

# Factors Associated with Migraine Occurrence in Ramadan: A Prospective Survey from a Tertiary Headache Clinic

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## Abstract

**Objective:** All adult Muslims are obligated to abstain from food and drinks for about 11-16 hours daily during the month of Ramadan on the Islamic calendar, and this was reported to exacerbate migraine. The aim of this work was to study the factors, other than fasting, that may contribute to the occurrence of headache during Ramadan among Egyptian migraineurs.

**Methods:** This was a prospective survey conducted on Muslim migraine patients attending the headache clinic in Alexandria University hospital in Egypt during the month before Ramadan. Patients were given a diary to fill data about their headache, dietary consumption, fluid intake, sleep habits, and spiritual/religious practice during Ramadan.

**Results:** Twenty-nine patients participated with 222 days (148 days with migraine and 74 days without migraine). On comparing days with and days without headache, the factors significantly correlated with the occurrence of migraine were initial insomnia, certain spiritual/religious behaviors, fluid intake, coffee consumption, number of meals and certain food items ( $P < 0.05$ ).

**Conclusion:** Sleep habits, spiritual behaviors, eating habits and fluid intake contribute to migraine occurrence in Ramadan and should be considered for adequate control of the disease during fasting states.

**Keywords:** Diet; Fluid; Food; Fasting; Insomnia; Migraine; Sleep Habits; Spiritual Practice

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**Citation:** Abdou AM, Hamdy MM, Hamdy E (2020) Factors Associated with Migraine Occurrence in Ramadan: A Prospective Survey from a Tertiary Headache Clinic, *Neurol Sci Neurosurg*, Volume 2:1. 112. DOI: <https://doi.org/10.47275/2692-093X-112>.

**Received:** November 05, 2020; **Accepted:** November 20, 2020; **Published:** November 27, 2020

## Introduction

Fasting is a well-known trigger of migraine attacks [1], and in Islam, all healthy adult Muslims are obligated to fast for about 11-16 hours daily for a whole month called "Ramadan" – the ninth month on the Islamic lunar calendar. According to Pew Research Center, Muslims constitute up to one fourth of the world population (~1.8 billions) [2]. Given the fact that migraine affects about 12% of the population, it is estimated that about 216 million Muslims suffer from migraine [3]. During the month of Ramadan, Muslims must abstain from all types of food and drinks (including water, gums, and cigarettes) daily from dawn to dusk. After dusk, they are allowed to eat and drink freely until the next dawn. Fasting for such long periods in Ramadan is reported to exacerbate migraine frequency and severity and to prolong the duration of migraine attacks [4,5]. About 6% of Muslims cannot continue fasting because of their severe migraine attacks [4]. However, the data about the impact of Ramadan on headache exacerbation are not consistent among different studies. Gabr WM, et al. (2013) for instance, found that there was a considerable reduction in the frequency of migraine attacks in Ramadan in comparison to other months, whilst the duration and severity of the attacks did not significantly change [6]. Such conflicting findings might suggest that there are several contributing factors to the

impact of Ramadan on migraine.

Apart from fasting, Ramadan is considered a holy month in Islam. Muslims increase their prayers and moral behaviors. They pray long prayers after having their breakfast, a prayer called "Taraweeh", in a big gathering at homes or in *masjids*. There by, they increase both their physical activity and spirituality. Spirituality in Ramadan is relatively higher among Muslims in comparison to the remaining months of the year. Additionally, Muslims change their sleep pattern and their food habits in Ramadan [7]. All these factors (i.e. sleep habits, dietary patterns, hydration state, spirituality, and physical activity) are known to affect migraine and, therefore, might contribute to the alteration in migraine characteristics noted during Ramadan period [8-11].

Identifying factors affecting migraine among Muslims in Ramadan is essential for improving the patients' satisfaction and patients' quality of life. As fasting during Ramadan is one of the main pillars of Islam, it is essential to identify factors, other than fasting, that may contribute to the exacerbation of migraine in Ramadan. This will help the estimated 216 million Muslim migraineurs to reduce the exacerbation of migraine attacks during Ramadan. To the best of our knowledge, there is a lack of data about this topic in literature. Therefore, the aim of this research was to study the potential factors, other than fasting, that may affect



migraine during Ramadan among Muslim migraineurs.

## Patients and Methods

This was a prospective study conducted on adult Muslim migraineurs attending the headache clinic at Alexandria University Hospital in Egypt during April and May 2019 (i.e. corresponding to the month before Ramadan on the Islamic lunar calendar).

All adult Muslim migraineurs attending the clinic and fulfilling the diagnostic criteria of migraine according to the international classification of headache disorders - 3<sup>rd</sup> edition (ICHD-3) were invited to participate in this study [12]. Patients who accepted to participate were given a diary to fill on daily basis during different days in Ramadan whether they had a migraine attack or they did not. The diary included four sections: headache section, sleep data section, spirituality section, and food and drinks section. The headache section included questions about the occurrence of headache, headache onset and offset time, headache description, headache severity (using the Numerical rating scale (NRS) [13]), headache sites, associated symptoms and headache impact on the activity of daily living and work. The sleep section included questions about sleep onset time, wake-up time, experiencing initial insomnia, having naps, naps time and naps duration. The spirituality section included questions about different prayers (e.g. five main prayers and *taraweeh*), Quran reciting, Athkar reading and Duaa. The fourth section included questions about special habits (e.g. smoking and stimulant consumption), amount of fluid intake, number of meals and food items consumed.

At the end of the month, the diaries were collected from all patients, and the extracted data were fed into a computer for analysis. Only completely-recorded days were included in this study. The days reported by all patients were divided into days with migraine and days without migraine, and a comparative analysis between them was made. Days when patients did not fast due to causes other than migraine (e.g. menstruation) were excluded from the study.

## Statistical Analysis

IBM SPSS software package version 20.0 (Armonk, NY: IBM Corp) was used for statistical analysis [14]. Qualitative data were described using number and percent, and quantitative data were described using range (minimum and maximum), mean, median and standard deviation. The Kolmogorov-Smirnov test was used to verify the normality of distribution of variables. Mann Whitney test was used to compare between two groups for not normally distributed quantitative variables. Univariate logistic regression was assessed. Significance of the obtained results was judged at the 5% level (15). The statistical power of the results was calculated using G\*power 3.1.9.4 program [16], the power calculated was 94%.

## Ethics

Ethical approval was obtained from the Ethics Committee of the Alexandria Faculty of Medicine which is constituted and operates according to the International Conference on Harmonization Good Clinical Practice (ICH GCP) guidelines and applicable local and institutional regulations and guidelines which govern EC operation for the last 9 years [17]. It has a Federal wide Assurance (FWA) from 2010.

## Results

### Demographics and Clinical Data

Of forty patients given the diaries, 29 filled the required data

adequately at different days in Ramadan. The vast majority of the participating migraineurs were females (89.7%). The mean age of the patients was  $32 \pm 7.87$  (20-46) years, and the mean disease duration was  $13 \pm 10.19$  (1-35) years. About 62% (n=18) of the patients had chronic migraine.

After exclusion of incompletely recorded days, 222 days were fully-filled and analyzed; 148 of them were days with migraine and 74 were days without migraine. In 53.4% (n=79) of the days, migraine was reported to be unilateral. The most common sites affected were forehead (74.3%), temples (70.9%), central (37.2%), back of the head (37.2%), behind eyes (31.8%), and neck (22.3%). The mean duration of migraine attacks was  $6.13 \pm 4.19$  (1-22) hours, and the mean headache severity reported was  $6.19 \pm 2.27$  (2-10). Activity of daily living was affected in the vast majority of the patients (73.6%). Household activities were negatively affected in 20.9% of the days, and work was negatively affected in 20.3%. In 14.2% of the days, both work and household activities were impaired. Of the 148 days with migraine, 7 days were reported to be days of absenteeism (4.7%). Analgesics were used in almost half of the days with migraine (44.6%, 66 days), and the most commonly used analgesics were conventional analgesics, ergots and triptans (used in 28, 17, and 12 days, respectively). In eleven days (7.4%), patients reported using more than one type of analgesics to get over their migraine attacks.

### Factors Affecting Migraine in Ramadan

To study the different factors that may potentially affect migraine occurrence, a comparative analysis was made between the days with migraine (n=148) and the days without migraine (n=74). The studied factors were sleep habits, spiritual/religious behaviors, fluid intake, dietary habits and food items.

**Sleep habits:** On comparing the sleep habits among days with migraine and days without migraine, it was found that initial insomnia was significantly more prevalent among days with migraine (41.2%) in comparison to days without migraine (12.2%) ( $p < 0.001$ ) (Table 1). On Univariate regression analysis, patients experienced initial insomnia at days with migraine 5.06 times more than days without migraine (Table 2). Having a nap, nap timing, nap duration and total sleep duration did not significantly differ between days with and days without migraine ( $P > 0.05$ ).

**Spiritual/religious behaviors:** The spiritual/religious behaviors studied were the five main prayers, taraweeh prayer, Quran reciting, Athkar reading and Duaa. The mean number of five prayers was not significantly different between days with and days without migraine. For the taraweeh prayer, the duration and place of prayer were significantly correlated with the occurrence of headache. The mean duration of taraweeh praying was significantly longer among days without migraine ( $24.5 \pm 36.8$  minutes) than days with migraine ( $10.7 \pm 24.2$  minutes) (OR=0.99, CI=0.97-0.99,  $p=0.002$ ) (Table 2 and Table 3). Praying taraweeh at home was associated with a 3.2 times increased risk of migraine occurrence in comparison to praying at masjids ( $p=0.023$ ). Reciting Quran and reading of the Athkar were also more encountered during days without migraine (52.7% and 55.4%, respectively). The odds of migraine occurrence with Qur'an reciting and Athkar reading were 0.39 (CI: 0.22-0.69) and 0.519 (CI: 0.29-0.91), respectively (Table 2).

**Fluid intake, special habits and eating habits:** Fluid intake was significantly correlated with migraine occurrence. At days without migraine, the mean number of fluid cups consumed was significantly



**Table 1:** Comparison between days with migraine and days without migraine according to sleep habits.

	Days with/without headaches		Test of Sig.	p
	Yes (n = 148)	No (n = 74)		
<b>Initial insomnia</b>	61 (41.2%)	9 (12.2%)	$\chi^2=19.289^*$	<0.001*
<b>Having a nap</b>	48 (32.4%)	21 (28.4%)	$\chi^2= 0.379$	0.538
<b>Nap timing</b>	(n = 47)	(n = 19)		
- Within 5 hours before breakfast	26 (55.3%)	11 (57.9%)	$\chi^2= 0.036$	0.849
- More than 5 hours before breakfast	21 (44.7%)	8 (42.1%)		
<b>Nap duration</b>	(n = 148)	(n = 74)		
- Mean $\pm$ SD.	0.9 $\pm$ 1.4	0.9 $\pm$ 1.6	U= 5325	0.691
- Median (Min. – Max.)	0 (0 – 7)	0 (0 – 7)		
<b>Total sleep duration</b>				
- Mean $\pm$ SD.	6.7 $\pm$ 2.7	6 $\pm$ 2.5	U=4699.5	0.085
- Median (Min. – Max.)	6.9 (0 – 16)	6.2 (0 – 11.5)		

$\chi^2$ : Chi square test

FE: Fisher Exact

U: Mann Whitney test

p: p value for comparing between the studied groups

\*: Statistically significant at  $p \leq 0.05$

**Table 2:** Univariate analysis for the parameters affecting days with headaches (n = 222).

	Univariate			
	p	OR	95% CI	
			LL	UL
<b>Sleep habits</b>				
<b>Initial insomnia</b>	<0.001*	5.064	2.344	10.938
<b>Sleep duration</b>	0.082	0.909	1.817	1.012
<b>Spiritual/religious practices</b>				
<b>Tarweeh praying at home</b>	0.023*	3.173	1.174	8.574
<b>Tawarweeh duration [in minutes]</b>	0.002*	0.985	0.976	0.994
<b>Quran reciting</b>	0.001*	0.392	0.221	0.697
<b>Athkar reading</b>	0.023*	0.519	0.295	0.912
<b>Eating and drinking habits and food items</b>				
<b>Fluid intake (number of cups)</b>	0.034*	0.878	0.778	0.99
<b>Number of meals</b>	0.004*	0.444	0.256	0.77
<b>Coffee number of cups</b>	0.015*	2.337	1.182	4.886
<b>Fried food</b>	0.018*	2.855	1.199	6.798
<b>Citrus fruits</b>	0.037*	4.364	0.976	19.513
<b>Apricot</b>	0.031*	0.371	0.146	0.943
<b>Watermelon</b>	0.002*	12.746	1.683	96.531
<b>Desserts (Konafa/Qatayef)</b>	0.025*	0.495	0.26	0.943
<b>Eggs</b>	0.003*	0.414	0.227	0.754
<b>Dairy products</b>	0.012*	2.145	1.177	3.909

OR: Odd's ratio

CI: Confidence interval,

\*: Statistically significant at  $p \leq 0.05$

higher (4.4 $\pm$ 2.3) than the mean number of cups consumed during migraine days (3.7 $\pm$ 2.3) ( $p=0.019$ ). A one-cup increase in fluid intake was associated with 12% risk reduction of developing headache (OR=0.88, CI=0.78-0.99,  $p=0.034$ ). Smoking and consuming stimulantssuch as tea or coca-containing soft drinks were not significantly different between days with headache and days without (Table 4). Coffee was the only stimulant that was significantly correlated with the occurrence of headache. Consumption of one cup of coffee increased the odds of developing headache 2.3 times (OR=2.33, CI=1.18-4.89,  $p=0.015$ ). Eating more meals was also found to be protective against developing headache. In days with migraine, the mean number of meals eaten was 2.4 $\pm$ 0.6, whilst the mean number of meals in days without migraine was 2.7 $\pm$ 0.6 ( $p=0.003$ ). Eating one more meal reduced the risk of developing migraine by 56% (OR=0.44, CI=0.23-0.77,  $p=0.004$ ).

**Table 3:** Comparison between days with migraine and days without migraine according to spiritual/religious behaviors.

	Days with/without headaches		Test of Sig.	p
	Yes (n = 148)	No (n = 74)		
<b>Tarweeh praying place</b>	(n = 45)	(n = 28)		
- Home	33 (73.3%)	13 (46.4%)	$\chi^2= 5.361^*$	0.021*
- Masjed	12 (26.7%)	15 (53.6%)		
<b>Tawarweeh duration [in minutes]</b>				
- Mean $\pm$ SD.	10.7 $\pm$ 24.2	24.5 $\pm$ 36.8	U=4454.50*	0.004*
- Median (Min. – Max.)	0 (0 – 12)	0 (0 – 12)		
<b>Number of Five-Prayers performed</b>				
- Mean $\pm$ SD.	3.3 $\pm$ 2.3	3.6 $\pm$ 2.2	U=5166	0.416
- Median (Min. – Max.)	5 (0 – 5)	5 (0 – 5)		
<b>Quran reciting</b>	45 (30.4%)	39 (52.7%)	$\chi^2=10.428^*$	0.001*
<b>Athkar reading</b>	58 (39.2%)	41 (55.4%)	$\chi^2= 5.251^*$	0.022*
<b>Duaa</b>	104 (70.3%)	54 (73.0%)	$\chi^2= 0.176$	0.675

$\chi^2$ : Chi square test

FE: Fisher Exact

U: Mann Whitney test

p: p value for comparing between the studied groups

\*: Statistically significant at  $p \leq 0.05$

**Food items:** The food diaries filled by the patient were extracted into an excel sheet. Different food items reported were evaluated particularly the food items that are known to precipitate migraine. Because the amounts of different food items reported by the patients was low, the food items consumed was studied in the form of Yes/No variables. Of the various food items reported, fried food (OR=2.8, CI=1.19-6.78,  $p=0.018$ ), citrus fruits (OR=4.36, CI=0.98-19.51,  $p=0.037$ ), apricots (OR=0.37, CI=0.14-0.94,  $p=0.05$ ), watermelon (OR=12.74, CI=1.68-96.53,  $p=0.002$ ), desserts namely Konafa and Qatayef (OR=0.49, CI=0.26-0.94,  $p=0.025$ ), dairy products (OR=2.14, CI=1.17-3.91,  $p=0.012$ ) and eggs (OR=0.42, CI=0.23-0.75,  $p=0.003$ ) were found to significantly affect the occurrence of migraine. The different food items studied are depicted in table 5.

## Discussion

Several studies have demonstrated that migraine attacks are exacerbated during Ramadan, and they attributed such exacerbation to fasting(4,5). Fasting, however, is not be the only cause of exacerbation of migraine attacks during Ramadan, and othercontributing factors should be considered and addressed. Results from this study showed that certain sleep habits, spiritual/religious behaviors, fluid intake and eating habits were considerably associated withthe occurrence of headache among Muslim migraineurs in Ramadan.



**Table 4:** Comparison between days with migraine and days without migraine according to fluid intake, special habits and food habits.

	Days with/without headaches		Test of Sig.	p
	Yes (n = 148)	No (n = 74)		
Smoking	6 (4.1%)	1 (1.4%)	$\chi^2= 1.180$	<sup>FE</sup> p=0.429
Number of cigarettes smoked				
Mean $\pm$ SD.	0.5 $\pm$ 2.8	0.1 $\pm$ 1.2	U= 5327.0	0.275
Median (Min. – Max.)	0 (0 – 20)	0 (0 – 10)		
Stimulants intake (Yes/No)	85 (57.4%)	42 (56.8%)	$\chi^2= 0.009$	0.924
Tea (number of cups)				
Mean $\pm$ SD.	0.3 $\pm$ 0.6	0.4 $\pm$ 0.6	U= 4872.0	0.077
Median (Min. – Max.)	0 (0 – 4)	0 (0 – 2)		
Coffee (number of cups)				
Mean $\pm$ SD.	0.3 $\pm$ 0.6	0.1 $\pm$ 0.3	U= 4701.0*	0.018*
Median (Min. – Max.)	0 (0 – 3)	0 (0 – 1)		
Coca-containing soft drinks				
Mean $\pm$ SD.	0.1 $\pm$ 0.5	0.1 $\pm$ 0.2	U= 5400.0	0.689
Median (Min. – Max.)	0 (0 – 5)	0 (0 – 1)		
No. of cups of all stimulants				
Mean $\pm$ SD.	0.9 $\pm$ 1	0.8 $\pm$ 0.9	U= 5470.50	0.99
Median (Min. – Max.)	1 (0 – 6)	1 (0 – 4)		
Fluid intake (number of cups)				
Mean $\pm$ SD.	3.7 $\pm$ 2.3	4.4 $\pm$ 2.3	U= 4430.0*	0.019*
Median (Min. – Max.)	3 (1 – 11)	4 (1 – 11)		
Number of meals				
Mean $\pm$ SD.	2.4 $\pm$ 0.6	2.7 $\pm$ 0.6	t= 3.033*	0.003*
Median (Min. – Max.)	2.5 (1 – 3)	3 (1 – 5)		

$\chi^2$ : Chi square test

FE: Fisher Exact

U: Mann Whitney test

p: p value for comparing between the studied groups

\*: Statistically significant at  $p \leq 0.05$

Adequate and regular sleep is essential for prevention and control of migraine [18]. In Ramadan, most Muslims change their sleep habits (19). They do not only shift their diurnal pattern of sleep, but also tend to sleep for a shorter time at night and have a nap in the afternoon or before dusk [19]. Such change in sleep pattern might contribute to the occurrence of migraine headache. In this study, initial insomnia was associated with a high risk for the occurrence of migraine (OR=5.06, CI=2.34-10.93). In accordance with this finding, the results from a prospective population-based cohort study (HURT2 and HURT3) depicted that insomnia was associated with a 40% increased risk of headache (20). Insomnia may exacerbate migraine either through disturbance of the inhibitory pain descending system or through increasing certain inflammatory mediators e.g. interleukin-6 [20]. In Ramadan, some migraineurs tend to sleep before dusk (before the official time of breakfast) as a trial to reduce or prevent migraine after a long period of fasting. Results from our study, however, did not show that having a nap would have an impact on the occurrence of headache, neither did the nap duration nor the nap timing ( $p > 0.05$ ).

Ramadan is a month of heightened worship and spiritual reflection [21]. During this month, Muslims practice self-control, exercise patience and try to get into a sublime state of mind that allow them to develop positive feelings [21]. Such practices allow them to cope better with pain, and to adopt more adaptive behaviors with their diseases [22]. Common spiritual/religious behaviors practiced during Ramadan include reciting the holy Quran, *Duaa* and reading the *Athkar*. *Duaa* is oral praying where Muslims ask Allah for certain wishes and demands. *Athkar*, on the other side, are a special type of *Duaa* that is said as

**Table 5:** Comparison between days with migraine and days without migraine according to food items.

	Days with/without headaches		Test of Sig.	p
	Yes (n = 148)	No (n = 74)		
<b>Fried food</b>	34 (23.0%)	7 (9.5%)	$\chi^2= 5.983^*$	0.014*
<b>Protein consumed</b>				
<b>None</b>	31 (20.9%)	20 (27.0%)	$\chi^2=$	0.173
<b>Beef</b>	46 (31.1%)	23 (31.1%)	7.717	
<b>Chicken/Ducks/Birds</b>	45 (30.4%)	17 (23.0%)		
<b>Fish/Sea food</b>	15 (10.1%)	4 (5.4%)		
<b>Combination</b>	11 (7.4%)	8 (10.8%)		
<b>Meat type</b>				
<b>None</b>	31 (20.9%)	20 (27.0%)	$\chi^2=$	0.52
<b>Red</b>	46 (31.1%)	24 (32.4%)	2.262	
<b>White</b>	62 (41.9%)	24 (32.4%)		
<b>Both</b>	9 (6.1%)	6 (8.1%)		
<b>Vegetables</b>	61 (41.2%)	36 (48.6%)	$\chi^2= 1.108$	0.293
<b>Fruits</b>	82 (55.4%)	39 (52.7%)	$\chi^2= 0.145$	0.703
<b>Tomatoes</b>	45 (30.4%)	22 (29.7%)	$\chi^2= 0.011$	0.918
<b>Apricot</b>	9 (6.1%)	11 (14.9%)	$\chi^2= 4.643^*$	0.031*
<b>Watermelon</b>	22 (14.9%)	1 (1.4%)	$\chi^2= 9.701^*$	0.002*
<b>Citrus fruits</b>	16 (10.8%)	2 (2.7%)	$\chi^2= 4.353^*$	0.037*
<b>Desserts (Konafah/Qatayef)</b>	27 (18.2%)	23 (31.1%)	$\chi^2= 4.659^*$	0.031*
<b>Beans</b>	37 (25%)	26 (35.1%)	$\chi^2= 2.493$	0.114
<b>Falafel</b>	1 (0.7%)	2 (2.7%)	$\chi^2= 1.521$	<sup>FE</sup> p= 0.258
<b>Eggs</b>	34 (23%)	31 (41.9%)	$\chi^2= 8.528^*$	0.003*
<b>Pickled food</b>	14 (9.5%)	9 (12.2%)	$\chi^2= 0.388$	0.533
<b>Dairy products</b>	68 (45.9%)	21 (28.4%)	$\chi^2= 6.339^*$	0.012*
<b>Milk</b>	40 (27%)	13 (17.6%)	$\chi^2= 2.429$	0.119
<b>Yogurt</b>	34 (23%)	10 (13.5%)	$\chi^2= 2.778$	0.096
<b>Cheese [Any type]</b>	76 (51.4%)	40 (54.1%)	$\chi^2= 0.144$	0.704
<b>White cheese</b>	56 (37.8%)	25 (33.8%)	$\chi^2= 0.350$	0.554
<b>Swiss Cheese</b>	14 (9.5%)	9 (12.2%)	$\chi^2= 0.388$	0.533
<b>Cottage cheese</b>	3 (2%)	2 (2.7%)	$\chi^2= 0.102$	<sup>FE</sup> p= 1.000
<b>Cheddar cheese</b>	3 (2%)	3 (4.1%)	$\chi^2= 0.771$	<sup>FE</sup> p= 0.403
<b>Feta cheese</b>	4 (2.7%)	2 (2.7%)	$\chi^2= 0.0$	<sup>FE</sup> p= 1.000
<b>Aged cheese</b>	1 (0.7%)	1 (1.4%)	$\chi^2= 0.252$	<sup>FE</sup> p= 1.000
<b>Chocolate</b>	24 (16.2%)	12 (16.2%)	$\chi^2= 0.0$	1
<b>Nuts</b>	4 (2.7%)	4 (5.4%)	$\chi^2= 1.037$	<sup>FE</sup> p= 0.446
<b>Ice cream</b>	4 (2.7%)	3 (4.1%)	$\chi^2= 0.295$	<sup>FE</sup> p= 0.689

$\chi^2$ : Chi square test

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p: p value for comparing between the studied group

\*: Statistically significant at  $p \leq 0.05$

reminders at certain times of the day and with certain religious acts. Such behaviors provide some sort of meditation that may reduce the headache frequency and improve the pain tolerance [11]. Results from our study revealed that reciting Quran and reading the *Athkar* reduced the risk of migraine occurrence by 61% ( $p=0.001$ ) and 49% ( $p=0.023$ ), respectively. Additionally, Muslims pray a special long prayer called “*Taraweeh*” during night in Ramadan [23]. Praying is a sort of physical exercise, and it harmonizes both the inner peace and the outer health [23]. In this study, patients who spent more time praying the *Taraweeh* prayer were less likely to have headache (OR=0.98, CI=0.97-0.99). The place where they performed the prayer had also a considerable influence on the occurrence of headache. At days when patients prayed at masjids (i.e. outdoors), migraine attacks were less likely to be experienced than at days when they prayed at home. *Taraweeh* praying outdoors in fresh air, in congregation and for long periods might have reduced the probability of migraine occurrence through improving



physical activity, emotional wellbeing, sense of social gathering and unity, and heightening spirituality [22,24].

Fluid intake, special habits and dietary habits were also considered in this study as potential contributors to the occurrence of migraine in Ramadan. Results from our study showed that a one-cup increase in fluid intake was associated with a 12% risk reduction of developing headache. Though the actual mechanism by which hydration may improve migraine remains elusive, a number of studies from literature revealed similar findings. For instance, data from a randomized controlled trial conducted on 102 patients with headache showed that increased water intake was significantly associated with improvement in the migraine-specific quality of life score [25]. In another study, water-deprivation was reported to be a precipitant of migraine [26]. Regarding the special habits (e.g. smoking and stimulants use), coffee was the only stimulant that was significantly associated with the occurrence of migraine. For every 1 cup increase in coffee consumption, the odds of occurrence of migraine was 2.3. Coffee was reported in several studies to exacerbate migraine via stimulating adenosine receptors, vasoconstriction and releasing stimulatory neurotransmitters [27].

The frequency of meals and the food items ingested had also an impact on the occurrence of migraine headache among the recruited patients in this study. Eating an additional meal reduced the odds of having migraine by 56%. Skipping meals has long been reported to exacerbate migraine via several proposed mechanisms [1,28]. Disturbed sympathetic activity, prolonged hypoglycemia and reduction of glycogen-derived glucose in astrocytes synapses are the main hypothesized pathophysiological mechanisms of triggering migraine headache with hunger [1]. On studying food items consumed during Ramadan, fried food, citrus fruits, apricot, watermelon, desserts, eggs and dairy products were significantly associated with the occurrence of migraine in the recruited patients. Fried food was reported in previous literature studies to exacerbate headache because it contains linoleic and oleic fatty acids which are known migraine triggers [29]. Phenolic amines and octopamine are the chemical triggers of migraine contained in citrus fruits [29]. Apricots and eggs, which are low-tyramine foods, were associated with a lower risk for headache occurrence [30]. Consumption of apricots or eggs reduced the odds of occurrence of migraine by 63% ( $p=0.031$ ) and 59% ( $p=0.003$ ), respectively. On the other hand, watermelon (a tyramine-rich fruit) increased the risk of migraine occurrence in this study with an odds ratio of 12.7 (CI=1.66-96.53) [30]. Muslims, from different countries worldwide, have a habit of making specific types of desserts in Ramadan called “*Kunafa*” and “*Qatayef*”. Consumption of *Kunafa* and/or *Qatayef*, in our study, was associated with a reduction in the odds of occurrence of migraine by 51% ( $p=0.025$ ). The mechanism by which such deserts contribute to the reduction of migraine might be related to their impact on blood glucose level [1,31]. In literature, certain types of cheese were reported to trigger migraine [29,32]. In our sample, however, none of the reported types of cheese (white, Swiss, cottage, cheddar, feta or aged cheese) were significantly correlated with the occurrence of migraine ( $P>0.05$ ). Consumption of dairy products in general, however, increased the risk of having migraine with an odds ratio of 2.14 (CI=1.17-3.91). Dairy products are hypothesized to trigger migraine via certain allergenic proteins e.g. casein [29]. Unlike what was reported from literature, chocolate, nuts, ice cream, tomatoes, cheese and pickled foods did not have an influence on the occurrence of migraine in our patients [33]. Such difference might be attributed to the small quantities consumed by the patients in our study.

The main limitations of this study are that we cannot confirm

cause-effect relationship between migraine occurrence and the studied variables, and further research is recommended to establish a clear relationship. Another limitation was the unevenness between the number of days with headache and days without headache, and therefore a variance bias cannot be excluded. The strength of this study is that it is the first, to the best of our knowledge, to address the different contributing factors that may affect migraine in Ramadan during fasting states in a multidimensional view. This would help Muslim migraineurs to consider these factors for adequate control of their headache in Ramadan without having to break the fasting state which is one of the obligatory pillars in Islam.

## Conclusion

Several factors are associated with migraine headache occurrence in Ramadan among fasting Muslim migraineurs. These factors include sleep disturbance (e.g. initial insomnia), spiritual habits (e.g. reciting Quran, reading Athkar, praying Taraweeh for long periods in masjids), coffee consumption, the amount of fluid intake, the number of meals ingested, and certain food items (e.g. fried food, citrus fruits, watermelon, apricot, dairy products, eggs and desserts as *Kunafa* and *Qatayef*). These factors should be considered for adequate control of migraine in Ramadan.

## Key Message

Several factors, other than fasting, contribute to the occurrence of migraine in Ramadan such as sleep habits, spiritual practices, fluid intake and food habits. These factors need to be taken into consideration for adequate control of migraine in Ramadan.

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