyst tool for quantitative studies (19). This tool is a validated generic checklist consisting of 14 items with scores from 0 to 2 (yes = 2, partial = 1, no = 0) and the possibility to score 'not applicable' when an item is not applicable to a particular study. Items judged 'not applicable' were excluded from the calculation of the summary score. This score was calculated by summing the scores obtained across the relevant items and dividing that by the total possible score. The maximum total possible score is 28. Two authors (AA and HB) independently rated the selected studies using the QualSyst tool. In case of disagreement, consensus was reached through discussion or consultation of a third co-author (HC).

RESULTS

Study selection

The selection procedure is summarized in Figure 1. The initial database search yielded 91 articles. After removing duplicates, 76 studies were examined. Three studies were derived from the same project, and only the earliest one, published in 2006, was retained (20). Sixty-two studies were also excluded after screening titles and abstracts. The remaining 12 articles met the eligibility criteria of this systematic review.

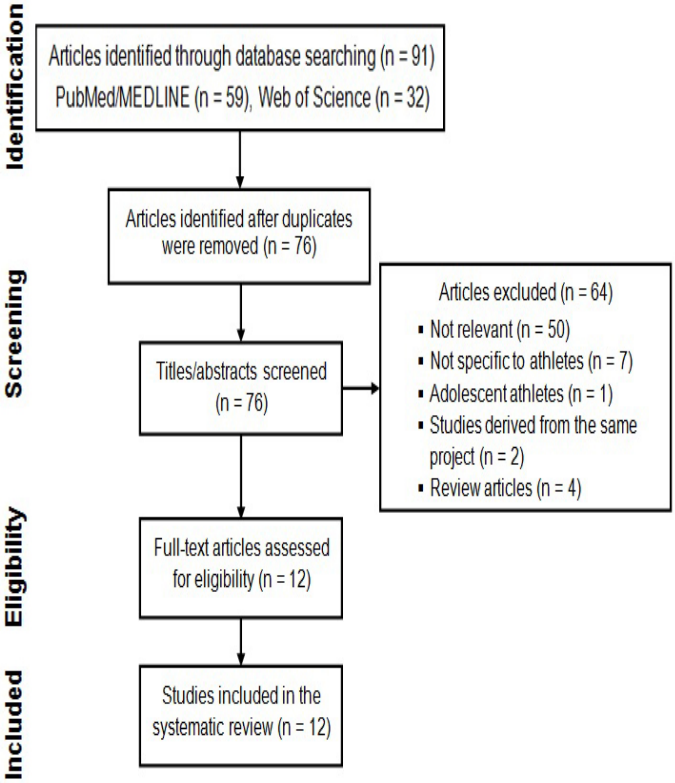

Figure 1: Flow of study selection through the phases of the review.

Study characteristics

The main characteristics of selected studies are displayed in Table 1. All selected studies used a single-group pre-post design without a control group of non-fasting subjects. Five studies were conducted in Tunisia (20-22,25,31), four in Iran (26,28-30), two in Turkey (24,27), and one in France (23). The sample sizes varied from 8 (23,31) to 34 (28).

A total of 183 athletes were included (171 males and 12 females). Their mean ages ranged from 15 to 27 years. Most of them were soccer players (21,24,25). The remaining athletes were rugby players (20), judo athletes (22), middle-distance runners (23), wrestlers (26,30), taekwondo players (29), and karate players (31), with two studies enrolling athletes of different sport disciplines (27,28).

Table 1. Main characteristics of selected studies.

Study	Participants	Age (years)	Country	Measurement season	Measurement periods	Measurement time points	Hours of fasting before testing	Body composition indicators	Ramadan fasting effects
Bouhlel et al. (20)	9 male rugby players	19.0 ± 2.0	Tunisia	Autumn (October-November)	❧ BR ❧ W1R ❧ W4R	14:00-16:30 h	-	BM	↓ during Ramadan
								BMI	↓ during W4R
								BF%	↓ during W4R
								LM	NS
Abedelmalek et al. (21)	11 male soccer players	22.1 ± 0.2	Tunisia	Summer	❧ BR ❧ W1R ❧ W4R	18:00 h	15 h	BM	↓ during Ramadan
								BMI	↓ during W4R
								BF	↓ during Ramadan
Chaouachi et al. (22)	15 male elite judo athletes	18.0 ± 1.0	Tunisia	Autumn (October-November)	❧ BR ❧ BegR ❧ ER	14:00-16:00 h	-	BM	↓ during ER
								BF	↓ during ER
Chennaoui et al. (23)	8 male middle-distance runners	25.0 ± 1.3	France	Autumn (November)	❧ BR ❧ D7R ❧ D21R	10:00 h	-	BM	NS
								BF%	NS
Güvenç (24)	16 male soccer players	17.4 ± 1.2	Turkey	Summer (August-September)	❧ BR ❧ W1R ❧ ER	16:00-18:00 h	-	BM	NS
								LM	NS
								BF%	NS
								ΣSKF	↓ during Ramadan
								TBW	NS
Hammouda et al. (25)	15 male professional soccer players	17.3 ± 0.3	Tunisia	Summer (August-September)	❧ BR ❧ W2R ❧ W4R	07: 00 h 17: 00 h	-	BM	↓ during Ramadan
								BF%	↓ during W4R
								LM	NS
Hosseini et al. (26)	9 elite male wrestlers	22.5 ± 1.9	Iran	Summer	❧ BR ❧ W2R ❧ W4R	-	-	BM	↓ during Ramadan
								BMI	NS
								BF%	NS
Karli et al. (27)	10 male elite power athletes	22.3 ± 1.2	Turkey	Autumn (September-October)	❧ BR ❧ ER	15:00-17:30 h	-	BM	NS
								BMI	NS
								FFM	NS

								BF%	NS
								TBW	NS
Kordi et al. (28)	34 male athletes from different sports (volleyball, karate, taekwondo, and football): one group trained 1 hour before Iftar (BI) and the second group of 20 athletes trained at 3 hours after Iftar (AI)	21.6 ± 4.0	Iran	Summer (August-September)	❧ BR ❧ W1R ❧ W4R	Just before the training time	-	BM	↓ during Ramadan
								BMI	↓ during Ramadan
								ΣSKF	❧ NS in the BI group ❧ ↓ during W1R in the AI group
Memari et al. (29)	12 female taekwondo players	15-27	Iran	Summer (August-September)	❧ BR ❧ W2R ❧ W4R	16:00-18:00 h	14 h	BM	↓ during Ramadan
								BMI	↓ during Ramadan
Mirzaei et al. (30)	14 male collegiate wrestlers	20.1 ± 2.5	Iran	-	❧ BR ❧ ER	-	-	BM	↓ during ER
								FFM	↓ during ER
								BF%	↓ during ER
Zarrouk et al. (31)	8 karate players	17.2 ± 0.5	Tunisia	Summer (August-September)	❧ BR ❧ D7D ❧ D28R	-	-	BM	NS
								BMI	NS
								FM	NS
								LM	NS

ge is presented as mean values ± standard deviation; NS: non-significant effect; BR: before Ramadan; W1R: first week of Ramadan; W2R: second week of Ramadan; W4R: fourth week of Ramadan; eginning of Ramadan; ER: at the end of Ramadan; D7R: day 7 of Ramadan; D21R: day 21 of Ramadan; D28R: day 28 of Ramadan; BF: body fat; BF%: body fat percentage; BM: body mass; BMI: body FM: fat-free mass; FM: fat mass; LM: lean mass; TBW: total body water; ΣSKF: sum of skinfolds.

Table 2. Quality appraisal of included studies.

Study	Question described	Appropriate study design	Appropriate subject selection	Subjects' characteristics described	Random allocation	Researchers blinded	Subjects blinded	Outcome measures well defined and robust to bias	Sample size appropriate	Analytic methods well described	Estimate of variance reported	Controlled for confounding	Results reported in detail	Conclusion supported by results?	Total score
Bouhlel et al. (20)	2	1	2	2	NA	NA	NA	2	1	2	2	1	2	2	19
Abedelmalek et al. (21)	2	1	2	2	NA	NA	NA	2	1	2	2	1	2	2	19
Chaouachi et al. (22)	2	1	2	2	NA	NA	NA	2	1	2	2	1	2	2	19
Chennaoui et al. (23)	2	2	2	2	NA	NA	NA	2	1	2	2	1	2	2	20
Güvenç (24)	2	2	2	2	NA	NA	NA	2	2	2	2	2	2	2	22
Hammouda et al. (25)	2	2	2	2	NA	NA	NA	2	1	2	2	1	2	2	20
Hosseini et al. (26)	2	2	2	1	NA	NA	NA	2	1	1	2	1	2	2	18
Karli et al. (27)	2	2	2	2	NA	NA	NA	2	1	2	2	1	2	2	20
Kordi et al. (28)	2	1	2	1	NA	NA	NA	1	1	1	2	1	2	2	16
Memari et al. (29)	2	1	2	1	NA	NA	NA	1	1	2	2	1	2	2	17
Mirzaei et al. (30)	2	2	1	1	NA	NA	NA	1	1	2	2	1	2	2	17
Zarrouk et al. (31)	2	2	2	1	NA	NA	NA	2	1	2	2	1	2	2	19

NA: not applicable.

Quality assessment

The quality of studies was generally acceptable, with a median [interquartile] total score of 19 [16-22] (Table 2). No study was excluded because of low-quality scores. One observed weakness was the lack of control group of non-fasting subjects. Moreover, one study (30) did not indicate the season in which the experiment was conducted.

Results of included studies

Body mass. Overall, body mass decreased during (20,21,25,26,28,29) or toward the end of Ramadan (22,30), while four studies showed no significant effect of RF on this variable (23,24,27,31).

Body mass index. BMI was lower during (28,29) or at the end of Ramadan (20,21) compared to before Ramadan. Three studies demonstrated unchanged BMI (26,27,30).

Body fat. Body fat decreased during (21) or at the end of Ramadan (22), with one study showing unchanged body fat (31).

Body fat percentage. There was a decrease in body fat percentage toward the end of Ramadan (20,21,25,30), while four studies found no significant effect of RF on this body composition indicator (23,24,26,27).

Fat-free mass. One study (30) showed a decrease in fat-free mass in the last two days of Ramadan, while another study (27) found no significant effect of RF on this variable.

Lean mass. Lean mass was assessed in five studies (20,21,24,25,31) and was unchanged during Ramadan compared to before Ramadan.

Sum of skinfolds. One study (23) showed a decrease in the amount of body fat, as measured by skinfolds.

Total body water. Total body water was evaluated in two studies (24,27) and was unchanged during Ramadan compared to before Ramadan.

DISCUSSION

This systematic review focused on studies assessing the effects of RF on body composition aspects in athletes. The main results of the twelve studies included showed that lean mass was unchanged while body fat or body fat percentage decreased mainly toward the end of Ramadan compared to before Ramadan.

Besides the limited number of studies included in this systematic review, the measured parameters aimed at estimating body composition were not consistent among them. One study (29) measured body mass and BMI only. Five studies assessed body mass along with body fat (21,22) or body fat percentage (23,26,28) estimation. Five studies measured body mass alongside lean mass (20,21,25,31) or fat-free mass (30) and body fat (31) or body fat percentage (20,21,25,30) estimation. Finally, two studies measured body mass along with lean mass (24) or fat-free mass (27), body fat percentage, and total body water estimation.

Three studies (24,27,31) showed a non-significant effect of RF on body mass as well as body composition aspects. However, other investigations found a decrease in body mass accompanied with a lower body fat percentage and unchanged lean mass (20,21,25) or decreased fat-free mass (30) toward the end of Ramadan compared to before Ramadan. The discrepancies between studies may be due to different methods used to estimate body composition. Some studies used bioelectrical impedance measurements to estimate body fat percentage (24,25,27,30), fat-free mass (24,27,30), lean mass (25), and/or total body water (24,27). The other studies used skinfold caliper measurements to estimate body fat percentage (20,22,28) or fat mass (23). There is no preferred method for quantifying body composition; this is rather determined by the context and subject characteristics (5).

To explain the decrease in body fat or body fat percentage observed toward the end of Ramadan, authors have suggested that there may be an increased fat oxidation at the end of Ramadan (22,24,25,30). Moreover, authors speculated that lean tissue was conserved despite the fat mass loss because training continued during Ramadan (20,24). Güvenç (24) proposed that geographical, socioeconomic, and cultural differences between Muslim countries and communities may influence the dietary practices and daily habits and thus may contribute to the discrepancies between studies. He suggested that maintaining regular training regimen, body fluid balance, daily energy intake, and sleep duration as before Ramadan allows athletes to avoid any RF-related detrimental effects on aerobic exercise performance or body composition.

Limitations

Although this is the first systematic review of studies examining the effects of RF on body composition in athletes, the findings must be interpreted with substantial caution as all of the studies selected for this review did not include a control group of non-fasting participants.

Furthermore, body composition estimation may be more accurate by using dual-energy x-ray absorptiometry to reduce the possibility of operator error.

CONCLUSION

There is not sufficient evidence to support the decrease in body composition indicators' values during Ramadan among athletes. Many aspects of body composition still need to be more thoroughly assessed and further research, especially well-conducted randomized controlled trials, is urgently required to determine the proper effects of RF upon body composition in athletes.

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