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The Literature Review on the Effects of Different Dietary Intervention Patterns on Blood Glucose Levels in Patients with Type 2 Diabetes

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ABSTRACT

Diabetes prevention and control is a huge public health challenge worldwide. The number of newly diagnosed cases of Type 2 diabetes continues to increase significantly each year, and the number of confirmed cases also increases each year. Intervention and management strategies for type 2 diabetes are closely linked to dietary patterns. Although existing research has confirmed that certain dietary patterns play a role in the prevention of type 2 diabetes, improving blood sugar control, and reducing the risk of the disease, there are still several dietary approaches whose mechanisms remain unclear or lack sufficient clinical evidence to support them. Their long-term effects and applicability require further investigation. Summarizing the documentary evidence related to the occurrence and development of Type 2 diabetes mellitus in various nutritional techniques, this paper proposes a theoretical basis for more scientific and effective clinical management and optimization of patient nutrition.

KEYWORDS

Dietary patterns; Type 2 diabetes; Blood glucose; Literature review

1. INTRODUCTION

As per the 10th edition of the International Diabetes Federation (IDF) Global Diabetes Atlas, the number of individuals with diabetes was 537 million in 2021. This number is expected to reach about 643 million by 2030 and rise further to 783 million by 2045 [1]. Facing the persistent expansion of the diabetes epidemic, strengthening early diagnosis mechanisms and improving global prevention and treatment systems have become critical. Type 2 diabetes constitutes the primary group of diabetes patients. In the development of type 2 diabetes mellitus (T2DM), obesity serves as a key factor, showing a strong connection between the two conditions. Whilst sustained excessive energy intake remains the core cause of poor glycaemic control among T2DM patients.Strict blood sugar management in the early stages of diabetes aids in reducing the risk of subsequent complications. In daily life, adopting healthy dietary patterns and meal structures can contribute to glycaemic control and committed to preventing the onset of type 2 diabetes [2].

Although multiple dietary pattern studies have demonstrated short-term positive effects on glycaemic control in T2DM, significant controversy persists regarding their long-term safety, sustainability, and applicability across diverse populations. Further high-quality, long-term research is required to provide evidence-based support. This review analyzed the impact of several dietary methods that have been widely applied in the last five years on blood sugar levels in patients with T2DM:

Mediterranean diet, herbal diet, low-carbon diet, Ketogenic model, intermittent fasting and Eastern diet.

2. MEDITERRANEAN DIET

2.1. Definition and Mechanisms of the Mediterranean Diet

The Mediterranean diet is a plant-based dietary pattern originating from Mediterranean coastal nations (Greece, Spain, southern Italy, etc.). Characterised by dietary diversity, it emphasises ample consumption of fruit, vegetables, and whole grains. Complementary components include whole grains, nuts, extra virgin olive oil, moderate use of herbs and spices, fish, and limited red meat. Moderate red wine consumption is also permitted.

This dietary pattern is rich in monounsaturated fatty acids, dietary fibre, antioxidants, and polyphenolic compounds. The monounsaturated fats in the Mediterranean diet help lower LDL cholesterol while raising HDL cholesterol, thereby reducing disease risk [3]. Furthermore, the high dietary fibre content enhances insulin sensitivity and lowers postprandial blood glucose and lipid levels [4]. Extra virgin olive oil contains polyphenols that have strong antioxidant and anti-inflammatory properties, can inhibit inflammation and oxidative stress response, and after termination of the associated signaling pathway, showed obvious results in alleviating chronic mild inflammation associated with diabetes.

2.2. Mediterranean Diet and Type 2 Diabetes

The Mediterranean diet is acclaimed as the world's optimal dietary pattern. As its influence and popularity continue to grow, numerous researchers have explored its relationship with type 2 diabetes. Zhang Kuo et al. (2022) conducted a meta-analysis of 9 high-quality randomized controlled trials and found that the Mediterranean diet has the following benefits: it can significantly reduce fasting blood sugar and blood sugar levels within 2 hours of meals in patients with type 2 diabetes [5]. The intervention proves most effective when sustained for ≥12 months, positioning it as a viable long-term dietary strategy for diabetes prevention and management. In the same year, Peyman Sarsangi et al. (2022) summarized data from 16 prospective cohort studies. With the help of random effects models and two-stage dose-dependent models, it has been shown that improving the results of the Mediterranean diet is linearly associated with a reduced risk of developing Type 2 diabetes mellitus. That is, with each 1-point increase in the score of the Mediterranean diet, the risk of developing Type 2 diabetes in humans will be significantly reduced by 3%; and compared to people with low eating habits, the likelihood of developing diabetes in people with high levels of nutrition decreases by 17% [6]. This finding provides precise quantitative indicators for dietary guidance in the field of public health. Xing Zheng et al. (2024) that synthesized data from 1,371 patients with type 2 diabetes across seven RCTs. The analysis revealed that the primary benefits of the Mediterranean diet are not reflected in lipid regulation; in other words, its value is more focused on the effective control of blood sugar levels [7].

3. PLANT-BASED DIETS

3.1. Definition and Mechanisms of Plant-Based Diets

Plant-based diets prioritise plant-derived foods as the primary dietary source. They may be strictly vegetarian or include minimal animal products, emphasising the reduction or avoidance of animal-based foods [8].

The positive impact of a plant-based diet on blood sugar is primarily reflected in its "low energy, high fiber" characteristics, which help reduce weight and decrease visceral fat, ultimately improving the body's insulin sensitivity. Dietary fibre slows glucose absorption and stimulates short-chain fatty acid (SCFA) production. Antioxidants and anti-inflammatory nutrients mitigate inflammation. The synergistic effects of low saturated fat, high unsaturated fat, phytosterols, and micronutrients improve lipid metabolism, ultimately lowering blood glucose levels and reducing complication risks.

3.2. Plant-Based Diets and Type 2 Diabetes

A study conducted by Xiu Yang et al. (2021) in Henan, China, tracked approximately 38,000 rural adults. The results revealed that the higher the adoption of plant-based diets, the lower the risk of developing type 2 diabetes; in other words, there is a clear negative correlation between the two. This conclusion contributes crucial local data to the "Chinese solution" for diabetes prevention [9]. Given the substantial proportion of fruits and vegetables in plant-based diets, Che Anis Jauharah Che Mohd Zin et al. (2022) synthesised multiple studies indicating that polyphenols in fruits and vegetables (e.g., resveratrol, anthocyanins) can lower fasting blood glucose [10]. The primary mechanisms involve enhancing insulin signalling and reducing insulin resistance. However, the effects vary significantly between different polyphenols, necessitating further clinical trials for validation. A controlled study by Yang Shushu et al. (2024) indicates that individuals with a higher Healthy Plant-Based Diet Index have a significantly reduced risk of developing type 2 diabetes, lowered by 43% [11]. In contrast, those with a higher Unhealthy Plant-Based Diet Index experience an increased risk of the disease by 42%. Regarding healthy plant-based diets, a meta-analysis by Ali Nikparast et al. (2025) analyzed a number of data and showed that adhering to healthy plant-based habits can lead to a 19% reduction in diabetes incidence and an increase in risk by about 10% [12]. In contrast, focusing on unhealthy plant-based foods may increase this risk by 10%. One should focus on choosing healthy plant-based foods in order to truly convert these benefits into health gains. Based on this, it can be inferred that plant-based dietary patterns exhibit certain restrictive characteristics. The impact of a plant-based diet on the risk of type 2 diabetes primarily depends on the quality of the diet, rather than simply being based on it being plant-based foods.A health-oriented plant-based diet shows protective effects, whereas the consumption of unsuitable plant foods may increase potential risks. Promoting plant-based diets must therefore prioritize "healthiness" to realise their public health value [13].

4. LOW-CARBOHYDRATE DIETS

4.1. Definition and Mechanism of Low-Carbohydrate Diets

The core strategy of a low-carbohydrate diet significantly reduces the intake of traditional carbohydrates such as rice, wheat, and starchy foods. It emphasizes a nutritional combination based on protein-rich foods, healthy fats, and large amounts of fresh vegetables. The aim is to optimize energy sources and metabolic pathways through this adjustment. The low-carbohydrate diet strategy focuses on reducing the intake of sugars and starchy foods to regulate blood sugar levels and optimize metabolic function.

By reducing carbohydrate intake, this diet lowers glycaemic load, decreases insulin requirements, and enhances insulin sensitivity, thereby directly lowering blood glucose levels [14]. Concurrently, it reduces hepatic and pancreatic fat deposition, alleviates the burden on pancreatic beta cells, improves their function, and diminishes glucotoxicity. These effects further enhance glycaemic control and alleviate diabetes.

4.2. Low-Carbohydrate Diets and Type 2 Diabetes

In recent years, dietary interventions for type 2 diabetes have increasingly focused on low-carbohydrate approaches. Akinori Yaegashi et al. (2023), utilising the JACC cohort, found that higher low-carbohydrate diet scores were associated with reduced type 2 diabetes risk in Japanese men (OR=0.64), particularly for plant-based low-carbohydrate patterns (OR=0.51). The association was not significant in women [15]. For the Japanese population, a low-carbohydrate, high-fat, high-protein diet does not constitute a significant risk factor for diabetes. In addition, several researchers have conducted limited studies on the effects of low-carbohydrate diet strategies on blood glucose control in patients with type 2 diabetes, and based on these findings, they have developed corresponding theoretical insights. Three controlled studies from China indicate that a 30% low-carbohydrate diet effectively lowers blood glucose in type 2 diabetes patients without increasing hypoglycaemic risk, demonstrating favourable clinical efficacy [16-18].

5. KETOGENIC DIET

5.1. Definition and Mechanism of the Ketogenic Diet

The ketogenic diet refers to a nutritional approach that is low in carbohydrates, moderate in protein, and high in fats. The ketogenic dietary strategy aims to mimic short-term fasting conditions, prompting the body to preferentially consume fat for energy and thereby inducing ketone production as an alternative metabolic fuel source.

By drastically restricting carbohydrate intake, the ketogenic diet eliminates the primary source of glucose, compelling the body to shift from glucose-based energy production to fat-based energy production. This process not only directly lowers blood glucose levels but also significantly reduces insulin requirements by enabling the liver to metabolise fat into ketone bodies as an alternative energy source to glucose. Concurrently, the accompanying weight reduction and decrease in hepatic fat contribute to improved insulin resistance and enhanced insulin sensitivity. This multi-pathway synergy facilitates stable glycaemic control in individuals with type 2 diabetes.

5.2. The Ketogenic Diet and Type 2 Diabetes

The study by Mohamed Rafiullah et al. (2022) conducted a meta-analysis to compare and evaluate the differences in effects between very low-carbohydrate ketogenic diets and traditional dietary recommendations in patients with type 2 diabetes [19]. The research findings present a certain degree of uncertainty and divergence. The results were inconclusive. Over a 6-month intervention, a very low-carbohydrate ketogenic diet showed notable efficacy in managing blood sugar levels and promoting weight loss among patients with obesity and diabetes. However, at 12 months, the overall effect showed no significant difference from the control group, with evidence quality rated as moderate to low. Poor patient adherence to strict carbohydrate restriction remains the primary challenge for the very low-carbohydrate ketogenic diet. Current evidence is insufficient to routinely recommend this diet for clinical management.

6. INTERMITTENT FASTING

6.1. Definition and Mechanisms of Intermittent Fasting

Intermittent fasting, also termed time-restricted eating, is a dietary pattern involving periodic alternation between eating and fasting periods. It typically modifies metabolic function by adjusting meal timing rather than food composition, thereby regulating blood glucose, lipid, and blood pressure levels.

By periodically extending fasting periods, intermittent fasting reduces hepatic glycogen stores and decreases gluconeogenesis, thereby initially lowering fasting blood glucose. It subsequently enhances insulin receptor sensitivity, alleviates β-cell burden, and improves postprandial glucose control. Concurrently, it promotes fat oxidation, reduces visceral adipose tissue, and diminishes inflammation and lipotoxicity, indirectly stabilising blood glucose levels.

6.2. Intermittent Fasting and Type 2 Diabetes

Research examining intermittent fasting interventions for glycaemic control in type 2 diabetes patients includes both standalone intermittent fasting studies and combined approaches pairing intermittent fasting with specific dietary patterns. Current evidence supports intermittent fasting as a feasible short-term dietary intervention strategy, though its long-term benefits remain limited. Further large-scale, standardised studies are required to validate its advantages for this population, with a focus on long-term maintenance strategies. Zhang Jiapeng et al. (2021) conducted a meta-analysis incorporating seven randomised controlled trials (RCTs), finding that intermittent fasting significantly reduced body weight (MD = -2.75 kg, $P < 0.00001$) and low-density lipoprotein cholesterol (MD = 0.58 mg/dL, $P < 0.00001$) in overweight or obese patients. $P < 0.0001$) in overweight or obese individuals [20]. However, no statistically significant effects were observed on glycaemic control (SMD = −0.56, $P = 0.19$) or fat-free mass. The conclusion indicated that intermittent fasting demonstrates efficacy in weight reduction and lipid regulation, though its hypoglycaemic effects remain inconclusive, necessitating further high-quality research. Suresh K Sharma et al. (2023) conducted a meta-analysis incorporating 11 studies, revealing no significant difference between intermittent fasting and conventional dietary patterns in reducing glycated haemoglobin (SMD -0.08, p=0.19) or fasting blood glucose (SMD 0.06, p=0.69) in type 2 diabetes patients [21]. Whilst intermittent fasting may be suitable for preventive interventions in prediabetes, it offers no superiority over conventional diets for glycaemic control in diagnosed type 2 diabetes patients. That same year, Xiao Yang et al. (2023) confirmed through a randomised controlled trial that Chinese medicine-based nutritional therapy, grounded in intermittent fasting principles, significantly promotes remission in type 2 diabetes [22]. This study confirms that traditional Chinese medicine nutrition therapy demonstrates significant clinical efficacy in patients with diabetes, effectively promoting the alleviation of their condition over a period of at least one year. Miri Ann Pelc (2023) outlined a personalized approach integrating a low-carbohydrate diet with intermittent fasting, allowing a type 2 diabetes patient to attain remission under medical oversight and cease all hypoglycemic medications [23]. Although the American Diabetes Association has not explicitly endorsed intermittent fasting, this dietary combination may represent a safe and effective remission strategy, offering novel perspectives for clinical practice. However, caution is warranted regarding hypoglycaemia, ketosis risks, and adherence challenges; implementation should be individualised under medical supervision. Current evidence supports its short-term efficacy, though long-term safety and benefits warrant further investigation.

7. ORIENTAL DIET

7.1. Definition of the Oriental Diet

The Oriental dietary pattern, also termed the Oriental healthy dietary pattern, is a healthy eating model based on the southeastern coastal regions of China (including Zhejiang, Shanghai, Fujian, and Jiangsu) [24]. The 2022 Chinese Dietary Guidelines state that the Oriental diet is characterised by light, low-salt preparation and dietary diversity, featuring abundant fruits, vegetables, and a variety of fish and shellfish.

7.2. Oriental Diet and Type 2 Diabetes

The Oriental dietary pattern exhibits certain geographical limitations, as its characteristics derive from local residents' eating habits. Currently, several Chinese researchers have focused their dietary studies on blood sugar control in patients with Type 2 diabetes on the Oriental diet model. The Eastern diet, based on diverse and high-quality plant-based foods, demonstrates superior comprehensive improvement in metabolic indicators and may serve as an effective dietary intervention strategy for type 2 diabetes patients.

Zhang Xuanhan et al. (2025) conducted a systematic analysis of the relationship between the Eastern diet and type 2 diabetes, confirming that this dietary pattern shows positive effects in improving patients' blood sugar, blood lipids, and blood pressure [25]. The underlying mechanism involves enhancing insulin sensitivity, regulating lipid metabolism, alleviating oxidative stress, and facilitating weight management. These mechanisms work together to show a positive impact on the prevention and treatment of diabetes as well as improving the quality of life for patients. It constitutes a sustainable dietary plan that aligns with the eating culture of Chinese residents.

8. CONCLUSION AND OUTLOOK

Dietary intervention forms the basis of type 2 diabetes management.The Mediterranean diet and its long-term safety and cardiovascular benefits related to plant-based diets are primarily attributed to their anti-inflammatory properties and high fiber content, which show significant advantages in cardiovascular health studies. Methods such as ketogenic diet, low-carbohydrate diet and intermittent fasting aim for short-term hypoglycemia and weight loss, which has a positive impact. However, it is crucial to comprehensively assess their long-term safety, feasibility of sustained adherence, and potential health risks.At the same time, exploring and integrating dietary patterns suitable for the characteristics of Eastern populations is undoubtedly a complex and far-reaching task that requires in-depth research and extensive discussion. Future dietary management for diabetes must transcend singular dietary approaches, integrating the strengths of diverse dietary patterns with precision nutrition principles to develop personalised, sustainable dietary intervention strategies. This will maximise both glycaemic control and overall health benefits. Clinical practice should adhere to individualised principles, carefully weighing benefits against risks to achieve long-term, safe, and effective glycaemic management.

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