

## SYSTEMATIC REVIEW

# The Effectiveness of Low-Carbohydrate Diet on The Type 2 Diabetes Mellitus Patients' Quality of Life Improvement: A Systematic Review

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## ABSTRACT

**Introduction:** This is a systematic review of articles that focus on a low-carbohydrate diet as an intervention for Type 2 Diabetes Mellitus patients. Knowledge of proper nutritional intake is essential in managing the disease and improving the patients' quality of life. Therefore, this study aims to determine the benefits of a low-carbohydrate diet in improving the quality of life of Type 2 Diabetes Mellitus patients. **Methods:** The articles used were obtained from online databases, such as PubMed, Science Direct, and Google Scholar with the keywords "diabetes mellitus diet" AND "low-carbohydrate diet" OR "quality of life." Furthermore, the criteria used in selecting the articles include full text, published in 2012-2019, and a Randomized Control Trial study. The quality of articles was then assessed using Joanna Briggs Institute (JBI). **Results:** The review of seven articles discovered that a low-carbohydrate diet effectively improves the health status. **Conclusion:** Implementing a low-carbohydrate diet by adjusting the type of diet improves the health condition of Type 2 Diabetes Mellitus patients.

**Keywords:** Diet, Low Carbohydrate, Diabetes Mellitus, Type 2

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## INTRODUCTION

Type 2 Diabetes Mellitus is a non-communicable disease caused by insulin resistance or inadequate production, and it is characterized by a 90% increase in blood sugar levels which causes damage to the body organs such as the heart, eyes, and kidneys (1). Meanwhile, insulin is a hormone produced by the pancreatic cells to control glucose levels and it is influenced by several risk factors such as genetics, lifestyle, obesity, and aging. The prevalence of the disease increased from 417 million cases in 2015 to 642 million cases in 2040. Several cases of the disease have also been recorded in developed and developing countries, especially in the Asian region.

Furthermore, the highest cases were recorded in China with approximately 6.5 million people (12%), and these numbers are likely to increase to 21 million in 2025 (2). Based on epidemiological trends, the increasing prevalence of the disease is influenced by various factors such as gender, genetics, change of diet, and lack of physical activity. Consequently, various interventions have been introduced, including diet therapy, which is

a nutritional effort to control blood glucose levels and prevent complications. The therapy also helps to curtail physical, psychological, social and, spiritual health problems as well as to improve the patients' quality of life (3).

Diet is an independent intervention that provides education, knowledge, and skills on nutrition to complement efforts from doctors and nurses (4)(5) against the increasing complications of Diabetes mellitus. Furthermore, balanced nutrition is essential to improve health and prevent the disease. Nutritional diet also aims to control the intake of high fiber, low-fat and low-calorie to prevent the increase of blood sugar levels and body weight. The recommended diet for patients and the community are foods rich in fat and carbohydrates, which promotes physical activity. Meanwhile, food consumption is influenced by various factors, namely the glycemic response to food (food carbohydrate content), nature of starch, type of sugar, the form of food, as well as how to process and cook the food.

Diet is a fundamental component of Diabetes mellitus management which controls glucose, lipid, and bodyweight of the patients. Dietary management also needs to consider the life conditions and health of the patients while implementing a diet program plan

by involving the patients and the family to determine the fiber content, protein, fat, and low-carbohydrates (6). Furthermore, a low-carbohydrate diet is the main intervention carried out by adjusting the carbohydrate needs based on the patient's condition through regulating meal portions, calories, and the intake. A Carbohydrate diet is an effective conventional therapy for losing weight and controlling blood glucose levels (7).

Previous studies results also showed that a low-carbohydrate diet effectively reduces HbA1c levels, weight, controlling blood sugar levels, and improves the quality of patients' life (8). However, the increased prevalence of the disease requires short and long-term effective treatment by nurses that provide knowledge, health education, skills, motivation by caring and involving the family and community (9).

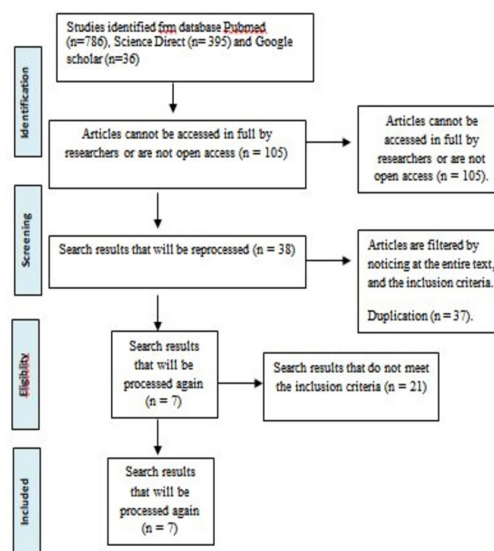
The prevention of Diabetes mellitus mortality and morbidity requires management through low-carbohydrate diet interventions as well as the role of nurses supported by government policies. This study was carried out to provide specific knowledge and information from various perspectives on the benefits of the diet in managing the disease. Therefore, this study review aims to determine the benefits of a low-carbohydrate diet in improving the quality of life of Type 2 Diabetes Mellitus patients.

**METHODS**

This is a systematic review, and the articles used were obtained from electronic databases such as PubMed, Science Direct, and Google Scholar. These 3 databases were selected because they are easily accessed and contain complete articles, which can be analyzed in detail. Meanwhile, the researcher used the keywords "diabetes mellitus diet" AND "low-carbohydrate diet" OR "quality of life," while the criteria for selection include full text, published between 2012-2019 with DOI, and Randomized Control Trial (RCT) studies (Figure 1). The article selection was carried out using PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) guide, consisting of 5 steps, while the quality scoring was carried with Joanna Briggs Institute (JBI). Subsequently, the articles were analyzed by reading and understanding, then the data obtained were extracted to a table. The differences and similarities in the content and findings of the articles were also analyzed (Table I).

**RESULTS**

1219 articles were screened after the search process, 105 were then selected based on the title and abstract, while 21 articles did not fulfil the inclusion criteria. The articles that are ready to be selected are seven articles according to the purpose of writing and the



**Figure 1: Article selection flow based on PRISMA**

predetermined criteria. Additionally, articles obtained on low-carbohydrate diets and quality of life of Type 2 Diabetes Mellitus patients were studies conducted in the United States, Japan, Sweden and Australia. The selected articles are studies related to various low-carbohydrate diet interventions including LFD/LCD (Low Fat Diet/Low Carbohydrate Dietary), randomized samples consuming a low-carbohydrate diet accompanied by a physical exercise program, Low-Carbohydrate Diet and Calorie Restricted Diet (CRD) and low-carbohydrate diet through online media. Meanwhile, Guldbrand et.al observed that the administration of LCD was more effective than LFD in weight loss with  $p < 0.001$ , improving the quality of life of Type 2 Diabetes Mellitus patients. Implementing a low-carbohydrate diet also improves the physical, psychological, social and spiritual conditions in the patients.

**DISCUSSION**

Type 2 Diabetes mellitus is a disease that lowers the blood glucose levels due to a decrease in pancreas insulin production (12), and effective treatment is needed to control blood glucose levels in the management, which involves only the patients. The treatment also helps to reduce the effects of complications, treatment costs and improve the patients' quality of life. Meanwhile, one of the treatment managements carried out is diet (13), which is a part of the 5 pillars of Diabetes Mellitus management (14). This is consistent with studies by Kimura, Kondo, Aoki, Shirakawa, and Kamiyama, 2018, where they reported that a low-carbohydrate diet was effective in weight loss, controlling plasma glucose levels, and lipid profiles (8).

Davis et.al, 2012 also showed that Diabetes-39 improves the quality of life. Furthermore, this study's results indicated that a low-carbohydrate diet intervention is

Table 1 : Summary Article

Researcher and Year	Setting	Method	Sample and Data	Intervention	Result
Davis et.al, 2012	United States	Selection and trial of random samples by comparing low-carbohydrate and low-fat diets and measuring quality of life by using Diabetes-19 and QOL in patients with Diabetes mellitus.	105 samples of Type 2 Diabetes Mellitus patients are randomly selected with overweight/obesity. With the criteria of being diagnosed with Diabetes mellitus at least 6 months, IMT 25 kg/m <sup>2</sup> and HbA1c between 6-11%.	A low-carbohydrate diet started for 2 weeks by limiting 20-25 grams of carbohydrates and will add 5 grams of carbohydrates each week, if weight loss goals are achieved.	A low-carbohydrate diet is effective in losing weight, controlling blood sugar and improving the quality of life of patients with Type 2 Diabetes Mellitus.
Gulbrand et.al, 2014	Sweden	A prospective randomized trial was conducted on 61 samples by using the SF-36 questionnaire.	The sample in the study was 61 samples of Type 2 Diabetes Mellitus patients who had a low-carbohydrate diet intervention for 2 years.	LFD/ LCD ( <i>Low Fat Diet/ Low Carbohydrate Dietary</i> ).	The <i>Low-Carbohydrate Dietary</i> intervention was effective in losing body weight (p<0.009). Interventions that have been carried out for 12 months can improve physical function and body health (p 0.042-009) as well as improve quality of life.
Brinkworth et.al, 2016	Australia	Randomizing 115 samples by using IMT (34,6) dan the value of HbA1c (7,3%).	A sample of 115 patients with Type 2 Diabetes Mellitus was conducted to measure the long-term effects of a high and low-carbohydrate diet on the psychology of the patients with Type 2 Diabetes Mellitus.	Randomizing samples that consumed a low-high diet and low-carbohydrate accompanied by a physical exercise program (3x a week) for 1 year. In addition, the measurement of mental and psychological well-being used <i>Profile Mood States</i> (POMS), <i>Beck Depression Inventory</i> (BDI) and quality of life (QoL-Diabetes-39)/D-39.	The low-carbohydrate diet intervention was effective in losing weight between the two groups (p=0.91), while the effect on mood and psychology (p<0.05) as well as quality of life (p<0.08).
Sato et.al, 2017	Japan	<i>Randomized Controlled Trial</i> (RCT) by conducting a prospective event-controlled trial.	66 samples of patients with Type 2 Diabetes Mellitus that were done by comparing between the <i>Dietary Low Carbohydrate</i> and <i>Calorie Restricted Diet</i> (CRD) groups.	<i>Dietary Low-Carbohydrate and Calorie Restricted Diet</i> (CRD) were carried out for 6 months. Type 2 Diabetes Mellitus patients manage their diet independently and are monitored regularly. 1 year later, the researcher analyzed clinical data and nutrition consumed by the 2 intervention groups.	1 year after the intervention, from 66 samples that consisted 27 samples from the <i>Dietary Low-Carbohydrate</i> group and 22 samples from the <i>Calorie Restricted Diet</i> (CRD) group, found that it was effective in reducing HbA1c, BMI, and improving quality of life of Type 2 Diabetes Mellitus patients.
Saslow et.al, 2017	United States	Randomizing sample of Type 2 Diabetes Mellitus that consisted of low-carbohydrate and low-fat diet groups	34 samples consisted of low-carbohydrate (n=16) and low-fat (n=18) diet groups.	Comparing low-carbohydrate and low-fat diets for 12 months. Samples are recommended to keep rest adequately and exercise regularly	12 months after the intervention, it could reduce HbA1c (6.6% to 6.1%) in the low-carbohydrate diet group than in the low-fat diet group (6.9% to 6.7%) with p<0.007, lose weight with p<0.001, reducing medicine use p<0.005.
Saslow et.al, 2017	United States	Randomizing research samples conducted on the control and intervention groups of patients with Type 2 Diabetes Mellitus who were overweight, HbA1c 6.5-9%.	The sample in this study was the Type 2 Diabetes Mellitus patients that were randomized with the criteria of being overweight, HbA1c 6.5-9%.	Advising a low-carb diet through online media for 32 weeks by applying the plate diet method.	The intervention of low-carbohydrate diet was effective in losing weight, HbA1c, and controlling KGD in the intervention group with p<0.001 and p<0.002 in the control group.
Kimura et.al, 2018	Japan	<i>Randomized Controlled Trial</i> (RCT) by conducting a randomized control test that was carried out at a general clinic in the Kanagawa area, Japan.	The sample of this study was 48 patients with Type 2 Diabetes Mellitus who were randomly selected through the minimization method using a randomized number table.	Comparing 2 groups that having a low-carbohydrate diet for 12 weeks.	There was no difference in changes in HbA1c in the control and intervention groups (P=0.95). However, there was a difference between the low-carbohydrate diet intervention group that was experiencing an increase in protein intake (P=0.0085) compared to the control group.

effective for losing weight, controlling blood sugar levels, HbA1c, and improving quality of life. The success of the intervention is supported by the provision of health education about Diabetes Mellitus and decision-making to determine the appropriate dietary intervention strategy

by adjusting the conditions for patients (15).

Meanwhile, Gulbrand et.al (2014) stated that the low-carbohydrate dietary intervention was effective in losing body weight (p<0.009) and low-fat dietary (p<0.03).

The intervention used on the two groups for 12 months improved physical function, body health ( $p < 0.001$ ) and quality of life (16). This finding is consistent with Brikworth et.al, 2016 that a low-carbohydrate diet is effective in losing weight, controlling blood sugar levels and optimizing patients' quality of life than a high-carbohydrate diet. This is proven by reducing the use of antidiabetic medicine and combining diet with physical activity which improves the patients' health and social quality of life (17).

Furthermore, this study's results are in line with Sato et.al (2017) that a low-carbohydrate diet is effectively carried out by adjusting the carbohydrate consumption in each patient's daily life, with an intake of 189-243g/day and calories 176-262g/day. The intervention is also supported by providing education related to nutrition for patients with the disease (18). Saslow et.al (2017) also stated that low-carbohydrate diet interventions are carried by engaging in physical activity as well as providing social and psychological support to improve the patient's quality of life (19).

Meanwhile, Saslow et.al (2017) showed that online-based diet programs is also applicable by all Diabetes Mellitus patients in the United States and it increases motivation and make dietary changes possible through the internet (20). Another study by Kimura et.al, 2018 stated that the effectiveness of a low-carbohydrate diet carried out in collaboration with nutritionists by providing education and motivation is effective in controlling the patients' diet. Conclusively, low-carbohydrate diet intervention is effective for Type 2 Diabetes Mellitus patients (8).

## CONCLUSION

From the results of this review, a low-carbohydrate diet is an appropriate nutritional intervention for Diabetes Mellitus by regulating the amount of carbohydrates based on the patients' health conditions. The intervention is also effective for reducing Hb1Ac, controlling blood sugar levels, reducing caring costs, and improving patients' quality of life. Further study is needed on the influence of culture and the role of nurses in providing low-carbohydrate diet interventions in a community, hence, it can be used as a guide in the management of the disease.

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