Iran Red Crescent Med J. 2016 August; 18(8):e26130. doi: 10.5812/ircmj.26130.

Published online 2016 June 8. **Research Article**

Nutritional Education Needs in Relation to Ramadan Fasting and Its Complications in Tehran, Iran

Zhaleh Shadman,[1] Mahdieh Akhoundan,[2] Nooshin Poorsoltan,[2] Mohsen Khoshniat Nikoo,[2,*] Bagher Larijani,[1] Camelia Akhgar Zhand,[1] Mozhdeh Soleymanzadeh,[1] Zahra Alsadat Seyed Rohani,[1] and Zahra Jamshidi[1]

[1]Endocrinology and Metabolism Research Center, Endocrinology and Metabolism Clinical Sciences Institute, Tehran University of Medical Sciences, Tehran, IR Iran
[2]Diabetes Research Center, Endocrinology and Metabolism Clinical Sciences Institute, Tehran University of Medical Sciences, Tehran, IR Iran

[*]*Corresponding author*: Mohsen Khoshniat Nikoo, Diabetes Research Center, Endocrinology and Metabolism Clinical Sciences Institute, Tehran University of Medical Sciences, Tehran, IR Iran. Fax: +98-2184902477, E-mail: M.khoshniatnikoo@yahoo.com

Received 2014 December 15; **Revised** 2015 June 07; **Accepted** 2015 August 15.

Abstract

Background: Ramadan fasting is associated with some lifestyle changes. A lack of nutritional needs knowledge or the improper performance of fasting, particularly in relation to time, type and amount of food intake, can cause disorders such as indigestion, bloating, constipation, headaches and other clinical problems.
Objectives: To investigate the general knowledge regarding dietary factors associated with Ramadan fasting and its related complications.
Patients and Methods: This prospective, non-interventional, observational study was conducted from April to July, 2012 to coincide with the month before and the month of Ramadan. The initial participants were 600 fasting and 588 non-fasting people (aged 18 - 65 years, BMI 18.5 - 40 kg/m^2) chosen by random cluster sampling in Tehran, Iran. A questionnaire of Ramadan fasting nutritional knowledge was developed and validated in a pilot study. The Likert scale was used two weeks before Ramadan and during the third and fourth weeks of Ramadan to estimate Ramadan-related complications. Seven-day, 24 - hour food recalls were used to assess food intakes.
Results: The lowest level of general knowledge was identified in the context of foods associated with hunger (22.1%) and hypoglycemia (24.8%) and the highest level of general knowledge was identified in reference to unsuitable foods for Sahar (91.4%). During Ramadan, all attributed complications increased in fasting subjects ($P < 0.001$). High calorie, carbohydrate, fat and protein intakes in the Ramadan diet were associated with some gastrointestinal and sleep complications ($P < 0.05$).
Conclusions: Despite the relatively high level of knowledge in the context of the general principles of a diet to prevent Ramadan-related complications, practical training in regard to the amounts of nutrients associated with Ramadan-related complications is both necessary and recommended.

Keywords: Ramadan, Fasting, Education, Diet, Adverse Effects

1. Background

Ramadan fasting is associated with some variations in dietary habits in regard to time and meal composition. The meal number often decreases to two meals a day. The Sahar meal is reported as a breakfast and includes about 30% of the total daily calorie intake. The higher proportion of calorie intake is seen during Iftar with approximately 60% of the total daily calorie intake occurring then. The feeling of nighttime heaviness has been reported (1). The decrease in meal frequency may be associated with an intensifying feeling of hunger. However, people who were hungry throughout the day could not completely consume an iso-caloric meal and reported abdominal fullness after breaking fast (2). Other prevalent gastrointestinal complications are flatulence, heaviness (3) and constipation (4). Lifestyle changes along those who observe Ramadan fasting may also have important effects on sleep behaviors (5). The variation of time of and amount of food intakes could lead to disruptions in the sleep cycle that would reduce sleep quality during Ramadan (6). The prevalence of headaches also increased during Ramadan (7). Considering the association between dietary intake and several gastrointestinal disorders (8), sleep quality (9) and headaches (10), estimating food intake values associated with these disorders could be an effective step in formulating Ramadan-related scientific recommendations for fasting.

2. Objectives

The objective of this study was to investigate the general knowledge regarding dietary factors associated with Ramadan fasting and its related complications (gastrointestinal, sleep quality and headaches).

3. Materials and Methods

This prospective, non-interventional, observational study was approved by the ethics committee of the Endocrinology and Metabolism Research Center of Tehran University of Medical Sciences (E - 00180) and conducted in Tehran, Iran, from April to July, 2012, to coincide with the month before and the month of Ramadan.

To obtain a representative sample, a two-stage random cluster sampling method was used to collect information. First, two districts from each of the four geographical points (north, south, east and west Tehran) were randomly selected. Second, two neighborhoods located at different geographical points within the selected districts were randomly selected. The criteria for eligible households were as follows: resident individuals who were home at the time of admission, were 18 - 65 years old, had a BMI 18.5-40 kg/m^2 and were willing to participate. For those who were not available at the time of study, a subsequent survey was arranged. The ethical consideration was confidentiality of personal information. Among the 18,039 included samples, 600 eligible subjects who intended to fast and an age-matched 588 eligible subjects who did not intend to fast were entered into the study. A team of interviewers, who were trained by researchers, did the survey. Fasting was defined as 25 fasting days for men and 20 for women. Not fasting was defined as fasting for less than five days out of 30 days. Exclusion criteria were suffering from any acute or chronic disease such as cardiovascular, renal, hepatic, or thyroidal disease, cancer and so on.

Because there was no valid questionnaire available to assess the knowledge of suitable food choices for Ramadan fasting and its possible effects on Ramadan-related complications, a questionnaire entitled "Questionnaire of Ramadan fasting nutritional knowledge" was developed. The concepts and issues included in the questionnaire were identified based on previous studies as well as interviews with 50 healthy controls. Next, the questions and their related multiple-choice answers were designed. To assess the face validity of the primary 21 - item questionnaire, it was given to four nutritionists who were asked to comment on the accuracy of the answers and ensure that no more than one correct answer was listed for each question. Using the feedback from the experts, all duplicate answers were omitted and any similar options were merged. To examine the questionnaire's content validity, three experts and 10 healthy subjects were asked to respond to the questions and evaluate whether the questionnaire was explicit in the questions and options and also covered all of the topics of interest. The questionnaire's CVR was assessed and if an item score was over 0.63, the item was considered to be suitable. A separate CVI was calculated for each item. Items with a score of over 0.71 were retained. Following the scoring process, all necessary changes were applied and discrepancies were resolved. In the pilot study, a modified version of the questionnaire was completed by 50 healthy subjects selected using convenience sampling. The questionnaire's reliability was tested using Cronbach's alpha coefficient, which was calculated to be 0.87. The final version of the questionnaire consisted of 15 questions and was used for data collection. The percentages of correct answers of less than 50, 50 - 70, 70 - 90 and above 90 were defined as poor, average, good and excellent, respectively.

To estimate the Ramadan-associated variation of complications (gastrointestinal complications including thirst, hunger, indigestion, constipation, flatulence, heartburn; sleep quality, hypotension and headache), the Likert scale was used two weeks before Ramadan and during the third and fourth weeks of Ramadan. Seven-day, 24-hour food recalls were used to assess the dietary intakes in the mentioned times to estimate the food frequency, energy intake and macronutrient composition of the diet. The dietary data were analyzed with adjusted, validated software (Nutritionist: version 4.0; Tinuviel Software, Warrington, United Kingdom). Another questionnaire including age, sex, educational status and subjects' knowledge source was also required to be completed by participants.

The physical activity level (PAL) for each participant was assessed two weeks before Ramadan by a validated questionnaire defined by nine different metabolic equivalent (MET) levels ranging from sleep/rest (0.9 MET) to high-intensity physical activities (> 6 METs). Height was measured with a wall-mounted stadiometer to the nearest 0.1 cm. Weight was determined to the nearest 0.1 kg on a properly calibrated electronic digital scale, without shoes, with minimal clothing and after voiding. Two measurements were obtained and averaged, with a third measurement taken if the first two differed by 0.1 kg or more. Body mass index (BMI) was estimated as the ratio of body weight to height squared and expressed as kg/m2. Waist circumference was determined by placing a measuring tape in a horizontal plane around the abdomen just above the right iliac crest. Three measurements were made to the nearest 0.1 cm and averaged.

3.1. Statistical Analysis

All statistical analyses were performed by SPSS software (version 16.0; SPSS Inc., Chicago). The Mann-Whitney test was used to determine a baseline and the endpoint differences of each complication between the two groups as ordinal data. The Wilcoxon test was used to determine the inter-differences of complications in each group. The Chi-square test was used to compare the distribution of correct answers in each area and also the distribution of changes of each complication (gastrointestinal disorders, sleep quality and headache) between fasting and non-fasting groups. The same statistical test was used to identify the association of educational status with knowledge levels. To estimate the amount of food intakes associated with the complications, first, the mean and median nutrient intakes and physical activity levels were identified in subjects with and without each complication. Next, the classification for intakes and physical activity levels were done according to the median values and logistic regression was used to compare the distribution of complications among the classified groups. An alpha level of less than 0.05 was accepted in all tests as statistically significant. With the assumption of the mean number of Ramadan-attributed adverse effects in fasting and non-fasting groups as 26% and 11%, respectively, and a sample size of 580 in each group, a power value of 99% was generated.

4. Results

Of the 600 fasting and 588 non-fasting initial participants, 581 and 580 completed the study, respectively. Table 1 shows the basic characteristics of participants. Distribution of the correct answers in each field and the comparison between the two groups are presented in Table 2.

Food awareness regarding indigestion and the prevention of hypotension was higher among participants with a high educational status ($P = 0.02$ and < 0.001, respectively). There were no significant differences for the other variables (data not shown). The three primary sources of information were television (61.6%), experts (16.9%) and relatives and friends (11.2%).

Table 3 shows the distribution of changes in some Ramadan-related complications in fasting and non-fasting participants. The Mann-Whitney test using the Likert scale raw data showed no differences in the baseline values between the two groups. However, there were statistically significant differences in variables including the feelings of thirst ($P < 0.001$) and heaviness ($P = 0.003$) during the month of Ramadan between the two groups. Also, the Wilcoxon test showed a significant increase in the feelings of thirst, heaviness and weakness ($P < 0.001$) in fasting subjects. All considered complications increased in fasting subjects during Ramadan fasting according to the 3-group categorization of 1) no change, 2) increase and 3) decrease in the level of complications in comparison to the control group ($P < 0.001$).

The associations between the changes in gastrointestinal symptoms and sleep quality with dietary intakes and physical activity level are presented in Table 4.

5. Discussion

This prospective study showed that despite a relatively good knowledge about the prevention methods of complications attributed to Ramadan fasting, sleep quality decreased and gastrointestinal complications including thirst, hunger, bloating, heaviness, abdominal fullness, constipation and heartburn, weakness and headache all significantly increased in fasting individuals. In a similar study, gastrointestinal complications were reported in 58.4% of participants with bloating and heaviness as the highest (19.9%) and diarrhea as the lowest (0.06%). Among the total frequency of symptoms, belching, bloating and plenitude feeling were the most frequent (3).

A low knowledge level was observed in connection with which foods increase hunger and reduce blood glucose during fasting. Also, only a small percentage of participants were aware of the glucose-lowering effects and consequent hunger effects of sweets eaten at Sahar. Education in this area is necessary. An average knowledge level was observed for the categories of suitable food groups for the Sahar meal, constipation prevention and foods causing bloating. A good knowledge level was observed in regard to the sufficient and recommended fluid intakes and suitable foods for breaking fast, food types that may increase the feeling of thirst and gastrointestinal disturbance, approaches for fluid compensation, heartburn-related foods and ways of prevention and also Ramadan-related hypotension and headaches. An excellent knowledge level was observed in regard to the fact that high fat foods were not suitable for Sahar. Educational status only showed a significant association with the knowledge about foods responsible for indigestion and also how to prevent hypotension. Television accounted for the first primary source for information about Ramadan fasting. Thus, it seems that the best method for education of the general populace would be through mass media, especially television.

Although the participants' knowledge levels were seen as reasonable, all considered complications increased by 16-35% during Ramadan fasting. Some dietary components

Table 1. Basic Characteristics of Studied Subjects[a]

	Fasting Subjects (n = 588)	Non-Fasting Subjects (n = 580)	P Value[b]
Age, years	34 ± 13	36 ± 14	0.13
Sex			0.01[c]
Female	418 (71.1)	351 (60.6)	
Male	170 (28.9)	229 (39.4)	
Weight, kg	71 ± 14	69 ± 15	0.21
Waist circumference, cm	85 ± 11	83 ± 13	0.29
Physical activity level, MET	1.6 ± 0.48	1.7 ± 0.43	0.06
Educational status			0.63
Illiterate	2 (0.3)	3 (0.5)	
Primary school	14 (2.4)	22 (3.7)	
Guidance school	22 (3.7)	13 (2.3)	
High school	168 (28.6)	143 (24.7)	
University	382 (65)	399 (68.8)	

[a] Mean ± standard deviation was presented for quantitative data and number (percent) for qualitative.
[b] P Value for t-test (quantitative data) or Chi-square test (qualitative data).
[c] P Value for Fisher's exact test.

Table 2. Distribution of Correct Answers in Each Field of Knowledge and Comparison Between Fasting and non-Fasting Subjects[a]

Field of Knowledge	Fasting Subjects	Non-Fasting Subjects	Overall	P Value[b]
Suitable food groups for Sahar	67.4	67.6	67.5	0.48
Unsuitable foods for Sahar	91.3	91.7	91.4	0.80
Adequate liquid intakes	70.8	69.5	69.9	0.75
Foods increase the feeling of thirst	89.9	89.8	89.9	0.21
Foods increase the feeling of hunger	22.1	19.9	21.2	0.91
Foods responsible for indigestion	75.2	74.5	74.9	0.98
Foods suitable for Iftar	86.9	82.9	85.2	0.61
Body liquid restoration	82.6	77.3	80.4	0.01
Foods for preventing constipation	68.5	71.8	69.8	0.70
Foods responsible for flatulence	60.7	59.3	60.1	0.79
Foods responsible for heartburn	73.5	67.6	71.0	0.25
The ways of preventing heartburn	77.9	76.9	77.4	0.93
The ways of preventing hypotension	72.1	75.9	73.7	0.38
The ways of preventing headache	75.2	78.7	76.7	0.26
The ways of preventing hypoglycemia	24.8	23.1	24.1	0.12

[a] Numbers in the table represent the percentage of correct answers.
[b] Chi-square test.

and their increase or decrease may be associated with these complications.

The mean physical activity level higher than 1.3 MET was associated with a sense of thirst during fasting days. If Ramadan coincides with warm seasons, as it did in the present study, it may increase this sense due to higher perspiration and dehydration. Long-lasting or moderate to severe intensity physical activity also causes dehydration

Table 3. Distribution of Changes of Ramadan-Related Complications During Ramadan

	No Change (%)	Increase (%)	Decrease (%)	P Value[a]	P Value[b]
Sleep quality					< 0.001
Fasting	64.4	14.8	20.8	0.30	
Non-fasting	74.9	12.6	12.6	0.60	
Thirst					< 0.001
Fasting	49.5	35.7	14.8	< 0.001	
Non-fasting	71.2	19.1	9.8	0.34	
Hunger					< 0.001
Fasting	49.2	30.3	20.5	0.25	
Non-fasting	72.6	15.8	11.6	0.42	
Flatulence					< 0.001
Fasting	64.6	16.5	18.9	0.11	
Non-fasting	81.9	8.8	9.3	0.80	
Heaviness					< 0.001
Fasting	51.2	34.3	14.5	< 0.001	
Non-fasting	76.9	10.6	12.5	0.69	
Constipation					< 0.001
Fasting	70.2	16.6	13.2	0.88	
Non-fasting	86.1	9.3	4.6	0.52	
Heartburn					< 0.001
Fasting	71.9	19.0	9.2	0.14	
Non-fasting	86.0	5.1	8.8	0.25	
Weakness					< 0.001
Fasting	50.5	33.0	16.5	< 0.001	
Non-fasting	76.1	13.6	10.3	0.34	
Headache					< 0.001
Fasting	50.9	24.6	20.5	0.34	
Non-fasting	75.3	13.5	11.2	0.53	

[a] Wilcoxon test.
[b] Chi-square test for differences of changes between fasting and non-fasting subjects.

and thirst. It is recommended that fasting people avoid daytime activities higher than 1.3 MET and consume adequate fluids from sunset to dawn. Moreover, to prevent or alleviate thirst, it is recommended that fasting people consume adequate amounts of fruits and vegetables at Iftar and Sahar meals. In our study, a dietary fiber intake of less than 10 g/day was associated with increased thirst and hunger. Therefore, it is necessary to take adequate fiber from suitable food sources at Sahar. For example, the consumption of five servings of fruits and vegetables, a quarter cup of legumes and wholegrain breads at the Sahar meal can prevent the feelings of thirst and hunger during fasting days. Also, consuming high fat and fried foods especially at Sahar may lead to thirst. Salty and spicy foods also increase the feeling of thirst and should be avoided. In this study, a sodium intake of higher than 1500 mg at Sahar and a total sodium intake higher than 2000 mg were also associated with thirst. Furthermore, the intakes of more than 40 g of fat and 40 g of protein at Sahar were associated with thirst. Thus, fasting people should not only avoid salty foods, but also consume low-salt foods at Iftar or bedtime. A Sahar calorie intake of higher than 1000 Kcal was recognized as causing thirst. This effect could be explained by the consumption of high calorie foods, as well

Table 4. Association of Ramadan-Associated Lifestyle Characteristics With Sleep Quality and Gastrointestinal Complications in Fasting People[a]

Complication	Variable (Median)	Group 1[b]	Group 2	OR (95% CI)[c]
Decreased sleep quality				
	Separately intake the meals Iftar and dinner (yes/no)	71/49	220/241	1.59 (1.05 - 2.38)
	Calorie intake at Iftar-dinner (≥/< 1200 Kcal)	70/50	221/240	1.52 (1.01 - 2.28)
	Protein intake at Iftar-dinner (≥/< 50 g)	91/29	199/262	4.10 (2.61-6.52)
Increased daytime thirst				
	Physical activity (≥/< 1.3 Kcal/body weight/hour)	137/70	154/220	2.81 (1.96 - 3.98)
	Salt intake at Sahar (≥/< 1500 mg)	153/54	138/236	4.80 (3.33 - 7.04)
	Daily salt intake (≥/< 3000 mg)	123/84	168/206	1.79 (1.27 - 2.53)
	fruits and vegetables intake at Sahar (yes/no)	67/140	224/150	0.32 (0.22 - 0.46)
	Dietary fiber intake at Sahar (≥/< 10 g)	50/157	242/133	0.17 (0.12 - 0.25)
	Fat intake at Sahar (≥/< 40 g)	135/72	156/218	2.62 (1.84 - 3.72)
	Protein intake at Sahar (≥/< 40 g)	129/78	162/212	2.16 (1.52 - 3.06)
	Calorie intake at Sahar (≥/< 1000 Kcal)	116/91	175/199	1.45 (1.03 - 2.04)
Increased daytime hunger				
	Dietary fiber at Sahar (≥/< 10 g)	77/99	214/191	0.69 (0.48 - 0.99)
	Carbohydrate intake at Sahar (≥/< 70 %/Kcal)	114/62	177/228	2.37 (1.64 - 3.42)
Increased bloating				
	Carbohydrate intake at each meal (≥/< 150 g)	58/38	233/252	1.65 (1.06 - 2.58)
	Dietary fiber intake at each meal (≥/< 15 g)	23/73	268/217	0.25 (0.15 - 0.42)
	Soluble fiber intake at each meal (≥/< 6 g)	31/65	260/225	0.41 (0.26 - 0.66)
Increasing heaviness and abdominal fullness				
	Calorie intake at each meal (≥/< 1500 Kcal)	131/68	160/222	2.67 (1.87 - 3.81)
	Meal volume (≥/< 1000 ml)	151/48	140/242	5.43 (3.69 - 7.99)
	Fat intake at each meal (≥/< 40 g)	119/80	172/210	1.81 (1.28 - 2.57)
Increased incidence of constipation				
	Daily dietary fiber intake (≥/< 15 g)	33/63	258/227	0.46 (0.29 - 0.73)
	Daily liquid intake (≥/< 750 ml)	29/67	262/223	0.37 (0.23 - 0.60)
Heartburn				
	Fat intake at each meal (≥/< 45 g)	68/42	223/248	1.80 (1.77 - 2.75)
	Calorie intake at each meal (≥/< 1500 Kcal)	66/44	225/246	1.64 (1.07 - 2.05)
Headache				
	Carbohydrate intake at Iftar (≥/< 200 g)	98/45	193/245	2.76 (1.85 - 4.12)
	Daily tea consumption before Ramadan (≥/< 5 cups)	104/39	187/251	3.58 (2.37 - 5.41)
	Smoking before Ramadan (yes/no)	111/32	180/258	4.97 (3.21 - 7.69)

[a] Only significant associations were shown.
[b] Distribution for prevalence of each complication were reported according to two groups as group 1 (with complication) and group 2 (without complication).
[c] Odds ratios for logistic regression.

as foods with higher salt, fat and protein content. Regarding hunger, it seems that a low fiber intake at Sahar may result in an elevated insulin response and hypoglycemia in fasting individuals (11). Also, a carbohydrate proportion of more than 70% of the calories consumed during Sahar was associated with increased daytime hunger.

Food components related to bloating have been described as soluble fiber and a high carbohydrate intake (11). In this study, an intake of dietary and soluble fiber more than 15 g and 6 g, respectively, and a carbohydrate intake of more than 150 g at each meal were related to increased bloating. In addition, overeating and a calorie intake higher than 1500 Kcal, a food volume of more than 1000 ml and a fat intake above 40 g per meal were identified as causing fullness and heaviness. Thus, a high consumption of fried and fatty foods, carbonated beverages, excessive consumption of sugar-sweetened desserts such as Zoolbia and Bamie, water and bulky and heavy foods can lead to a feeling of heaviness after eating. To prevent gastrointestinal disturbances in this period the aforementioned foods should be avoided.

During Ramadan, bulky food intake is especially seen at the time of breaking the fast and may result in gastroesophageal reflux disease and heartburn. Foods related to delayed gastric emptying (e.g., those fried and high in fat) are more likely to cause such complications (12). In this study, a calorie and fat intake above 1500 Kcal and 45g per meal, respectively, were associated with heartburn. It is recommended to avoid bulky and fatty foods to prevent heartburn induced by Ramadan fasting. Although it has not been shown as a cause for the increase of reflux in healthy people during and after Ramadan (13), consuming a high volume of food, especially during the Iftar meal, may increase the risk of disease in susceptible individuals. Such people should avoid bulky, high fat and fried foods (8).

Calorie restriction and decreases in physical activity are also risk factors for constipation, although adding dietary fiber and consuming a lot of water and liquids could moderate the impact (14, 15). Often due to changes in diet and sleep patterns, irregularity and decreased bowel movement are observed (4). However, it is possible by obtaining sufficient sources of dietary fiber such as fruits and salads at the Sahar and Iftar meals and their intervals to help maintain regular bowel movements and prevent an increase in transient time, constipation and bloating (16). Our results showed that a daily fiber intake of less than 15 g and daily liquids intake of less than 750 ml were associated with an increased risk of constipation during Ramadan. Thus, the intake of sufficient amounts of water and liquids, whole grains, fruits and vegetables would help to prevent constipation during Ramadan.

In the present study, 28.8% of the fasting group reported decreased sleep quality. Other studies have also shown delays in the sleep-wake cycle and decreased deep sleep (17). In this study, being on two separate meals of Iftar and dinner was identified as a factor for decreased sleep quality. Furthermore, a calorie intake of more than 1200 Kcal and a protein intake of more than 50 g at Iftar and dinner were associated with decreased sleep quality in fasting individuals. Sleep onset is associated with a rapid decrease in core body temperature and the maximum loss occurs 60 minutes before bedtime (18). Increased sleep latency in Ramadan may be associated with increased bedtime body temperature caused by a delay in mealtime and its thermogenic effect (17). In one study, the percentages of participants reporting a lack of sleep quality, thirst and hunger were 65%, 19% and 7%, respectively (19). It seems that among macronutrients, proteins cause the highest thermogenic effect (20) and thus play a strong role in increasing body temperature and subsequently decreasing sleep quality.

Ramadan fasting has been suggested as a cause of headaches (21). Of our studied population, 24.6% reported an increase of headaches during Ramadan. In one related study, headache occurrences increased by 48% in those who had a history of headaches and also occurred in 38% of participants who had no history of headaches (7). Hypoglycemia and some selected foods have been suggested as causes of headaches (22). Headaches that occur during this period have often been attributed to several factors including hypoglycemia (23), withdrawal of caffeine (10), changes in sleep patterns (24) and stress (25). Our findings suggested that a carbohydrate intake of higher than 200 g at Iftar and more than 80% of calorie intake at Sahar and Iftar meals in total, a pre-Ramadan headache history and being accustomed to drinking more than five cups of tea a day or smoking before Ramadan were all associated with an increased incidence of Ramadan-related headaches. To prevent these headaches, gradually reducing tea, coffee and cigarette consumption one or two weeks before Ramadan may be useful.

To our knowledge, this was the first comprehensive and clearly designed study that explores the participants' knowledge along with the occurrence or changes in sleep quality and gastrointestinal complications that have been attributed to Ramadan fasting. Furthermore, studying a large sample size and control group was a strong point of the present study. A limitation of this study is that the findings cannot be generalized for all fasting people in the country or the world because dietary and lifestyle patterns may vary to some extent in different populations.

5.1. Conclusion

The results of this study show that it is necessary to educate people about preventive methods for hypoglycemia and related hunger and weakness. Also, despite the relatively high level of knowledge of the general principles of a diet that will prevent Ramadan-attributed complications, determining the associated amounts of nutrient intake and educating the general populace would be effec-

tive steps in minimizing the number of complications related to Ramadan fasting.

Acknowledgments

The authors thank all who participated in or collaborated with the present study.

Footnotes

Authors' Contributions: Zhaleh Shadman: designed the study, coordinated its implementation, drafted the manuscript and performed the statistical analysis; Mahdieh Akhoundan, Nooshin Poorsoltan, Camelia Akhgar Zhand, Mozhdeh Soleymanzadeh, Zahra Alsadat Seyed Rohani and Zahra Jamshidi: participated in the acquisition of data and revision of the manuscript; Mohsen Khoshniat and Bagher Larijani: participated in the design of the study and revision of the manuscript.

Funding/Support: This study was supported by the Endocrinology and Metabolism Research Center of Tehran University of Medical Sciences in Tehran, Iran. No reimbursements, fees, funding or salaries were received from any organization that holds or has applied for patents concerning the contents of the manuscript.

Competing Interests: There are no financial or non-financial competing interests (political, personal, religious, ideological, academic, intellectual, commercial or any other) to declare in relation to this manuscript.

References

1. Karaagaoglu N, Yucecan S. Some behavioural changes observed among fasting subjects, their nutritional habits and energy expenditure in Ramadan. *Int J Food Sci Nutr.* 2000;**51**(2):125–34. [PubMed: 10953756].
2. Stote KS, Baer DJ, Spears K, Paul DR, Harris GK, Rumpler WV, et al. A controlled trial of reduced meal frequency without caloric restriction in healthy, normal-weight, middle-aged adults. *Am J Clin Nutr.* 2007;**85**(4):981–8. [PubMed: 17413096].
3. DARVISH MS. Relative frequency of minor digestive symptoms in healthy fasting Muslems and their relation to dietary pattern. *Med J Mashhad Univ Med Sci.* 2002;**45**(75):59–66.
4. Sana SK. Cyclic motor activity, migrating motor complex. *Gastroenterology.* 1985;**89**:894–9.
5. BaHammam A. Assessment of sleep patterns, daytime sleepiness, and chronotype during Ramadan in fasting and nonfasting individuals. *Saudi Med J.* 2005;**26**(4):616–22. [PubMed: 15900372].
6. Zerguini Y, Dvorak J, Maughan RJ, Leiper JB, Bartagi Z, Kirkendall DT, et al. Influence of Ramadan fasting on physiological and performance variables in football players: summary of the F-MARC 2006 Ramadan fasting study. *J Sports Sci.* 2008;**26 Suppl 3**:S3–6. doi: 10.1080/02640410802614944. [PubMed: 19085447].
7. Topacoglu H, Karcioglu O, Yuruktumen A, Kiran S, Cimrin AH, Ozucelik DN, et al. Impact of Ramadan on demographics and frequencies of disease-related visits in the emergency department. *Int J Clin Pract.* 2005;**59**(8):900–5. doi: 10.1111/j.1742-1241.2005.00460.x. [PubMed: 16033610].
8. Beyer P. Medical nutrition therapy for lower gastrointestinal tract disorders. Krause's Food, Nutrition and Diet Therapy. ed 10 ed. Philadelphia: PA, WB Saunders; 2000.
9. Edwards SJ, Montgomery IM, Colquhoun EQ, Jordan JE, Clark MG. Spicy meal disturbs sleep: an effect of thermoregulation?. *Int J Psychophysiol.* 1992;**13**(2):97–100.
10. Hughes JR. Clinical importance of caffeine withdrawal. *N Engl J Med.* 1992;**327**(16):1160–1. doi: 10.1056/NEJM199210153271609. [PubMed: 1528212].
11. Jenkins DJ, Gassull MA, Leeds AR, Metz G, Dilawari JB, Slavin B, et al. Effect of dietary fiber on complications of gastric surgery: prevention of postprandial hypoglycemia by pectin. *Gastroenterology.* 1977;**73**(2):215–7. [PubMed: 873118].
12. Krenitsky J, Decher N. Medical nutrition therapy for upper gastrointestinal trac disorders. 13 ed ed. Saunders; 2012.
13. Hakkou F, Tazi A, Iraqui L, Celice-Pingaud C, Vatier J. [The observance of Ramadan and its repercussion on gastric secretion]. *Gastroenterol Clin Biol.* 1994;**18**(3):190–4. [PubMed: 7926431].
14. Astrup A, Vrist E, Quaade F. Dietary fibre added to very low calorie diet reduces hunger and alleviates constipation. *Int J Obes.* 1990;**14**(2):105–12. [PubMed: 2160441].
15. Finocchiaro C, Pezzana A, Galletti R, Costantino A, Malfi G, Demagistris A. [Role of diet in the treatment of constipation. Review of the literature]. *Minerva Dietol Gastroenterol.* 1989;**35**(3):165–70. [PubMed: 2557563].
16. Nomani MZ, Khan AH, Shahda MM, Nomani AK, Sattar SA. Predicting serum gastrin levels among men during Ramadan fasting. *East Mediterr Health J.* 2005;**11**(1-2):119–25. [PubMed: 16532680].
17. Roky R, Chapotot F, Hakkou F, Benchekroun MT, Buguet A. Sleep during Ramadan intermittent fasting. *J Sleep Res.* 2001;**10**(4):319–27. [PubMed: 11903862].
18. Murphy PJ, Campbell SS. Nighttime drop in body temperature: a physiological trigger for sleep onset?. *Sleep.* 1997;**20**(7):505–11. [PubMed: 9322266].
19. Laraqui CH. The effects of fasting and of the quality of sleep on work during the month of Ramadan. *Arch Mal Prof Med.* 2001;**62**:115–20.
20. Reed GW, Hill JO. Measuring the thermic effect of food. *Am J Clin Nutr.* 1996;**63**(2):164–9. [PubMed: 8561055].
21. Bank J, Marton S. Hungarian migraine epidemiology. *Headache.* 2000;**40**(2):164–9. [PubMed: 10759917].
22. Dalton K. Food intake prior to a migraine attack–study of 2,313 spontaneous attacks. *Headache.* 1975;**15**(3):188–93. [PubMed: 1176281].
23. Blau JN, Cumings JN. Method of precipitating and preventing some migraine attacks. *Br Med J.* 1966;**2**(5524):1242–3.
24. Dexter JD. The relationship between stage III + IV + REM sleep and arousals with migraine. *Headache.* 1979;**19**(7):364–9. [PubMed: 229086].
25. Mosek A, Korczyn AD. Yom Kippur headache. *Neurology.* 1995;**45**(11):1953–5. [PubMed: 7501139].