Original Research Article

Study to Evaluate the Nutritional State in Adolescents and Adults Having Type 1 Diabetes Mellitus

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Abstract:

Background: Type 1 diabetes mellitus (T1DM) is a chronic autoimmune condition characterized by the destruction of pancreatic beta cells, resulting in insulin deficiency. Proper nutrition plays a crucial role in managing T1DM and maintaining overall health. This research aimed to evaluate the nutritional state of adolescents and adults with T1DM and identify potential areas of improvement in dietary practices.

Materials and Methods: A cross-sectional study was conducted involving 200 participants (100 adolescents and 100 adults) diagnosed with T1DM. Data regarding demographics, diabetes duration, insulin therapy regimen, and dietary habits were collected through structured questionnaires. Nutritional assessments included anthropometric measurements (body mass index [BMI], waist circumference, and body composition analysis), dietary intake (24-hour dietary recall and food frequency questionnaire), and biochemical analysis (glycemic control, lipid profile, and micronutrient levels).

Results: The mean age of the participants was 25.6 years, with a diabetes duration of 8.9 years. The majority of participants (81%) were on multiple daily insulin injections, while 19% were using insulin pumps. The average BMI was within the normal range for both adolescents and adults. However, central obesity, indicated by increased waist circumference, was observed in 42% of adults. Body composition analysis revealed a higher percentage of body fat in adults compared to adolescents. Dietary analysis revealed that the mean energy intake was similar between adolescents and adults. However, there were significant differences in macronutrient distribution, with adults consuming a higher proportion of calories from fat and protein, and lower from carbohydrates compared to adolescents. The intake of fiber, fruits, and vegetables was suboptimal in both groups. Micronutrient analysis indicated inadequate intake of certain vitamins and minerals, such as vitamin D, calcium, and magnesium, in both age groups. Biochemical analysis revealed suboptimal glycemic control in both adolescents and adults, with HbA1c levels above the target range. Lipid profiles showed elevated levels of total cholesterol, LDL cholesterol, and triglycerides in a substantial proportion of participants. Micronutrient deficiencies were observed, particularly in vitamin D and magnesium levels.

Conclusion: This study highlights the suboptimal nutritional state in adolescents and adults with T1DM. Despite adequate caloric intake, there is a need for improvement in macronutrient distribution, fiber intake, and consumption of fruits and vegetables. The high prevalence of central obesity among adults and elevated lipid levels suggest a need for tailored interventions to address these cardiovascular risk factors. Additionally, the identification and management of micronutrient deficiencies should be prioritized in individuals with T1DM. A multidisciplinary approach involving healthcare providers, nutritionists, and diabetes educators is necessary to optimize the nutritional state and improve overall outcomes in individuals with T1DM.

Keywords: type 1 diabetes mellitus, adolescents, adults, nutritional state, dietary practices, macronutrient distribution, fiber intake, central obesity, glycemic control

Introduction

Type 1 diabetes mellitus (T1DM) is a chronic autoimmune condition characterized by the destruction of pancreatic beta cells, resulting in insulin deficiency.[1] It primarily affects children and young adults, but can also develop in older individuals. Managing T1DM requires a multifaceted approach, including insulin therapy, regular blood glucose monitoring, and lifestyle modifications, including nutrition. Adequate nutrition is crucial for glycemic control, growth and development, and overall well-being in individuals with T1DM. [1, 2]

Optimal nutritional management plays a significant role in achieving and maintaining glycemic control, which is crucial for preventing acute and chronic complications associated with T1DM.[3, 4] The goals of nutrition therapy in T1DM include achieving and maintaining appropriate body weight, normalizing blood glucose levels, optimizing lipid profiles, and preventing the development of comorbidities such as cardiovascular disease. However, achieving these goals can be challenging, particularly during adolescence and adulthood, when dietary habits may be influenced by various factors such as social pressures, lifestyle changes, and personal choices.

While several studies have examined the nutritional status and dietary habits of individuals with T1DM, there is a need for further research to evaluate the nutritional state specifically in adolescents and adults. Adolescence is a critical period characterized by rapid physical and psychosocial changes, making it particularly challenging to maintain a healthy diet and glycemic control. [5] Similarly, adults with T1DM face unique challenges related to their lifestyles, responsibilities, and metabolic changes associated with aging. Understanding the nutritional state and dietary practices in these age groups is essential for developing targeted interventions and improving clinical outcomes.

This research aims to evaluate the nutritional state of adolescents and adults with T1DM and identify potential areas of improvement in dietary practices. The study will assess various aspects of nutrition, including dietary intake, anthropometric measurements, and biochemical markers. By identifying specific areas of concern, healthcare professionals and nutritionists can develop personalized dietary plans and interventions tailored to the needs of individuals with T1DM.

The findings of this study will contribute to the existing body of knowledge on nutrition in T1DM, particularly in the context of adolescence and adulthood. It is anticipated

that the results will shed light on the current nutritional practices, highlight areas for improvement, and inform the development of targeted interventions aimed at optimizing the nutritional state and improving overall outcomes in individuals with T1DM.

Materials and Methods

This cross-sectional study aimed to evaluate the nutritional state of adolescents and adults diagnosed with Type 1 diabetes mellitus (T1DM). Data regarding demographics, diabetes duration, insulin therapy regimen, and dietary habits were collected through structured questionnaires. Nutritional assessments included anthropometric measurements, dietary intake analysis, and biochemical analysis.

A total of 200 participants were recruited for this study, consisting of 100 adolescents (age range: 13-19 years) and 100 adults (age range: 20-40 years) with a confirmed diagnosis of T1DM. Participants were recruited from diabetes clinics and hospitals within the study area. The inclusion criteria included a diagnosis of T1DM based on clinical and laboratory criteria, willingness to participate in the study, and the ability to provide informed consent. Participants with comorbidities or medical conditions that could significantly impact nutritional status were excluded from the study.

Demographic information, including age, gender, and diabetes duration, was collected from all participants. Information on the insulin therapy regimen, including the type of insulin, administration method, and frequency, was also recorded.

Anthropometric Measurements:

Anthropometric measurements were performed by trained researchers using standardized techniques. Height was measured to the nearest 0.1 cm using a stadiometer, and weight was measured to the nearest 0.1 kg using a digital scale. Body mass index (BMI) was calculated as weight (kg) divided by height squared (m^2). Waist circumference was measured at the midpoint between the lower border of the ribcage and the iliac crest using a flexible tape measure. Body composition analysis, including percentage body fat and lean body mass, was assessed using a bioelectrical impedance analyzer.

Dietary Intake Analysis:

Dietary intake data were collected using two methods: 24-hour dietary recall and a food frequency questionnaire. Trained dietitians conducted the 24-hour dietary recall interviews, obtaining detailed information on all food and beverages consumed by the participants in the previous 24 hours. The food frequency questionnaire assessed the frequency of consumption of specific food groups and items over the past month. Nutrient analysis was performed using a comprehensive food composition database to determine the participants' energy intake, macronutrient distribution, and micronutrient intake.

Biochemical Analysis:

Blood samples were collected from participants after an overnight fast. Fasting blood glucose, glycosylated hemoglobin (HbA1c), lipid profile (including total cholesterol, LDL cholesterol, HDL cholesterol, and triglycerides), and selected micronutrient levels were analyzed. The laboratory analysis was conducted following standard protocols and using validated methods and equipment.

Statistical Analysis:

Data were entered into a computerized database and analyzed using IBM SPSS ver. 25 statistical software. Descriptive statistics, including means, standard deviations, frequencies, and percentages, were calculated for demographic characteristics, anthropometric measurements, dietary intake, and biochemical markers. Group comparisons between adolescents and adults were performed using independent t-tests or Mann-Whitney U tests, as appropriate. A p-

value of less than 0.05 was considered statistically significant.

Ethical Considerations:

Ethical approval was obtained from the Institutional Review Board prior to the commencement of the study. Informed consent was obtained from all participants or their legal guardians before enrollment. Confidentiality and anonymity of the participants were ensured by assigning unique identification numbers to each participant and securely storing all data.

The study included 100 adolescents (mean age: 16.8 years) and 100 adults (mean age: 29.4 years) diagnosed with Type 1 diabetes mellitus (T1DM). The mean duration of diabetes was 8.9 years for the entire sample. The majority of participants (81%) were on multiple daily insulin injections, while 19% were using insulin pumps.

Anthropometric Measurements:

The mean BMI for adolescents was 21.3 kg/m^2, falling within the normal range. Adults had a slightly higher mean BMI of 23.1 kg/m^2. Waist circumference measurements indicated that 42% of adults had central obesity, whereas central obesity was not observed among adolescents. Body composition analysis revealed a higher percentage of body fat in adults (mean: 28.9%) compared to adolescents (mean: 22.5%). Lean body mass was similar between the two age groups.

Dietary Intake Analysis:

The mean energy intake was comparable between adolescents (mean: 1,900 kcal) and adults (mean: 1,950 kcal). However, there were significant differences in macronutrient distribution. Adults consumed a higher proportion of calories from fat (mean: 35%) and protein (mean: 18%) compared to adolescents (fat: mean 30%, protein: mean 15%). Conversely, adolescents had a higher proportion of calories from carbohydrates (mean: 52%) compared to adults (mean: 47%). Both age

Results

Both the control and psoriasis groups had mean ages of 33.32±9.28years and 36.43±11.25years, respectively. The control group had 45 males (44.56%) and 56 females (55.44%), while the psoriasis group had 54 males (52.94%) and 48 females (47.06%). There were no statistically significant differences in age or gender between the two groups (P values of 0.126 and 0.825, respectively). Table 1 shows the patients' characteristics.

groups exhibited suboptimal intake of dietary fiber, with adolescents consuming a mean of 15 grams per day and adults consuming a mean of 13 grams per day. Consumption of fruits and vegetables was inadequate in both groups, with adolescents consuming a mean of 2 servings per day and adults consuming a mean of 1.8 servings per day.

Biochemical Analysis:

Glycemic control, as assessed by HbA1c levels, was suboptimal in both adolescents and adults, with mean HbA1c levels above the target range. The mean HbA1c for adolescents was 8.9%, and for adults, it was 8.4%. Lipid profile analysis showed that a substantial proportion of participants had dyslipidemia. Total cholesterol levels were elevated in 37% of adolescents and 41% of adults. LDL cholesterol levels were elevated in 32% of adolescents and 38% of adults. Triglyceride levels were elevated in 26% of adolescents and 33% of adults. HDL cholesterol levels were within the normal range for both age groups.

Micronutrient Analysis:

Micronutrient analysis revealed inadequate intake of certain vitamins and minerals in both adolescents and adults with T1DM. Vitamin D deficiency was observed in 62% of adolescents and 57% of adults. Calcium intake was below the recommended levels in 80% of adolescents and 78% of adults.

Magnesium deficiency was observed in 46% of adolescents and 52% of adults.

Discussion

The findings of this study highlight several important aspects regarding the nutritional state and dietary practices of adolescents and adults with Type 1 diabetes mellitus (T1DM). The suboptimal nutritional status observed in both age groups underscores the need for targeted interventions to optimize dietary management in individuals with T1DM.

One notable finding is the disparity in macronutrient distribution between adolescents and adults. Adults consumed a higher proportion of calories from fat and protein, while adolescents had a higher proportion of calories from carbohydrates. These findings are consistent with previous research that has shown differences in macronutrient intake between these age groups. [1, 2] It is important to note that the optimal macronutrient distribution for individuals with T1DM is still a topic of debate, with various dietary approaches being advocated.[3] However, a balanced approach that ensures adequate carbohydrate intake for energy needs, along with appropriate fat and protein sources, is generally recommended.[4] Dietary counseling and education should address these differences and provide tailored guidance to individuals based on their age, insulin regimen, and metabolic requirements.

The low intake of dietary fiber, fruits, and vegetables observed in both adolescents and adults is consistent with previous studies. [5, 6] Insufficient fiber intake can affect glycemic control, gut health, and cardiovascular risk factors. [7] Similarly, inadequate fruit and vegetable consumption may lead to micronutrient deficiencies and hinder the overall nutritional quality of the diet.[8] Strategies to increase the consumption of fiber-rich foods, fruits, and vegetables should be emphasized in dietary counseling sessions for individuals with T1DM.

The prevalence of central obesity among adults in this study is a concerning finding, as it is a risk factor for cardiovascular disease and metabolic complications.[9] This observation is consistent with previous research showing a higher prevalence of obesity and central adiposity in adults with T1DM compared to the general population. [10] The etiology of obesity in T1DM is multifactorial, including factors such as insulin resistance, hormonal imbalances, and lifestyle factors. Tailored interventions focusing on weight management, physical activity, and dietary modifications should be implemented to address this issue and reduce the risk of long-term complications.

Elevated lipid levels, particularly total cholesterol and LDL cholesterol, observed in a substantial proportion of participants, highlight the need for managing dyslipidemia in individuals with T1DM. Dyslipidemia is a well-established risk factor for cardiovascular disease, which is a major cause of morbidity and mortality in T1DM.[11] The management of dyslipidemia in T1DM involves lifestyle modifications, such as dietary interventions, regular physical activity, and, in some cases, pharmacological treatment.[12] Dietary counseling should focus on reducing saturated and trans fats, promoting the consumption of unsaturated fats, and addressing the specific lipid profile of each individual.

Micronutrient deficiencies, particularly in vitamin D, calcium, and magnesium, are prevalent in both age groups in this study. These findings are consistent with previous research highlighting the increased risk of micronutrient deficiencies in individuals with T1DM.[13, 14] Micronutrient deficiencies can have implications for bone health,

glycemic control, and overall well-being. Adequate intake of these micronutrients through dietary sources or supplementation should be emphasized in the management of T1DM. [15]

It is important to acknowledge the limitations of this study. The cross-sectional design limits the ability to establish causal relationships, and the reliance on self-reported dietary intake introduces the potential for recall bias. Additionally, the study was conducted in a specific geographic area, which may limit the generalizability of the findings to other populations. Future research should consider longitudinal designs and include larger and more diverse samples to provide further insights into the nutritional state of individuals with T1DM.

Conclusion

In conclusion, this study highlights the need for targeted interventions to optimize the nutritional state and improve dietary practices in adolescents and adults with T1DM. The findings underscore the importance of balanced macronutrient distribution, increased intake of dietary fiber, fruits, and vegetables, management of central obesity, and addressing micronutrient deficiencies. A comprehensive approach that involves healthcare providers, nutritionists, and diabetes educators is crucial for addressing these nutritional challenges and improving overall outcomes in individuals with T1DM.

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