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Original Article

Metabolism and diabetes in Ramadan fasting: Exploring health trends and relationships through systematic literature network analysis

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Abstract

Ramadan fasting is widely acknowledged for its positive impacts on health, yet it also presents inherent risks, prompting a need for comprehensive exploration into its metabolic implications and its effects on diabetes. This study introduces a novel methodology called systematic literature network analysis (SLNA), which merges bibliometric analysis with systematic literature review (SLR). The aim of this study was to examine the global research landscape concerning Ramadan fasting, metabolism, and diabetes. Through the systematic search strategy, 206 relevant documents were analyzed. Through co-occurrence analysis mapping, the study uncovered four distinct cluster groups, revealing intricate relationships and evolving trends within the field. Moreover, the trajectory of research publications on Ramadan fasting from 2001 to 2023 was tracked, highlighting a growing interest in this domain. The bibliometric analysis emphasized a consensus regarding the beneficial effects of Ramadan fasting on individual health, particularly in improving lipid profiles, managing body weight, regulating glucose levels, and nutrient intake. However, significant variations in research focus were observed across predominantly Muslim countries, with notable exceptions like Indonesia and Brunei Darussalam absent among the top contributors. Furthermore, the analysis shed light on the balanced selection of research subjects by authors, indicating a nuanced approach to exploring the multifaceted aspects of Ramadan fasting, metabolism, and diabetes. These findings offer significant perspectives for researchers aiming to contextualize their studies within the wider conversation on this subject, thereby aiding in a more profound comprehension of the intricate relationship between fasting, metabolic functions, and the management of diabetes.

Keywords: Ramadan fasting, lipid profile, diabetes, SLNA, bibliometric analysis

Introduction

Ramadan fasting has beneficial health effects but also presents risks on the other hand. This fasting activity is a mandatory practice for every adult Muslim, lasting 29–30 days and taking place in month 9 of the Islamic calendar. In healthy conditions, an individual can maintain the balance of energy availability in the body. During fasting, metabolic compensation occurs to maintain sufficient energy levels. This involves the metabolism of fats and carbohydrates, such as glucose. This action will impact the lipid profile and result in weight loss. Individuals with normal organ function who fast will experience an improvement in lipid profiles and body mass index

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(BMI) reduction [1]. Risks arise when those fasting are diabetic patients [2-5] with high threats of hypoglycemia and ketoacidosis [6]. This raises an important question about how fasting can be utilized for health while minimizing its potential risks [4].

Previous studies, while numerous, have typically focused on Ramadan fasting at the meta-analysis and systematic literature review (SLR) levels, yet these findings are often too specific [7,8]. Studies using the meta-analysis and SLR only approach are not sufficient. These two types of studies have limitations [9] because they are unable to fully demonstrate the global quantitative and qualitative relationship between the studies. Meta-analysis tends to have a high level of data selectivity and sometimes even emphasizes the selection of a single type of study [10]. Moreover, the research trends are unable to be identified if using meta-analysis. This means there are limitations that need to be covered by another methodological approach. In this context, the significance of bibliometric analysis is highly important, offering researchers a crucial panoramic view of the landscape for precise positioning of their research within the broader discourse.

Bibliometric analyses on Ramadan fasting, as explored by scholars such as Karasneh *et al.* [11], Husain *et al.* [12], Dehghanbanadaki *et al.* [13], Obaideen *et al.* [14], Nouira *et al.* [15], Beshyah *et al.* [16], and AbuShihab *et al.* [17], have been conducted. Nonetheless, these investigations lack an intricate examination concerning the interplay of Ramadan fasting, metabolism, and diabetes. Furthermore, the systematic literature network analysis (SLNA) methodology introduced by Collicia *et al.* [18], presents a promising approach for a more comprehensive assessment due to its integration of visualization methodologies and thorough literature scrutiny. The novelty of this study lies in its application of the SLNA framework to explore the intricate relationships between Ramadan fasting, metabolism, and diabetes. Previous studies [11-17], have primarily focused on bibliometric analysis without delving deeply into the metabolic implications and diabetic outcomes associated with Ramadan fasting. By utilizing the SLNA approach, this study might provide a comprehensive visualization and detailed scrutiny of the global research landscape, identifying gaps and emerging trends that were previously overlooked. The aim of this study was to comprehensively scrutinize the global research landscape concerning Ramadan fasting, metabolism, and diabetes utilizing the SLNA framework.

Methods

Search strategy and database

This study employed the SLNA approach, integrating bibliometric network analysis and SLR method [18]. The literature search was conducted in the Scopus database as of February 28, 2024, covering the years 2001–2023. The Scopus database was selected because it represents quality articles suitable for bibliometric analysis [19,20]. To optimize the search, a search string was constructed combined with Boolean operators. Some keywords used are also representative of previous studies but with a meta-analysis approach [21]. Therefore, the use of some keywords from previous studies [7,8,21-23] with a bibliometric approach also serves as a consistency test of previous research findings. In this study, a co-occurrence unit analysis was used to view qualitative and quantitative relationships between topics. Additionally, an analysis of the number of publication growths (documents) and study trends was conducted. The SLNA analysis approach began with bibliometric mapping using VOSviewer software and then continued with an SLR. In the bibliometric analysis, the study focused on the visual patterns of keyword relationships. Once these relationships were identified, the study progressed to a detailed analysis through an SLR, which involved thoroughly examining the findings of each relevant reference.

Search string

The search strategy employing a combination of titles, keywords, and abstracts in the Scopus database was set. This approach ensured comprehensive coverage and precision in retrieving relevant literature. By integrating these elements, the search string was designed to capture the most prominent studies, facilitating a thorough exploration of the topics. This method was crucial for identifying the existing research and for pinpointing specific areas of interest that this study aimed to address. The following search string was used: ("Ramadan fasting" OR "Islamic fasting" OR "fasting during Ramadan" OR "religious fasting") AND ("body weight" OR "body mass index"

OR "BMI" OR "lipid profiles" OR "blood lipids" OR "cholesterol levels" OR "triglycerides" OR "glucose levels" OR "fasting glucose" OR "blood glucose" OR "glycemic control") AND ("observational study" OR "clinical trial" OR "cohort study" OR "cross-sectional study" OR "longitudinal study").

Eligibility criteria

All original research articles, clinical trials, observational studies, cohort studies, cross-sectional studies, and longitudinal studies published between 2001 and 2023 were considered eligible. Studies were included if they investigated aspects such as body weight, BMI, lipid profiles, blood lipids, cholesterol levels, triglycerides, glucose levels, fasting glucose, blood glucose, or glycemic control. Exclusion criteria comprised non-article publications (such as conference papers, book chapters, abstracts without full texts, and documents without author keywords) and studies not published in English. This rigorous selection process ensured that the included studies were relevant, comprehensive, and of high quality.

Data collection process

The data collection process involved a comprehensive search of the Scopus database, using a predefined search strategy to identify relevant studies on metabolism and diabetes during Ramadan fasting. After the records were identified from the database, a thorough screening process was conducted, followed by an assessment of eligibility. Those eligible articles were then extracted and analyzed. The extraction process focused on capturing key variables such as study design, sample size, intervention details, outcomes measured, and results. This methodical approach ensured the accuracy and consistency of the data collected for the review.

The search, tabulation, and selection of references used in this study adapted from the principles of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram [24]. While the use of the PRISMA checklist is not obligatory for bibliometric studies, here we adapted the PRISMA guideline from its traditional application in SLRs to suit the bibliometric analysis component of the study. This adaptation aimed at providing a structured and transparent reporting framework that aligned with the rigorous standards expected in systematic reviews while also accommodating the unique aspects of bibliometric analysis. By incorporating an adapted version of the PRISMA checklist, we aimed to ensure that the study was both methodologically sound and easy to be interpreted by other researchers, thereby facilitating a better understanding of the research landscape around Ramadan fasting, metabolism, and diabetes. This guideline was used to ensure that the data met eligible criteria and to guarantee the transparency of a good literature study process.

Research questions

This study narrowed its scope to concentrate primarily on reviewing findings, leading to the formulation of specific research questions. These questions were designed to guide a targeted exploration of the key issues and trends within the chosen field, ensuring that the analysis was both comprehensive and relevant. This focused approach allowed for a deeper understanding of the subject matter, providing clear insights that were directly applicable to the broader context of the research. The formulated research questions of the present study are: (1) what is the relationship between Ramadan fasting and diabetes management; (2) what is the relationship between Ramadan, lipid profiles and cardiovascular health; (3) what is the relationship between Ramadan fasting and body weight management; (4) how does Ramadan fasting compare to other forms of intermittent fasting in terms of trends and relationships with various health and metabolic outcomes; and (5) what is the relationship between nutrient intake during fasting and health outcomes.

Results

Study selection

Using the Scopus database, we identified 239 records on the topic of Ramadan fasting and human health through specific search strings spanning from 2001 to 2023. Following a thorough screening process, 33 records were excluded due to being non-article types, lacking abstracts or

author keywords, or not being in English, resulting in 206 records being deemed suitable for inclusion. These 206 records were systematically analyzed for a comprehensive bibliometric analysis, highlighting trends, gaps, and key contributors within the research landscape of Ramadan fasting and its impact on human health. The final selection comprised 206 references eligible for SLNA analysis **Figure 1**.

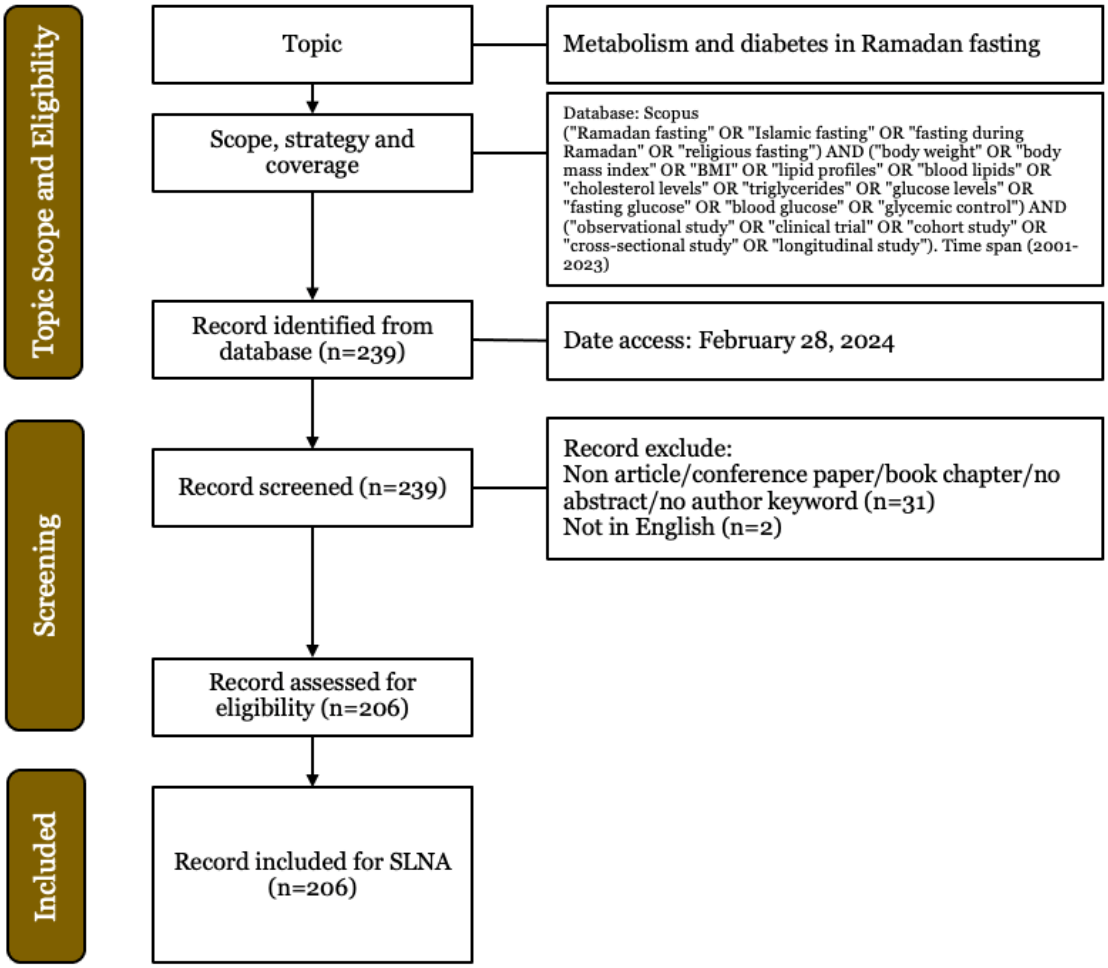

Figure 1. PRISMA flow diagram in Ramadan fasting studies.

Global publication growth

Globally, researchers are giving strong attention to the study of Ramadan fasting, as seen from the growth in publications (**Figure 2**). Based on the analysis of publication distribution per year, from early 2001–2014, the number of publications per year was still <10. A significant increase occurred in the period 2015–2023. Although there was some fluctuation in 2023, the projection indicated a continuing upward trend. This projection of numbers is expected to keep rising because the R-squared (R^2) value had a very promising result at 0.9044 (**Figure 2**).

The disparities in research or publication among Muslim countries are presented in **Figure 3**. The United Arab Emirates leads with the highest number of publications, followed closely by Saudi Arabia and the United Kingdom. Other countries like Pakistan, Turkey, and Egypt also contribute significantly, but there is a notable drop in the number of documents from countries like Iran and Kuwait. This distribution indicates a varied level of research focus and resources allocated to studying health-related aspects of Ramadan fasting, underscoring the need for more balanced and extensive research efforts across different regions.

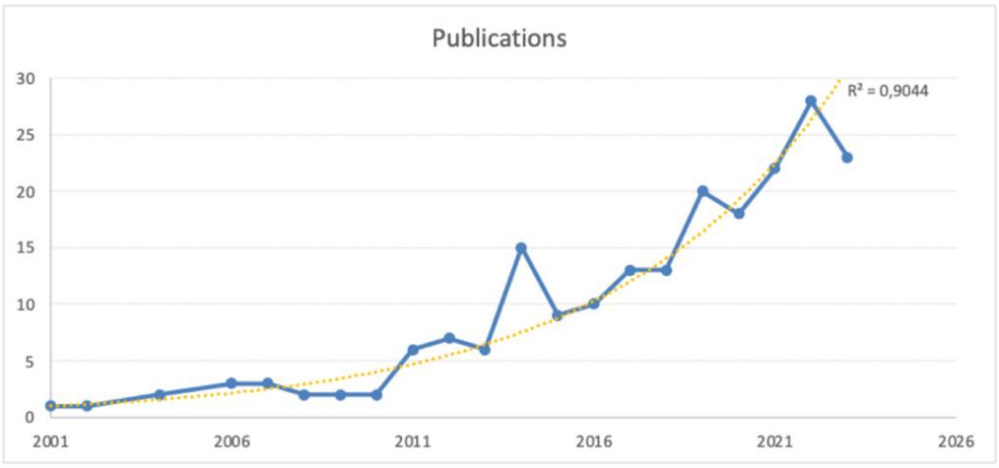

Figure 2. Growth in the number of publications on metabolism and diabetes in the context of Ramadan fasting over time, illustrating a consistent increase with an exponential growth pattern in recent years.

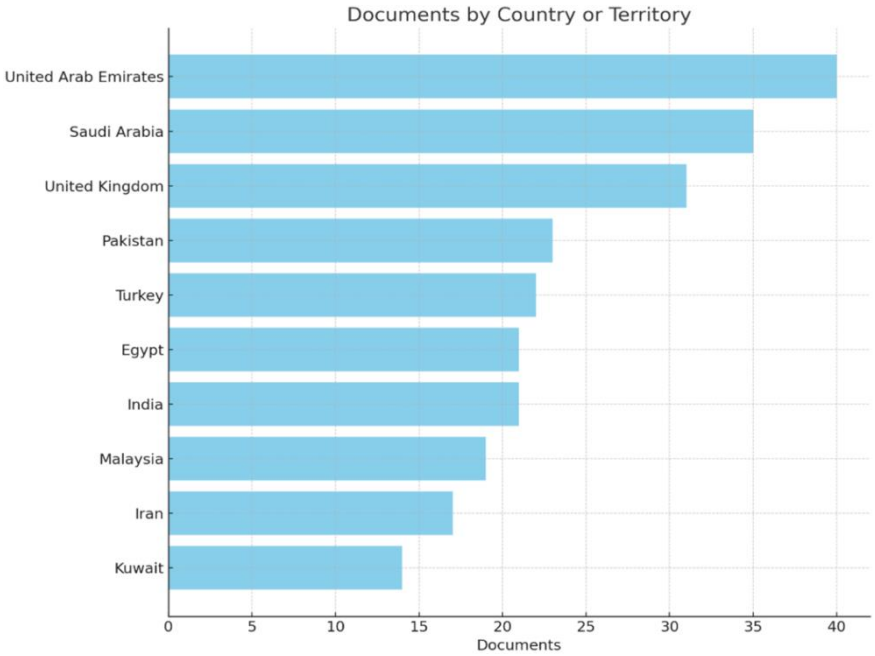

Figure 3. Number of publications on metabolism and diabetes in the context of Ramadan fasting by country.

Global landscape Ramadan fasting research trends

The network visualization illustrates the interconnections and research focus areas related to Ramadan fasting from 2014 to 2022 is presented in **Figure 4**. Central to the network are key terms such as "Ramadan fasting," "fasting," "type 2 diabetes," and "hypoglycemia," indicating these as primary research topics. The map shows strong links between Ramadan fasting and various health-related keywords, including "lipid profile," "body weight," "insulin resistance," and "glycemic control." Other significant connections are observed with "type 1 diabetes," "pregnancy," and "obesity." This visualization underscores the breadth and evolution of research on Ramadan fasting, highlighting the increasing attention to metabolic health, diabetes management, and broader health outcomes associated with fasting practices. In the global landscape trend, it is evident that emerging topics are those that have appeared after the year 2020. These trending topics include obesity, quality of life, blood lipids, time-restricted feeding, sleeping patterns, religious fasting, inflammatory cytokines, and empagliflozin.

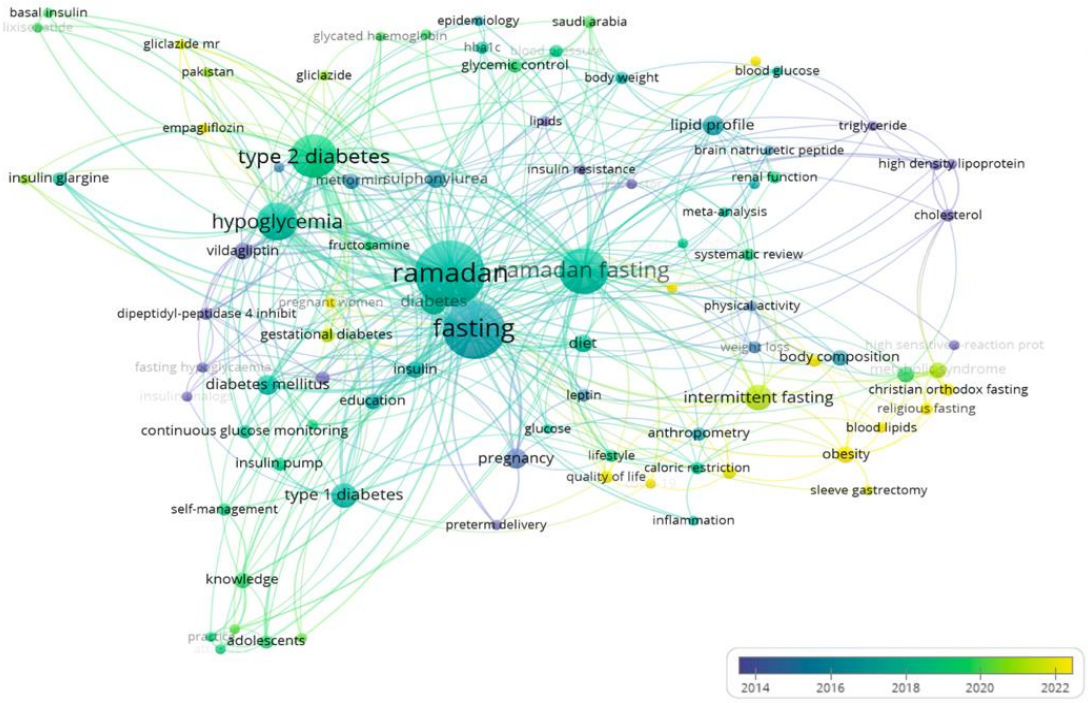

Figure 4. Global landscape of Ramadan fasting research trends. The color gradient represents the timeline of research, with newer topics like intermittent fasting and body composition emerging in recent years.

Clustering global landscape in Ramadan fasting

Literature analysis indicated a significant correlation between Ramadan fasting (yellow color cluster) and diabetes management (**Figure 5**). Our data suggested the need for careful monitoring and insulin therapy adjustment during the fasting month to prevent hypoglycemia (blue color cluster) (**Figure 5**). The urgency of this issue was reflected in a study conducted on 360 participants in Saudi Arabia, which outlined the high hypoglycemic risks for diabetic patients during fasting [6]. Other studies emphasized the importance of patient education on blood sugar management and medication dosing adjustments [25,26]. Fasting offers an opportunity to review diabetes treatment plans and the effectiveness of nutritional interventions on glycemic control. The detailed trends and relationships of each topic member with the main topic are presented in the cluster visualization, which provides an overview of the study spectrum, as illustrated in **Figure 5**.

Clustering relationships, emerging topics, and citations in Ramadan fasting

We then created a map for each cluster or topic under review. The relationships between clusters, trend topics at the cluster level, and emerging topics are presented in **Figure 6** to **Figure 10**. This sub-visual analysis provides important and in-depth information as it shows detailed studies on aspects of relationships, emerging topics, citations, and trends.

The relationships between clusters, trend topics at the cluster level, and emerging topics between Ramadan fasting and diabetes management are presented in **Figure 6**. The variation and spectrum of studies can be seen from the number and distance between nodes in the clusters. Within the study of topics on Ramadan fasting and type 2 diabetes, there was a relationship between the Ramadan fasting (yellow), fasting (red), and the type 2 diabetes (blue) (**Figure 6**). It is evident that the relationship in this study is closely linked to lipid profile and blood sugar parameters. The intersection of studies occurred in the type 2 diabetes cluster and the fasting cluster, indicating a strong relationship between the study topics. For example, when studying diabetes, the aspect of insulin also needs to be explained (**Figure 6A**). The overlay visualization showed that the latest topics were on pregnant women, empagliflozin, and gliclazide modified release (MR) (**Figure 6B**). Meanwhile, the visualization based on the citation levels of publications showed the highest citations for topics on body weight, epidemiology, gliclazide, and dipeptidyl peptidase (**Figure 6C**).

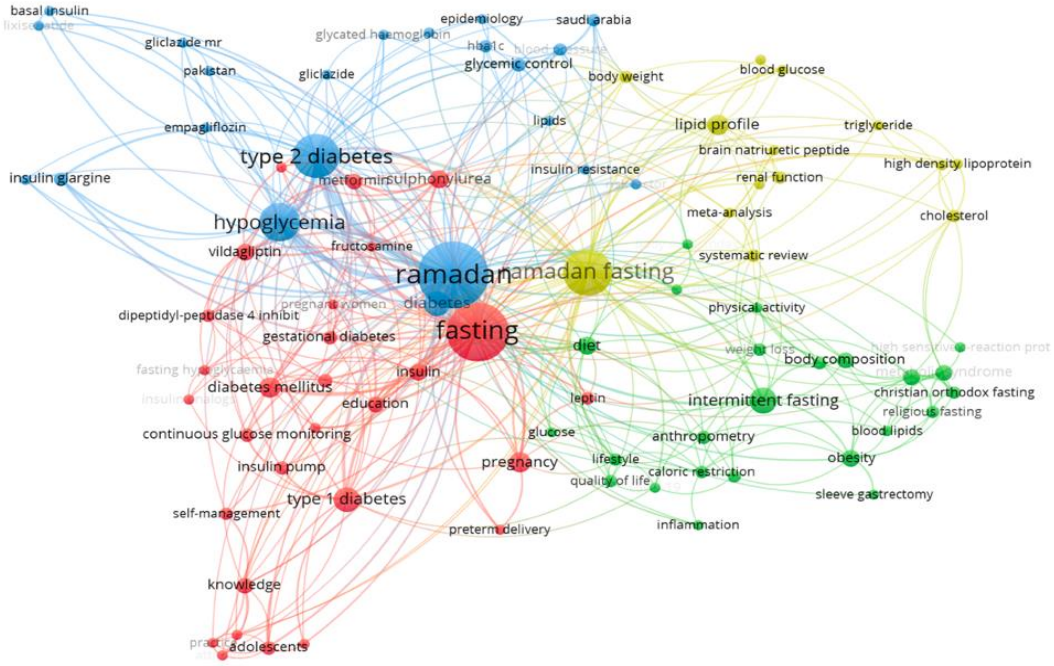

Figure 5. Global landscape co-occurrence analysis-based study relationship based on cluster which showing type 2 diabetes position (blue color).

The relationships between clusters, trend topics at the cluster level, and emerging topics between Ramadan fasting and lipid profile are presented in **Figure 7**. The mapping revealed a strong conceptual relationship between the lipid profile cluster (yellow), fasting cluster (red) and the type 2 diabetes cluster (blue) (**Figure 7**). In this mapping, it is evident that the analysis of lipid profiles is closely related to the management of diabetes, particularly type 2 diabetes. In **Figure 7**, the lipid profile is strongly related to the blue cluster and slightly to the red cluster (A). The overlay visualization showed that blood glucose was an emerging topic (**Figure 7B**), which is a concern in recent research. The highest citations were found in studies on body weight, blood glucose, and triglycerides (**Figure 7C**). This indicates that the aspect of lipid profile will develop through studies with the highest citations.

The relationships between clusters, trend topics at the cluster level, and emerging topics between Ramadan fasting and body weight are presented in **Figure 8**. The body weight cluster (yellow) has a strong relationship with diabetes (blue) and some relationships with the fasting (red) (**Figure 8A**). This clearly shows that body weight is significantly influenced by lipid profiles and blood sugar levels. In calorie management, there is a potential risk of hypoglycemia. The overlay visualization did not yet show any emerging topic (**Figure 8B**). The topics with the highest citations were related to triglycerides, body weight, and blood glucose (**Figure 8C**). Visualization indicated that the relationships between glycemic control, Saudi Arabia, and blood pressure studies were close. These citations indicate the potential development of body weight studies from the aspects of lipid profile and blood sugar.

The relationships between clusters, trend topics at the cluster level, and emerging topics between Ramadan fasting and intermittent are presented in **Figure 9**. The topic of obesity remains an interesting study from 2022 onwards, followed by studies on quality of life, blood lipids, religious fasting, and pregnant women (**Figure 9**). The data showed the relationship between intermittent fasting clusters (green) and Ramadan fasting (yellow) and diabetes management (blue) clusters (**Figure 9A**). The overlay visualization showed the latest topics, including body composition, blood lipids, obesity, caloric intake, quality of life, and COVID-19 (**Figure 9B**). It is indeed an integral part and a tendency for obese individuals to fast in order to control their weight. The highest citations were on the topics of caloric restriction and blood lipids (**Figure 9C**). The presence of these trending topics shows substantial accommodation in the strategic studies of Ramadan fasting.

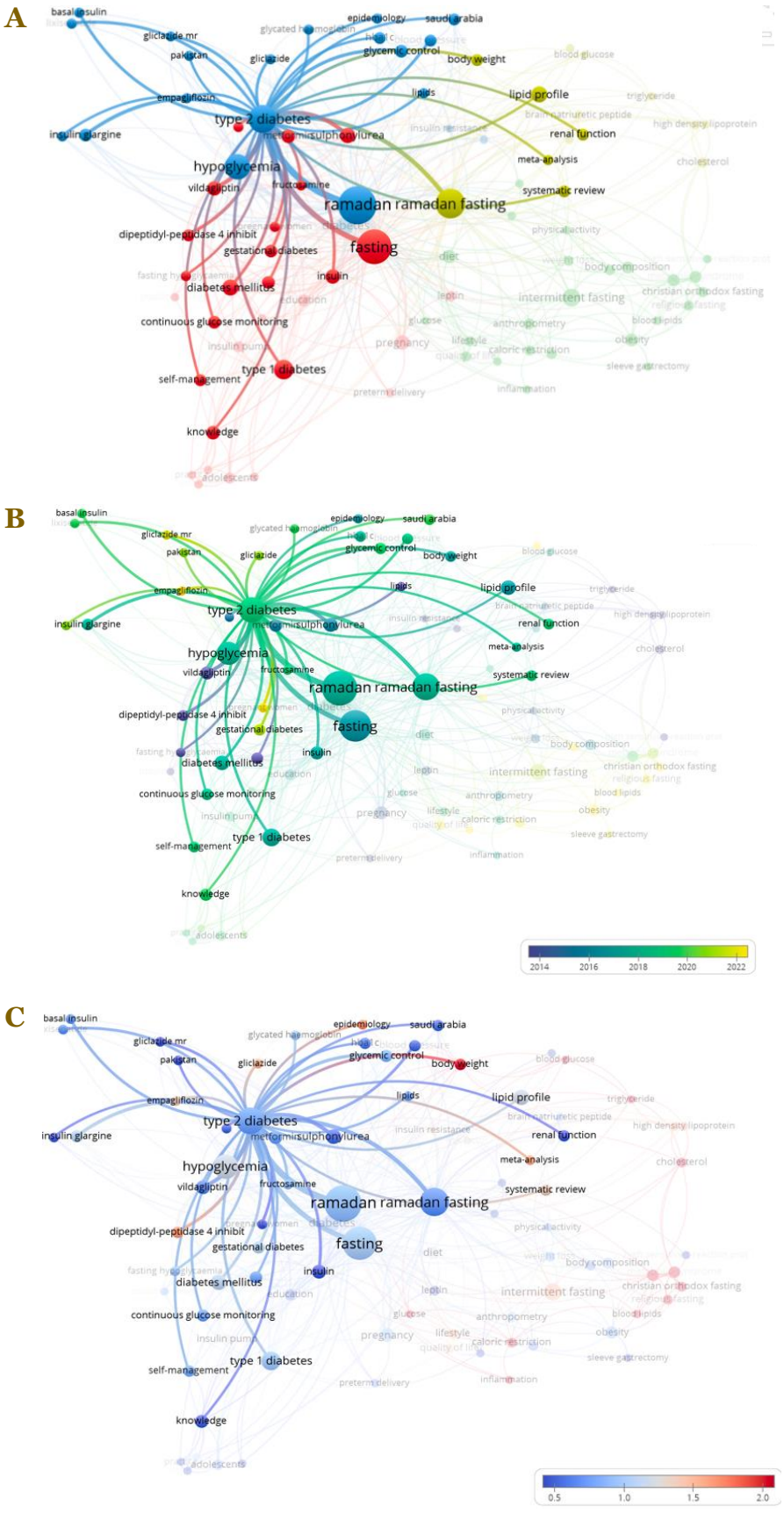

Figure 6. Relationships, trends, and emerging topics in type 2 diabetes management. Inter-topic relationships between the type 2 diabetes management luster and with other clusters (A); trends in the topics of Ramadan fasting and type 2 diabetes management studies (B); citation levels in studies on Ramadan fasting and type 2 diabetes management (C).

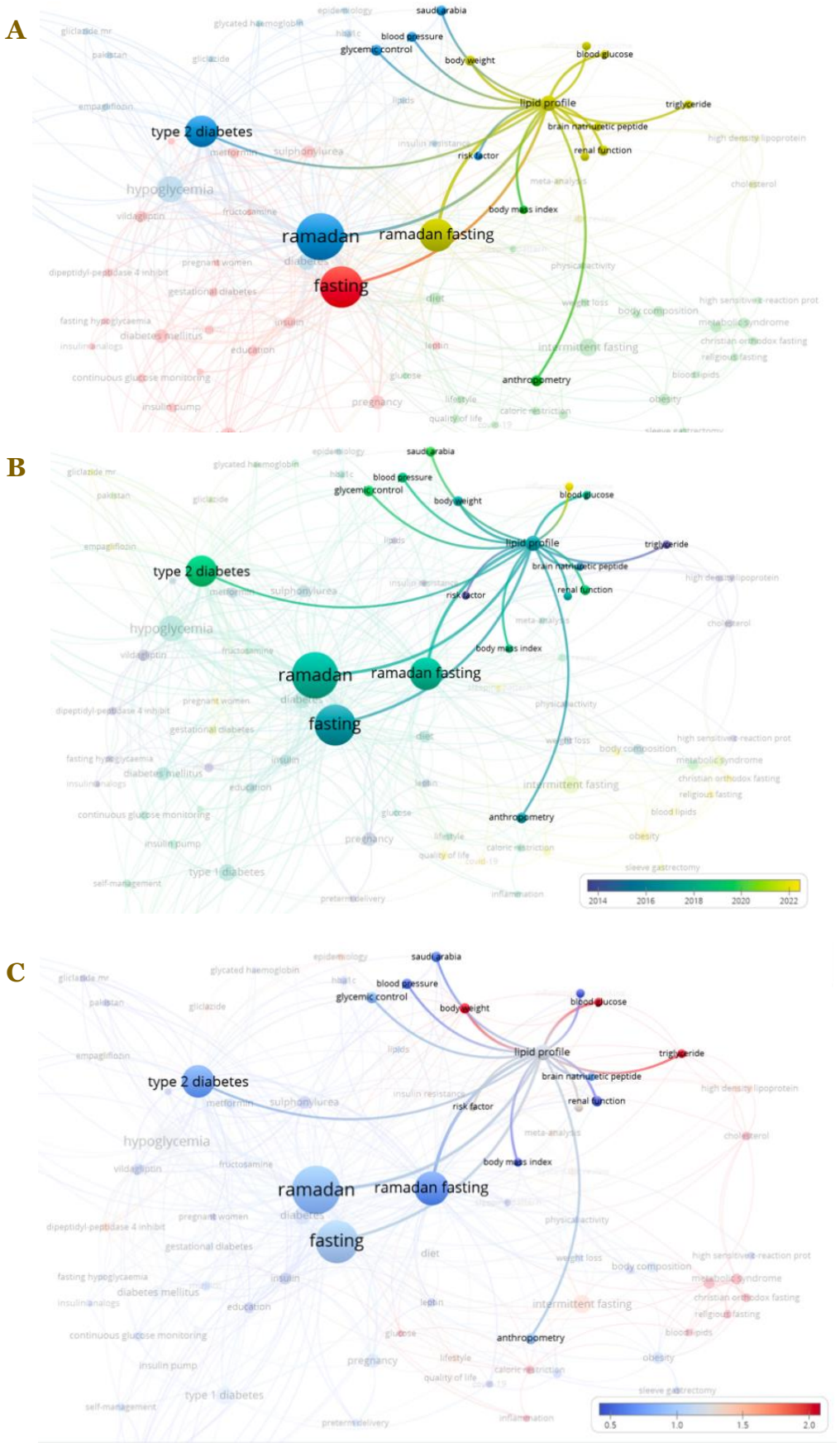

Figure 7. Relationships, trends, and emerging topics in lipid profile. Inter-topic relationships within the lipid profile cluster and with other clusters (A); trends in the topics of Ramadan fasting and lipid profile studies (B); citation levels in studies on Ramadan fasting and lipid profile (C).

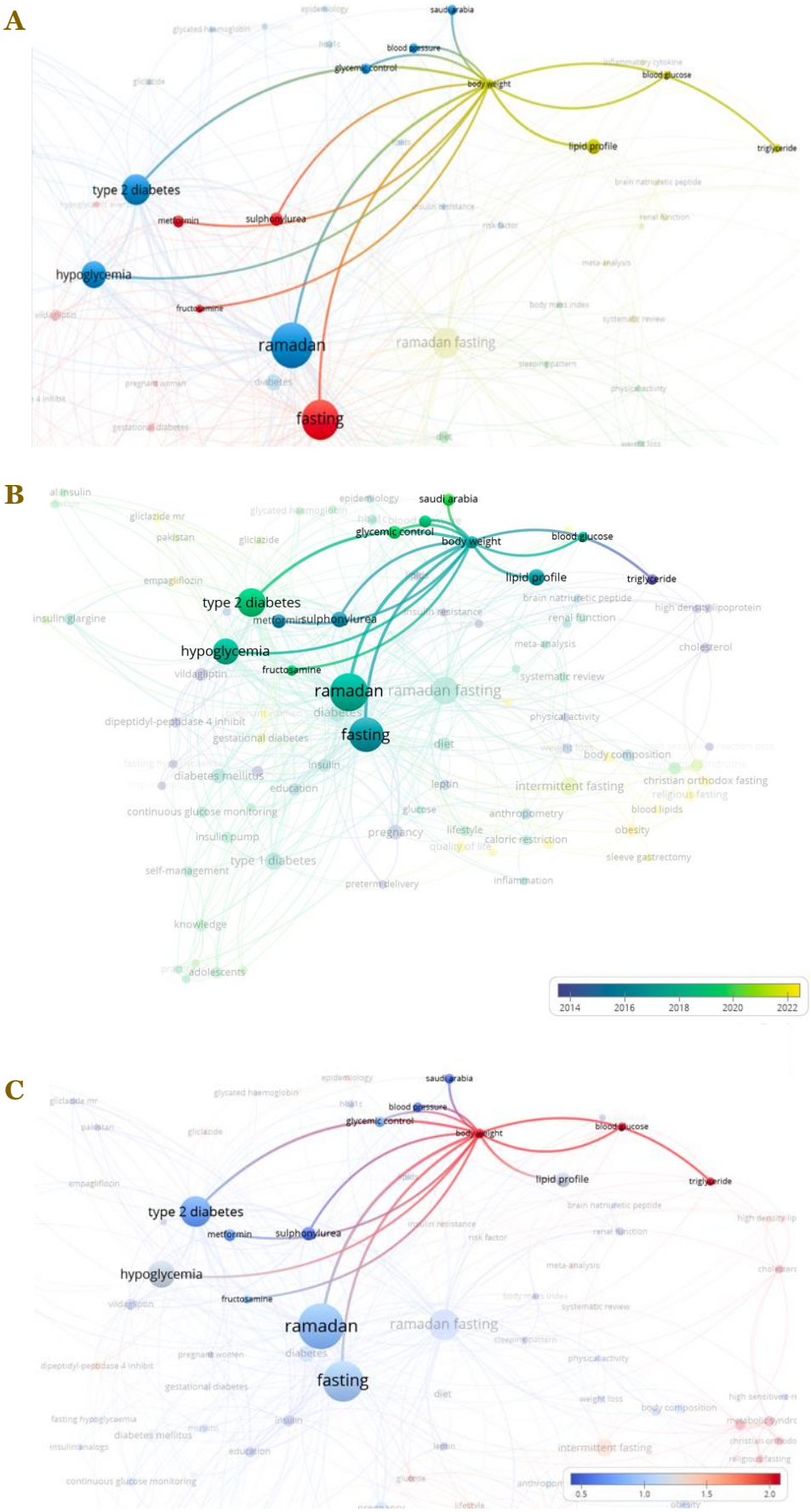

Figure 8. Relationships, trends, and emerging topics in body weight. Inter-topic relationships within the body weight cluster and with other clusters (A); trends in the topics of Ramadan fasting and body weight studies (B); citation levels in studies on Ramadan fasting and body weight(C).

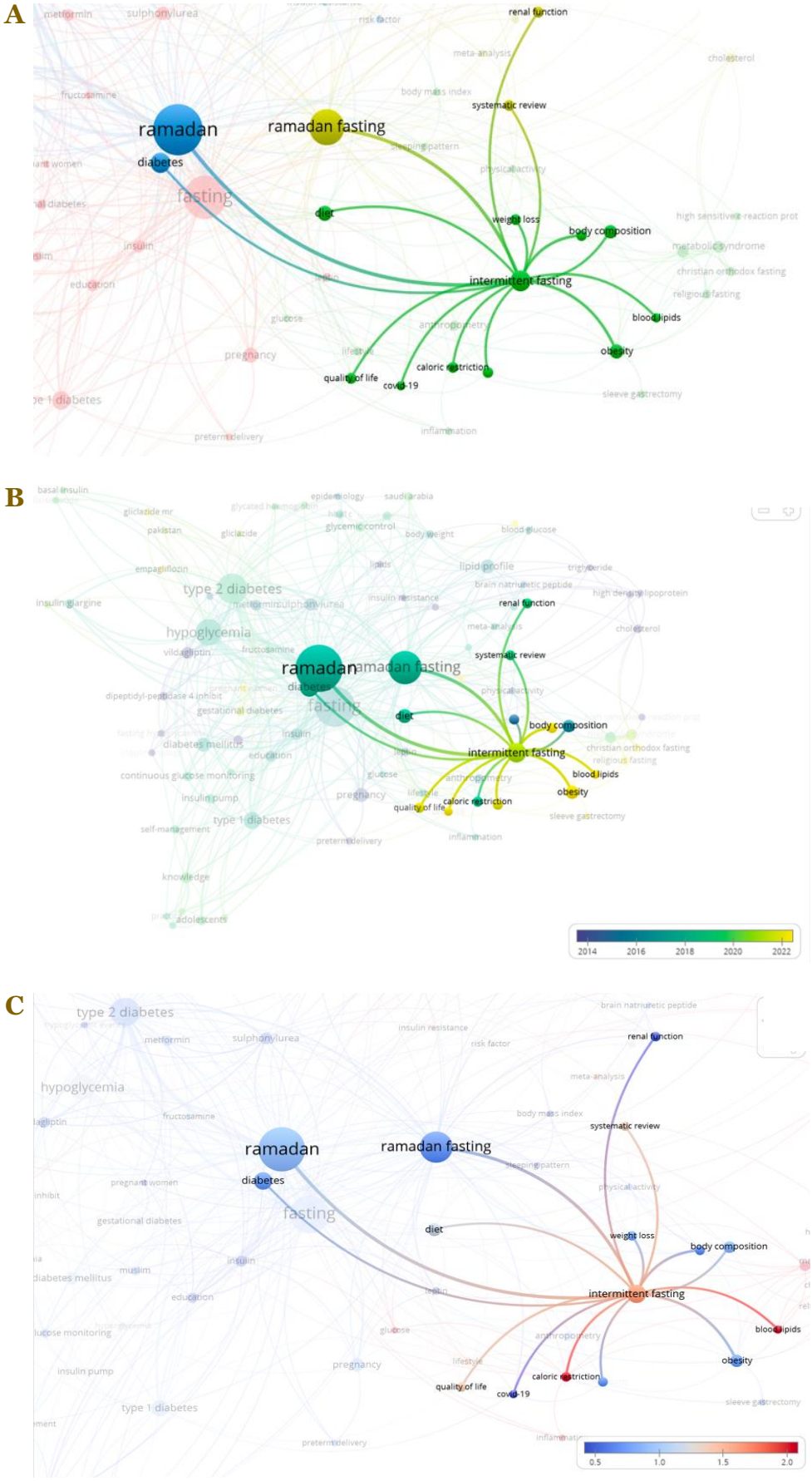

Figure 9. Relationships, trends, and emerging topics in intermittent fasting. Inter-topic relationships within the intermittent fasting cluster and with other clusters (A); trends in the topics of Ramadan fasting and intermittent fasting studies (B); citation levels in studies on Ramadan fasting and intermittent fasting (C).

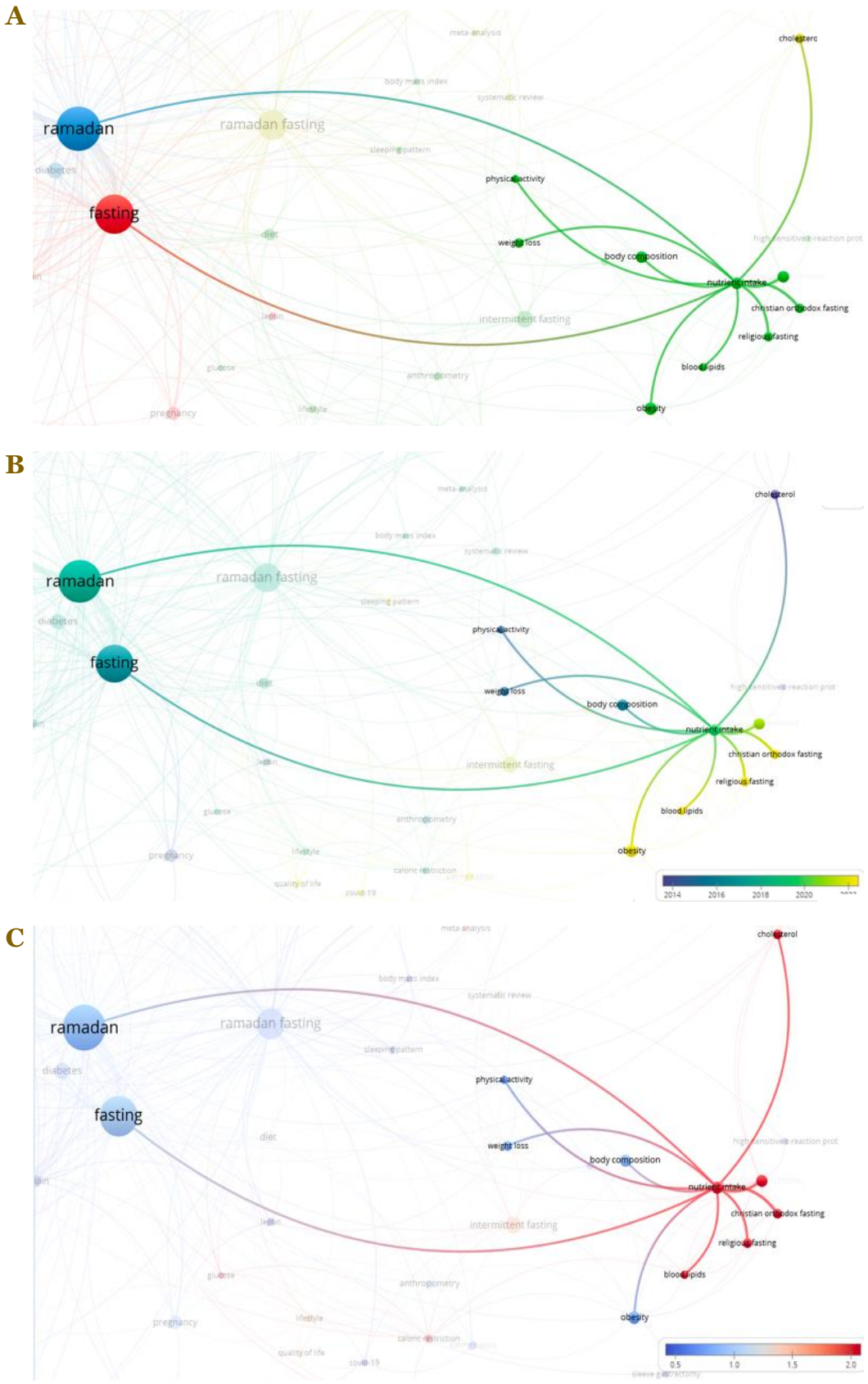

Figure 10. Relationships, trends, and emerging topics in nutrient intake. Inter-topic relationships within the nutrient intake cluster and with other clusters (A); trends in the topics of Ramadan fasting and nutrient intake studies (B); citation levels in studies on Ramadan fasting and nutrient intake (C).

The relationships between clusters, trend topics at the cluster level, and emerging topics between nutrient intake during fasting and health outcomes are presented in **Figure 10**. The nutrient intake cluster (red) had a relationship with Ramadan (blue) and fasting (red), though the relationship distance was quite far (**Figure 10A**). It is evident that the aspect of nutritional intake is a concentrated area of study that is strongly related to religious fasting and metabolic syndrome. The emerging topics include obesity, blood lipids, religious fasting, and Christian Orthodox fasting (**Figure 10B**). The topics with the highest citations were cholesterol, nutrient intake, religious fasting, blood lipids, and Christian Orthodox fasting (**Figure 10C**). In the map, there are many potential topics for researchers marked with yellow and small node sizes. This potential is also reinforced by the high citation rates spread across several concentrated topics.

Discussion

There are actually a large number of publications of Ramadan fasting if carried out in all fields of science, such as economic, social, and maybe historical. However, in this study, limitations were carried out, namely analyzing fasting studies only in the health sector. This difference is also apparent when comparing the number of documents found in this study with those in previous studies. In earlier studies by Dehghanbanadaki *et al.* [13], Karasneh *et al.* [11], and Obaideen *et al.* [27], the number of documents analyzed was larger because the selection filters were not as strict, allowing review type documents to be included. Additionally, the search string keywords used were more general. This focused approach was deliberately chosen to delve deeper into the specific impacts of Ramadan fasting on health-related outcomes, allowing for a more comprehensive analysis of the complexities involved. It enables us to directly address the gaps in the current literature, particularly in the evaluation of health interventions during Ramadan. Additionally, by distinguishing our methodology from broader reviews, we provide a clearer foundation for future research recommendations that are specifically tailored to healthcare practices and policies in Ramadan-observing communities.

Interestingly, this study reveals disparities in Ramadan fasting and metabolism research. Not all predominantly Muslim countries are leaders in research on Ramadan fasting and health. This is evident from the absence of countries like Indonesia and Brunei in the top ten, even though they have the largest majority Muslim populations in the world [28]. Several factors could contribute to this absence. One possible factor is the level of research funding and infrastructure in these countries, which may not be as developed as in countries that are leading in this area of research. Additionally, there might be cultural and institutional priorities that place less emphasis on scientific research compared to other areas. Indonesia also still has shortcomings in health research data management [29]. Furthermore, the availability of expertise and collaboration opportunities with international research communities could be limited. This finding aligns with a 2023 study that discussed the gap in Ramadan fasting studies in majority-Muslim countries [30]. The United Kingdom (UK) ranks third in research activity after the United Arab Emirates and Saudi Arabia (**Figure 3**). The UK's presence in this graph indicates that non-majority Muslim countries also have a high interest in fasting studies. An example is the study by Hanif *et al.*, emphasizing the importance of guidelines for diabetes patients who will fast. This urgency arises because diabetic patients are at risk of hypoglycemia and ketoacidosis [31].

Gender-based Ramadan fasting research is crucial. For women, pregnancy may make it difficult to fast. Even if some can manage, it is undoubtedly with strict nutritional management since the fetus requires continuous nutrition. Research on fasting among genders is equally important. Men working in industrial and mining sectors need optimal performance during their work. It poses a significant challenge because for approximately eight hours of work, they do not eat or drink. This is where the importance lies for an industry or company to design nutritional management and rest duration strategies. Industries should not chase targets without carefully considering the health and safety of their workers. The design of such strategies is a tangible commitment of an organization to Sustainable Development Goal 3 (SDG 3), especially in the aspect of good health and well-being [30].

The findings of these studies can provide important information for many researchers to understand the current positioning of their research and projections for future research. To gain a deeper understanding of the relationships, developments, and impacts of the study, we

conducted an in-depth analysis at the cluster level. This cluster analysis employs the SLNA approach to attain a more comprehensive understanding of the findings. Moreover, these insights are crucial in understanding physiological processes under various conditions, such as during fasting.

During fasting, glucose levels significantly decrease. This reduction occurs because an individual fasting must refrain from eating and drinking from Suhoor (before dawn) until Iftar (after sunset) [32]. Individuals with normal organ function have a good homeostatic ability. They can maintain glucose levels within the normal range. This is achieved as the glycogen reserves in the liver are broken down and converted into glucose [33]. In this process, the vital role of the liver in maintaining blood glucose balance through glycogenolysis is evident [34]. The glucose thus formed is then distributed through blood vessels to target tissues, including the brain and muscles **Figure 11**.

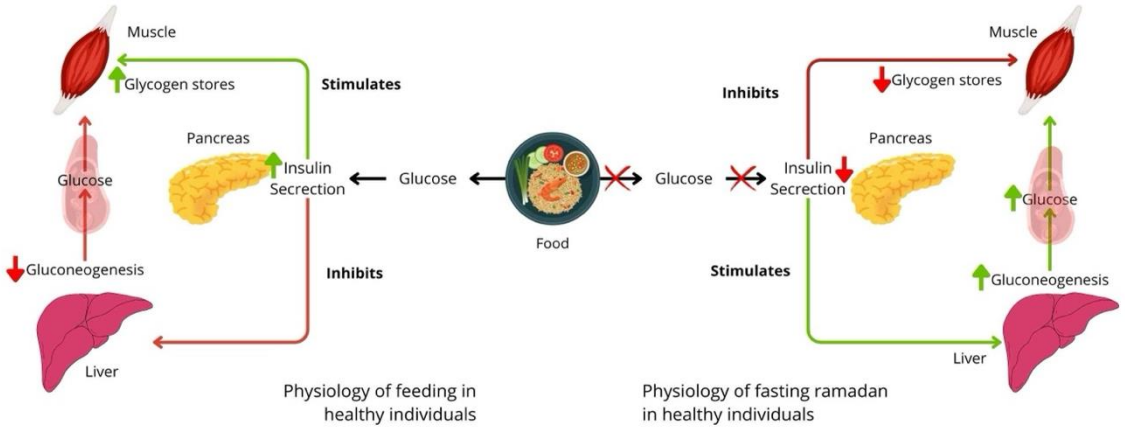

Figure 11. Relationship between fasting and the regulatory mechanisms of blood glucose homeostasis. During fasting, blood glucose levels gradually decrease and when levels fall below the normal threshold, the body compensates by initiating gluconeogenesis, which raises glucose levels and consequently inhibits glycogen storage in muscles. Under normal conditions, the opposite occurs. Incoming food is converted into glucose and high blood glucose levels stimulate glycogen storage in muscles and inhibit gluconeogenesis.

Research on the impact of fasting on pregnant women is particularly intriguing because pregnant individuals must ensure adequate energy intake, primarily to maintain glucose levels. However, excessive consumption can lead to gestational diabetes [35,36]. Gliclazide MR is used to manage type 2 diabetes. This medication belongs to a class known as sulfonylureas, which work by stimulating the pancreas to release more insulin. Therefore, it is crucial to examine the effectiveness and safety of this medication [35-38]. The reason Gliclazide MR emerges as a significant topic in the context of Ramadan fasting and diabetes management is due to several factors. Firstly, Gliclazide MR offers a modified release formulation, which provides more stable and prolonged blood glucose control compared to immediate-release formulations. This is particularly beneficial during Ramadan, where meal patterns and fasting periods can cause significant fluctuations in blood glucose levels. The modified release helps in maintaining better glycemic control throughout the day and night fasting periods, reducing the risk of hypoglycemia, which is a major concern during prolonged fasting [41].

Interestingly, emerging research on diabetes focuses on the Gulf region, which includes Kuwait, Saudi Arabia, the United Arab Emirates, and Qatar, areas with high diabetes prevalence [42]. This research is vital because preventive measures and proper lifestyle management are believed to be able to reduce the already high prevalence of diabetes in these areas.

Strong trending topics in the study of Ramadan Fasting and Diabetes Management include body weight, epidemiology, empagliflozin, and dipeptidyl-peptidase 4 inhibitors. Body weight is used as a key indicator in diabetes management, especially in determining BMI. The reason is that excess energy accumulation is stored in adipose tissue, which then progressively increases body weight [43]. On a larger scale, the prevalence of diabetes needs to be monitored using

epidemiological approaches in areas with high consumption patterns [44]. Studies on medications and biometric parameters have become crucial in diabetes management. For instance, a research examined the safety of using empagliflozin in fasting individuals [45]. Similar research has been conducted on dipeptidyl-peptidase 4 inhibitors [46]. In addition to managing diabetes, attention to cardiovascular health is also critical.

Lipid profiles are closely linked to cardiovascular health, thus regular monitoring of LDL and HDL levels is essential [23]. Various studies have shown that Ramadan fasting improves lipid profiles. This is supported by a study on 57 individuals aged between 18–58 years, which showed an improvement in lipid profiles after fasting [47].

Data reveals a close relationship between Ramadan fasting and changes in lipid profile, suggesting the role of fasting in heart health management. Findings indicate a decrease in LDL cholesterol and an increase in HDL cholesterol, showcasing the potential benefits of fasting on cardiovascular risk. Cardiovascular health is a significant concern in fasting studies. This is reflected in a cross-sectional study conducted on a population aged 25–50 years, which found improvements in blood pressure reduction [48]. This study is complex, utilizing anthropometric indices, physical examinations, biochemical tests, and structured questionnaires, making it quite representative. This discussion should explore the mechanisms that may involve improved insulin sensitivity and dietary composition changes during Ramadan.

Ramadan fasting has been shown to have significant effects on inflammatory markers, specifically cytokines. Studies indicate that fasting can lead to a reduction in pro-inflammatory cytokines such as IL-6 and TNF-α [49,50]. The prolonged fasting periods during Ramadan induce metabolic shifts that enhance the body's anti-inflammatory response. This includes increased autophagy and the modulation of immune cell function, resulting in decreased systemic inflammation. Additionally, the dietary patterns observed during Ramadan, which often include reduced intake of processed foods and increased consumption of anti-inflammatory foods like fruits and vegetables, further contribute to the reduction of inflammatory cytokines. These changes can improve overall metabolic health and reduce the risk of chronic diseases associated with inflammation, such as diabetes and cardiovascular disease.

While the benefits of Ramadan fasting on lipid profiles and cardiovascular health are becoming increasingly apparent, it is important to consider the underlying biological mechanisms that facilitate these improvements. Studies suggest that the alteration in eating patterns during Ramadan, which includes prolonged fasting periods followed by a concentrated intake of food, may trigger metabolic adaptations that enhance lipid metabolism [51,52]. These adaptations could include increased fatty acid oxidation and improved regulatory control of lipid synthesis pathways [50,53]. Additionally, the dietary shifts that often accompany Ramadan—such as reduced consumption of processed foods and increased intake of fruits, vegetables, and whole grains—might also play a critical role in improving lipid profiles. This integrated view not only underscores the importance of dietary quality during fasting but also highlights the potential of Ramadan fasting as a model for developing targeted dietary interventions aimed at reducing cardiovascular risk.

Furthermore, these metabolic adaptations and dietary improvements during Ramadan fasting can contribute to more effective fat catabolism, which is crucial for weight management. The accumulation of fat leads to obesity, indicated by a BMI and body weight above the normal threshold. Excess fat progressively accumulates in adipose tissue [54]. Intensive catabolism of these fat deposits is necessary for weight reduction. Fasting is one of the many metabolic methods for this.

The relationship between fasting and weight management has been extensively reviewed in research. Co-occurrence mapping illustrates a strong link between Ramadan fasting and weight loss (**Figure 8**). In one study, fasting effectively improved adult weight management [55]. This discussion could explore how the restructuring of eating patterns and caloric restriction during fasting contribute to weight reduction. Focus may be given to how fasting affects body fat and lean mass, as well as the role of fasting in promoting long-term behavioral changes related to food and physical activity.

The principles of intermittent fasting, which involve alternating periods of eating and fasting, align with the metabolic benefits observed during Ramadan fasting. Intermittent fasting

is an eating pattern alternating between periods of eating and fasting. This fasting activity in various studies has shown to be beneficial for health, especially in improving lipid profiles [56]. There are several methods of intermittent fasting, generally defined by a time schedule, not food portion size. Examples include the 16/8 method, where one fasts for 16 hours and eats within an 8-hour window each day [57], or the 5:2 method, where one eats normally for five days of the week and restricts calorie intake on the remaining two days. The findings of intermittent fasting align with the study by Su *et al.*, which elucidated the significant role of intermittent fasting in enhancing metabolic health, particularly in improving blood glucose levels and reducing body weight [58]. That study demonstrates that intermittent fasting helps in regulating insulin sensitivity and glucose metabolism, which are critical factors in managing diabetes and preventing metabolic syndrome. Additionally, the study highlights how intermittent fasting aids in weight loss by promoting fat oxidation and reducing caloric intake, thereby contributing to overall better health outcomes [58]. These benefits underscore the potential of intermittent fasting as a viable dietary intervention for metabolic health improvement.

Ramadan fasting is often considered a form of intermittent fasting because it involves a period of no food or drink from dawn until sunset, followed by a period of eating at night [59]. This creates a consistent daily cycle of fasting and eating for a full month. However, Ramadan fasting also has strong spiritual and religious aspects, which distinguish it from other forms of intermittent fasting typically undertaken for health reasons or weight loss.

Therefore, the primary focus of intermittent fasting is on scheduling when you eat and when you do not, rather than on the food portions consumed. Nonetheless, many who practice intermittent fasting also tend to adjust their food intake to maximize the health benefits, focusing on the quality of meals consumed during their eating windows. This approach not only optimizes the physiological benefits of fasting but also complements the spiritual and psychological well-being fostered by Ramadan fasting, highlighting its holistic impact on health.

In addition to the timing and quality of food intake, nutritional adequacy during Ramadan fasting is crucial. It's not just about quantity but also about composition (portions). Consuming too much fat leads directly to obesity and dyslipidemia. An individual's lipid levels are highly influenced by the amount and type of food consumed [33]. Consuming too much carbohydrate too often pushes towards hyperglycemia and diabetes. Although the effects develop slowly, they are significantly impactful on the body.

Research related to Ramadan fasting considers significant nutritional aspects, including intake and meal timing. This discussion could cover food quality, adequacy of macro and micronutrients, and strategies for maintaining optimal nutrition during the fasting period. Looking at the existing mapping, studies of types of foods such as fruits, vegetables, and fiber are still very rare (**Figure 10**). This certainly opens up potential gaps for research. One significant study related to nutrient intake during fasting was conducted by Kokkinopoulou *et al.*, involving 176 volunteers [60]. In that study, anthropometric measurements were taken, blood samples were collected for biochemical parameters, and nutrient intake data were gathered [60].

Moreover, understanding the dynamics of eating behavior during Ramadan can provide insights into the broader implications of intermittent fasting on long-term health. This includes examining shifts in meal frequency, changes in portion sizes, and the timing of nutrient intake. Such insights are essential for formulating dietary guidelines that can help mitigate the adverse effects of altered eating patterns during fasting. Establishing comprehensive nutritional strategies that are tailored to individual needs and cultural practices will be instrumental in promoting health and well-being during Ramadan and similar fasting periods.

This study has several limitations. Firstly, the analysis was conducted using data from only one database, Scopus, which may not capture the full breadth of research on Ramadan fasting. Secondly, the study period was restricted to publications from 2021 to 2023, potentially overlooking relevant studies published outside this timeframe. Additionally, the inclusion criteria were limited to English-language publications, excluding valuable research conducted in other languages.

Conclusion

Ramadan fasting positively impacts health but also poses risks in other aspects. Muscle and brain cells are crucial parts that must always have sufficient energy needs met. Under normal conditions, an individual can maintain the balance of energy availability in the body. On the other hand, the activity of Ramadan fasting effectively restores lipid profile parameters to normal conditions. Our bibliometric study found collective concordance between Ramadan fasting and an individual's health status, particularly regarding the improvement of lipid profiles and glucose levels. Globally, the study on Ramadan fasting produced four main clusters, with the largest being the cluster of type 2 diabetes and hypoglycemia. This study has also highlighted the existing disparities in research publications in predominantly Muslim countries. Research trends can also be clearly illustrated in mapping with co-occurrence analysis units.

Ethics approval

Not required.

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Competing interests

The authors have no relevant financial or non-financial interests to disclose.

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Underlying data

Derived data supporting the findings of this study are available as part of the study.

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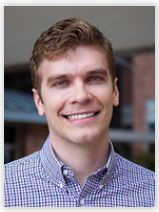

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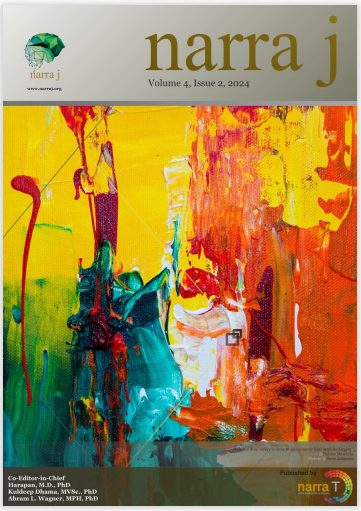

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ORIGINAL ARTICLE

Acute toxicity, secondary metabolites, and antioxidant activity of Macaranga tanarius from post-coal mining and non-mining areas in East Kalimantan, Indonesia

Ika Fikriah, Muhammad A. Masruhin, Swandari Paramita, Eva Marliana, Aman S. Panggabean, Sjarif Ismail, Irawan W. Kusuma, Yong-ung Kim, Soo-Ya Kim

DOI: 10.52225/narra.v4i2.791

PDF

Meta-analysis of the effectiveness of educational programs about HIV prevention on knowledge, attitude, and behavior among adolescents

Diah Ratnawati, Mega H. Huda, Muhammad A. Mukminin, Widyatuti Widyatuti, Agus Setiawan

DOI: 10.52225/narra.v4i2.870

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Factors related to first COVID-19 booster vaccine acceptance in Indonesia: A cross-sectional multi-center study

Abdul R. Mohi, Ikhwan Y. Kusuma, Muhammad N. Massi, Muhammad A. Bahar

DOI: 10.52225/narra.v4i2.858

PDF

Remedial effects of Formula-100 therapeutic milk and Bregas Nutriroll ready-to-use therapeutic food on Indonesian children with severe acute malnutrition: A randomized controlled trial study

Anwar Lubis, Hadi Riyadi, Ali Khomsan, Rimbawan Rimbawan, Indhira Shagti

DOI: 10.52225/narra.v4i2.846

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Minding the gap: Assessing patient expectations versus experiences in drug information services at community health centers (Puskesmas) in Indonesia urban settings

Rezki N. Azizah, Habibie Habibie, Dian S. Arsyad, Muhammad A. Bahar

DOI: 10.52225/narra.v4i2.838

PDF

Anti-aging and immunomodulatory role of caffeine in Drosophila larvae

Firzan Nainu, Sartini Sartini, Muhammad A. Bahar, Asbah Asbah, Reski A. Rosa, Mukarram Mudjahid, Muhammad F. As'ad, Nadila P. Latada

DOI: 10.52225/narra.v4i2.818

PDF

Optimizing antimicrobial synergy: Green synthesis of silver nanoparticles from Calotropis gigantea leaves enhanced by patchouli oil

Pati Kemala, Khairan Khairan, Muliadi Ramli, Zuchra Helwani, Asep Rusyana, Vanizra F. Lubis, Khairunnas Ahmad, Ghazi M. Idroes, Teuku R. Noviandy, Rinaldi Idroes

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Urban children at risk of violence: A qualitative study of experiences of parents, teachers, and service providers of collaborative support

Nurjannah Nurjannah, Rina S. Oktari, Haiyun Nisa, Wida Y. Viridanda, Wenny Aidina, Shr-Jie Wang
DOI: 10.52225/narra.v4i2.793

PDF

Role of antioxidants in reducing oxidative stress and seizure frequency in drug-resistant epileptic patients

Jufitriani Ismy, Amanda Soebadi, Irawan Mangunatmadja, Merci Monica, Teny T. Sari, Klara Yuliarti
DOI: 10.52225/narra.v4i2.790

PDF

Effect of black garlic (Allium sativum) on gonadosomatic index, follicle-stimulating hormone level and spermatozoa quality: A study in monosodium glutamate-exposed rat model

Ika I. Bani, Zulkarnain Zulkarnain, Gholib Gholib, Dedy Syahrizal, Taufiq P. Nugraha, Akmal Ramadhan, Muslim Akmal, Nora Maulina
DOI: 10.52225/narra.v4i2.617

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Global prevalence and determinants associated with the acceptance of monkeypox vaccination

Dewi Indiastari, Jonny K. Fajar, Fredo Tamara, Odis Runesi, Lukman N. Hakim, Kusnul Chotimah, Alinda Rahmani, Teguh D. Saputro, Dian Afrilla, Ervin Firmansyah, Daniel Dau, Volodymyr Dzhyvak
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Metabolism and diabetes in Ramadan fasting: Exploring health trends and relationships through systematic literature network analysis

Baharuddin Baharuddin, Adi Wijaya
DOI: 10.52225/narra.v4i2.850

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Transcriptomic analysis of profibrinolytic and fibrinolytic inhibitor genes in COVID-19 patients

Ika K. Febrianti, Andani E. Putra, Raveinal Raveinal, Aisyah Elliyanti

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Aspirin-clopidogrel combination therapy for ischemic stroke patients: Clinical efficacy and cost-effectiveness analyses in low-resource setting

Najmiatul Fitria, Dian Febiana, Muhammad Akram, Rahmi Yosmar
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Effect of pH and neutrophil count on the motility and persistence of spermatozoa in the vagina of candidiasis rat models

Raja AW. Iswara, Andon Hestiantoro, Yuli Budiningsih, Retno A. Werdhani, Ponco Birowo, Puspita E. Wuyung, Dedi Afandi
DOI: 10.52225/narra.v4i2.823

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Neutrophil-to-lymphocyte ratio as a predictor of low cardiac output syndrome after open heart surgery in children with congenital heart disease

Dewi S. Laila, Andri Perdana, Ruth K. Permatasari, Muzal Kadim, Najib Advani, Bambang Supriyatno, Novie A. Chozie, Mulyadi M. Djer
DOI: 10.52225/narra.v4i2.736

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Association between COVID-19 severity with liver abnormalities: A retrospective study in a referral hospital in Indonesia

Ummi Maimunah, Ulfa Kholili, Amie Vidyani, Titong Sugihartono, Willa M. Tanaya, Firda I. Wessels, Mohammed A. Alshawsh, Muhammad Miftahussurur
DOI: 10.52225/narra.v4i2.816

PDF

Black garlic exhibited hepatoprotective effect against monosodium glutamate-induced hepatotoxicity in animal model

Nora Maulina, Indra Zachreini, Gholib Gholib, Abdulhadi Suwandi, Muslim Akmal
DOI: 10.52225/narra.v4i2.799

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SHORT COMMUNICATION

Role of estradiol and C-reactive protein levels on genitourinary syndrome in menopausal women

Muhammad FG. Siregar, Masakazu Terauchi, Immanuel DL. Tobing, Roni B. Lubis, Selly Azmeila, Hotma P. Pasaribu, Oky Prabudi, Edy Ardiansyah, Iman H. Effendi

DOI: 10.52225/narra.v4i2.626

PDF

Role of pediatric risk of mortality (PRISM IV) score at 24 and 72 hours of hospitalization in predicting mortality among critically ill pediatric patients treated in PICU

Aridamuriany D. Lubis, Badai B. Nasution, Andriamuri P. Lubis, Kelvin Supriami

DOI: 10.52225/narra.v4i2.780

PDF

Relationship between G protein level with left ventricular systolic function in children with acyanotic heart disease

Herlina Dimiati, Mira Srikandi, Te Haypheng, Nora Sovira, Heru N. Herdata, Bakhtiar Bakhtiar, Eka D. Edward

DOI: 10.52225/narra.v4i2.531

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Comparison of RT-PCR cycle threshold values between individual and pooled SARS-CoV-2 infected nasopharyngeal swab specimens

Handa Yani, Toh D. Yuan, Aridamuriany D. Lubis, Lia K. Iswara, Inke ND. Lubis

DOI: 10.52225/narra.v4i2.765

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Motor improvement in Parkinson's disease patients receiving caffeine adjuvants: A double-blind randomized controlled trial in Indonesia

Muhammad Hamdan, Ade P. Suharto; Priya Nugraha; Wardah R. Islamiyah

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Comparison of leptin and estrone levels between normal body mass index and obese menopausal women

Muhammad FG. Siregar, Masakazu Terauchi, Rizka A. Sari, Cut A. Adella, Muhammad O. Prabudi, Melvin NG. Barus, Riza Rivany, Immanuel DL. Tobing, Selly Azmeila

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Predictive biomarkers of preeclampsia severity in a low resource setting: Role of red blood cell indices, NLR, and albumin-to-creatinine ratio

Immanuel DL. Tobing, Sarma N. Lumbanraja, Letta S. Lintang, Rafli R. Edwar, Ichwanul Adenin, Muara P. Lubis, Khairani Sukatendel, Eva Suarthana

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Perindopril and losartan affect ACE-2 and IL-6 expression in obese rat model

Andrianto Andrianto, Hanestya O. Hermawan, Primasitha M. Harsoyo, Bagas SI. Zaini, Akbar R. Muhammad

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Application of artificial intelligence technology in monitoring students' health: Preliminary results of Syiah Kuala Integrated Medical Monitoring (SKIMM)

Rovy Pratama, Rachmad Suhanda, Zahratul Aini, Nurjannah Nurjannah, Teuku A. Geumpana

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Role of neutrophil-to-lymphocyte ratio and platelet-to-lymphocyte ratio in diagnosing neonatal sepsis

Beby S. Hasibuan, Guslihan Dasatjipta, Bugis M. Lubis, Sanny Sanny

DOI: 10.52225/narra.v4i2.763

PDF

New zeolite-based composite pads with high-volume blood absorption for early warning of postpartum hemorrhage

Sulastri Sulastri, Tongku N. Siregar, Muhammad Adlim, Hasanuddin Hasanuddin, Muktaridha Muktaridha

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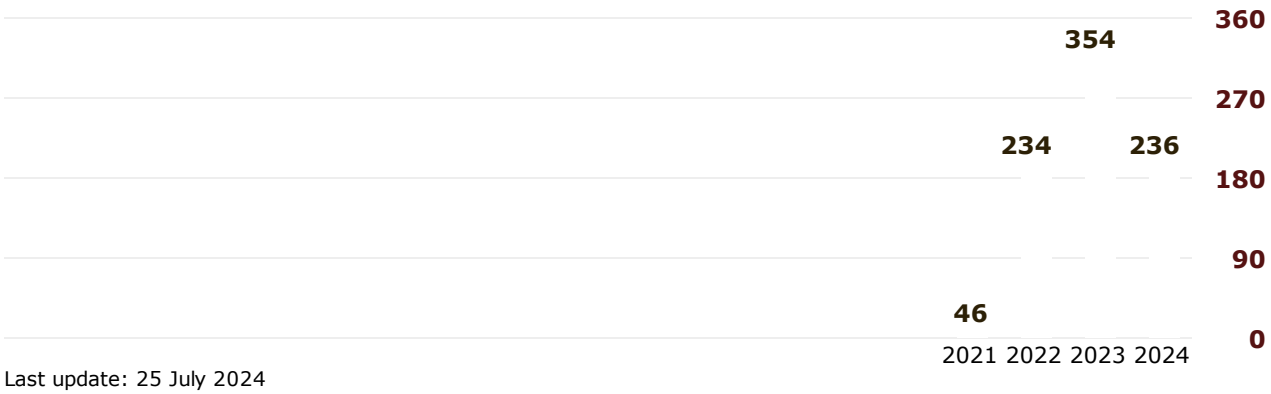

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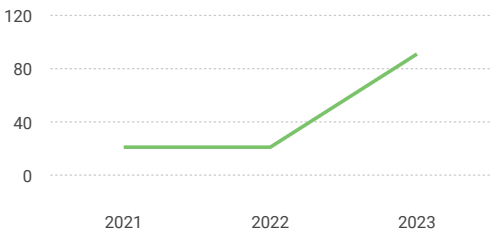

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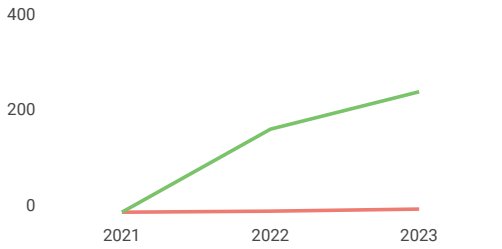

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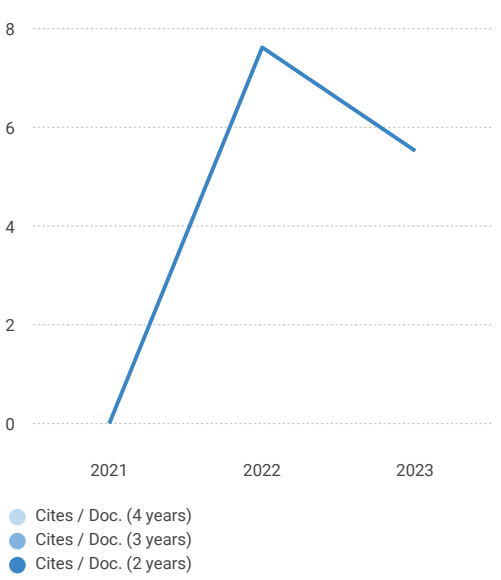

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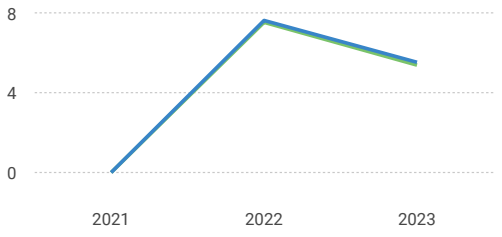

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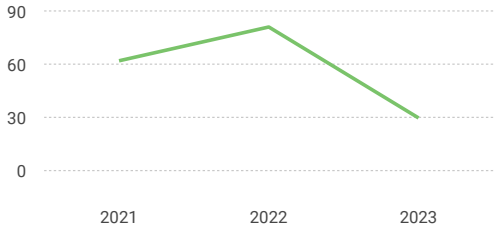

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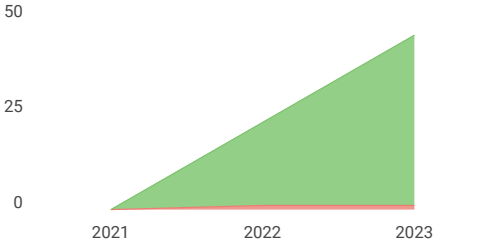

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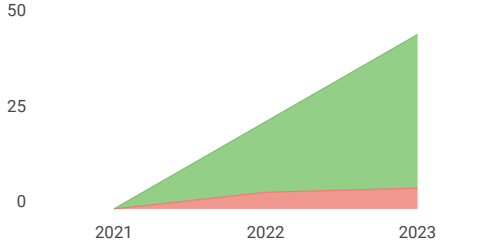

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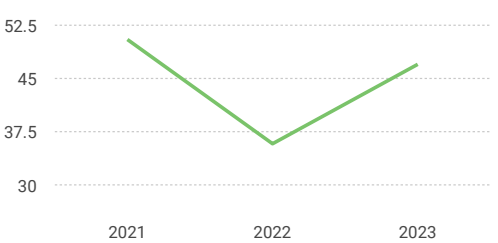

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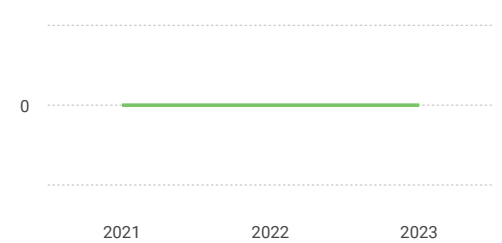

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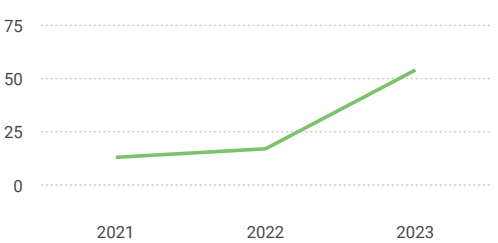

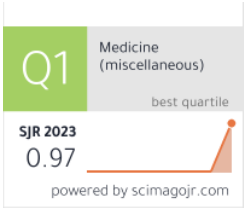

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