

THE EFFECT OF RAMADAN FASTING ON INFLAMMATORY CYTOKINES IN OBESE PEOPLE: A LITERATURE REVIEW

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Abstract: Obesity is the forerunner of various metabolic and non-metabolic diseases today. Obesity, which is associated with low-grade inflammatory conditions that are often not recognized, requires special attention. Ramadan fasting, which Muslims observe for 30 consecutive days, has been widely studied for its positive effects on health, including reducing inflammatory conditions in the body. This review aims to assess the impact of Ramadan fasting on inflammatory cytokines in obese patients from various existing studies. All English language papers in the PubMed and Science Direct databases were searched using keywords such as Ramadan fasting, inflammation, cytokine, and obesity from 2021 to 2025. Six studies were included in this review. Data extraction was conducted based on the main data of the studies; the primary outcomes of the analysis were mean changes in inflammatory cytokines levels during the holy month of Ramadan in fasted subjects. Ramadan fasting was proven to reduce inflammatory cytokines not only in people who are obese but also in people with normal nutritional status. It showed that fasting during Ramadan can prevent metabolic and non-metabolic complications. Carrying out Ramadan fasting has a good effect on health.

Keywords: Ramadan fasting, Inflammation, Cytokine, Obesity, Metabolic

Introduction

Globally, the prevalence of obesity remains exceptionally high. The NCD Risk Factor Collaboration (NCD-RisC) estimates that by 2024, more than one billion people in the world will be living with obesity, with details of nearly 880 million adults and 159 million children and adolescents aged 5-19 years. Obesity is a complex, multifactorial condition characterized by excessive fat accumulation, which has become a global health epidemic due to its significant association with various chronic diseases, such as diabetes, cardiovascular disease, and metabolic syndrome (Haam et al., 2023).

In recent years, various interventions have been explored to mitigate inflammation and improve metabolic health in obese populations. One of the primary mechanisms underlying these comorbidities is chronic low-grade inflammation, often manifested through elevated levels of inflammatory cytokines such as TNF- α , IL-6, and CRP (Khanna et al., 2022; Karczewski et al., 2018). This inflammatory state contributes to insulin resistance, impaired metabolic function, and increased cardiovascular risk in obese individuals.

Ramadan fasting is a significant religious practice in the Muslim community. A popular form of intermittent fasting is the Ramadan fasting pattern, a spiritual practice that involves abstaining from food and drink from dawn to sunset for a month (Meo & Hassan,

2015). Ramadan fasting has been recognized for its potential health benefits, including weight loss, improved metabolic markers, positive alteration in the metabolic profile about the risk of certain chronic diseases, and a reduction in inflammatory responses (Halawa, 2020; Sadeghirad et al., 2014; Al-Jafar et al., 2024).

A growing body of research suggests that Ramadan fasting can modulate inflammatory cytokines, particularly in individuals with obesity. Fasting has been shown to reduce the secretion of pro-inflammatory cytokines such as IL-6 and TNF- α , which are often elevated in obese individuals due to the chronic low-grade inflammation associated with excess adiposity (Patterson et al., 2016; Adawi et al., 2017). These effects may be attributed to changes in the gut microbiota, the improvement in gut microbiota changes, insulin sensitivity improvement sensitivity, and the restoration of metabolic balance during fasting periods (Patterson et al., 2016).

Given the increasing prevalence of obesity and its associated inflammatory markers, understanding the impact of Ramadan fasting on inflammatory cytokines in obese individuals is of considerable clinical relevance. This literature review aims to explore the available evidence regarding the effects of Ramadan fasting on inflammatory cytokine levels in obese populations, as well as the potential mechanisms through which fasting may exert these effects. By synthesizing the findings from various studies, this review will provide a clearer understanding of the role of Ramadan fasting as a potential intervention for reducing inflammation and improving metabolic health in obese individuals. Investigating the effect of Ramadan fasting on inflammatory cytokines in obese individuals is crucial, as it may provide insights into the potential therapeutic applications of this practice.

Literature Review

Obesity

An excessive accumulation of body fat defines obesity and is commonly measured using the Body Mass Index (BMI). According to the World Health Organization (WHO), obesity in adults is people with a BMI greater than or equal to 30, and children over 5 years old are children with a standard deviation (based on the median growth standard reference from WHO) greater than two. Children under five are considered obese if they have a standard deviation (based on the median growth standard reference from WHO) more significant than three (WHO, 2024). This condition is a risk factor for numerous health issues, including cardiovascular diseases and diabetes (Haam et al., 2023).

Obesity and Inflammation

Obesity is characterized by a chronic low-grade inflammatory state with elevated levels of pro-inflammatory cytokines. Cytokines are crucial in cell signaling, particularly in immune responses and inflammation. Pro-inflammatory cytokines, such as IL-6 and TNF- α , contribute to chronic inflammation, a common feature in obesity. In contrast, anti-inflammatory cytokines like IL-10 help mitigate these effects. The excessive adipose tissue secretes these cytokines, exacerbating inflammation and contributing to the development of obesity-related complications such as insulin resistance and atherosclerosis (Khanna, 2022; Karczewski, 2018).

Inflammation is triggered by obesity. Numerous internal and external cues that obesity offers can cause an inflammatory reaction in adipose tissue. These processes are frequently seen as the connection between adipose tissue inflammation and long-term calorie excess. Dysregulation of fatty acid balance increases adipose cell growth and mortality, endoplasmic reticulum (ER) stress, mitochondrial dysfunction, local hypoxia, and others are some of these pathways. These triggers come together when the nuclear factor-kappa B (NF- κ B) and c-Jun N-terminal kinase (JNK) pathways are activated, frequently regarded as signaling hubs. Pro-inflammatory cytokine production rises, and pro-inflammatory M1 macrophage infiltration is encouraged when these pathways are activated (Zatterale et al., 2020).

Fasting

Ramadan fasting is required in Islam, according to Surah al-Baqarah verse 183: "O you who believe, you must fast just as those who came before you must be terrified." This fasting is held from dawn until dusk, with food and water available before and after dawn (Mohamed, Ahmed, et al., 2020). Fasting in Islam also has therapeutic benefits. Not eating and drinking at a set time gives the digestive system a break, allowing the body to detoxify. It aligns with modern scientific findings on intermittent fasting, which have shown improved metabolic health and cognitive function. During Ramadan, people usually fast for 12 to 19 hours each day and eat and drink during fasting, which differs from the 24-hour day.

Another type of fasting is intermittent fasting. Intermittent fasting is a meal-time limitation that includes alternating-day fasting, various comparable full-day fasting patterns, and time-limited feeding (in which the day's food is consumed over 6 hours, allowing for an 18-hour fast).

Fasting and Inflammatory

Ramadan fasting has been shown to benefit various health-related outcomes, including weight management and the reduction of inflammation (Halawa, 2020; Meo & Hassan, 2015). Specifically, studies have reported that Ramadan fasting can decrease the levels of pro-inflammatory cytokines, such as interleukin-1 beta (IL-1 β), interleukin-6, and tumor necrosis factor alpha. These inflammatory markers have been linked to the development of obesity and associated metabolic disorders, including type 2 diabetes and cardiovascular disease.

Fasting during Ramadan has also been associated with an increase in anti-inflammatory cytokines. Elevated levels of IL-10, an anti-inflammatory cytokine, help counteract the detrimental effects of pro-inflammatory cytokines. This shift towards a more anti-inflammatory profile can be beneficial for obese individuals (Adawi, 2017). In a recent systematic review and meta-analysis, the authors found that fasting during Ramadan can significantly reduce body weight, body mass index, and waist circumference in both healthy and overweight/obese individuals. (Sadeghirad et al., 2014). By lowering inflammation and improving metabolic health, Ramadan fasting can significantly reduce the risk of chronic diseases in obese individuals. Conditions such as type 2 diabetes, cardiovascular diseases, and metabolic syndrome are closely linked to obesity and inflammation. Therefore, the anti-inflammatory effects of fasting can help mitigate these risks. The modulation of cytokine levels and the reduction in inflammation also contribute to an enhanced immune response. A balanced immune system is crucial for the body to fend off infections and other diseases. Obese individuals, who often suffer from impaired immune function due to chronic

inflammation, can benefit substantially from the immunomodulatory effects of Ramadan fasting.

Method

The review was conducted through bibliographic searches using several academic databases, including PubMed and ScienceDirect. This study aimed to explore the effects of Ramadan fasting on inflammatory cytokines in obese individuals. Literature searching has been conducted for articles published in English since 2021. The authors used the following MeSH (Medical Subject Headings) search terms and Boolean: Ramadan fasting AND inflammation AND obesity AND cytokine. These search terms were applied in various combinations to ensure comprehensive retrieval of original articles and were not restricted to titles alone but were expanded to include keywords, abstracts, and full texts.

Studies focused on patients with chronic diseases other than obesity were excluded, as the aim was to precisely evaluate the impact of Ramadan fasting on inflammatory cytokines in obese populations. Studies involving fasting practices other than those observed during Ramadan were also excluded. Information gathered from the bibliographic searches, including the title, topic, abstract, geographic location of the study, and key terms, was utilized to assess the relevance of each article.

After an initial screening of articles based on these criteria, the full texts and abstracts of the remaining articles were reviewed in detail. A total of 12 studies met the inclusion criteria and were subsequently included in the final review. These studies were analyzed for their findings on the relationship between Ramadan fasting and inflammatory cytokine levels in obese individuals, focusing on the physiological mechanisms and clinical implications identified by the researchers.

Results and Discussion

We found several studies that examined how fasting during Ramadan affected cytokine-related inflammation in obese patients over five years, as seen in the graphic below.

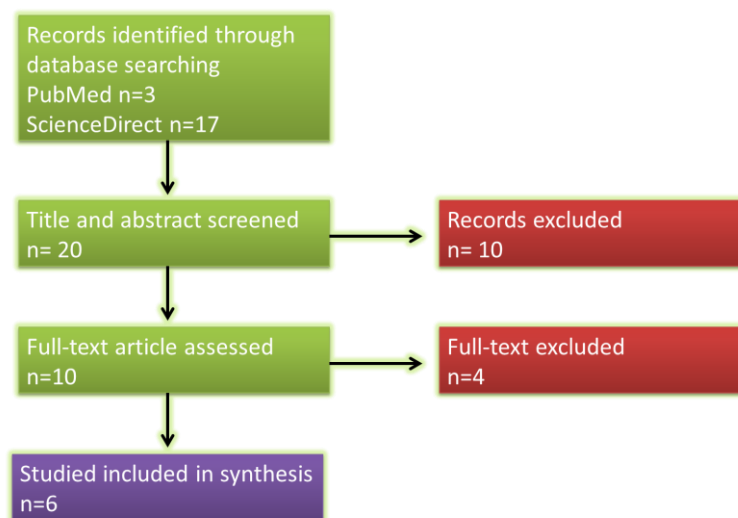


Figure 1. Flowchart of literature searching

The influence of Ramadan fasting on inflammatory cytokines, such as TNF- α , IL-6, and CRP, plays a central role in the pathophysiology of obesity and its comorbidities, including insulin resistance, metabolic syndrome, and cardiovascular diseases, particularly in obese individuals. Ramadan fasting, an intermittent fasting pattern from dawn to sunset, has been shown to induce various metabolic changes, and this literature review aims to synthesize the findings from recent studies on how Ramadan fasting affects inflammatory cytokines, particularly in obese populations.

Several studies have explored the relationship between intermittent fasting during Ramadan and inflammatory markers. Inflammatory cytokines, such as TNF- α , IL-6, and CRP, play a central role in the pathophysiology of obesity and its comorbidities, including insulin resistance, metabolic syndrome, and cardiovascular diseases. Bhatti and Mindikoglu (2022) reviewed the effects of fasting from dawn to sunset on immune system modulation, concluding that Ramadan fasting significantly reduces levels of pro-inflammatory cytokines, including TNF- α and IL-6. A randomized controlled study conducted on 28 male subjects with obesity showed that 14 subjects who fasted from dawn to sunset for one month had a significantly lower plasma IL-6 level on the 15th day of one-month dawn to sunset fasting, the day after the end of one-month dawn to sunset fasting, and 21 days after the end of one-month dawn to sunset fasting compared with the plasma levels before one-month dawn to sunset fasting. In contrast to these findings, there was no significant change in IL-6 levels in control subjects who did not fast. A study of 57 overweight and obese subjects who performed dawn-to-sunset fasting showed a considerable reduction in the serum levels of pro-inflammatory cytokines, including IL-6 and TNF- α , along with a significant increase in the anti-inflammatory cytokine IL-10 and IL-10/IL-6 ratio at the end of 23–30 days of dawn to sunset fasting compared with the baseline values. This study also showed a reduction in insulin-like growth factor-1 (IGF-1) levels at the end of 23–30 days of dawn-to-sunset fasting compared with the baseline values. IGF-1 promotes inflammation in peripheral mononuclear and endothelial cells, and several other studies of dawn-to-sunset fasting reported a reduction of IGF-1 with fasting. This study demonstrated that pro-inflammatory cytokines would decrease even after one or two weeks of dawn-to-sunset fasting in obese subjects.

These findings are supported by other studies that show a reduction in these cytokines during fasting periods. For example, Madkour et al. (2022) found that Ramadan fasting decreased inflammatory markers in obese individuals, specifically noting reductions in CRP, IL-6, and TNF- α , suggesting that fasting could help reduce obesity-associated chronic inflammation. One hundred fourteen subjects (75 males and 39 females, 38.7 ± 11.7 years, body mass index (BMI) of 30.41 ± 5.09 kg/m²) were recruited. Significant reductions were observed in serum Haptoglobin, IL-6, TNF- α , triglycerides (TG), total cholesterol (TC), LDL, BMI, and fat mass (FM). In contrast, a significant elevation was observed in serum CD163, HDL, and IL-10 at the end of the IF month for the whole population. Based on the Hp polymorphism, significant decreases in Hp, BMI, FM, TG, LDL, and TNF- α , with significant increases in HDL and CD163 levels, were observed among subjects with Hp2-2 and Hp2-1 phenotypes. A more pronounced reduction in FM was reported in subjects with Hp2-2 compared to Hp2-1.

The pathophysiology of obesity involves a low-grade, chronic inflammation characterized by elevated levels of pro-inflammatory cytokines. This chronic inflammation

is considered a major contributor to insulin resistance, type 2 diabetes, and cardiovascular diseases. Twenty obese men, age: 31.8 ± 7.05 years, BMI: $33.1 \pm 4.2 \text{ kg m}^{-2}$, performing regular Ramadan fasting, were randomized into two groups: combination training ($n = 10$) and without training ($n = 10$). The combination training group participated in a High-intensity interval training (HIIT) program combined with resistance exercises for 4 weeks. Body composition, blood glucose, lipid profile, liver biomarkers, and inflammation were assessed before and after 4 weeks. Both groups showed a significant decrease in weight, fat mass (FM), fat percentage (Fat%), and waist circumference (WC) and an improvement in blood glucose, lipid profile, and inflammation (i.e., CRP ($p < 0.05$)). The results suggest that combining Ramadan fasting and training induces more significant changes in body composition, lipid profile, inflammation, and liver biomarkers (Maaloul et al., 2023). By reducing these cytokines, Ramadan fasting may ameliorate some of the adverse health effects of obesity. In a study by Madkour et al. (2023), the authors observed that Ramadan fasting was associated with significant changes in plasma metabolomics, including the reduction of inflammatory markers in individuals with obesity. This study investigated the lipidomic alterations related to 29–30 days of Ramadan diurnal intermittent fasting (RIF) in metabolically healthy overweight and obese subjects. A prospective cohort of 57 overweight and obese adults with an age range of 18–58 years was observed prior to and after Ramadan. Anthropometric, biochemical (lipid profile, glycemic, and inflammatory markers), and dietary intake measurements were taken at both time points. RIF was associated with improved levels of lipid profile compartments and inflammatory markers. This study demonstrates that RIF is related to improvements in plasma sphingosine, sphinganine sphingomyelin, and dihydro sphingomyelin lipid species, as well as improved lipid profile and inflammatory markers, which may confer short-term protection against cardiometabolic problems in patients with overweight/obesity. It suggests that fasting may act as an anti-inflammatory intervention, particularly in overweight and obese populations.

Similarly, research by Ghashang et al. (2021) demonstrated that fasting during Ramadan significantly reduced serum IL-6 levels in healthy young men, highlighting the potential for fasting to reduce inflammation in diverse populations. Fifty healthy adult males were recruited and divided into two equal groups: the fasting group (FG) and the non-fasting group (NFG). FG was evaluated at T1: one week before, T2: mid-, T3: last days of, and T4: one week after Ramadan. The NFG were assessed only at T1 and T3. In FG, significant alterations of IL-1 β were observed. Insignificant differences concerning the measured cytokines were found between the FG and NFG at T1 and T3. Circulating IL-1 β increased significantly from T2 to T4 and from T3 to T4. At T3, TNF- α was correlated significantly with anthropometric parameters such as the body weight, the skeletal muscle mass, and the fat-free mass, whilst IL-12 was correlated significantly with the skeletal muscle mass, the fat-free mass, and the body water mass at T4. Significant Alterations of IL-1 β during RF in FG were observed. Anthropometric parameters correlate with TNF- α and IL-12 levels during T3 and T4, respectively. These findings are consistent with other studies that suggest a systemic reduction in pro-inflammatory cytokines such as IL-6, TNF- α , and CRP, which are often elevated in obese individuals. The study aimed to investigate the influence of intermittent fasting on serum IgA, salivary IgA (sIgA), interleukin (IL)-17, and IL-22 levels. Forty healthy men aged 19–29 years were evaluated before and during the fourth week of Ramadan fasting for IgA levels by the nephelometric method as well as salivary

IgA (sIgA), IL-17, and IL-22 amounts using enzyme-linked immunosorbent assay (ELISA). Serum IgA levels reduced significantly at the end of Ramadan fasting (225.8 ± 87 vs. 196 ± 70 mg/dl) (p-value < 0.001); however, sIgA amounts did not differ between before and the last week of Ramadan. Serum IL-17 reduced significantly (2.93 ± 1.51 vs. 2.17 ± 1.33 pg/ml) (p-value = 0.006), whereas IL-22 levels remained approximately unchanged. Four weeks of intermittent fasting during Ramadan reduced the serum levels of IgA and IL-17 but did not affect the production of sIgA and IL-22. These findings indicate a limited impact of intermittent fasting on mucosal immunity (Soleimanifar et al., 2023).

The mechanisms underlying the anti-inflammatory effects of Ramadan fasting are multifaceted and not yet fully understood. However, some key pathways have been proposed. Crespo et al. (2025) suggested that circadian disruption, resulting from intermittent fasting, might regulate metabolic and immune responses. By synchronizing eating and fasting windows, Ramadan fasting may help restore circadian rhythms, improving metabolic control and reducing inflammation. Furthermore, the study by Mindikoglu et al. (2022) on peripheral blood mononuclear cells showed that fasting induces an anti-inflammatory and anti-atherosclerotic proteome, suggesting that the immune system becomes less responsive to inflammatory stimuli during fasting periods.

Additionally, studies have highlighted autophagy's role in fasting's anti-inflammatory effects. Malhab et al. (2025) found that intermittent fasting during Ramadan was associated with the overexpression of autophagy genes in obese individuals, possibly contributing to reducing inflammation. Autophagy, a cellular process that degrades and recycles cellular components, has been linked to reduced inflammation and improved immune function (Madkour et al., 2023). It suggests fasting may enhance autophagic processes, which could help modulate the inflammatory responses in obese individuals.

Fasting has also been shown to influence the immune system in other ways. Studies on type 2 diabetes patients, such as those conducted by Sydor et al. (2024), demonstrated that religious intermittent fasting improved metabolic markers and liver health while reducing inflammation. It suggests that through its impact on immune cell function, Ramadan fasting may have broader applications for inflammatory diseases beyond obesity. Moreover, the study by Soleimanifar et al. (2023) on serum IgA and cytokines during Ramadan fasting showed that levels of IL-17 and IL-22, which are involved in inflammatory and immune responses, were significantly altered. This indicates that fasting during Ramadan affects systemic inflammation and modulates immune responses that could be beneficial in chronic inflammatory diseases like obesity.

The available evidence from various studies strongly suggests that fasting during Ramadan has a beneficial effect on inflammatory cytokines in obese individuals. By reducing pro-inflammatory markers such as TNF- α , IL-6, and CRP, Ramadan fasting may help mitigate the chronic low-grade inflammation associated with obesity and its comorbidities. The mechanisms behind these effects may involve the regulation of circadian rhythms, modulation of autophagy, and alterations in immune cell function. Although more research is needed to understand the long-term effects and the precise pathways involved fully, current studies provide a promising foundation for using Ramadan fasting as a therapeutic tool to improve inflammation and metabolic health in obese populations.

Conclusion

The literature consistently supports the hypothesis that Ramadan fasting has a beneficial effect on inflammatory cytokines in obese individuals. By reducing pro-inflammatory cytokines such as TNF- α and IL-6, Ramadan fasting may mitigate the chronic inflammation associated with obesity and reduce the risk of related comorbidities. The underlying mechanisms of these effects may involve immune system modulation, circadian rhythm regulation, and alterations in lipid metabolism. Although more research is needed to fully understand the long-term impacts, current evidence suggests fasting during Ramadan may be an effective strategy for improving inflammatory profiles and overall metabolic health in obese populations.

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