The Ketogenic Diet and Its Impact on Insulin and Lipid Profiles in Overweight and Obese Adults: A Systematic Review

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Abstract

Background: Obesity and overweight are major worldwide health concern with significant health and economic effects. The ketogenic diet (KD), characterized by high-fat and low-carbohydrate intake, has emerged as a popular strategy for weight reduction and long-term benefits on insulin sensitivity and blood lipids. **Aim:** This systematic review aimed to assess the impact of ketogenic diets on insulin levels and lipid profiles in overweight and obese adults. **Method**: We conducted a systematic search in accordance with the PRISMA 2020 guidelines and the PICOS framework. Five interventional studies met the inclusion criteria, evaluating the effects of various forms of ketogenic diets compared to standard or non-ketogenic diets in adults aged 18–65 years with BMI ≥25 kg/m². **Results**: Across all studies, ketogenic diets led to significant weight loss, improved insulin sensitivity, and enhanced lipid profiles compared to control groups, with long-term benefits. Lipid results were largely favorable, with lower triglycerides and LDL cholesterol and higher HDL cholesterol, but significant variability was noted. **Conclusion and Recommendations:** The ketogenic diet was effective in enhancing insulin regulation and producing beneficial changes in lipid profiles between overweight and obese adults. While findings support its short-and medium-term efficacy, professional supervision is recommended. Further high-quality studies are needed to clarify long-term outcomes

***Keywords**:* Diet therapy, Insulin sensitivity, Ketogenic diet, Lipid profile, Obesity, Weight loss.

1. Introduction

Obesity and overweight are increasingly recognized as chronic health conditions characterized by excessive body fat accumulation (Bosy-Westphal & Müller, 2021). The World Health Organization (WHO) classifies individuals with a Body Mass Index (BMI) of 25 kg/m² or higher as overweight, and those with a BMI of 30 kg/m² or greater as obese. Globally, the prevalence of obesity has reached alarming levels (Xie et al, 2025). As of 2022, more than 2.5 billion adults, approximately 43% of the global adult population, were classified as overweight or obese, and among them, over 890 million, about 16% were obese according to the WHO. This marks a significant increase compared to previous decades, representing a continued upward trajectory since the 1970s. Once primarily prevalent in high-income nations, obesity now affects populations across all economic strata, including low- and middle-income countries, posing a significant global public health concern that demands urgent, coordinated action (WHO, 2024).

The consequences of obesity extend beyond weight-related issues. It is a major risk factor for various chronic diseases such as cardiovascular disease, type 2 diabetes mellitus (T2DM), certain cancers, musculoskeletal disorders, and sleep-related breathing conditions (Janez et al., 2024). Additionally, obesity is associated with psychological challenges, including depression, anxiety, and diminished self-esteem. These complications impact not only individual health and quality of life but also exert substantial economic pressure on healthcare systems (Adam & Wani, 2022). Effective obesity management requires integrative approaches, including physical activity promotion, behavioral modification, and nutritional interventions, supported by healthcare systems and policy frameworks (Philippou & Andreou, 2022).

Among dietary strategies, the KD has emerged as a promising intervention for weight management and metabolic improvement. Originally developed in the 1920s to treat refractory epilepsy, the KD induces a metabolic state known as ketosis. This is achieved through a macronutrient distribution consisting of high fat (approximately 70–80% of daily caloric intake), moderate protein (20–25%), and very low carbohydrates (5–10%). In ketosis, the liver metabolizes fatty acids into ketone bodies, which serve as an alternative energy source, especially for the brain and other peripheral tissues (Imdad et al., 2022).

Multiple variants of the KD have been developed, including the Standard Ketogenic Diet (SKD), the Modified Atkins Diet (MAD), the Medium-Chain Triglyceride (MCT) diet, and the Low-Glycemic Index Treatment (LGIT) (Zhu et al., 2022). These approaches differ slightly in macronutrient composition and clinical applicability, but all aim to maintain a state of ketosis. It is essential to note that not all low-carbohydrate diets induce ketosis; excessive protein consumption can increase gluconeogenesis, thereby reducing ketone production. Despite growing interest, concerns about the long-term safety and adherence to KD persist. Common short-term side effects referred to as "keto flu" include fatigue, headache, gastrointestinal upset, and electrolyte disturbances (Malinowska & Żendzian-Piotrowska, 2024).

Long-term adherence, particularly when unsupervised, may lead to micronutrient deficiencies, nephrolithiasis, and potential reductions in bone mineral density. These considerations necessitate ongoing clinical monitoring, especially in at-risk populations (Nuwaylati, Eldakhakhny, Bima, Sakr, & Elsamanoudy, 2022). The physiological basis for KD's metabolic benefits lies in its capacity to improve insulin sensitivity and modulate lipid metabolism (Spigoni et al, 2022). Obesity is associated with chronic low-grade inflammation and insulin resistance. Hyperinsulinemia, resulting from the body's compensatory response to decreased insulin sensitivity, exacerbates glucose dysregulation and increases the risk of developing T2DM (Szukiewicz, 2023). By substantially reducing carbohydrate intake, the KD lowers postprandial glucose levels and suppresses insulin secretion, thereby enhancing insulin sensitivity; this metabolic adaptation has been associated with significant reductions in fasting insulin levels and improvements in hemoglobin A1c (HbA1c) among overweight and obese individuals (Skow & Jha, 2023).

Similarly, obesity is often associated with dyslipidemia, which is characterized by elevated triglyceride levels, reduced high-density lipoprotein (HDL) cholesterol, and frequently increased low-density lipoprotein (LDL) cholesterol (Vekic, Stefanovic, & Zeljkovic, 2023). The KD has been shown to beneficially modulate these lipid parameters. It may reduce triglyceride concentrations and increase HDL cholesterol levels. However, its effects on LDL cholesterol remain inconsistent, with some individuals experiencing elevations. These variations are likely influenced by factors such as dietary fat composition, genetic predisposition, and the duration of dietary adherence. Therefore, regular monitoring of the lipid profile is essential during KD implementation, particularly in individuals at elevated cardiovascular risk (Suarez et al, 2024).

Given the metabolic complexity of obesity and its related comorbidities, this paper aimed to assess the impact of the KD on blood insulin levels and lipid profiles in overweight and obese individuals. Understanding KD's influence on these biomarkers is essential for optimizing its application as a therapeutic dietary strategy within clinical and community health contexts.

1.1.Aim of the study

The aim of the study was to assess the impact of the KD on blood insulin levels and lipid profiles in overweight and obese individuals.

1.2.Research Question

Table 1 summarizes the key elements of the research question *"What are the effects of the ketogenic diet on blood insulin levels and lipid profiles in overweight and obese individuals?"* in accordance with the PICOS criteria.

Table 1: PICOS framework

PICOS Component	Description
Population (P)	Adults aged ≥ 18 years of age to ≤ 65 years with a BMI ≥25 kg/m² (overweight) or ≥30 kg/m² (obese).
Intervention (I)	Ketogenic diets, including Classical KD, Modified Atkins Diet (MAD), Low Glycemic Index Treatment (LGIT), Medium-Chain Triglyceride (MCT) diets, and other variations designed to induce ketosis.
Comparison (C)	Placebo, usual care, or non-ketogenic diets.
Outcomes (O)	Changes in blood insulin levels, lipid profiles (including total cholesterol, LDL, HDL, triglycerides) and weight
Study Design (S)	Primary interventional studies were included, as well as studies where data underwent secondary analysis related to ketogenic diet

	adherence, even if this was not the initial focus. Case studies, letters, reviews, and conference abstracts were excluded.

2. Method

2.1. Design

A systematic review was conducted in accordance with the PRISMA 2020 guidelines (Page et al, 2021), utilizing both the checklist and flow diagram to enhance methodological quality and reporting transparency. Additionally, the PICOS framework (Population, Intervention, Comparison, Outcomes, and Study design) was utilized to systematically structure the research question and guide the selection and synthesis of evidence. This framework facilitated a focused and comprehensive examination of the effects of the KD.

2.2. Participants

The inclusion criteria included: Adults aged $\geq$ 18 years to $\leq$ 65 years with a BMI of 25.0-29.9 kg/m^2 or above who were eligible for the study. Interventions included any KD variation intended to cause nutritional ketosis. Placebos, normal care, and non-ketogenic dietary regimens were used as comparators. To measure metabolic outcomes, studies included at least a seven-day intervention and follow-up period, and studies that compared various KD regimens were also included.

Exclusion criteria included studies that involve children, teens, pregnant or nursing women, the elderly, any individual with present or former eating disorders, and those taking insulin or lipid-lowering medications. Furthermore, studies with no significant results for blood insulin or lipid profiles, as well as non-primary research such as reviews, conference papers, case reports, letters, duplicates, and in vitro studies, were excluded.

2.3 Study Selection Strategy

A comprehensive search of the literature was performed to find studies that investigated the effect of ketogenic diets on blood insulin levels and lipid profiles in overweight and obese adult populations. The search was completed in August 2024 and used the following electronic databases: MEDLINE, PubMed, ClinicalTrials.gov, the World Health Organization International Clinical Trials Registry Platform (ICTRP), Web of Science Core Collection, Google Scholar, and the Egyptian Knowledge Bank. This systematic review included English-language papers that investigated the effects of the KD on blood insulin levels and lipid profiles in adults.

To improve sensitivity and eliminate publication bias, we manually reviewed the reference lists of all included studies to find additional relevant articles. The search technique used Medical Subject Headings (MeSH) and free-text keywords specific to each database to locate material on KD, insulin management, and lipid metabolism in overweight and obese individuals.

Search terms were developed using the PICOS framework and included:

- Population: ("obesity"[MeSH Terms] OR "overweight"[MeSH Terms] OR obesity[tiab] OR overweight[tiab] OR "body mass index"[MeSH Terms] OR BMI[tiab]) AND ("adult"[MeSH Terms] OR adult*[tiab])
- Intervention: ("ketogenic diet"[MeSH Terms] OR "low-carbohydrate diet"[MeSH Terms] OR "ketogenic diet"[tiab] OR "very low carbohydrate diet"[tiab] OR "VLCD"[tiab] OR "nutritional ketosis"[tiab] OR "modified Atkins diet"[tiab] OR "MCT diet"[tiab])

- Outcomes: (“insulin”[MeSH Terms] OR “insulin resistance”[MeSH Terms] OR insulin[tiab] OR “HOMA-IR”[tiab] OR “fasting insulin”[tiab]) AND (“lipids”[MeSH Terms] OR “cholesterol”[MeSH Terms] OR “lipid profile”[tiab] OR “LDL”[tiab] OR “HDL”[tiab] OR “triglycerides”[tiab] OR “dyslipidemia”[MeSH Terms])
- Study Design: (“randomized controlled trial”[Publication Type] OR “clinical trial”[Publication Type] OR “intervention study”[tiab] OR “RCT”[tiab] OR “trial”[tiab]).

Search terms were tailored for each database. To focus on titles and abstracts in PubMed and MEDLINE, MeSH keywords were employed alongside field tags (for example, [tiab]). To enhance retrieval, Google Scholar used a broader search syntax without any filters.

Boolean operators, truncation, and phrase searching were utilized to refine and improve the search results. Filters were applied across databases for language (English), population (human adults), and study type (interventional studies) as necessary to ensure compliance with the inclusion criteria.

Following the search process, two independent reviewers (AA and AI) carried out the study selection using a two-phase screening approach. During the initial phase, titles and abstracts were assessed for their relevance to the objectives of the review.

In the second phase, full-text articles from potentially eligible studies were retrieved and evaluated against the predetermined inclusion and exclusion criteria. Any discrepancies between the reviewers were resolved through discussion. If consensus could not be reached, a third reviewer was consulted to facilitate agreement.

2.4.Study Selection Process

A total of 112 records were identified through electronic database searches, and 19 additional records were retrieved from other sources. Following the removal of 12 duplicate records, 119 records remained for screening based on title and abstract. Of these, 32 records were excluded due to lack of relevant or original data (n = 17), use of animal models (n = 1), or being review articles (n = 14).

A total of 87 full-text articles were assessed for eligibility. Among these, 82 articles were excluded for the following reasons: use of dietary interventions other than ketogenic diets (n = 14), studies conducted in populations other than adults (n = 19), irrelevance to the study objectives (n = 21), or failure to report adequate outcome data (n = 28). Ultimately, 5 studies met all eligibility criteria and were included in the final systematic review. The complete study selection process is illustrated in the PRISMA flow diagram (Figure 1).

2.4.1. Screening Process

The screening process was carried out systematically to ensure the precise identification of eligible studies. Initially, all retrieved study titles were reviewed by one evaluator (AA). Titles that evidently did not fulfil the inclusion criteria—such as those pertaining to pediatric populations, older adults, pregnant or lactating women, or non-ketogenic dietary interventions—were excluded. Abstracts were reviewed when eligibility could not be determined from the title alone.

Abstracts deemed potentially relevant were further assessed by the review team. In cases of uncertainty, the full-text articles were retrieved and reviewed in consultation with co-investigators (AA and AI). Final eligibility was confirmed by two independent reviewers (AI and ER) based on the predefined inclusion and exclusion criteria. Reference lists of the included studies were manually searched to identify additional potentially eligible studies. For these, steps B through D were repeated.

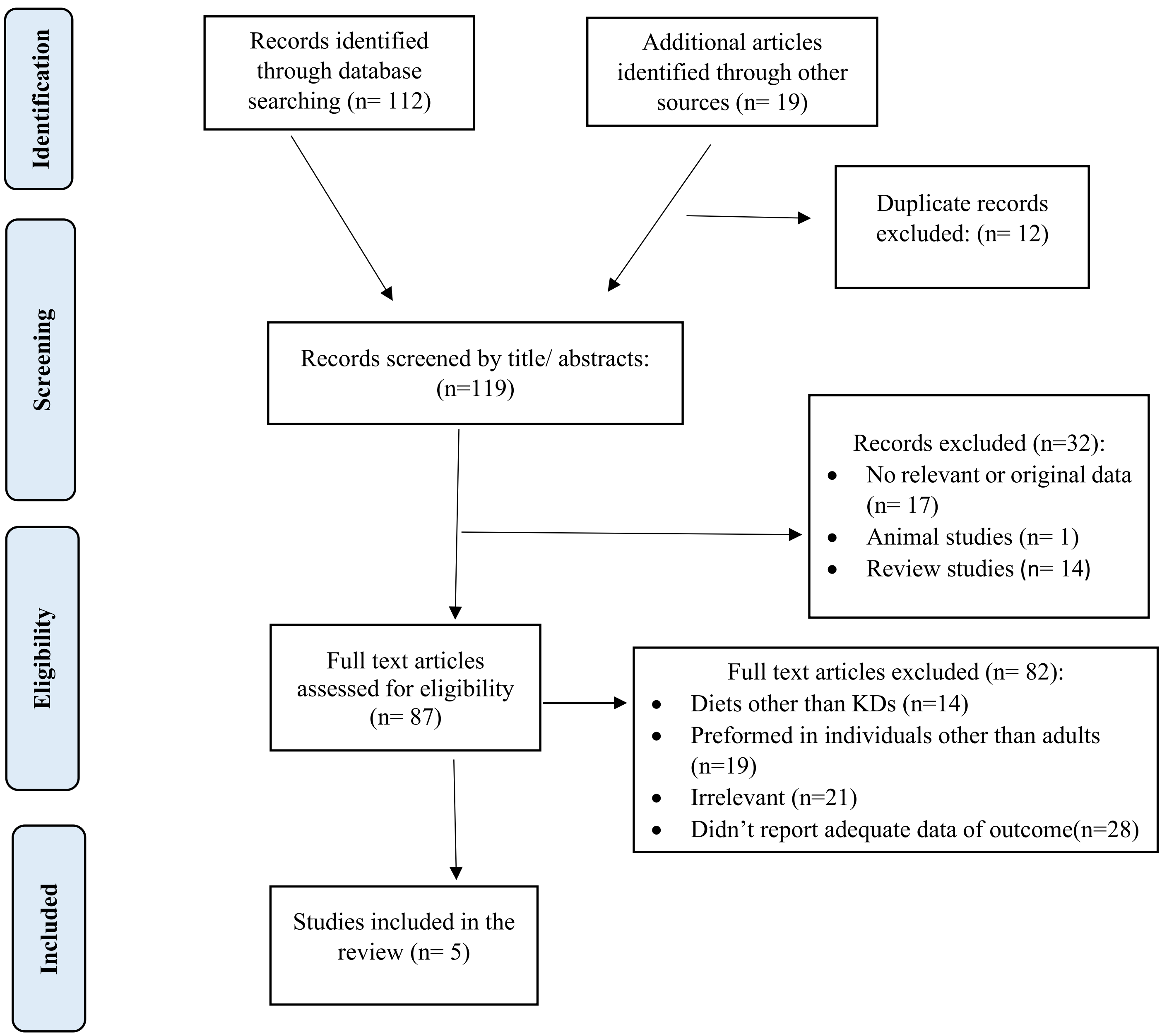

Figure 1. *PRISMA 2020 flow diagram*

2.4.2. Study Characteristics

A total of five studies met the inclusion criteria and were included in this systematic review. All studies were published in English and conducted across various countries, including Italy, the United States, Spain, and Poland. Four studies followed a randomized controlled trial (RCT) design, while one employed a non-randomized interventional design. The intervention periods ranged from 4 weeks to 2 years, with ketogenic diet protocols compared to either standard low-calorie diets, usual care, or non-restrictive diets.

The ketogenic interventions varied in caloric and macronutrient composition but consistently emphasized very-low-carbohydrate intake to induce nutritional ketosis. Some studies applied structured dietary regimens (e.g., Low-Calorie Ketogenic Diet [LCKD] or Very-Low-Calorie Ketogenic Diet [VLCKD]), while others incorporated digital tools, such as app-based delivery with acetone breath biofeedback. Control groups were assigned standard low-fat diets, unrestricted diets, or calorie-restricted non-ketogenic diets. The detailed characteristics of the included studies are presented in Appendix **Table 2**.

Participant Characteristics

All included studies recruited adult participants aged ≥ 18 to ≤ 65 years, with reported mean ages ranging from 39 to 58.1 years. Sample sizes varied considerably, ranging from 32 to 242 participants. The body mass index (BMI) of participants, as reported across studies, generally fell within the overweight to obese range, though exact BMI values were not uniformly reported in all studies. All trials included both male and female participants, although only one study provided detailed sex-disaggregated data. Dropout rates ranged from 8% to 25% in the intervention groups and from 10% to 46% in the control groups, reflecting variations in study duration and participant adherence.

2.4.3 Data Extraction

Relevant data were systematically extracted using a standardized format. Two reviewers (AA), (AI) extracted key study characteristics, including participant demographics, study design, sample size, age range, BMI range, type and protocol of the ketogenic diet intervention, duration of the intervention, follow-up period, and reported primary and secondary outcomes such as changes in insulin levels and lipid profiles. The main findings of each study were also recorded. Third reviewer (ER) cross-verified all extracted data to ensure completeness, consistency, and accuracy. The data extraction template used is presented in Appendix **Table 2**.

2.5. Quality Assessment

The methodological quality of the included studies was assessed by two independent reviewers (AA and AI) using the Scottish Intercollegiate Guidelines Network (SIGN) checklist (Mackay, Gall, Jampana, Sleith, & Lip, 2025). The first reviewer performed the initial appraisal, and the second verified all assessments. Any discrepancies were resolved through discussion to reach a consensus. The assessment of methodological quality showed significant differences within the included studies. Schiavo et al. (2021), Lyman et al. (2022), and Falkenhain et al. (2022) used standardized dietary programs, detailed data collection processes, and addressed any potential bias, which increased the reliability of their findings. Sajoux et al. (2019) established objectives and acceptable criteria, but did not assess scientific quality or publication bias, resulting in a moderate risk of bias. Michalczyk, Klonek, Maszczyk, & Zajac (2020) stated the research question and baseline characteristics, but did not give clear processes for study selection or bias assessment, consequently reducing the validity of the results. All research reported conflicts of interest and directly contributed to answering the review question. Appendix **Table 3**.

3. Results

Relationship Between Ketogenic Diets, Weight Loss, Insulin Regulation, and Blood Lipid Profiles

This review found that KD consistently produced better results in weight loss, insulin management, and lipid profile improvement than non-ketogenic methods.

Weight Loss

All five trials showed that KD produced higher weight reduction than control interventions. In Luigi Schiavo's RCT, individuals following a ketogenic diet showed a significant weight loss from 112.0 ± 9.2 kg to 91.8 ± 9.6 kg over four weeks. The control group reduced weight from 106.5 ± 8.7 kg to 84.1 ± 7.6 kg, whereas the ketogenic group had a more significant reduction (Schiavo et al, 2021). In contrast, the long-term study by Kade S. Lyman, a two-year intervention, demonstrated a significant mean weight loss of -12.3 ± 12.0 kg and a BMI reduction of -4.5 ± 3.2 in the ketogenic group. Moreover, the control group experienced minimal change, with a weight loss of only -1.4 ± 4.8 kg and BMI decrease of -0.4 ± 1.6, highlighting the sustained efficacy of ketogenic diets over time (Lyman, et al, 2022).

Sajoux reported that participants on a very-low-calorie ketogenic diet (VLCKD) reduced their weight from 96.0 ± 16.3 kg to 76.6 ± 11.1 kg, while those on a low-calorie diet (LCD) showed a smaller decrease from 93.0 ± 13.2 kg to 87.6 ± 12.3 kg. In addition, Kaja Falkenhain observed more modest effects; the ketogenic group's weight declined from 94.7 ± 17.1 kg to 89.1 ± 16.3 kg, while the control group changed from 94.1 ± 14.7

kg to 91.6 ± 14.2 kg. Although both groups lost weight, the ketogenic group had a more favorable outcome (Falkenhain et al., 2022).

Lastly, Małgorzata Michalczyk demonstrated notable decreases, with body weight reducing from 89.08 ± 14.68 kg to 75.36 ± 13.47 kg and BMI declining from 32.52 ± 4.50 to 27.47 ± 3.92. On the other hand, the control group showed slight weight and BMI changes, reinforcing the effectiveness of the ketogenic approach (Michalczyk et al.,2020).

Insulin Regulation

Consistently reduced fasting insulin levels and improved insulin sensitivity. In Schiavo's trial, insulin levels decreased markedly from 11.4 ± 7.9 µIU/mL to 4.3 ± 1.9 µIU/mL in the ketogenic group, while the control group declined from 8.9 ± 5.4 µIU/mL to 5.3 ± 2.3 µIU/mL. The higher reduction in the intervention group indicates better insulin control associated with ketosis (Schiavo et al, 2021). Additionally, Lyman's long-term study showed similar improvements, with insulin decreasing from 25.8 ± 15.3 µIU/mL to 13.2 ± 8.7 µIU/mL in the ketogenic group, compared to a slight reduction in the control group 24.3 ± 16.1 µIU/mL to 22.6 ± 14.5 µIU/mL, suggesting that prolonged dietary adherence enhances insulin sensitivity (Lyman et al, 2022).

Sajoux evaluated insulin resistance using the HOMA-IR index, showed a substantial improvement in the ketogenic group from 4.43 ± 2.37 to 1.71 ± 0.57. The low-calorie control group improved from 3.28 ± 1.54 to 1.98 ± 2.31, suggesting the additional advantage of nutritional ketosis beyond caloric restriction alone (Sajoux et al, 2019). While, In Falkenhain's trial, insulin reductions were minimal, with the ketogenic group showing a larger relative decline −23%; 95% CI: −36 to −8 compared to the control group

−16%; 95% CI: −31 to 2, consistent with previous evidence of mild to moderate improvements in insulin control even over short durations (Falkenhain, et al, 2022).

In Michalczyk's study, fasting insulin levels reduced significantly in the ketogenic group, from 14.12 ± 4.75 μIU/mL to 6.61 ± 2.63 μIU/mL, while the control group's levels remained largely unchanged (13.78 ± 4.21 μIU/mL to 13.80 ± 3.63 μIU/mL), confirming a clear insulin-lowering effect of the intervention (Michalczyk, et al, 2020).

Blood Lipid Profiles

Improvements in blood lipid parameters, particularly in triglycerides and HDL cholesterol, were frequently observed in ketogenic groups. In Schiavo's study, triglycerides dropped from 220 ± 36 mg/dL to 114 ± 15.2 mg/dL, total cholesterol decreased from 226 ± 15.6 mg/dL to 164 ± 43.4 mg/dL, and LDL cholesterol fell from 147 ± 25.3 mg/dL to 78.2 ± 11.4 mg/dL. HDL levels increased from 38.5 ± 7.6 mg/dL to 71 ± 8.3 mg/dL, showing an overall favorable shift in lipid profile. Interestingly, HDL rose even more in the control group, from 33.8 ± 8.3 mg/dL to 83 ± 6.5 mg/dL, suggesting potential variability in response (Schiavo et al, 2021).

Lyman reported a reduction in triglyceride levels from 204.6 ± 120.5 mg/dL to 156.8 ± 102.4 mg/dL in the ketogenic group. In contrast, the control group exhibited a much smaller improvement, 195.7 ± 130.3 mg/dL to 189.4 ± 129.2 mg/dL, supporting a triglyceride-lowering benefit of the ketogenic diet (Lyman et al, 2022). Additionally, Sajoux did not report detailed lipid outcomes; however, the significant reduction in HOMA-IR implies possible improvements in lipid metabolism, as insulin resistance is often associated with dyslipidemia (Sajoux et al, 2019).

In Falkenhain's study, HDL cholesterol levels remained largely unchanged in both groups (around 5.2–5.3 mmol/L), and no notable lipid effects were observed, likely due to the short duration and moderate dietary intensity (Falkenhain et al, 2022). While, Michalczyk observed significant lipid improvements. Triglycerides in the ketogenic group decreased from 213.45 ± 63.60 mg/dL to 129.13 ± 46.23 mg/dL, while HDL increased from 36.71 ± 4.42 mg/dL to 44.14 ± 5.07 mg/Dl (Michalczyk et al, 2020). Conversely, the control group exhibited a slight increase in triglycerides and no improvement in HDL, demonstrating the superiority of the ketogenic intervention in lipid regulation.

4. Discussion

The increasing burden of obesity has driven interest in dietary strategies that not only promote weight loss but also improve metabolic health. Among these KD, which provides substantial benefits in managing obesity, hyperlipidemia, and certain cardiovascular risk factors, particularly over the short- to medium-term. While numerous dietary strategies have been proposed for weight reduction, KD is often regarded as one of the most effective approaches for improving obesity outcomes (Patikorn et al., 2023).

The findings of this review provided strong evidence that ketogenic diets are effective in achieving meaningful reductions in body weight and BMI. In particular, the studies reviewed demonstrated both rapid short-term reductions and sustained long-term benefits, highlighting the adaptation of KD as a dietary approach. These results are in agreement with Castellana et al. (2020), who confirmed through a meta-analysis that very-low-calorie ketogenic diets induce significant and rapid weight loss, particularly when applied in structured programs. Moreover, Bueno et al. (2013) emphasized that KD remains superior to low-fat diets in maintaining weight reduction over extended periods, supporting the sustained outcomes observed in Lyman's two-year intervention. However, some analyzes caution that differences in adherence and long-term sustainability may influence outcomes. Ge et al. (2020) found that while KD was more effective than low-fat diets in the short term, differences narrowed after one year, suggesting adherence challenges over time. While Falkenhain's study showed more modest results, this may reflect such adherence variability, underscoring the importance of professional supervision to ensure the effectiveness of KD.

Regarding insulin regulation, the studies showed that KD improves insulin sensitivity and reduces fasting insulin levels. These findings are consistent with Sajoux's results using HOMA-IR, which confirmed reductions in insulin resistance during KD. Comparable outcomes were reported by Zhou, Wang, Liang, & Chen (2022), who concluded in a meta-analysis that KD enhances glycemic control and reduces markers of insulin resistance in overweight and diabetic patients. Such improvements are attributed to the carbohydrate-restricted nature of KD, which minimizes postprandial glucose excursions and lowers the demand for insulin secretion (Szukiewicz, 2023). Furthermore, a systematic review by Goldenberg et al. (2021) reported that low-carbohydrate and ketogenic diets achieved greater improvements in HbA1c in patients with type 2 diabetes compared to higher-carbohydrate diets, especially in the first six months. Nevertheless, not all studies fully support these benefits. Snorgaard, Poulsen, Andersen, and Astrup (2017) highlighted that while KD improves glycemia, the effect may diminish over longer durations, partly due to waning adherence. Similarly, Falkenhain's trial revealed only modest benefits, possibly due to lower adherence and the shorter intervention period, indicating that both intensity and duration are critical to achieving substantial metabolic improvements.

Regarding lipid profile changes, the reviewed studies demonstrated favorable effects on triglycerides and HDL cholesterol, while the impact on LDL cholesterol was less consistent. These findings are supported by Suarez, Velasquez, and Ahmed (2024), who observed consistent reductions in triglycerides and improvements in HDL, but variable effects on LDL across KD interventions. Similarly, Vekic, Stefanovic, & Zeljkovic (2023) stressed that lipid responses to KD are highly dependent on dietary fat composition and individual variability. The inconsistency in LDL findings, as observed in Lyman's study, should therefore be interpreted with caution, as patient-specific factors and dietary adherence play an important role. More recently, Popiolek-Kalisz (2024) emphasized that while KD can be cardio-protective through HDL and triglyceride improvements, the possibility of LDL elevations in some individuals highlights the need for careful monitoring. The inconsistency in LDL findings, as observed in Lyman's study, should therefore be interpreted with caution, as patient-specific factors, genetic predisposition, and dietary adherence play an important role. Nevertheless, the overall lipid profile changes suggest that KD can contribute to cardiovascular risk reduction when carefully monitored.

5. Conclusion and Recommendations

The findings of this review support the therapeutic potential of ketogenic diets in improving weight, insulin sensitivity, and lipid parameters in obese and overweight adults. While there was consistent evidence for reductions in triglycerides and improvements in HDL, the effects on LDL remain variable and warrant further investigation. Moreover, adherence and supervision appear to be key determinants of success, highlighting the importance of integrating KD within structured, evidence-based clinical practice

6. Declaration of Conflicting Interests

The authors declare that there are no conflicts of interest.

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