

Intermittent Fasting as An Alternative Diet Strategy for T2DM Patients: A Systematic Review

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ABSTRACT

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Type 2 diabetes mellitus is a chronic metabolic disorder that requires lifestyle-based interventions, particularly dietary modification. Intermittent fasting has emerged as a promising approach; however, evidence of its effectiveness remains inconclusive. This research aims to determine how intermittent fasting, implemented as a non-pharmacological dietary strategy, influences metabolic regulation, body composition, and dietary behavior in adults with type 2 diabetes mellitus. This study was designed as a systematic literature review following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, focusing on randomized controlled trials (RCTs) published between 2020 and 2025. Comprehensive literature searches were conducted across three primary databases, including PubMed, ScienceDirect, and ClinicalKey. Methodological quality was assessed using the Revised Cochrane Risk-of-Bias Tool (RoB 2), and data were extracted systematically and synthesized narratively. The search identified 382 articles, of which nine RCTs met the inclusion criteria. The results show that 6 out of 9 studies reported statistically significant reductions in HbA1c ($p < 0.05$), with reductions ranging from -0.91% to -1.9%. Significant weight loss was observed across most studies, ranging from 2.98 kg to 9.7 kg ($p < 0.01$). Furthermore, lipid profiles showed significant improvements, particularly in triglycerides ($p < 0.05$) and total cholesterol ($p \leq 0.023$) in selected trials. However, none of the reviewed studies examined eating behavior traits, highlighting a research gap. Future studies should explore behavioral and adherence aspects to assess the long-term feasibility of intermittent fasting in diabetes care.

ABSTRAK

Diabetes melitus tipe 2 merupakan gangguan metabolik kronis yang memerlukan intervensi berbasis gaya hidup, terutama melalui modifikasi pola makan. Puasa intermiten telah muncul sebagai pendekatan yang menjanjikan; namun, bukti mengenai efektivitasnya masih belum konklusif. Penelitian ini bertujuan untuk mengetahui bagaimana penerapan puasa intermiten sebagai strategi diet nonfarmakologis memengaruhi regulasi metabolik, komposisi tubuh, dan perilaku makan pada individu dewasa dengan diabetes melitus tipe 2. Penelitian ini dirancang sebagai tinjauan literatur sistematis yang mengikuti pedoman Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), dengan fokus pada Randomized Controlled Trials (RCT) yang diterbitkan antara tahun 2020 hingga 2025. Pencarian literatur yang komprehensif dilakukan melalui tiga basis data utama meliputi PubMed, ScienceDirect, dan ClinicalKey. Kualitas metodologis dievaluasi menggunakan Revised Cochrane Risk-of-Bias Tool (RoB 2), dan data diekstraksi secara sistematis serta disintesis secara naratif. Pencarian literatur mengidentifikasi 382 artikel, dan sembilan RCT memenuhi kriteria inklusi. Hasil penelitian menunjukkan bahwa 6 dari 9 studi melaporkan penurunan

HbA1c yang signifikan secara statistik ($p < 0,05$), dengan rentang penurunan antara -0,91% hingga -1,9%. Penurunan berat badan yang signifikan teramati pada mayoritas studi, berkisar antara 2,98 kg hingga 9,7 kg ($p < 0,01$). Lebih lanjut, profil lipid menunjukkan perbaikan signifikan, terutama pada kadar trigliserida ($p < 0,05$) dan kolesterol total ($p \leq 0,023$) pada uji klinis tertentu. Namun, tidak ada penelitian yang menilai perilaku makan, sehingga menyoroti adanya kesenjangan penelitian. Studi mendatang disarankan untuk meneliti aspek perilaku dan kepatuhan guna menilai kelayakan jangka panjang penerapan puasa intermiten dalam pengelolaan diabetes



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A. INTRODUCTION

The World Health Organization (WHO) defines diabetes as a severe metabolic disease characterized by elevated glucose or blood sugar, resulting from the body becoming resistant to insulin or failing to produce enough insulin. High blood sugar levels over a prolonged period can lead to further complications in the human body, such as problems with blood vessels, eyes, kidneys, heart, and nerves (WHO, 2024). Poorly managed conditions can lead to a worsening prognosis and even death. The management of diabetes mellitus has been developed involving various studies and the formulation of conceptual theories as frameworks for intervention management. However, the prevalence of Diabetes Mellitus is still increasing. An estimated 589 million people globally suffer from diabetes, and this is projected to increase to 852.5 million people by 2050 (International Diabetes Federation, 2025). The rising rate of diabetes as a global epidemic is closely linked to eating habits shaped by modern-era shifts, following the development of industrial systems and fast-food habits. Fast food contains high intakes of calories, sugar, and unhealthy fats, which contribute significantly to obesity and metabolic disorders, thereby increasing the risk of developing diabetes mellitus (Hu, 2011; Mahaputera & Hutapea, 2025).

Nutritional management is a key element of behavioral therapy and a pillar of appropriate care and education for diabetes patients. However, the fundamental concept emphasizes that there is no single universal diet that meets every patient's needs (Elsayed et al., 2023). Various recommended dietary models for people with diabetes may include: the Mediterranean diet, DASH (Dietary Approaches to Stop Hypertension) diet, flexitarian diet, plant-based diets, and low-carbohydrate diets. However, non-adherence to therapeutic recommendations, including dietary ones, is one of the most serious problems in treating diabetes patients. It is one of the most significant barriers to achieving the benefits of diabetes therapy (Sińska & Kucharska, 2023).

Intermittent fasting (IF) is a dietary pattern involving energy restriction and fasting with time limitations. IF has unique and specific properties that can trigger systemic metabolic improvements through metabolic switching and induce specific tissue metabolic adaptations, including changes in the gut microbiome, adipose tissue remodeling, correction of circadian rhythm disorders, and increased autophagy in peripheral tissues (Chen et al., 2023).

Intermittent fasting can affect body performance, such as improving glucose levels, lipid levels, heart rate, blood pressure, and body weight (Fauzi & Elvandari, 2024).

Intermittent fasting is an eating pattern that involves cycling between periods of eating (eating state) and periods of fasting (fasting state). There are no specific restrictions on the types of food that can be eaten, but there are time limits on when to consume them. Food is only consumed during a predetermined time period, whether in hours, days, or weeks (Hamdani & Fahlevi, 2025). The goals of intermittent fasting can vary, including weight loss, improving metabolism, enhancing metabolic health, and promoting general health. This method is considered more flexible and adaptable to an individual's lifestyle, as well as less restrictive than traditional caloric restriction methods.

However, it is important to note that the success of intermittent fasting in achieving fat loss, muscle maintenance, and energy optimization heavily depends on various factors, including the duration and type of fast, the quality and quantity of nutritional intake during the eating window, and physical activity routines (Herz et al., 2024). Improper implementation of intermittent fasting, especially without balanced nutritional fulfillment, can lead to a decline in physical and mental performance, as well as the risk of muscle mass loss. Therefore, it is crucial to consider these aspects holistically and devise a strategy that includes a balanced diet, adequate physical exercise, and sufficient rest.

Previous research has shown positive results of intermittent fasting on weight loss, blood sugar control, and improved metabolic function. However, available studies tend to focus on quantitative aspects, such as weight reduction and general biochemical parameters over a specific period, without deeply exploring the physiological experiences and bodily changes individuals undergo. Understanding eating behavior traits, such as dietary adherence and appetite control, is also crucial as these factors directly influence the long-term clinical success and sustainability of the intervention in patients with T2DM (Hapi & Pratama, 2023; Nowosad & Sujka, 2021; Silverii et al., 2023; Yopa Frisdiana, 2024).

Despite increasing attention, the influence of intermittent fasting as an alternative dietary intervention remains insufficiently explored, particularly in relation to dietary behavior and its integration into daily diabetes management. Therefore, this systematic review seeks to evaluate the clinical effectiveness of intermittent fasting as a dietary strategy for improving metabolic outcomes (HbA1c and lipid profiles), body composition, and specific eating behavior traits (such as satiety and dietary adherence) in adults with type 2 diabetes mellitus.

B. METHODS

1. Design

The present review applied a systematic literature review approach, structured according to the PRISMA framework to ensure transparent and reproducible reporting. The systematic review design in this article specialized in searching for articles with Randomized Controlled Trials (RCTs) designs to synthesize the highest level of evidence regarding the clinical effectiveness of intermittent fasting as a dietary strategy in controlling metabolic status in patients with type 2 diabetes mellitus.

2. Search Methods

Relevant studies were identified through comprehensive searches in PubMed, ScienceDirect, and ClinicalKey between September and October 2025. The article search was performed using a structured strategy with a combination of general and specific keywords, including: ("Type 2 Diabetes Mellitus" OR T2DM OR "Diabetic Patients") AND ("Intermittent Fasting" OR "Time-Restricted Feeding" OR "Alternate-Day Fasting" OR "Periodic Fasting") AND ("Nutrition Education" OR "Dietary Counseling" OR "Behavioral Intervention") AND ("Glycemic Control" OR HbA1c OR "Body Weight" OR "Eating Behavior" OR "Dietary Habits" OR "Dietary Strategy"). Search keywords were adapted to the journal database, such as using MeSH (Medical Subject Headings) terms for searches on the Pubmed site.

The inclusion criteria for this study were: 1) Employed a randomized controlled trials (RCTs) design, 2) Were available as full-text articles (published in English or Indonesian), 3) Articles released between 2020 and 2025, 4) Articles with an appropriate study quality assessment, 5) Addressed at least one relevant outcome related to glycemic control, body composition, or metabolic parameters.

The exclusion criteria for this study were: 1) Research without full-text access and using languages other than those specified, 2) Research not including at least one variable from the predetermined topic, 3) Articles with poor study quality assessment results, 4) Literature in the form of reviews, whether narrative/traditional review, literature/systematic review, or meta-analysis.

3. Data Extraction

A structured data extraction form was developed to collect key information consistently across all included studies. Articles from the databases were then assessed and analyzed using a structured data extraction form according to the inclusion and exclusion criteria, which contained: 1) Article title, 2) Author(s) and year of publication, 3) Research methodology (design, sample, variables, intervention, and analysis), 4) Main outcomes and findings.

4. Data Synthesis

A narrative approach was applied to integrate and interpret the outcomes of the included trials. Data were systematically organized following the established extraction protocol, and the synthesis highlights how intermittent fasting influences metabolic regulation and glycemic outcomes in type 2 diabetes.

5. Search Outcome

The study selection proceeded through several sequential steps. Initially, records that did not meet the inclusion criteria or appeared as duplicates across databases were removed. The remaining studies then underwent title and abstract screening, followed by full-text assessment and methodological quality appraisal. Based on this process, nine studies out of the 382 records initially retrieved were deemed eligible and included in the final review.

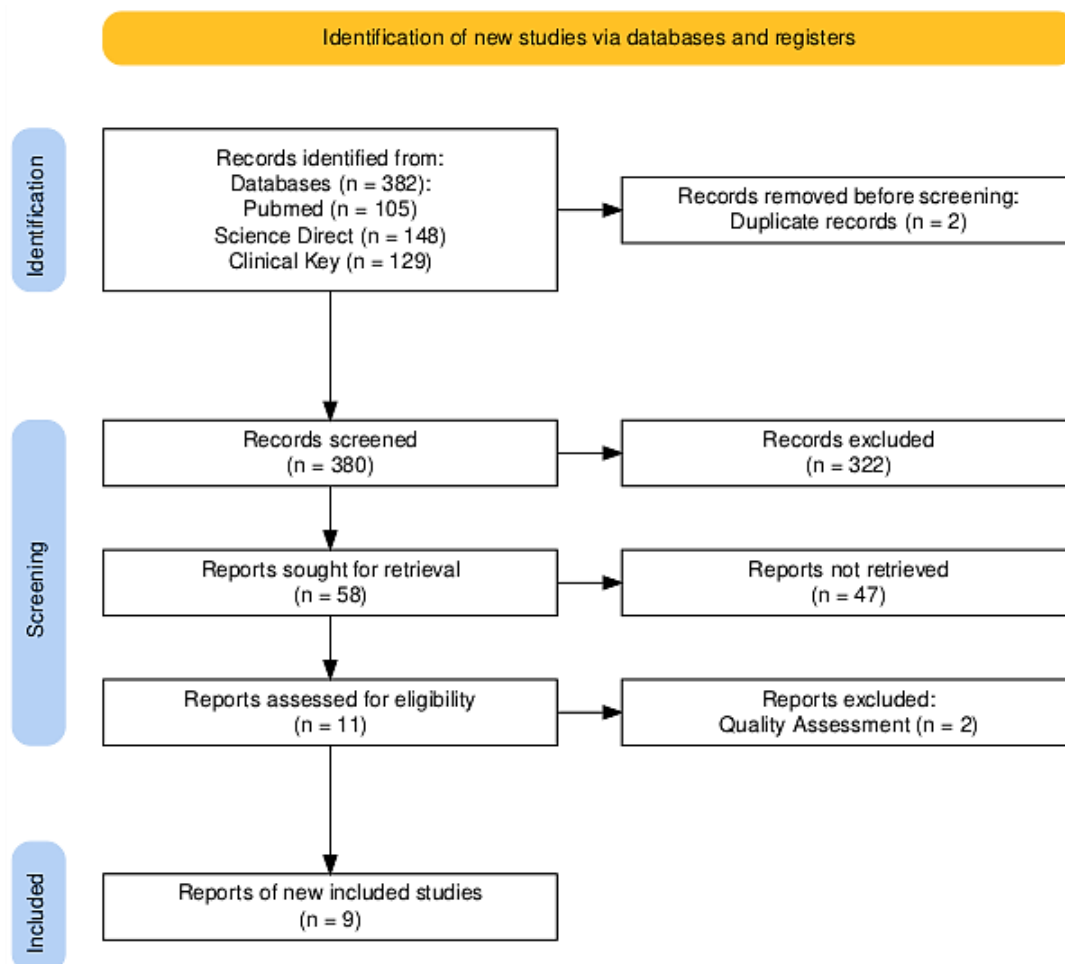


Figure 1. PRISMA Flow Diagram: Intermittent Fasting as an Alternative Diet Strategy for T2DM Patients: A Systematic Review (Haddaway et al., 2022)

6. Quality Appraisal

Each included article was independently assessed for methodological rigor using the Revised Cochrane Risk-of-Bias Tool for Randomized Trials (RoB 2). This tool evaluates potential bias across multiple domains, such as randomization, blinding, and outcome reporting. Only studies rated as low risk or some concerns were considered in the final synthesis to maintain the reliability of the findings.

Table 1. Critical Appraisal Using Revised Cochrane Risk-of-Bias Tool for Randomized Trials

Study	Quality Appraisal	Result
(Guo et al., 2024)	Low Risk of Bias	Included
(Sukkriang & Buranapin, 2024)	High Risk of Bias	Excluded
(Obermayer et al., 2023)	Some Concern	Included
(Nofal et al., 2025)	Some Concern	Included
(Teong et al., 2023)	High Risk of Bias	Excluded
(Che et al., 2021)	Some Concern	Included
(Pavlou et al., 2023)	Some Concern	Included
(Hegedus et al., 2024)	Some Concern	Included
(Andriessen et al., 2022)	Some Concern	Included

(Li et al., 2024)	Low Risk of Bias	Included
(Bravo-Garcia et al., 2025)	Some Concern	Included

C. RESULT AND DISCUSSION

Result

A total of 382 records were retrieved across the three databases (PubMed = 105, ScienceDirect = 148, Clinical Key = 129). After applying the inclusion and exclusion criteria, 11 studies proceeded to full-text assessment. Of these, two were excluded due to high risk of bias, leaving nine studies for the final analysis.

Table 2. Summary of Study Included in Review Process

No.	Title, Author, and Publication Year	Research Methodology (Design, Subjects, Variables, Instruments, Analysis)	Research Results
1	A 5:2 Intermittent Fasting Meal Replacement Diet and Glycemic Control for Adults with Diabetes: The EARLY Randomized Clinical Trial (Guo, dkk, 2024).	<p>Design: Randomized Controlled Trial (RCT) or Active Parallel Controlled Clinical Trial.</p> <p>Subjects: 405 participants randomly divided into 3 groups: IF 5:2 MR group, Metformin group, and Empagliflozin group.</p> <p>Variables: Intermittent Fasting Meal Replacement Diet, Weight Loss, and Glycemic Control (HbA1c levels).</p> <p>Instruments: Informed Consent, CONSORT reporting guideline, E-Hospital Medical Records, Web-response System.</p> <p>Analysis: Analysis of Covariance (ANCOVA), multiple pairwise comparison test (follow-up test) using the Tukey-Kramer test, and Post hoc subgroup analyses. Data analyzed using SPSS, version 24.0.</p>	<ul style="list-style-type: none"> - This study concluded that a 16-week intervention with 5:2 Intermittent Fasting Meal Replacement (MR) improved glycemic control and facilitated weight loss in newly diagnosed type 2 diabetes patients. - HbA1c Levels: The IF 5:2 MR group reduced HbA1c levels more significantly (-1.9%) compared to the metformin (-1.6%) and empagliflozin (-1.5%) groups. - Weight Loss: The IF 5:2 MR group experienced more significant weight loss (-9.7 kg) compared to the metformin (-5.5 kg) and empagliflozin (-5.8 kg) groups.
2	Efficacy and Safety of Intermittent Fasting in People with Insulin-Treated Type 2 Diabetes (INTERFAST-2)—A Randomized Controlled Trial (Obermayer, et al, 2023)	<p>Design: Randomized Controlled Trial (RCT).</p> <p>Subjects: 46 respondents randomly divided into two groups: 24 in the control group and 22 in the intervention group.</p> <p>Variables: Intermittent Fasting, Body weight, HbA1c, and Reduction in Insulin Dose.</p> <p>Instruments: Questionnaire, Anthropometric Record, Laboratory Test, and Web-based data collector (CGM LibreView Software).</p> <p>Analysis: Unpaired t-tests and linear mixed-effect models.</p>	<ul style="list-style-type: none"> - This study concluded that Intermittent Fasting (IF) is a safe and feasible diet option, which improves glycemic control, reduces body weight, and lowers total daily insulin doses in individuals with type 2 diabetes undergoing insulin therapy. - HbA1c Reduction: The percentage reduction in HbA1c was significantly greater (-27.3 ± 12.0 mmol/mol) in the intervention group compared to the control group (0.1 ± 6.1 mmol/mol). - Weight Loss: The intervention group experienced significant

			weight loss, while the control group gained weight.
			- Insulin Dose: The intervention group experienced an average decrease in insulin dose requirement of 9 IU, while the control group had an average increase of 4 IU.
3	Effect of intermittent Islamic fasting management of metabolic syndrome:a randomized control trial (Nofal H. A., et al, 2025)	<p>Design: Randomized Controlled Open-label Trial.</p> <p>Subjects: 54 respondents randomly divided into two groups, each with 27 people for the intervention and control groups.</p> <p>Variables: Intermittent Fasting, Anthropometric Measurement, Blood Pressure, Glycemic Parameter, and Lipid Profile.</p> <p>Instruments: Self-administered questionnaire, Semi-structured interview, The Simple Lifestyle Indicator Questionnaire (SLIQ), Dietary Record, Anthropometric Record, and Laboratory Test.</p> <p>Analysis: Chi-square test for categorical variables; independent samples t-test and Mann-Whitney U test for quantitative data. Paired t-test or Wilcoxon signed-rank test for within-group changes. Data analyzed using SPSS version 28.</p>	<p>- These results indicate that adding Intermittent Islamic Fasting (IIF) to lifestyle modification yields significantly better health outcomes than lifestyle modification alone. Both groups showed significant improvements in healthy lifestyle scores after six months.</p> <p>- Fasting Effect: There were statistically significant differences between groups regarding percentage change in weight ($p < 0.001$), waist circumference ($p < 0.001$), systolic blood pressure ($p = 0.042$), diastolic blood pressure ($p < 0.001$), fasting blood glucose ($p < 0.001$), triglycerides ($p < 0.001$), HDL ($p < 0.001$), and total cholesterol ($p = 0.023$), with better improvements in the intervention group.</p>
4	Time-restricted feeding improves blood glucose and insulin sensitivity in overweight patients with type 2 diabetes: a randomized controlled trial (Che T., et al, 2021)	<p>Design: Randomized Controlled Trial (RCT).</p> <p>Subjects: 104 respondents randomly divided into two groups: 50 in the control group and 54 in the TRF intervention group.</p> <p>Variables: Time Restricted Feeding, HbA1c, Fasting Plasma Glucose, Insulin Sensitivity, and Body weight.</p> <p>Instruments: Self-administered questionnaire, BMI Record, Laboratory Test, and SF-12 QoL questionnaire form.</p> <p>Analysis: Independent samples t-tests and Pearson χ^2 tests. Repeated measures analysis of variance (ANOVA). Analysis using SPSS, version 25.</p>	<p>- This result shows that 10-hour time-restricted feeding (TRF) enhanced blood glucose improvement and insulin sensitivity, led to weight loss, reduced the required dose of hypoglycemic drugs, and improved quality of life. It may also provide cardiovascular benefits by reducing lipid levels.</p> <p>- Effect of TRF: The TRF group showed significant improvements in almost all measures. Key results include: Glycemic Control: More significant reduction in HbA1c ($-1.54\% \pm 0.19$) and fasting glucose. Weight Loss: Significantly more weight loss (-2.98 kg vs. -0.83 kg). Insulin Sensitivity: Improved insulin sensitivity and β-cell function.</p>

5	Effect of Time-Restricted Eating on Weight Loss in Adults with Type 2 Diabetes A Randomized Clinical Trial (Pavlou V., et al, 2023)	<p>Design: Randomized Controlled Trial (RCT).</p> <p>Subjects: 75 respondents randomly divided into three groups of 25 each: TRE group, CR group, and control group.</p> <p>Variables: Time Restricted Eating, Weight loss, and HbA1c levels.</p> <p>Instruments: Self-administered questionnaire, Anthropometric Record, Laboratory Test, and Web-based data collector (CGM DexCom).</p> <p>Analysis: A linear mixed model. Data analyzed using R software, version 4.3.1.</p>	<ul style="list-style-type: none"> - This result shows that intermittent fasting is an effective nutritional strategy for individuals with metabolic syndrome, leading to significant improvements in physical and metabolic health measures. - Weight Loss: The TRE group experienced the most significant weight loss (-3.56% [95%CI, -5.92% to -1.20%]; P = .004) compared to the CR and control groups. - HbA1c Levels: The TRE and CR groups experienced a decrease in HbA1c levels (-0.91% and -0.94% respectively), indicating a positive impact.
6	Randomized Controlled Feasibility Trial of Late 8-Hour Time-Restricted Eating for Adolescents With Type 2 Diabetes (Hegedus E., et al, 2022)	<p>Design: Randomized Controlled Feasibility Study.</p> <p>Subjects: 27 respondents divided 1:1 into two groups: Late TRE (ITRE) group and Control group.</p> <p>Variables: Late Time Restricted Eating, Adherence and Respondent Satisfaction, Anthropometric Measurement, and Glycemic Parameter.</p> <p>Instruments: Questionnaire, Semi-structured interview, Anthropometric Record, Laboratory Test.</p> <p>Analysis: Descriptive Statistics, Wilcoxon Rank Sum Test & Fisher's Exact Test. Mixed-effects longitudinal regression model. Data analyzed with RStudio 4.2.2.</p>	<ul style="list-style-type: none"> - This result shows that an 8-hour late time-restricted eating (ITRE) intervention is feasible, safe, and acceptable for adolescents with type 2 diabetes. Recruitment, retention, and adherence rates were high. The ITRE group followed their eating window an average of 6.2 out of 7 days per week. No negative side effects were found. - Covariates: There was a decrease in BMI percentage (-3.4%; p = 0.02) and HbA1c (-0.4%; p = .06). However, this decrease was not significant compared to the control group. - Energy and Calories: The TRE group showed an energy decrease of -271.4 kcal/day, while the control group had an increase of +293.2 kcal/day (P Value = 0.01).
7	Three weeks of time-restricted eating improves glucose homeostasis in adults with type 2 diabetes but does not improve insulin sensitivity: a randomised crossover trial (Andriessen C., et al, 2022).	<p>Design: Randomized Crossover Study.</p> <p>Subjects: 14 respondents divided 1:1 into two groups of 7 respondents each.</p> <p>Variables: Time Restricted Eating and Glycemic Parameter (Glucose Homeostasis).</p> <p>Instruments: Self-administered Questionnaire, Semi-structured interview, Anthropometric Record, Laboratory Test.</p>	<ul style="list-style-type: none"> - This result shows that a 10-hour daytime TRE intervention is a feasible, safe, and effective strategy for improving 24-hour glucose control in adults with type 2 diabetes. - Glucose Homeostasis: TRE increased time in the normoglycaemic range (15.1 vs 12.2 h per day, p=0.01) and reduced fasting glucose (7.6 vs 8.6 mmol/l, p=0.03). 24-hour glucose monitoring showed

		Analysis: Paired t-test. Data analyzed using SPSS Version 25.	positive results (6.8 vs 7.6 mmol/l, $p < 0.01$). No side effects were found.
8	Effects of healthy low-carbohydrate diet and time-restricted eating on weight and gut microbiome in adults with overweight or obesity: Feeding RCT (Li L., et al, 2024)	<p>Design: Two-by-two factorial Randomized Controlled Feeding Trial.</p> <p>Subjects: 96 adult participants with overweight or obesity, randomly assigned to 4 groups (24 each): (1) HLCD + TRE, (2) HLCD only, (3) TRE only, and (4) control.</p> <p>Variables Healthy Low-Carbohydrate Diet (HLCD) and Time-Restricted Eating (TRE), Changes in weight, BMI, body composition, metabolic parameters, and fecal microbiome.</p> <p>Instruments: Measurements of body weight, BMI, body composition, Continuous Glucose Monitoring (CGM).</p> <p>Analysis: Mixed-effects linear models and PERMANOVA. ANCOVA for comparisons. Data analyzed using SPSS v24 and FDR correction.</p>	<p>- This study concluded that a 12-week intervention with 25% calorie restriction resulted in significant weight loss in all groups (2.57–4.11 kg).</p> <p>- Intervention Effect: HLCD decreased body fat mass more than non-HLCD (–3.37 kg vs –2.44 kg; $p = 0.02$). This effect persisted 28 weeks post-intervention. TRE decreased BMI more than non-TRE (–1.33 vs –0.99 kg/m²; $p = 0.02$) and resulted in greater lean mass loss. The HLCD + TRE combination yielded the greatest weight loss (–4.11 kg) compared to control (–2.57 kg).</p>
9	Combined effects of time-restricted eating and exercise on short-term blood glucose management in individuals with Type 2 Diabetes Mellitus: The TREx study, a randomised controlled trial (Bravo-Garcia A.P. et al., 2025).	<p>Design: Randomized cross-over controlled trial with 4 lab-supervised test conditions.</p> <p>Subjects: 14 participants (5 female, 9 male) aged 35–65 with T2DM.</p> <p>Variables Independent: Time-restricted eating (TRE) and post-meal exercise. Dependent: glucose and insulin levels (AUC, iAUC), blood pressure, substrate oxidation, circadian-related gene expression.</p> <p>Instruments: Venous blood draws, CGM, Nanostring nCounter, DXA, HR and BP monitor.</p> <p>Analysis: Linear mixed-effects model (R 4.3.2); post hoc Tukey test, $p < 0.05$ significant.</p>	<p>- This study concluded that light post-meal exercise is more effective at lowering daily insulin levels than time restriction alone. The TRE + Ex combination has the potential to improve post-meal glycemic control and blood pressure.</p> <p>- Intervention Effect: Post-meal exercise significantly decreased 14-hour insulin AUC ($p = 0.01$), with no added effect from TRE. No significant difference in 14-hour glucose AUC. TRE + Ex lowered systolic and diastolic blood pressure (SBP –3 mmHg; DBP –1 mmHg, $p < 0.05$). TRE lowered post-prandial glucose 2 hours after lunch and dinner.</p>

Discussion

Effect on Glycemic Control

The synthesis results indicate that almost all studies reported significant improvements in glycemic control. The study by Guo et al (2024) reported an HbA1c level reduction of –1.9% in the IF group compared to the metformin (–1.6%) and empagliflozin (–1.5%) groups. The study by Obermayer et al (2023) also found that IF reduced HbA1c by -7.3 ± 12.0 mmol/mol and daily insulin dose requirements by 9 units. Furthermore,

research by Che et al (2021) showed that Time-Restricted Feeding with a 10-hour eating window provided significant improvements in HbA1c levels (-1.54%) and increased insulin sensitivity ($p = 0.005$). Meanwhile, Pavlou et al (2023) reported that Time-Restricted Eating reduced HbA1c levels by -0.91% and had efficacy comparable to traditional caloric restriction. Research by Nofal et al (2025) on Intermittent Islamic Fasting also demonstrated a significant decrease in fasting blood glucose levels ($p < 0.001$) and HbA1c after a six-month intervention. The study by Hegedus et al (2024) showed a trend of HbA1c reduction by -0.4%, although it was not statistically significant. Research by Li et al (2024) and Bravo-Garcia et al (2025) further indicated that while the combination of IF with a low-carbohydrate diet or physical exercise improved metabolic markers, the most significant statistical improvements were observed in postprandial insulin sensitivity following exercise ($p = 0.01$) and fat mass reduction through combined dietary restriction ($p < 0.05$).

Physiologically, these positive effects can be explained by the Metabolic Switching Theory, where during the fasting period, a metabolic transition occurs from using glucose to free fatty acids and ketones as the primary energy source, which increases insulin sensitivity and decreases peripheral glucose resistance (Longo et al., 2022; Mattson et al., 2018). These results reinforce the role of IF as an effective non-pharmacological alternative diet intervention in the glycemic control of type 2 diabetes patients.

Effect on Anthropometric Outcomes

The nine RCT studies also reported positive effects on anthropometric outcomes such as body weight, BMI, and waist circumference. The results from Guo et al (2024) noted a weight loss of -9.7 kg in the IF group, greater than the metformin group (-5.5 kg). Research by Che et al (2021) found a weight loss of -2.98 kg compared to -0.83 kg in the control group, while Pavlou et al (2023) reported a weight loss of -3.56% (95%CI, -5.92% to -1.20%). The findings from Li et al (2024) showed that the combination of HLCD and TRE provided the greatest weight loss effect (-4.11 kg) compared to HLCD alone (-3.37 kg) or a conventional diet (-2.57 kg). The study by Nofal et al (2025) found that IIF significantly reduced body weight, waist circumference, systolic, and diastolic blood pressure ($p < 0.05$). The Hegedus et al (2024) study reported a BMI decrease of -3.4% ($p = 0.02$) and lower daily energy intake.

Theoretically, these results support the concept of an energy restriction window and circadian rhythm alignment, which explain that restricting eating times optimizes the body's biological rhythms, lowers leptin levels, and increases fat oxidation (Varady et al., 2021). Thus, IF can be considered a more flexible and easily implemented alternative diet strategy compared to conventional diets focused on restricting calories or food types.

Effect on Lipid Profile

Four studies Bravo-Garcia et al (2025), Che et al (2021), Li et al (2024), Nofal et al (2025) also examined the effect of IF on lipid profiles. The results showed a significant decrease in triglyceride and total cholesterol levels, accompanied by an increase in HDL levels. The Nofal et al (2025) study reported that IIF decreased triglycerides ($p < 0.001$) and total cholesterol ($p = 0.023$) and increased HDL ($p < 0.001$). The Che et al (2021) study

showed lipid profile improvements aligned with increased insulin sensitivity. The Li et al (2024) study found that HLCD + TRE reduced visceral fat mass and improved body composition, while the Bravo-Garcia et al (2025) study showed that TRE + Exercise lowered blood pressure and daily insulin levels, which has positive implications for lipid metabolism.

From a physiological standpoint, IF triggers the activation of autophagy and lipid oxidation processes, which reduce visceral fat accumulation and enhance energy metabolism efficiency (Longo et al., 2022). This mechanism explains why IF not only impacts glucose control but also plays a role in preventing cardiovascular complications through a healthier lipid profile.

Limitations of The Study

Although this systematic review provides strong evidence regarding the clinical efficacy of intermittent fasting (IF), several limitations should be noted. First, there is a significant heterogeneity in the IF protocols (e.g., 5:2 fasting vs. 10-hour TRE) and the duration of interventions across the reviewed studies, which may influence the consistency of metabolic outcomes. Second, while the search strategy aimed to include behavioral aspects, most primary RCTs did not report objective data on eating behavior traits or long-term adherence, limiting the analysis of IF's sustainability. Finally, while the current findings offer significant insights, the relatively brief follow-up periods across most studies (3 to 7 months) suggest that further longitudinal research would be beneficial to fully capture the enduring impact of IF on diabetes complications and its role in fostering sustainable lifestyle shifts.

D. CONCLUSION AND SUGGESTIONS

This systematic review confirms, based on strong evidence from nine RCTs, that intermittent fasting, including 5:2 fasting and Time-Restricted Eating, is an effective and safe lifestyle intervention for improving key metabolic outcomes, particularly glycemic control, weight loss, and lipid profiles in patients with type 2 diabetes mellitus. However, the most crucial contribution of this review is the identification of a substantial knowledge gap. Despite a search strategy that explicitly included behavioral terms, none of the analyzed RCTs reported comprehensive data on eating behavior traits, such as satiety, eating habits, or long-term dietary adherence. This indicates that while the clinical efficacy of IF is established, the behavioral and psychological mechanisms required for long-term sustainability remain under-researched.

For healthcare providers, these findings imply that intermittent fasting can be integrated as a viable non-pharmacological strategy in T2DM management to enhance patient outcomes. Clinicians should consider these methods as evidence-based alternatives to traditional caloric restriction, provided they offer personalized guidance and close monitoring of glycemic safety. Given the identified behavioral gap, providers are encouraged to actively assess patient adherence and psychological readiness to ensure the long-term feasibility of this dietary approach in clinical practice.

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