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Tip-2 Diabetes Mellitus ve Öğün Tüketim Sıklığı

Type-2 Diabetes Mellitus and Meal Consumption Frequency

Sergen TUĞGÜM[1 A,B,C,E,F], Çiğdem BOZKIR[1 A,D,G]

[1]Erciyes University, Department of Nutrition and Dietetics, Kayseri, Turkey

[2]Inonu University, Department of Nutrition and Dietetics, Malatya, Turkey

ÖZ

Tip 2 diyabet, insan sağlığını tehdit etmeye devam eden kronik bir sağlık sorunudur. Beslenme, bu hastalığın etiyolojisinde önemli bir rol oynamaktadır. Tüketilen besin içeriğinin yanı sıra öğün sıklığı da bu hastalığı birçok yönden etkilemektedir. Çalışmalar, farklı yeme sıklığı kalıplarının, açlık-tokluk hissini ve bu hisleri düzenleyen bazı hormonların seviyelerini değiştirerek gıda tüketimi ihtiyacını artırabileceğini veya azaltabileceğini göstermiştir. Bu etki nedeniyle vücut ağırlığı artabilir veya azalabilir ve dolaylı olarak tip 2 diyabet tetiklenebilir. Değişen yemek sıklıkları, bu etkiyi tip 2 diyabetli bireylerde doğrudan hastalıkla ilişkili kan parametreleri yoluyla veya dolaylı olarak vücut ağırlığı ve iştah yoluyla gösterebilir. Bu derlemenin amacı, tip 2 diyabette karmaşık hastalık sürecini dikkate alarak yemek sıklığı ve diyabet arasındaki ilişki hakkında bilgi vermek ve bu ilişkiyi inceleyen çalışmaları bir araya getirmektir.

Anahtar Kelimeler: Tip 2 diyabet, öğün sıklığı, vücut ağırlığı, iştah.

ABSTRACT

Type 2 diabetes is a chronic health problem that continues to threaten human health. Nutrition plays an important role in the etiology of this disease. In addition to the nutrient content consumed, the frequency of meals also affects this disease in many ways. Studies have shown that different eating frequency patterns can increase or decrease the need for food consumption by changing the feelings of hunger-satiety and the levels of some hormones that regulate these sensations. Due to this effect, body weight may increase or decrease and type 2 diabetes can be triggered indirectly. Changing meal frequencies may show this effect directly in individuals with type 2 diabetes through blood parameters associated with the disease or indirectly through body weight and appetite. The purpose of this review is to provide information about the relationship between meal frequency and diabetes, taking into account the complex disease process in type 2 diabetes, and to bring together studies that examine this relationship.

Keywords: Type 2 diabetes, meal frequency, body weight, appetite.

1. INTRODUCTION

Diabetes mellitus (DM), with the most characteristic feature of hyperglycemia, is a chronic disease caused by insufficient insulin production from β cells of the pancreas or insulin not being used enough in cells (1,2). Increasing rapidly around the world, DM affected 382 million people worldwide in 2013, while this number reached 415 million in 2015 and 463 million in 2019, with more than 90% of people with diabetes having type 2 diabetes (T2DM) (3-5). In order to diagnose the disease, the plasma glucose level measured at any time period should be 11.1 mmol/L and above, fasting plasma glucose level should be above 7 mmol/L, glucose level should be 11.1 mmol/L and above two hours after the 75 g oral glucose tolerance test (OGTT), and should exceed 47.5 mmol/mol HbA1c value, which is considered an indicator

Sorumlu Yazar: Sergen TUĞGÜM
Erciyes University, Department of Nutrition and Dietetics, Kayseri, Turkey.
tuggumsergen@gmail.com
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of mean and long-term blood glucose concentrations. The significance levels of these criteria in diagnosis are considered equal (6-8).

Being overweight and obese are among the changeable risk factors associated with T2DM (9,10). The presence of T2DM, especially with increasing body mass index (BMI), causes hormonal changes in adipose tissue and some organs, creating a pathogenic link with other chronic diseases (11,12). Nutritional therapy and lifestyle changes play an important role in the prevention of T2DM or in the management of both type-1 diabetes (T1DM) and T2DM (13,14). Many studies have been carried out in order to develop optimum individual diet approaches for T2DM management and to facilitate patient compliance with these diets (15-17). Calorie restriction, intermittent fasting diet, high fiber diet, ketogenic diet, low and high protein diets, low carbohydrate and low glycemic index diets are some of the diet schemes studied for T2DM disease (18,19).

Although eating in excess of energy requirements is known to be one of the main factors leading to chronic diseases, the relationship between the frequency of meals and disease or health conditions is not clearly known (20). In the medical nutritional treatment of DM, frequency of meal consumption is as important as the content of the diet. In clinical practice, it is suggested that meals should be eaten with balanced distribution in order to achieve metabolic balance and weight control (21).

The purpose of this review is to examine whether the frequency of meal consumption has an effect on appetite and body weight. In addition, to examine the relationship between meal frequency and T2DM, in this way or independently.

Meal Frequency, Body Weight and Obesity

The concept of meal frequency is defined as the total number of meals consumed in one day (22). The frequency of the meals consumed during the day and how many snacks are eaten are affected by many factors. The most important of these factors are cultural and socio-demographic features (23,24). The concept of meal frequency does not have a universal basis. While eating three meals is common in western culture, dieticians generally recommend eating five or six meals for appetite control (25). The main purposes of this recommend is to increase the metabolic rate, reduce appetite and hunger, improve glycemic parameters and reduce body fat storage, and reach healthy body weight (26). Although the effects of this concept on health are not yet fully determined, (27) glycemic control, obesity, and cardiovascular disease affecting obesity are accepted as factors affecting blood pressure indirectly in people with T2DM (21,28,29). The fact that SE is highly valuable in strength training in athletic performance and rehabilitation and that the specific effects of this new training method during exercise are not fully known creates confusion about the most effective strength training. Therefore, the main aim of this review is to contribute to the creation of the most effective rehabilitation program by compiling studies analyzing the effect of suspension exercises on muscle activities.

In a review of epidemiologic studies examining the relationship between meal frequency and body weight (30), an inverse relationship between these two parameters was observed, but when the studies on the subject were evaluated as a whole, it was concluded that body weight depends on total calories consumed during the day rather than meal frequency. For this reason, it is also important to determine how food frequency affects total calorie intake in humans, and

whether it varies depending on ethnicity, gender and body weight (20,31). In addition, it is difficult to address the role of a single parameter on the energy balance, as each food habit (meal frequency, meal skipping, eating speed, junk food consumption) and diet content are closely related, but determining the impact of each parameter is extremely important to achieve weight management (22,32,33).

In a study examining the relationship between meal consumption frequency and body weight, 8-week diet periods including 1 meal/day and 3 meals/day frequency were applied to normal-weight and middle-aged individuals whose nutrient composition and calorie intake were optimized. At the end of the study, no significant difference was found in body weight compared to the baseline (27). The increase in meal frequency was associated with decreased weight and body fat in 9-10-year-old children with healthy weight, while it was found to increase BMI and waist-height ratio in children with central obesity (34). Similarly, an inverse relationship was determined between meal frequency and systolic and diastolic blood pressure, partly due to the presence of central obesity (28). As a result of 3 meals/day and 6 meals/day applied to the study group consisting of overweight and obese women, there was no significant difference in body weight change between the two groups (35). In a meta-analysis including studies examining the relationship between meal consumption frequency and body weight, the effects of various meal frequency types on different study groups were examined. There was no significant difference in terms of body mass between consumption frequencies of 1-2 meals/day, 3-4 meals/day, ≥5 meals/day. However, increasing meal frequency (≥5 meals/day) has been shown to result in improved body composition (36).

Meal Frequency and Appetite

The concept of appetite is known as the desire to consume food, and its mechanisms are governed by the hypothalamus and include the gastrointestinal system and adipose tissue (26, 37). Appetite control occurs through peripheral signals from adipose tissue and gastrointestinal peptides. These signals reach the hypothalamus nucleus and are integrated (38). There are many hormones that are secreted from various parts of the body and bind to their own receptors in the hypothalamus that increase or decrease appetite (39). Meal frequency affects appetite through many physiological mechanisms of action (33). Increasing frequency of meals may decrease the feeling of hunger (31), low frequency of meals may lead to health conditions similar to metabolic syndrome and high hunger feelings (40). But according to another view, high meal frequency is considered risky as it may cause more food intake throughout the day without changing the feeling of hunger (41). Despite this uncertainty, the interaction between hormones that regulate the appetite and the central nervous system, which is thought to be related to the frequency of eating, with increasing obesity has been better understood (42,43).

High and normal protein diets (eucaloric) were given to 13 overweight and obese participants on four separate days, as 3 meals and 6 meals. At the end of the study, it was shown that a high-protein diet provides more satiety than a normal diet, and 3 meals provide more satiety than 6 meals (44). Bachman and Raynor (45) applied two different meal plans of 3 meals/day or 100 kcal ≥ / 2-3 hours to participants including overweight and obese individuals, and evaluated the feeling of hunger in a 6-month period. In the two groups with similar physical activity and diet characteristics, the feeling of hunger decreased continuously during this period

among individuals with high meal frequency (100 kcal/2-3 hours) and was significantly lower in the sixth month compared to the other group.

Relationship of Meal Frequency with Diabetes, Risk Factors and Markers

Measuring fasting blood glucose alone does not provide sufficient evidence for a better understanding of the complex pathophysiology underlying T2DM. HbA1c level, which is one of the diagnostic criteria of the disease, affects the postprandial glucose level as much as the fasting glucose level (46). High postprandial glucose levels are one of the indicators of decreased glycemic control in the body. In fact, it is a leading parameter that gives clues about T2DM as a result of impaired glucose balance (47). In a study in obese individuals, a high-protein diet resulted in better postprandial glucose and insulin response, and glucose response was unchanged compared to 6 meals/day, despite a higher insulin response in those consuming 3 meals/day (48).

When the frequency of 1 meal/day was compared with the frequency of 3 meals/day in healthy individuals with normal weight, it was observed that plasma glucose levels increased significantly in those who consumed 1 meal/day as a result of the oral glucose tolerance test. Although partial beta cell function improved in individuals fed 3 meals/day, insulin, insulin sensitivity and HOMA-IR levels were similar between the two groups (49). As a result of the frequency of 3 meals/day and 6 meals/day applied to women with polycystic ovary syndrome in a randomized crossover pattern, no significant difference was found in glucose, HbA1c and HOMA-IR index in both meal frequencies. However, the fasting insulin level, which increased significantly at the frequency of 3 meals/day, decreased significantly at the frequency of 6 meals/day (50). It was revealed that there was no significant difference in blood glucose and insulin response in obese women fed for 3 months with two different meal frequencies (51). In a randomized controlled study, overweight and obese individuals were given normal protein and high protein diets with the frequency of 3 and 6 meals. Regardless of dietary protein, high meal frequency caused a decrease in glucose level and insulin response (44). In a study examining the effect of differences in meal frequency and food pattern on postprandial glucose metabolism, non-obese healthy individuals received 3 meals/12 hours (65% carbohydrates, 15% protein), 6 meals/12 hours (65% carbohydrates, 15% protein), and 6 meals/12 hours (35% carbohydrates, 45% protein) with high protein. At the end of the study, it was observed that 6 meals with high protein significantly reduced postprandial glucose and insulin response, and 6 meals caused higher glucose levels compared to 3 meals (52). Although eating with the frequencies of 3 and 6 meals caused a difference in glucose profile in healthy women and men, 24-hour glucose concentrations were similar, while consumption of 6 meals decreased insulin concentrations (53). In a study involving 1944 healthy men, it was shown that the risk of type 2 diabetes increased in those who consumed both 1-2 meals/day and 4 meals/day compared to those who consumed 3 meals/day. In a similar study involving 1560 healthy women, 1-2 meals/day, 3 meals/day, 4-5 meals/day and ≥6 meals/day consumption did not make a significant difference in terms of T2DM risk (54,55). In individuals with normal glucose tolerance, the frequency of 9 meals/day did not cause a significant difference in fluctuating glucose level compared to 3 meals/day, and decreased the maximum glucose level in those with impaired glucose tolerance. In both normal and impaired glucose tolerance, the insulin sensitivity index level was not significantly different based on the frequency of two meals (56).

Kahleova et al. in a study (57) found the frequency of 2 meals/day and 6 meals/day both improved β cell function and decreased HbA1c in individuals with T2DM, but it was concluded that low meal frequency provided lower fasting plasma glucose, glucagon and high insulin sensitivity (58). In another study, the frequency of 3 meals/day and 6 meals/day in people with impaired glucose tolerance did not cause a significant difference in plasma glucose and insulin levels after the oral glucose tolerance test, while 6 meals significantly reduced plasma glucose and HbA1c level in the T2DM group (59). Munsters et al. showed that higher meal frequency (3 meals and 14 meals, 55% carbohydrate, 15% protein, 30% fat) increased 24-hour mean glucose levels, but did not change insulin levels (60). In a prospective study followed for 4 years in terms of diabetes incidence, people who consumed 4 meals/day were found to have a lower risk of developing type 2 diabetes than those who consumed 3 meals a day (61). Consumption of 6 meals with high carbohydrates in obese women led to lower postprandial insulin levels than 3 meals with the same content (62).

Most of the available studies report that increased meal frequency leads to a decrease in both 24-hour and postprandial insulin concentrations, especially in healthy subjects (50,51). But the results about the glucose levels were inconsistent. However, as described in the first part of the review, the contents of the diets (such as simple/complex carbohydrate ratio, dietary protein content or dietary fat type) may also affect diabetes parameters. For this reason, explaining the macronutrient ingredients used in the studies and using a standard nutrient content would help to explain clearly the effect of meal frequency on diabetes parameters.

2. METHOD

Literature Review

In this review, a literature search was conducted in "Google Scholar, Medline (Pubmed) and Embase Library" in January 2023 to determine the effects of meal frequency on risk factors and parameters of T2DM. The keywords "meal frequency, body weight, appetite and type 2 diabetes" were used in the searches made within the scope of the review. The abstracts of the scanned articles were first read, then the full text of the studies whose topics were appropriate for the review were read and the data were obtained. To undertake the study, the information obtained from articles published between 2000 and 2022 that examined the effects of meal frequency on body weight, appetite and T2DM, respectively, were collected.

3. CONCLUSION

As a result, there is an inconsistency in short-term studies conducted between the relationship between meal frequency and appetite. In the long term, despite insufficient evidence, it has been shown that increased meal frequency tends to reduce hunger. There is no evidence that increased or decreased meal frequency changes body weight, but the change in consumption frequency may be related to body composition. The effect of meal frequency is explained in terms of diabetes risk with measurements such as glucose, insulin, insulin sensitivity and HbA1c level, which are considered markers of diabetes, especially in studies with healthy, overweight or obese individuals who are not diabetic. In healthy individuals, it can be mentioned that increasing meal frequency has potential positive effects on 24-hour and postprandial insulin levels. More studies are needed regarding the effect of meal frequency,

especially in diabetic individuals. It is anticipated that new studies will have positive effects on planning nutritional treatment for individuals with diabetes.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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