

Fasting in Ramadan and Its Effect on Body Mass Index, Blood Pressure, and Blood Glucose: A Theoretical Pre-Post Statistical Analysis

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Abstract:

Ramadan fasting is an obligatory practice of religion in the Islamic faith performed every year by millions of Muslims around the world. Its practice does not only have serious spiritual connotations but also triggers serious physiological and metabolic effects. Considering these complex facets, this paper presents a theoretical quantitative construct which aims at examining the impacts of Ramadan fasting on some of the most important health outcomes like Body Mass Index (BMI), blood pressure, and blood glucose levels. The analysis method is a pre- post statistical design, which allows pre- and post-assessment to be compared. Instead of basing on new empirical evidence, the manuscript is written in the form of a sequence of properly structured hypotheses, specifying the definition of certain variables, and recommending appropriate statistical procedures. The proposed recommendations are based on available biomedical evidence and existing biostatistical rules, which guarantees the methodological rigor. By illustrating how the practices of Islam could be subject to systematic quantitative research, the paper provides a strong scaffolding on which other future empirical studies could be built.

Keywords: Ramadan fasting, BMI, blood pressure, blood glucose, pre-post analysis, Islamic health, theoretical study

Introduction

Islam is among the major religions in the world, and the number of Muslims in Asia (about 69% and Africa 27%), is the largest in the world. To Muslims, Islam is not just a belief system, but a holistic lifestyle, which restricts spiritual, social, and behavioural practices. One of its fundamental religious duties is the fasting in the sacred month of Ramadan which is one of the five pillars of the Islamic religion.¹

In general, fasting refers to the intentional and willful avoidance of food, liquid, or a combination of the two, over a given length of time. The global religious and cultural fasting traditions differ significantly in the length, the frequency, and the rigidity of fasting.

Indicatively, Jewish fasting is celebrated on few days in a year, but Greek Orthodox Christians have the capacity of fasting a maximum of 180 to 200 days within one year. Conversely, Ramadan fasting is unique in its format, magnitude, and scale of the whole population². The ninth month of the Islamic lunar calendar is Ramadan which has a period of around 28 to 30 days. This time of fasting (Suhoor) to shell (Iftar) is obligatory to all healthy adult Muslims, and those who are pregnant, lactating, menstruating women and those with illness are allowed an exemption.

The period of fasting on a day to day basis on Ramadan also depends on the geographic area and time of the year and is normally between 12 and 16 hours, but can be more in some places. People also do not eat at all in rapid time, and they can only eat and drink at the night time between the sunset and the sunrise. This change in eating time will tend to cause the intake of massive amounts of foods and varieties of foods during evening meals generating a unique feeding behavior that is quite different to the routine daily routines³. These eating habits of the night with future social and religious engagements can interfere with circadian rhythms, feeding patterns and duration of sleep.

Considering a biomedical and population health approach, Ramadan fasting is a naturally developed model of time-limited dietary intake practiced by a huge humanity at the same time. Consequently, it has attracted more and more attention among researchers who want to know its impact on metabolic, cardiovascular and physiological health implications. Within the last twenty years, various researches have been conducted to explore the effects of Ramadan fasting on the well-being of healthy and those who have underlying health issues like diabetes, cardiovascular disease, and metabolic disorders.

Taken together, these studies imply that Ramadan fasting can cause alterations in metabolic status, such as the change in the level of fasting blood glucose, lipid profiles, haematological parameters, and body weight. Nonetheless, the results mentioned are not consistent. Whereas certain studies claim that metabolic parameters and body composition have been found to be positively changed by moderate degrees, other studies show that the changes are insignificant or inconsistent. Such inconsistencies are usually ascribed to the discrepancies in dietary practices, caloric intake, sex, age, physical activity status, ethnicity, fasting time and design of the methodology.

Although there is an increasing literature, there are still some critical gaps. Most of the studies vary in terms of statistical design, inability to control inter individual variability or inability to have standardized pre-post analytic frameworks. Additionally, in some of the Muslim-dominant areas, there are limited access to large-scale and quality empirical health data because of the logistic, ethical, or resource base. Under these circumstances, theoretical statistical modelling proves to be especially useful in the context of evidence-based hypothesis formulation, operationalisation of variables, and the selection of suitable methods.

Consequently, the current research aims to construct a theoretical, biostatistically based, study of intervention on the impact of Ramadan fasting on the selected health outcomes that include Body Mass Index (BMI), blood pressure⁴, and the fasting blood sugar levels using a pre-post study design. This paper intends to illustrate that the Islamic nature of health behaviours can be discussed within the context of rigorous quantitative reasoning and present a solid base of future empirical studies in the Islamic health and preventive medicine.

Islamic Perspective on Fasting and Health

Islamic teachings emphasize balance, moderation, and preservation of health. The Quran explicitly links fasting with spiritual and moral development:

“O you who believe, fasting has been prescribed for you as it was prescribed for those before you, that you may attain righteousness (Taqwa).” ([Quran 2:183](#))

Prophetic traditions also emphasize moderation in eating and drinking, suggesting indirect health benefits of fasting. From an Islamic viewpoint, fasting is not intended to cause harm but to promote physical restraint, self-regulation, and overall well-being. These principles align with contemporary health concepts related to metabolic balance and lifestyle regulation.

Literature Review

Biomedically, Ramadan fasting causes significant changes in the timing of meals, dietary intake, sleep cycles as well as circadian rhythms, which are important in metabolic and cardiovascular functions. In contrast to the continuous caloric restriction, Ramadan fasting is a type of diurnal time-limited feeding, with the absence of food during the day time followed by night feeding⁵. Such modifications form a distinctive physiological context that can affect body structure, glucose process, and blood pressure control in a number of mutually dependent ways.

Body weight and Body Mass Index (BMI) may be considered one of the most commonly studied effects of Ramadan fasting⁶. Theoretically, when fasting is done over a long period of time on a daily basis it can result in a decrease in overall energy consumption thus creating an energy deficit that will result in weight loss. Empirical studies have shown small decreases in body weight and BMI during or shortly after the Ramadan, especially in those adults who have normal or high body weight at baseline.

Nevertheless, the literature also suggests that these effects do not show homogenous effects on populations. Some individuals may compensate caloric deficits by increased overeating at night, eating energy-rich foods, and a lack of physical activity⁷. Heterogeneity of observed outcomes is further brought by gender, age, baseline BMI and cultural eating habits. These discrepancies point to the value of within subject pre-post comparisons which enable each subject to be his or her own control, and minimize confounding caused by inter-subject differences. Ramadan fasting has an additional effect on glucose metabolism, which is the effect on insulin sensitivity, hepatic glucose production and peripheral glucose uptake⁸. The fasting periods are also known to lead to metabolic conversion of glucose use to fatty acid oxidation⁹, which increases the sensitivity of insulin. A number of studies done on healthy subjects have shown the same stability of fasting blood glucose levels or slightly low levels of fasting blood glucose levels during Ramadan indicating better glycemic control.

Conversely, more erratic results have been found in works with people with diabetes or impaired glucose tolerance, and this case mostly relies on the medication use, the composition in the diet and the adherence to the fasting rules. The results emphasize the difficulty of glucose regulation in the period of Ramadan and the need of well-developed statistical investigations. A paired pre-post design is especially conducive to the requirements of detecting some subtle metabolic changes that might have been missed after cross-sectional comparisons. The activity of the autonomic nervous system, sodium in the diet, hydration, and vascular tone affect the regulation of blood pressure in Ramadan fasting¹⁰. Reduced sympathetic nervous system activity and increased parasympathetic dominion in fasting has been linked and this could be one contributor to the decreases in systolic and diastolic blood pressure. Also, a beneficial effect on the functionality of the endothelium and a decrease in oxidative stress during the fasting periods have been suggested as the possible mechanisms of cardiovascular advantages.

Empirical research on the effects of Ramadan on blood pressure has given mixed results. Certain studies note insignificant drops in blood pressure especially in normal individuals whereas some studies do not provide significant drops¹¹. The difference in hydration patterns, climate, and level of physical activity is often attributed to be some of the factors. These discrepancies also endorse the application of standardized within-subject statistical methods, which is less vulnerable to confounding by the difference in baseline. Another consequence of Ramadan fasting is the steep change in circadian rhythms with the change in the mealtime and sleep-wake patterns to the nighttime¹². It has been demonstrated that the disruption of circadian adaptation affects glucose tolerance, hormonal secretion, and blood pressure control. Although temporary circadian violation can be part of the metabolic stress, the physiological adaptive mechanisms during the Ramadan season can prevent the negative outcomes in normal people.

Circadian rhythms, metabolic control, and cardiovascular activity are intertwined, which points to the multidimensional character of health outcomes in fasting. Considering these complexities, a cross-sectional design or single post-Ramadan measurements may not capture the actual effects of fasting. The inconsistency that is evident in all empirical researches into Ramadan fasting highlights the necessity of a solid and uniform statistical model. A pre-post study design enables physiological parameters to directly compare between the same individuals thus controlling genetic, demographic and lifestyle-related confounders. The paired statistical tests like paired t -test or the paired Wilcoxon signed -rank test are specifically suitable in revealing the change in BMI, blood pressure, and blood glucose during fasting.

In this regard, a theoretical pre-post analytical approach is taken by the present research to integrate biomedical data and show how Ramadan fasting may be thoroughly analyzed through the application of accepted biostatistical concepts. Such a solution offers a consistent rationale to the empirical research in the future and improves the methodological consistency of the studies that assist in researching the Islamic practices of fasting. The main aim of the given theoretical research is to come up with a quantitative and biostatistically viable structure to investigate the impact of Ramadan fasting on the main health parameters, i.e., Body Mass Index (BMI), blood pressure, and level of fasting blood glucose. Through a combination of the available biomedical evidence and the existing body of statistical principles, the research attempts to show how changes related to fasting can be undertaken in a systematic manner without having primary empirical data. Another goal is to determine and defend suitable

statistical methods, especially methods that are appropriate in pre-post study designs, which can be utilized to evaluate the within-subject changes in these health outcomes. Moreover, the paper will attempt to provide a conceptual review of anticipated physiological patterns of Ramadan fasting in accordance with previous scientific evidence and emphasize on the expanded use of biostatistical techniques in research of Islamic health lifestyles.

Methodology

This study defines a pre-post observational study which is best placed to analyse the physiological and metabolic consequences of Ramadan fasting. The design can compare health metrics pre- and post-fasting due to the fact that each participant acts as his or her own control. This will reduce inter-individual variability due to genetic, demographic and lifestyle heterogeneity and increase the sensitivity of the further statistical analysis. The data acquisition strategy is defined in two standardised points, which are in time discrete. Pre-Ramadan or baseline measures are imagined to be taken one and two weeks prior to the fasting period, a temporal space during which the subjects are supposed to be living in accordance with their usual eating and way of life routines. The post-intervention measurements will be made one week after the end of Ramadan, thus, to record the instant physiological effects of the long-term fasting and limit the confounding effect of lifestyle normalisation in post-Ramadan. This time-based scaffold coincides with the current paradigms of methodological norms in studies focusing on Ramadan and allows identifying short-term metabolic and cardiovascular disturbances that could be directly linked to fasting behaviors. The pre-post study in its theoretical framework is especially beneficial to the effects of Ramadan fasting modelling. It supports the use of paired statistical methods, i. e. paired t-tests or non-parametric alternatives thereof, to compare differences in continuous health outcomes (e.g. Body Mass Index (BMI), blood pressure measurements, and fasting blood glucose levels). The hypothetical group to be discussed in this study is the group of adult participants (Muslims) aged 18-60 years, which is a demographic group that represents best of all the full participation in Ramadan. Having both male and female subjects will guarantee gender representation and relate to the diversely variable physiological responses that can occur in both sexes. The age group has been specifically chosen to exclude confounding effects of growth-related changes in the younger age group and age-related changes in metabolism in older age groups.

Fasting in Ramadan and Its Effect on Body Mass Index, Blood Pressure, and Blood Glucose: A Theoretical Pre-Post Statistical Analysis

Based on Islamic jurisprudence and ethical requirements in health research, a set of exclusion requirements have been established. Women who are pregnant and lactating are exempted due to their exemption of not fasting according to the Islamic law, and because they are met with very unique metabolic demands during gestation and lactation. Furthermore, persons with severe chronic pathologies - advanced cardiovascular disease, uncontrolled diabetes mellitus, or renal failure- are excluded in order to limit the possible health risks and to eliminate possible confounding physiological disturbances not related to the fasting regimen itself.

This theoretically defined cohort as a whole represents the characteristics of a healthy adult fasting community in general and offers a decent basis on which the expected physiological reactions to Ramadan fasting would be modelled. The suggested model strengthens internal validity by clearly defining inclusion and exclusion criteria and ensures a more certain belief that the identified pre- and post-intervention changes could be better explained by the ability of the fasting to induce behavioural and metabolic modifications.

Table 1. Study Variables and Operational Definitions

Variable Type	Variable Name	Measurement Scale	Unit
Independent Variable	Ramadan Fasting Status	Categorical (Binary)	Pre or Post
Dependent Variable	Body Mass Index (BMI)	Continuous	kg/m ²
Dependent Variable	Systolic Blood Pressure	Continuous	mmHg
Dependent Variable	Diastolic Blood Pressure	Continuous	mmHg
Dependent Variable	Fasting Blood Glucose	Continuous	mg/dL

The study variables in the proposed theoretical framework are outlined with great care to provide conceptual clarity and statistical strength. The independent variable is the Ramadan fasting status that is operationalised as binary categorical construct differentiating between pre-Ramadan and post- Ramadan states. This construct represents the exposure of interest namely

the observation of the Ramadan fasting period and acts as the main determinant on which health outcome changes are measured.

Dependent variables will include ideal physiological and metabolic health measures that have been commonly cited in studies on Ramadan fasting. Body mass index (BMI) is a continuous variable and is measured in kilograms per square metre (kg m^{-2}), which provides a standardised body composition index. One of the continuous measures of blood pressure: systolic and diastolic blood pressure in millimetres of mercury is measured (mm Hg) each of which indicates cardiovascular functioning. Also, it has a fasting blood glucose, as a continuous metabolic measure, and is measured in milligrams per decilitre (mg/dL), which describes glucose regulation during fasting.

All of the choices of these variables are deeply grounded in the available biomedical literature and indicate clinically meaningful outcomes as well as sensitive to dietary and behavioural change alongside Ramadan fasting. Since all outcome variables are considered continuous, the study will allow the use of parametric or non-parametric paired statistical tests depending on the distributional characteristics of the data.

The following statistical methods are theoretically proposed:

Table 2. Statistical Methods are Theoretically Proposed

Health Indicator	Statistical Test	Purpose
BMI	Paired t-test / Wilcoxon signed-rank test	Compare pre-post means
Blood Pressure	Paired t-test	Assess cardiovascular changes
Blood Glucose	Paired t-test	Evaluate metabolic changes
Effect Size	Cohen's d	Measure magnitude of change

The level of statistical significance is set at $\alpha = 0.05$.

The proposed pre-post observational study design corresponds well with the statistical analysis plan, which is well designed. Because they will be measured on the same persons prior to and after the Ramadan, within-subject analysis methods are considered the most suitable. Because

continuous outcomes like BMI, blood pressure, and fasting blood glucose are to be analyzed, the paired t -test as the main inferential statistical tool is suggested to measure the differences between the pre- and post-Ramadan scores.

When normality is not met, especially with small samples or skewed data, a non-parametric alternative, the Wilcoxon signed-rank test, is provided, which is especially used in case of BMI comparison. This flexibility guarantees the strength of statistical inference in a range of data conditions. Regarding blood pressure, paired t -tests are suggested to be used independently on systolic and diastolic values to assess possible changes in the cardiovascular system due to Ramadan fasting. Similarly, fasting blood glucose levels are recommended to be analyzed with the help of paired t -tests to determine the metabolic adaptations in relation to the long-term fasting periods.

The analysis plan also emphasizes the significance of testing the magnitude of observed changes in addition to statistical significance testing. To this end, Cohen d is suggested as the measure of effect size which therefore allows the practical and clinical implications of fasting-related changes to be interpreted regardless of the sample size. Estimation of effect size would be especially useful in theoretical and exploratory studies, where small but significant physiological changes can be expected. The statistical significance level will be established to be 0.05, which is typical of traditional standards in the biomedical and public health studies. This cutoff point is a tradeoff between the probability of Type I error and the adequate sensitivity of responses to fasting related changes. The suggested statistical analysis tools combined provide a logical and sound analytical paradigm to assess the physiological impacts of Ramadan fasting in future empirical research.

Expected Theoretical Outcomes

The review of current biomedical and epidemiological evidence shows that there is a high likelihood that Ramadan fasting would induce a slight drop in Body Mass Index (BMI), which is mainly related to the shift in the timing of meals, possible changes in total energy consumption, and further changes in metabolism, which are linked to the long-term fasting. Although compensatory nocturnal consumption can reduce the weight reduction in a few people, past researches indicate that even temporary fasting diets like Ramadan can still

produce quantifiable alterations in body weight and BMI, in healthy adults who do not experience significant changes in baseline eating routines.

As regards cardiovascular wellbeing, Ramadan fasting theoretically should stabilise, or have a small effect, on blood pressure, particularly systolic blood pressure. The latter changes can be mediated by a decrease in the work of the sympathetic nervous system, increase in vascular compliance, and dietary adjustments like reducing the amount of sodium intake during the day. Furthermore, behavioural aspects that are typically related to Ramadan, such as smoking cessation and improved self-control, might also play an additional role in the positive results in blood-pressure. The extent of these effects could differ in different individuals, but within-subject pre- post comparisons are bound to show some slight, yet clinically significant changes.

In terms of metabolic control, one can expect the positive changes in fasting blood-glucose levels, especially in non-diabetic people. Fasting relieves the need to increase insulin resistance and metabolic plasticity, which can facilitate the more efficient use and regulation of glucose. In healthy populations, these adaptations can be in the form of stable or mildly decreased fasting blood-glucose levels after Ramadan. The degree of improvement in glycaemic parameters, however, will be pegged on the metabolic status at the time of baseline, the composition of the diet in non-fasting periods and the observation of fasting.

These theoretical findings taken together should be statistically significant in an empirical study of sufficient power with the use of a suitable pre-post design and paired statistical tests. Even though the expected changes can be small in scale, their presence would give good evidence to prove the metabolic and cardiovascular outcomes of Ramadan fasting. The suggested theoretical framework can therefore be used to provide a consistent foundation to understand the health outcomes of fasting and to inform future empirical studies that use standardised statistical methods.

Discussion

Ramadan fasting is a single, naturally occurring intervention, which incorporates dietary control, behavioral control, and spiritual stimulation, thus providing an integrative paradigm of exploring human metabolic and cardiovascular adaptation. Theoretically, Ramadan schedules, imposed, time-limited eating can regulate the energy balance, insulin resistance, vascular activity, and circadian biology. Using a pre-post statistical technique, the existing framework

allows comparisons within the subject, in effect eliminating inter-subject heterogeneity that can be ascribed to gene, baseline metabolism, age and sexual factors. This type of design enhances the ability to detect minor physiological disturbances which otherwise would have been hidden under cross-sectional or cross-subject studies.

The theoretical construct also explains how Islamic praxis can be subjected to quantitative statistical inference in order to fill the gap between religious health practices and biomedical inquiry. The integration of spiritual and behavioral aspects into systematic analytical framework does not only enhance interdisciplinary research, but also enhances the possibility of culturally sensitive, evidence-based health practices. An example is the theoretical improvements in body mass index, blood pressure and fasting glucose which represent physiological processes, that is, caloric deficit, increased insulin responsiveness, and autonomic recalibration, which, although small, can add up to long-lasting cardiovascular and metabolic health in case Ramadan fasting is repeated every year or incorporated into habitual lifestyle interventions.

The paradigm also highlights the need to use biostatistical rigor in the study of religious and cultural phenomena. Pre-Post designs, which are standardized with a subsequent estimation of the effect sizes, help in quantifying the health outcomes, not only by demonstrating statistical significance, but also providing a quantitative measure of the magnitude as well as clinical importance of the changes induced by fasting. The method has the potential to inform the future in experimental designs, guide population health mandates, and cement the strength of research methodology in the area of Islamic health studies.

Significance of the Study

The current theoretical inquiry presents a few pertinent contributions to the fields of biostatistics and the new field of the Islamic health studies. Firstly, it provides a strictly statistical platform of questioning the impact of religious fasting, therefore, demonstrating the capacity in which quantitative methodologies can be methodically used to assess health consequences in a culturally specified milieu. Furthermore, the paper highlights how viable it can be to carry out theoretical pre- post analyses despite the absence of empirical evidence and, thus, provide a systematic basis on hypothesis, operationalization of variables and the design of analysis. Lastly, it proposes that future empirical studies should employ standardized methods

to achieve the rigor of the methodology and to be compatible across studies, which will eventually increase the validity of Ramadan fasting research results.

By establishing a conceptual gap between Islamic practice and modern scientific research, this work highlights the possibility contained in the practice of culturally informed health studies. It argues that the operationalization and analytical examination of religious practices can provide substantive information about lifestyle interventions that can provide benefits in metabolic, cardiovascular, and general health areas.

Limitations

The current study has a number of limitations inherent to the theoretical design despite its contributions. To begin with, there was no gathering of primary empirical data; all the analyses and hypotheses were made based on the available literature, and the well-known biostatistical principles. In turn, the model assumes complete compliance with Ramadan fasting, which can hardly represent the behavior of various populations. Second, the framework fails to include dietary composition, physical activity, sleep patterns, and other lifestyle covariates, which can have a significant impact on the outcomes of metabolism and cardiovascular. Third, the research focuses on short-term pre-and post-effects, thus it may not be covering long-term physiological changes or cumulative effects of years of repeated fasting. Finally, the changes that can be explained by the gender, age, ethnicity, and geographic location are also recognized but not directly modeled, which restricts the generalizability of the theoretical results to all Muslim groups.

Recommendations for Future Research

Based on the theoretical framework developed within the context of this paper, there are a series of recommendations that can be provided to inform future empirical studies. One, research must gather primary information based on standardized designs of pre post, so that measurement of BMI, blood pressure and fasting glucose among other health outcomes is accurately measured. Second, one should include covariates like nutrition, physical activity, sleep duration, and hydration condition that will enable the adjustment of possible confounding factors. Third, comparisons between fasting and non- fasting population should be incorporated in the research which will give more information about the special effects of Ramadan fasting in comparison to the regular lifestyle habit. Fourth, the longitudinal studies performed throughout

Ramadan periods are recommended to study cumulative and adaptive physiological responses to repetitive fasting. Lastly, it is possible that further investigations could rely on subgroup analyses, such as gender, age, initial health state, and cultural eating habits, and thus contribute to making the results relevant to more diverse Muslim groups.

Conclusion

It is revealed by the theoretical research that Ramadan fasting can be studied using a systematic analysis, in terms of pre-post quantitative statistics, without the primary data. Using the strict biostatistical concepts to a culturally relevant health behaviour the study generates insightful information on the possible metabolic and cardiovascular impacts of fasting such as small body mass index decreases, blood pressure stabilisation, and glucose regulation. The framework not only highlights the suitability of Islamic beliefs with the current scientific enquiry, but also offers a solid platform to guide further empirical research, emphasizing both methodological and practical issues to look into culturally informed lifestyle interventions.

Reference

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- ¹ Majid, A., Osama, M., Noman, M., Nisa, U., & Haider, I. (2023). Effect of Ramadan fasting on body weight and body mass index (BMI) in public sector undergraduate medical students of Peshawar. *Pakistan Journal of Medical Sciences*, 39(3), 662.
 - ² Tsitsou, S., Zacharodimos, N., Poulia, K. A., Karatzi, K., Dimitriadis, G., & Papakonstantinou, E. (2022). Effects of time-restricted feeding and ramadan fasting on body weight, body composition, glucose responses, and insulin resistance: a systematic review of randomized controlled trials. *Nutrients*, 14(22), 4778.
 - ³ Al-Jafar, R., Yuqi, W., Elliott, P., Tsilidis, K. K., & Dehghan, A. (2024). The dietary changes during Ramadan and their impact on anthropometry, blood pressure, and metabolic profile. *Frontiers in Nutrition*, 11, 1394673.
 - ⁴ Zairi, I., Bejar, M. A., Mrad, I. B., Mzoughi, K., & Kraiem, S. (2022). Effect of intermittent fasting and chronotherapy on blood pressure control in hypertensive patients during Ramadan. *arterial hypertension*, 26(2), 67-72.
 - ⁵ Ribas-Latre, A., Fernández-Veledo, S., & Vendrell, J. (2024). Time-restricted eating, the clock ticking behind the scenes. *Frontiers in Pharmacology*, 15, 1428601.
 - ⁶ Majid, A., Osama, M., Noman, M., Nisa, U., & Haider, I. (2023). Effect of Ramadan fasting on body weight and body mass index (BMI) in public sector undergraduate medical students of Peshawar. *Pakistan Journal of Medical Sciences*, 39(3), 662.

⁷ Mutti, C., Malagutti, G., Maraglino, V., Misirocchi, F., Zilioli, A., Rausa, F., ... & Parrino, L. (2023). Sleep pathologies and eating disorders: A crossroad for neurology, psychiatry and nutrition. *Nutrients*, 15(20), 4488.

⁸ Wang, Y., & Wu, R. (2022). The effect of fasting on human metabolism and psychological health. *Disease markers*, 2022(1), 5653739.

⁹ Morant-Ferrando, B., Jimenez-Blasco, D., Alonso-Batan, P., Agulla, J., Lapresa, R., Garcia-Rodriguez, D., ... & Bolaños, J. P. (2023). Fatty acid oxidation organizes mitochondrial supercomplexes to sustain astrocytic ROS and cognition. *Nature Metabolism*, 5(8), 1290-1302.

¹⁰ Akhtar, A. M., Ghouri, N., Chahal, C. A. A., Patel, R., Ricci, F., Sattar, N., ... & Khanji, M. Y. (2022). Ramadan fasting: recommendations for patients with cardiovascular disease. *Heart*, 108(4), 258-265.

¹¹ Aziz, N., Riaz, N. M., Pervaiz, H., Zafar, J., Azher, Z., & Sattar, A. EFFECTS OF FASTING ALONG WITH DIFFERENT DEMOGRAPHIC FACTORS ON BLOOD PRESSURE IN UNDERGRADUATE MEDICAL STUDENTS OF A PUBLIC SECTOR MEDICAL COLLEGE IN PUNJAB PAKISTAN.

¹² Ali, T., & Lessan, N. (2024). Chrononutrition in the context of Ramadan: Potential implications. *Diabetes/metabolism research and reviews*, 40(2), e3728.