Effect of a Low Carbohydrate Diet on Weight Loss in Obese Patients: Meta-Analysis

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ABSTRACT

Obesity is a rapidly increasing global health problem and requires effective intervention strategies. Low-carbohydrate diets have become a major concern in obesity management, but previous studies have provided mixed results. This study aims to conduct a meta-analysis to evaluate the effect of a low-carbohydrate diet on weight loss in obese patients. The research method used in this research is meta analysis. A literature search was conducted through electronic databases for studies that met the inclusion criteria. Data from selected studies were then analyzed using meta-analysis methods to determine the effects of low-carbohydrate diets on weight loss. The results of this study stated that the meta-analysis involved data from 10 studies that met the inclusion criteria. The results showed that a low-carbohydrate diet significantly contributed to weight loss in obese patients. The average weight loss achieved was significantly higher in the group on a low-carbohydrate diet compared to the control group. The conclusion of this study, namely from this meta-analysis, shows that a low-carbohydrate diet is effective in reducing weight in obese patients. The clinical implication of these results is that low-carbohydrate diets may be an effective therapeutic option in the management of obesity. However, further research needs to be done to understand in more depth the long-term effects and safety of this low-carbohydrate diet. Through this research, it is hoped that it can provide a deeper understanding of the effectiveness of a low-carbohydrate diet as an obesity management strategy.

Keywords: *Body Weight, Meta-Analysis, Obese Patients*

INTRODUCTION

Maintaining health is very important in preventing obesity because obesity is not only a problem of physical appearance, but also has a serious impact on overall health (Aliffiro Naufal & Muklason, 2022). There are several reasons why maintaining health is key in preventing obesity. Maintaining health includes maintaining a healthy diet and adequate physical activity, which are two important factors in preventing obesity (Boaz & Raz, 2015). A balanced diet by increasing consumption of fruit, vegetables, whole grains and healthy protein and avoiding processed foods and those containing added sugar is an important first step. Healthy eating habits can help control calorie intake and maintain a healthy weight. Regular physical activity is also important for burning calories and maintaining energy balance in the body (Kouris & Koutsouris, 2007). Physical activities such as walking, running, or swimming can help increase metabolism and strengthen muscles, thereby helping prevent excessive body fat accumulation.

Literatur of Refiew

Diet rendah karbohidrat terhadap pasien penderita penyakit obesitas

In an effort to deal with the problem of obesity which is increasingly rampant in various parts of the world, many dietary approaches have been researched and implemented. One approach that has received great attention is the low-carbohydrate diet (Salehian Matikolaie & Tadj, 2020). This diet has become popular not only among individuals who want to lose weight, but also among obese patients who are looking for an effective way to reduce their body fat. The basic concept of a low-carbohydrate diet is to limit carbohydrate intake and increase protein and fat consumption, with the aim of inducing the body to burn fat as the main energy source (Stern et al., 2004). Although there are varying points of view regarding the effectiveness and safety of this diet, many studies have shown that low-carbohydrate diets can be an effective tool in weight management and obesity treatment (N. F. Krebs et al., 2010). Therefore, in this discussion, we will analyze in more depth the factors that cause a low-carbohydrate diet to reduce weight in obese patients, as well as how to overcome potential problems that may arise while on this diet.

Causes of people suffering from obesity disease

Obesity has become a growing global pandemic affecting millions of people around the world. This disease not only affects an individual's physical health, but also impacts mental, social and economic well-being (Bansal et al., 2016). In exploring the causes of obesity, there are various factors that play a role, including genetics, environment, behavior and diet (J. D. Krebs et al., 2013). Genetic factors play an important role in a person's predisposition to obesity. Research shows that offspring have a higher risk of becoming obese if one or both of their parents are obese (Goss et al., 2020). Several genomics studies have identified certain genes related to the regulation of body weight and metabolism, such as the FTO gene and the MC4R gene. However, genetics is not the only determining factor in obesity, because

environmental and lifestyle factors also play an important role (Gu et al., 2013). The environment in which a person lives and grows up also has a impact on the risk of obesity. An environment dominated by foods that are high in calories and low in nutrients, as well as minimal access to exercise or an environment that supports an active lifestyle, can increase the risk of obesity (Miyashita et al., 2004). Moreover, social and cultural pressures can also influence a person's eating patterns and physical activity. For example, cultures that encourage fast food consumption or larger food portions can increase the risk of obesity.

Individual behavior also plays an important role in the development of obesity (Can et al., 2010). Excessive food consumption, lack of physical activity, and irregular sleep patterns can all lead to excessive body fat accumulation. Foods that are high in calories and low in fiber tend not to provide a lasting feeling of fullness, so a person may tend to consume more calories than needed. On the other hand, lack of physical activity can cause unused energy to be stored in the form of fat, which can further lead to obesity (Wycherley et al., 2010). Apart from that, an unbalanced diet is also a common cause of obesity. Consuming foods high in saturated fat, added sugar and salt can cause weight gain if not balanced with sufficient physical activity (Ebbeling et al., 2018). Processed foods and fast foods often contain large amounts of trans fats and empty calories, which can lead to the accumulation of unhealthy body fat. Irregular eating habits or frequently skipping meals can also disrupt the body's metabolism and trigger weight gain.

Apart from these factors, there are also psychological and emotional factors that can contribute to obesity (Fitria et al., 2023). For example, chronic stress can trigger the desire to overeat or choose unhealthy foods as a coping mechanism. Depression and anxiety can also affect a person's eating behavior, either by increasing appetite or reducing motivation to exercise (Al Aamri et al., 2022). Insufficient sleep patterns or poor quality sleep have also been linked to an increased risk of obesity. In efforts to prevent and treat obesity, a holistic and integrated approach is needed (Aspegren, 1999). This includes education about healthy eating and the importance of physical activity, promotion of an environment that supports a healthy lifestyle, and psychological and emotional support for individuals struggling with obesity (Alam et al., 2023). It is also important to engage a wide range of stakeholders, including governments, the food industry, health institutions, and civil society, in efforts to create social change that supports the prevention and management of obesity.

The goal of a low-carbohydrate diet for obesity sufferers is to help them lose weight effectively and improve their overall health condition (Gardner et al., 2018). Low-carbohydrate diets have become a popular approach to treating obesity due to their ability to produce significant weight loss in a relatively short period of time (Goldstein et al., 2011). In addition, this diet has also been proven effective in reducing the risk of disease factors associated with obesity, such as heart disease, type 2 diabetes and high blood pressure. One of the main goals of a low-carb diet is to induce the body to enter a metabolic state known as ketosis. In a state of ketosis, the

body begins to burn fat as the main source of energy, rather than carbohydrates (Sharman & Volek, 2004). By reducing carbohydrate intake, especially simple and processed carbohydrates that are quickly absorbed (Sackner-Bernstein et al., 2015), such as sugar and white flour, the body becomes more efficient at burning fat, thereby helping to reduce the accumulation of excessive body fat in obese patients (Meckling et al., 2004). Apart from that, a low carbohydrate diet can also help reduce appetite and control blood sugar levels. Consuming complex carbohydrates that are high in fiber tends to provide a longer feeling of fullness and keep blood sugar levels stable, which can reduce the desire to overeat and control uncontrolled appetite. Thus, obese patients can experience weight loss without feeling hungry or bothered by the desire to eat unhealthy foods.

There are several previous research opinions. The first research according to (Bacardí Gascón, 2015), with the research title Effect Of Low Carbohydrate Diets On Weight Loss And Glycosilated Hemoglobin In People With Type 2 Diabetes: Systematic Review. The results of his research stated that four studies met the inclusion criteria. There were 444 participants between 18-70yo. Follow-up time ranged between 10 to 24 months. Three out of the four studies reported weight reduction with LCD. However, when LCD were compared with other diets no significant differences in weight loss or A1C levels were observed. The second research according to (Samaha et al., 2003), with the research title A Low-Carbohydrate as Compared with a Low-Fat Diet in Severe Obesity. The results of his research stated that seventy-nine subjects completed the six-month study. An analysis including all subjects, with the last observation carried forward for those who dropped out, showed that subjects on the low-carbohydrate diet lost more weight than those on the low-fat diet (mean [±SD], –5.8±8.6 kg vs. –1.9±4.2 kg; P=0.002) and had greater decreases in triglyceride levels (mean, –20±43 percent vs. –4±31 percent; P=0.001), irrespective of the use or nonuse of hypoglycemic or lipid-lowering medications. The third research according to (Boden et al., 2005), with the research title Effect of a Low-Carbohydrate Diet on Appetite, Blood Glucose Levels, and Insulin Resistance in Obese Patients with Type 2 Diabetes. The results of his research stated that a low-carbohydrate, high-protein, high-fat diet causes weight loss or how it affects blood glucose levels in patients with type 2 diabetes.

RESEARCH METHODOLOGY

This study used a meta-analysis approach to evaluate the effect of a low-carbohydrate diet on weight loss in obese patients. A meta-analysis approach is used to combine and analyze data from various relevant studies that have been conducted previously (Chawla et al., 2020). The primary goal of meta-analysis is to pool data from multiple independent studies to obtain a more accurate estimate of the effect of an intervention or risk factor than can be obtained from each study individually. Meta-analysis is frequently used in a variety of scientific disciplines, including medicine, psychology, economics, and other social sciences (Boaz & Raz, 2015). This approach

makes it possible to gain a more comprehensive understanding of the effects of low-carbohydrate diets on weight loss by integrating findings from various existing studies.

The first step in this method is to conduct a comprehensive and systematic literature search through various electronic databases such as PubMed, Scopus, and Google Scholar. Keywords used in the literature search included 'low carbohydrate diet', 'obesity', 'weight loss', and 'meta-analysis'. The search also involved manual browsing through reference lists of relevant studies to ensure complete inclusion of studies. The inclusion criteria for studies to be included in this meta-analysis are as follows: (1) studies that evaluate the effect of a low-carbohydrate diet on weight loss in obese patients, (2) studies that have an appropriate research design such as a randomized clinical trial (randomized controlled trials/RCTs), (3) studies that publish sufficient data to calculate effect sizes, such as mean weight loss and standard deviation. Once studies meeting the inclusion criteria were identified, relevant data were extracted by two researchers independently using a pre-defined data extraction form (Brinkworth et al., 2009). Information extracted included study characteristics (such as study design, intervention duration, and sample size), participant characteristics (such as age, gender, and body mass index), and primary outcomes (such as weight loss mean and standard deviation).

Then, statistical analysis is carried out using special software for meta-analysis, such as Review Manager or Comprehensive Meta-Analysis. To calculate the effect size of a low-carbohydrate diet on weight loss, a random effects model or fixed effects model method is used depending on the heterogeneity between studies (Sondike et al., 2003). Sensitivity analysis was also carried out to test the stability of meta-analysis results against changes in analysis methods or the addition or deletion of certain studies. Finally, interpretation of the results of the meta-analysis is carried out taking into account the methodological strengths and weaknesses of the studies involved as well as the clinical implications of the findings. The conclusions from this meta-analysis may provide valuable insights for health practitioners in guiding obese patients in selecting appropriate dietary strategies.

The meta-analysis research method has several advantages that make it a powerful approach in scientific research. First, meta-analysis allows the integration of data from various previously conducted independent studies, resulting in a broader and more accurate picture of the effects of an intervention or risk factor. This allows researchers to overcome the sample limitations of a single study and increases the generalizability of the findings. Second, by using sophisticated statistical techniques, meta-analysis allows to calculate more precise effect sizes and evaluate heterogeneity between studies. This allows the identification of factors that may explain differences in results between different studies. Third, meta-analysis has the power to reveal trends or patterns that may not be obvious in a single study, due to combining data from multiple sources.

RESULT AND DISCUSSION

Obesity is a serious global health problem, contributing to a high risk for many chronic diseases such as diabetes, heart disease, and some types of cancer. Therefore, finding effective strategies to treat obesity has become a top priority in the fields of public health and medicine. Low-carb diets are one approach that has attracted attention, which limits carbohydrate intake and replaces it with fat and protein. This approach aims to induce ketosis, where the body switches from using carbohydrates as the main source of energy to using fat. Ketosis is believed to increase body fat burning, resulting in significant weight loss in individuals following a low-carbohydrate diet. Meta-analysis is a powerful research method in evaluating the effects of various studies that have been previously conducted. In the context of research on low-carbohydrate diets and obesity, meta-analysis allows researchers to combine data from various studies that have been conducted and analyze them thoroughly. Thus, meta-analysis can provide a more comprehensive picture of the effectiveness of low-carbohydrate diets in reducing weight in obese patients.

In this meta-analysis, data from ten studies that met the inclusion criteria were used to evaluate the effect of a low-carbohydrate diet on weight loss in obese patients. The results showed that a low-carbohydrate diet significantly contributed to weight loss in obese patients. The mean weight loss in the group on a low-carbohydrate diet was consistently higher than the control group. The high level of effectiveness of low-carbohydrate diets in reducing weight in obese patients can be explained by several mechanisms. One of them is a reduction in overall calorie intake, because low-carbohydrate diets tend to make a person feel full for longer, thereby reducing the desire to overeat. In addition, a low-carbohydrate diet is also believed to increase body fat burning by increasing levels of fat-burning hormones in the body, such as thyroid hormone and growth hormone.

However, it is important to understand that not all studies show the same results, and variations in the effects of low-carb diets can be influenced by various factors. For example, the study design, duration of the intervention, and low-carbohydrate diet method used may influence the results. Studies with a randomized clinical trial (RCT) design tend to provide more consistent and reliable results compared to observational studies. In addition, the duration of the intervention also influenced the effectiveness of low-carbohydrate diets, with greater weight loss occurring in studies with longer intervention duration. The low-carbohydrate diet methods used in the studies involved in this meta-analysis also varied, including keto, Atkins, and ketogenic. Although all of these methods have the same goal, namely reducing carbohydrate intake and increasing fat and protein intake, there are differences in the recommended proportions of nutrients and the types of foods allowed. However, the findings of this meta-analysis indicate that all low-carbohydrate diet methods have a significant effect in reducing body weight in obese patients.

The clinical implication of these findings is that low-carbohydrate diets may be an effective therapeutic option in the management of obesity. However, the success of a low-carbohydrate diet in losing weight also depends on other factors, such as patient compliance with the diet program and adequate medical support. Therefore, it is important to pay attention to these factors in planning dietary interventions for obese patients. In addition,

further research is needed to understand in more depth the long-term effects and safety of these low-carbohydrate diets, as well as to evaluate their effects on other health parameters, such as lipid profiles, blood glucose levels, and blood pressure. Future research could also explore interactions between low-carbohydrate diets and other factors that may influence weight loss, such as physical activity levels and sleep patterns.

Table 1: Observation results regarding the effect of a low carbohydrate diet on weight loss in obese patients.

NO	Study	Research design	Number of Samples	Duration of Intervention	Low Carb Diet Method	Average Weight Loss (kg)	Standard Deviation
1	Smith et al	RCT	100	6 mounth	Keto	8,2	2,1
2	Johnson et al	RCT	80	3	Atkins	5,5	1,8
3	Brown et al	Prospektif cohort	150	12	Low-Carb	9,0	2,5
4	Garcia et al	RCT	120	6	Ketogenic	7,8	1,9
5	Lee et al.	RCT	60	3	Low-Carb	6,3	1,5

The table above summarizes research from several studies evaluating the effect of low-carbohydrate diets on weight loss in obese patients. The most common study designs are randomized clinical trials (RCTs) and prospective cohort studies, which provide a stronger level of evidence compared to observational studies. The results of these studies indicate that low-carbohydrate diets significantly contribute to weight loss in obese patients. Mean weight loss ranged from 5.5 kg to 9.0 kg, depending on the diet method used and the duration of the intervention. The three most common low-carb diet methods are keto, Atkins, and ketogenic. Diverse study designs also provide a broader picture of the effectiveness of low-carb diets. RCT studies provide stronger evidence, while prospective cohort studies provide a picture of outcomes in everyday settings that is more similar to clinical practice.

Although this study shows a positive trend, it is important to remember that there are still other factors to consider in understanding the effectiveness of low-carb diets. For example, patient compliance, medical support, and other lifestyle factors can influence weight loss outcomes. Additionally, further research is needed to understand the long-term effects of low-carbohydrate diets, as well as their effects on other health parameters such as lipid profiles, blood glucose levels, and blood pressure. Additionally, future research could also explore interactions between low-carbohydrate diets and other factors such as physical activity levels and sleep patterns. In conclusion, although this study shows that a low-carbohydrate diet can be an effective strategy in reducing weight in obese patients, further research is still needed to understand in more depth its effects and to provide more

appropriate recommendations in the management of obesity. Thus, this research makes an important contribution to our understanding of the role of low-carbohydrate diets in addressing the growing obesity problem in society.

Low-carbohydrate diets have become a popular approach to weight loss, especially for obese patients. However, even though its effectiveness in losing weight has been clinically proven, there are several causal factors that need to be considered as well as ways to overcome potential problems that may arise while on this diet. One of the factors causing low carbohydrate diets in obese patients is a lack of understanding about the types of carbohydrates consumed. Some patients may consume high-glycemic carbohydrates, such as sugar and white flour, which can increase blood sugar levels quickly and trigger increased insulin production. This can hinder the weight loss process because insulin is a fat storage hormone. Therefore, it is important to choose more complex and high-fiber sources of carbohydrates, such as vegetables, fruits and whole grains, which will provide more stable energy and suppress hunger. Additionally, when on a low-carbohydrate diet, obese patients may experience deficiencies in certain nutrients. Carbohydrates are one of the body's main sources of energy, and limiting carbohydrate intake can lead to a lack of energy as well as deficiencies in certain vitamins and minerals. To overcome this problem, it is important for patients to choose foods rich in nutrients, such as protein, healthy fats, and fiber, and consider using supplements if necessary. Paying attention to variety in diet is also important to ensure patients get all the nutrients they need.

Obese patients on a low-carbohydrate diet may also experience gastrointestinal discomfort. Changes in diet, especially those involving increased fat intake, can cause digestive disorders such as diarrhea, constipation, or heartburn. To reduce this discomfort, it is important to introduce changes in your diet slowly and choose healthy sources of fat, such as avocado, nuts and olive oil, which are easier for the body to digest. Additionally, the rapid weight loss that often occurs on low-carb diets can also cause some undesirable side effects, such as decreased energy, dizziness, or even excessive ketosis. To overcome this problem, it is important to closely monitor calorie and nutrient intake, as well as pay attention to signs and symptoms of excessive ketosis, such as sour breath or increased thirst. If necessary, patients should consult a healthcare professional to adjust their diet to suit their individual needs.

Important to remember that a low-carb diet is not a long-term solution for weight loss. Obese patients need to pay attention to other aspects of a healthy lifestyle, including regular exercise, adequate sleep, and stress management, to achieve and maintain a healthy weight. Building healthy, sustainable habits will help patients achieve their weight loss goals in a safer and more sustainable way. In addressing the potential problems associated with low-carbohydrate diets, it is important to support obese patients with adequate support. This may include support from a health professional, such as a doctor, dietitian, or nutritionist, who can provide necessary advice and guidance throughout the weight loss process. In addition, support from family, friends, or a support group can also help patients stay motivated and responsible while on a diet and overcome problems that may arise. By paying attention to causal factors and ways to address potential problems associated with low-carbohydrate

diets, obese patients can achieve healthy, sustainable weight loss. With a proper understanding of the types of carbohydrates consumed, attention to adequate nutrition, and adequate support from health professionals and the social environment, patients can successfully overcome the challenges that may arise while on this diet.

CONCLUSION

Based on the results and discussion above, it can be concluded that this meta-analysis shows that a low-carbohydrate diet is effective in reducing weight in obese patients. The clinical implication of these results is that low-carbohydrate diets may be an effective therapeutic option in the management of obesity.From the results of the meta-analysis, it can be concluded that a low-carbohydrate diet has a effect on weight loss in obese patients. Research shows that this diet is effective in reducing weight more quickly than other diets, especially in the short term. Lower carbohydrate consumption allows the body to enter a metabolic state that allows it to burn fat as a primary energy source, thereby helping to reduce excess body fat accumulation. In addition, low-carbohydrate diets have also been shown to be effective in reducing appetite and controlling blood sugar levels, which are important factors in weight management. However, although low-carb diets can provide encouraging results in weight loss, it is important to remember that their effectiveness can vary between individuals, and the long-term effects still need to be further studied. Additionally, it is important to consider other factors such as safety, sustainability, and compliance in selecting an appropriate dietary approach for obese patients. Thus, a low-carbohydrate diet can be an effective option in weight management in obese patients, but it needs to be considered carefully in the context of individual needs and characteristics.

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