The Incidence of Myocardial Infarction during Ramadan

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ABSTRACT **Background:** Ramadan, one of the core tenets of Islam, requires a rigorous fasting regimen from dawn until sunset, during which practitioners abstain from all forms of food and drink. This substantial alteration in daily habits raises pertinent questions regarding its potential implications for cardiovascular health.

Objectives: To analyze the incidence of myocardial infarction (MI) throughout the Ramadan fasting period.

Methods: We retrospectively compared the incidence of MI occurring during Ramadan with that observed during the corresponding non-Ramadan months from 2010 to 2021 using medical records of Muslim patients admitted to the Galilee Medical Center. Ramadan's timing varies from year to year. We used a 3-year comparative framework to ensure seasonal alignment.

Results: During the study period and within a well-defined geographic region, we found that among Muslims, there were 405 MIs: 201 during Ramadan and 204 during non-Ramadan periods, $P = 0.282$.

Conclusions: The incidence of MI during Ramadan remained stable, indicating that the fasting practice does not significantly heighten the risk of MI.

IMAJ 2025; 27: 627–630

KEY WORDS: cardiovascular disease, fasting, myocardial infarction (MI), Ramadan

In the 12-month Islamic calendar, Ramadan is the ninth. This sacred period is marked by a daily fast from dawn until sunset, which is intended to instill virtues such as patience, self-discipline, and sacrifice. During Ramadan, adherents observe a complete abstention from all forms of nourishment as well as marital relations and other forms of bodily indulgence such as smoking and intravenous injections [1]. The timing of Ramadan shifts annually due to the lunar calendar, which causes the month to commence approximately 10 days earlier each year. Consequently, the duration of daily fasting varies according to seasonal changes and the length of daylight. Fasting periods are shorter during the winter months than in summer [2].

During Ramadan, Muslims consume two main meals: Suhoor (a pre-dawn meal) and Iftar (a fast-breaking meal after sunset). This transition to nocturnal eating patterns inherently involves modifications to sleep schedules, which may influence overall health [3]. These changes, including variations in caloric intake, alterations in medication schedules, and disruptions to circadian rhythms, have the potential to affect the incidence of myocardial infarction (MI) among those fasting [4,5].

Ischemia, a condition characterized by inadequate blood supply and oxygen to tissues, often results from the constriction or obstruction of blood vessels, leading to subsequent tissue damage and dysfunction. This lack of sufficient oxygen, or hypoxia, is a critical factor in the development of MI, which involves the necrosis of heart muscle tissue due to ischemia. MI is categorized under acute coronary syndromes, a group of conditions that encompass sudden or short-term changes in symptoms related to cardiac blood flow [6].

Despite the widespread observance of Ramadan in Israel, there is a notable lack of comprehensive data concerning the incidence of MI during this period. Limited research has investigated the effects of Ramadan fasting on acute coronary syndromes. For example, Temizhan and colleagues [7] demonstrated a significant reduction in acute coronary heart disease events during Ramadan compared to the periods preceding and following the fast. Similarly, a 2004 population-based study published by Hamad General Hospital in Doha, Qatar, found no significant differences in the incidence of MI or unstable angina during Ramadan relative to the rest of the year [8]. In addition, Almansori and colleagues in Saudi Arabia [9] reported that the incidence of acute coronary syndrome remained comparable during Ramadan and outside of this period.

PATIENTS AND METHODS

In this retrospective case-control study, we analyzed Muslim patients admitted to the Galilee Medical Center with MI during Ramadan from 2010 to 2021. The study compared MI incidence during Ramadan with equivalent non-Ramadan periods within the same Gregorian calendar years. A total of 406 consecutive patients were included, and data were extracted from medical records.

Patients were matched based on age and sex. Data were controlled for potential confounders, including smoking status, body mass index, hyperlipidemia, hypertension, diabetes mellitus, and medication use. Due to Ramadan's annual shift by approximately 10 days each Gregorian year, a 3-year comparative analysis ensured alignment within the same calendar timeframe. For example, the incidence of MI in Ramadan 2021 (April–May) was compared to the equivalent period in 2018. The study received institutional review board approval, ensuring patient anonymity and adherence to ethical research standards.

ETHICS ASPECTS

The data employed in this manuscript were collected with strict adherence to anonymization protocols, ensuring the protection of patient identities. Confidentiality was meticulously maintained, with all information securely archived in the hospital's electronic system. Access to patient data was exclusively limited to the research team. The data collection and analysis procedures adhered to ethical standards and received formal approval from the institutional review board, in accordance with the principles outlined in the Helsinki Declaration.

STATISTICAL ANALYSIS

Continuous variables were described using appropriate measures of central tendency and dispersion, including means, standard deviations, medians. Categorical variables were summarized as frequencies and percentages. The incidence of MI was calculated and reported with 95% confidence intervals for proportions within each period and presented as rates for 10,000 Muslim residents in the Acco sub-district area (number of Muslim residents reported by the Central Bureau of Statistics). For the entire period, the number of new MI events per person-year was estimated.

All Ramadan periods were aggregated into a single study cohort, while corresponding non-Ramadan periods from prior Gregorian calendar years were consolidated into a control cohort for statistical comparison. Continuous variables were analyzed using an independent sample *t*-test to determine the appropriateness of the sample size and variable distribution, while categorical variables were compared using Pearson's chi-square test (since expectancy > 5). The incidence of MI for each Ramadan period and the corresponding period (as well as the number of new MI events per person-year for the entire cumulative Ramadan period and the corresponding period) were compared with the Pearson chi-square test. Statistical significance was set at a two-tailed significance. Statistical analyses were performed using IBM Statistical Package for the Social Sciences statistics software, version 29 (SPSS, IBM Corp, Armonk, NY, USA).

RESULTS

During Ramadan, 72.6% males vs. 71.1% non-Ramadan were diagnosed with an MI. Diabetes prevalence was 48.4% vs. 43.8%, hyperlipidemia 68.2% vs. 72.4%, chronic drug use 76.6% vs. 75.4%, smoking 51.3% vs. 53.5%, and hypertension 65.2% vs. 65%, respectively.

Table 1 illustrates that clinical characteristics of MI patients were similar during Ramadan (n=201) and non-Ramadan periods (n=204), reflecting consistent risk profiles in both groups.

Table 1. Clinical characteristics of patients with myocardial infarction during Ramadan and corresponding non-Ramadan periods

	Non-Ramadan (n=204)	Ramadan (n=20)1	*P*-value
Age in years, mean ± standard deviation	60.2 (12.3)	59.9 (10.9)	0.798*
	60 (27–88)	59 (35–93)	
Female	59 (28.9%)	55 (27.4%)	0.741**
Male	145 (71.1%)	146 (72.6%)	
Diabetes mellitus	89 (43.8%)	95 (48.2%)	0.422**
Hyperlipidemia	147 (72.4%)	137 (68.2%)	0.384**
Smoking	108 (53.5%)	102 (51.3%)	0.690**
Hypertension	132 (65%)	131 (65.2%)	

*Independent sample *t*-test
**chi-square test

Our analysis of the incidence of MI during Ramadan versus respective periods [Table 2] showed no consistent pattern of increased cardiovascular risk. While fluctuations in incidence were observed across the years, MI rates remained relatively stable, with some years showing higher incidence during Ramadan and others during non-Ramadan periods. These variations suggest external factors, such as seasonal influences, may contribute to MI

Table 2. Incidence of myocardial infarction during Ramadan and corresponding non-Ramadan periods adjusted for the total population of the Acco subdistrict

	Non-Ramadan (n=204)	Ramadan (n=201)	*P*-value
Total number of residents in Acco subdistrict	1,176,700	1,290,100	
Number of myocardial infarctions to person-years**	0.000173	0.000156	0.282*

*chi-square test
**per 10,000 person-years

occurrence. Overall, the findings do not support a significant link between Ramadan fasting and increased MI risk.

Figure 1 provides a detailed representation of patient ages during the Ramadan periods analyzed in the study. The data indicate that there were no statistically significant differences in the age distribution between patients observed during Ramadan and those observed during non-Ramadan periods. Specifically, the mean age of patients during Ramadan was 59.93 years, compared to 60.22 years during non-Ramadan periods. Both periods encompassed a broad age range, from 35 to 93 years. These findings suggest that age was not a distinguishing factor affecting the incidence of MI between the two periods studied.

DISCUSSION

In this study, we elucidated the incidence of MI among the Muslim population during the month of Ramadan, contrasting it with MI rates observed during equivalent non-Ramadan periods over a 9-year period. The analysis determined that there were no statistically significant discrepancies in the incidence of MI between the Ramadan periods and their corresponding non-Ramadan intervals. Similar results were recently reported by Betesh-Abay and colleagues [10] from Israel. They found a slight increase in MI incidence during the month following Ramadan.

Although our study does not encompass specific data regarding the fasting compliance of the participants, it is important to acknowledge that adherence to Ramadan fasting is a prevalent and culturally ingrained practice within the local Muslim community, and is well-recognized by healthcare professionals. According to data from the Pew Research Center, over 90% of Muslims in Israel observe the Ramadan fast [11]. This high level of adherence underscores the validity of the study in assessing the potential health implications associated with Ramadan fasting.

During Ramadan, medication adherence can be significantly impacted due to the fasting schedule, which poses challenges for patients, especially those with chronic illnesses. Fasting from dawn until sunset requires individuals to modify their medication regimens, complicating adherence, particularly for those taking multiple daily medications. For example, patients with diabetes may find it difficult to regulate their blood sugar levels if their medications, which typically need to be taken with food, are not timed appropriately around the Iftar or Suhoor meals [12]. This misalignment can lead to risks of hyperglycemia or hypoglycemia, potentially resulting in serious health complications and increased hospital

Figure 1. The top years indicate the incidence of MI during Ramadan and the bottom years indicate the number of myocardial infarctions in the corresponding period in non-Ramadan years.

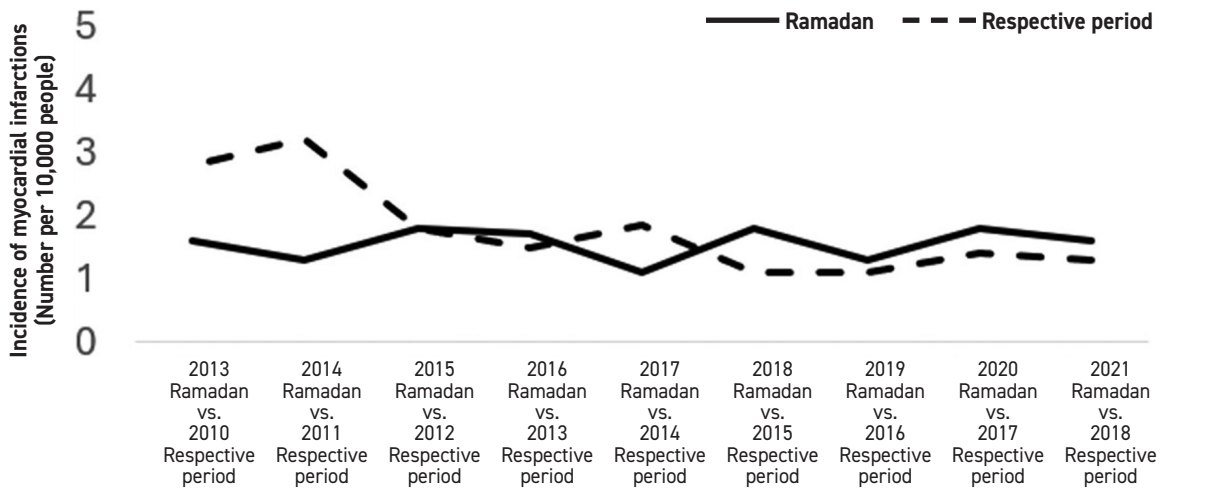
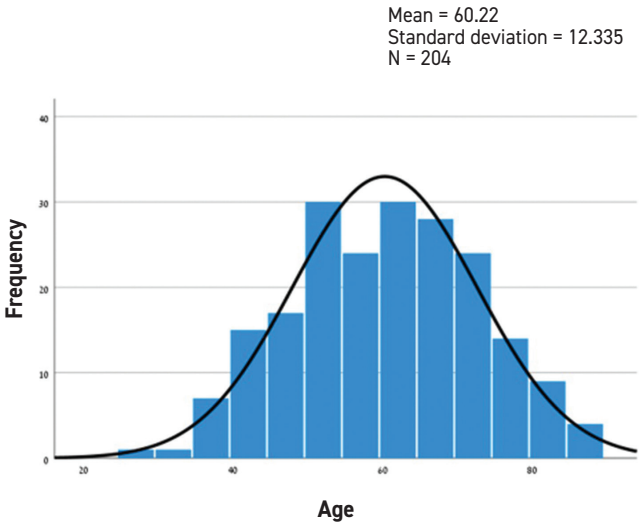


Figure 2. Distribution of the patient ages during the Ramadan period



visits [13,14]. Furthermore, the spiritual significance of Ramadan may lead some individuals to prioritize their religious practices over their medication schedules, creating a conflict between health management and religious observance [15]. It is crucial for healthcare providers to offer tailored education and support to patients, emphasizing the importance of medication adherence during this period and helping them adjust their regimens to align with the fasting schedule [16].

LIMITATIONS OF THE STUDY

The retrospective design limits causal inference between Ramadan fasting and MI due to incomplete documentation of fasting adherence. Thus, specific fasting status for individuals could not be determined. In addition, the study's focus on a single geographic region may affect the generalizability of the findings to other populations with different socioeconomic and cultural backgrounds. Variations in individual fasting practices was not considered. Future research should adopt a prospective approach with detailed fasting records and a more diverse population.

CONCLUSIONS

We found no significant correlation between the observance of Ramadan fasting and an increased incidence of MI. The evidence suggests that the impact of Ramadan fasting on the risk of MI is minimal and does not pose a substantial risk for most patients. Consequently, most individuals may safely continue fasting during Ramadan without an elevated risk of MI. This reassurance is particularly important for guiding clinical advice and supporting the adherence of patients to their fasting practices during this period.

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