Relationship between eating behavior and disease control on the quality of life in type 1 diabetes mellitus

Relação do ato de comer com o controle da doença e a qualidade de vida no diabetes mellitus tipo 1

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ABSTRACT

This study aimed to analyze the relationship between eating behavior, disease control, and quality of life in adults with type 1 diabetes mellitus (DM1). This cross-sectional study was conducted using an online questionnaire based on the Brazilian version of the Diabetes Quality of Life Measure (DQOL-Brazil), comprising questions on dietary control. A total of 103 volunteers (85.4% women) were included in this study. In relation to food, 68.9% said that they felt like eating when they were anxious, worried, or tensed. The overall score was 2.36 ± 0.75 on the DQOL-Brazil, with higher scores for the domains "satisfaction" and "diabetes-related concerns." The age variable had a negative correlation with the global DQOL-Brazil score and with the domains "impact," "social/vocational concerns," and "diabetes-related concerns." This study demonstrated an association between the act of eating and DM1 control, affecting the quality of life in these individuals.

Keywords: Type 1 diabetes mellitus, Nutrition, Quality of life, Eating behavior

RESUMO

O objetivo deste estudo foi analisar a relação do ato de comer com o controle da doença e a qualidade de vida em adultos com diabetes tipo 1 (DM1). Trata-se de estudo transversal, realizado através de um questionário *on-line* com a versão brasileira do *Diabetes Quality of Life Measure* (DQOL-Brasil) e de perguntas sobre controle alimentar. Foram incluídos 103 voluntários (85,4% mulheres). Nas relações com a comida, 68,9% disseram sentir vontade de comer quando estão ansiosos, preocupados ou tensos. O escore global foi de $2,36 \pm 0,75$ no DQOL-Brasil, e os domínios "satisfação" e "preocupações relacionadas ao diabetes" apresentaram valores mais altos. A variável idade teve correlação negativa com o escore global do DQOL-Brasil e com os domínios "impacto", "preocupações sociais/vocacionais" e "preocupações com diabetes". Esta pesquisa demonstrou associação entre o ato de comer com o controle do DM1, o que pode prejudicar a qualidade de vida desses indivíduos.

Palavras-chave: Comportamento alimentar; Diabetes mellitus tipo 1; Nutrição; Qualidade de vida.

INTRODUCTION

Diabetes mellitus (DM) is a disease characterized by hyperglycemia and may occur due to failure in the action or secretion of insulin by the pancreatic beta cells. Lack of insulin or defect in its action results in the body's inability to maintain normal glucose homeostasis.[1,2] There are several types of diabetes, such as type 1 diabetes (DM1), type 2 diabetes, gestational diabetes, and others, according to the Brazilian Society of Diabetes (SBD).[2,3]

DM1 is an autoimmune polygenic disease caused by the destruction of the pancreatic beta cells, resulting in an extreme deficiency in insulin production, which gradually becomes more aggressive. It was formerly known as insulin-dependent diabetes or juvenile diabetes.[1,2] It is a chronic autoimmune disease characterized by the formation of antibodies against pancreatic beta cells through an immunological process, leading to insulin deficiency.[2] According to the SBD guidelines, DM1 can be subdivided into two types: autoimmune (DM1A) and idiopathic (DM1B). In DM1A, insulin deficiency occurs due to autoimmune destruction of pancreatic beta cells, as confirmed by laboratory tests. In DM1B, insulin deficiency is of an idiopathic nature.[3]

The prevalence of DM1 is increasing worldwide, and researchers believe that the numbers could be even higher since many people present the disease without identifying this condition or without medical diagnosis.[4] According to data from the Vigitel 2021 survey published in 2022, approximately 9.1% of the Brazilian adult population was reportedly diagnosed for diabetes, being slightly more frequent among women (9.6%) than among men (8.6%), in absolute values.[5] The treatment of DM1 is guided by the SBD recommendations, which essentially follows the guidelines of the American Diabetes Association (ADA).[3] The Vigitel (2019) data indicated that 89.3% of individuals with diabetes underwent drug treatment for the disease, the frequency being slightly higher among women (90.8%) than among men (87.4%), in absolute values.[6] According to the International Diabetes Federation (IDF), approximately 16.8 million people were diagnosed with DM in Brazil in 2019. The prevalence of diabetes was higher in women (10.4%) than in men (8.4%).[7]

Insulin therapy is the mainstay of treatment for DM1. Insulin is a peptide hormone that is continuously released in low concentrations by pancreatic beta cells to limit fasting catabolism.[8] In DM1 or other conditions that lead to a complete loss of beta cells, such as total pancreatectomy, the lack of insulin leads to a catabolic state, characterized by glycogenolysis and gluconeogenesis in the liver, lipolysis in adipose tissues, and protein catabolism in muscles.[9] In DM1, pancreatic beta cells are destroyed, and treatment with exogenous insulin is required to prevent diabetic ketoacidosis.[10]

Insulin treatment can prevent chronic complications of DM1 and reduce episodes of hyperglycemia, a strategy being used by individuals with DM1 and other forms of DM.[8,11] However, even with insulin therapy, changes in habits, particularly those related to food, are important for the treatment of DM1. According to the ADA, inclusion of adequate nutrients from a varied, moderate, and balanced diet is the best nutritional strategy for promoting health and reducing the risk of chronic disease.[12]

Food and Nutrition Education aims to transmit information guided by strategies to position food and nutrition in a manner consistent with the understanding of health as quality of life and well-being; therefore, promoting changes to a healthier lifestyle, and bringing food as a factor for disease prevention and control for all individuals who adapt to the proposed changes.[13]

Nutritional therapy is essential for achieving therapeutic goals and should be guided

by a professional with knowledge and experience in the treatment of DM1. This must be in accordance with the patient's nutritional needs, glycemic control, and prescribed medications. However, in addition to the dietary plan offered by the nutritionist, the patient's preferences, access to healthy foods, ability and availability to make behavioral changes, and cultural factors are very important.[14,15]

Eating behavior is a set of cognitions that govern eating actions and habits. In this case, the nutritionist must identify dysfunctional and habitual behaviors to modify inappropriate cognitions, and teach behavioral changes and problem-solving strategies. Patients often need strategies that go beyond diet elaboration and prescription of exercises. A broader look at psychosocial conditions that can influence disease control is often necessary.[16] Therefore, this study aimed to verify the relationship between diet and disease control on the quality of life in individuals with DM1.

METHODOLOGY

STUDY DESIGN

This was a cross-sectional and observational study conducted from February 2022 to April 2022 using an online questionnaire and involved adult Brazilian patients with DM1. The study was based on a sample of convenience, and all those who agreed to participate were included, based on the inclusion and exclusion criteria described below.

POPULATION

The sample consisted of adult Brazilian men and women with DM1. Individuals with a confirmed diagnosis of DM1, aged 18–60 years,

and who answered the questionnaire completely were included. Participants who were not diabetic or had diabetes other than DM1, and who answered the questionnaire were excluded from the sample. Participants who did not complete the questionnaire or responded twice were also excluded. The online questionnaire for individuals with DM1 was disseminated through social networks, e-mails, and messaging applications such as WhatsAppÒ. The responsible researchers also contacted groups of patients with DM1 and their families, inviting them to participate in the research and respond to the questionnaire.

PROCEDURES

For this study, an online questionnaire was prepared through the Google Forms platform, allowing the access link to be shared with all research volunteers individually. This questionnaire addressed demographic, socioeconomic, and health issues, such as sex, age, education, family income, number of people in the household, and practice of physical activity, to characterize the research volunteers. It also included anthropometry, with requests for self-reported weight and height, as well as questions about DM1, diagnosis, and the relationship between eating habits and disease control.

To classify nutritional status, body mass index (BMI) was calculated and categorized as underweight, eutrophic, and overweight, including overweight and obesity in the same category depending on the sample number, following the definitions of the World Health Organization (WHO).[17]

To assess the relationship of the individual with DM1 with food, and eating actions, multiple-choice questions were asked about the act of eating, such as if the volunteers ate without guilt and with pleasure, if they ate out of fear of having

episodes of hypo- or hyperglycemia, or if they felt like eating when they were anxious, worried, or tensed. Moreover, the frequency of food refusal in individuals with DM1 owing to concerns about the disease was questioned. The answers to each of the above question had the options "never or almost never," "rarely," "occasionally," "frequently," and "almost daily." The volunteers were also asked if they ate more than usual when the food tasted good, as well as how they quantified their food.

HEALTH-RELATED QUALITY OF LIFE

For this research, the Brazilian version of the Diabetes Quality of Life Measure (DQOL-Brazil) questionnaire was used, which was available online to volunteers. This questionnaire is a public domain instrument translated into Portuguese and validated in individuals with DM1. The DQOL-Brazil questionnaire has 44 items divided into four domains: "satisfaction" (15 questions), "impact" (18 questions), "social/vocational concerns" (7 questions), and "diabetes-related concerns" (4 questions). This questionnaire assesses health-related quality of life. Answers to these questions varied on a 5-point scale. The degree of intensity and frequency may vary, and the closer the score is to 1, the better the health-related quality of life in this population. The closer the score is to 5, the worser the quality of life assessment in these volunteers.[18,19]

STATISTICAL ANALYSIS

The database was created using Microsoft Excel (Office 2013®) and analyzed using the Statistical Package for Social Sciences (SPSS®), version 19.0, for Windows (SPSS Inc., Chicago, IL, USA). The Kolmogorov–Smirnov test was used to assess normality and indicate the statistical test to

be used. Qualitative (categorical) variables were described using absolute and relative frequencies (percentages). Qualitative variables were compared using Chi-square or Fisher's exact test. Quantitative variables with a normal distribution were presented as the mean and standard deviation and compared using Student's *t*-test for independent samples. Pearson's correlation coefficient was used to verify correlations between quality of life and study variables, such as the domains of the DQOL-Brazil questionnaire, age, BMI, and weight. Statistical significance was set at 95% ($P \leq 0.05$).

ETHICAL ASPECTS

This study was approved by Faculdade de Minas Ethics Committee (number 5.180.524, CAAE 53665421.3.0000.5105). All participants signed an informed consent form, after due explanations about the research objectives and methods, before having access to the online questionnaire.

RESULTS

This study received 136 responses to the online questionnaire. However, 103 individuals with DM1 were finally included after excluding duplicates and applying the exclusion criteria. Mean age was 29.4 ± 8.5 years, with no differences between men and women ($P = 0.420$). Of the 103 participants in the survey, 88 were women (85.4%), and 15 were men (14.6%). Table 1 presents the participants' general characteristics. Moreover, there were no differences between the two sexes regarding education, per capita income, BMI, BMI categories, and practice of physical activity. However, differences in weight and height were observed between men and women (Table 1). Since there were no differences

in the sample characteristics and the number of men alone was relatively small, other variables (relationship with food and quality of life) have been presented for the total sample, without separating men and women.

Table 1. General characteristics of research participants with DM1 (2022)

Characteristics	TOTAL (n=103)	WOMEN (n=88)	MEN (n=15)	P-value#
Age (years)				
Mean ± SD	29.4 ± 8.5	29.2 ± 8.4	31.1 ± 9.2	0.420
Schooling – n (%)				0.838
Elementary school	0	0	0	
High school	34 (33.0%)	29 (33.0%)	5 (33.3%)	
University/College education	47 (45.6%)	41 (46.6%)	6 (40.0%)	
Graduate, master, or doctorate	22 (21.4%)	18 (20.4%)	4 (26.7%)	
Per capita income – n (%)				0.127
Up to 1 minimum wage	40 (38.8%)	37 (42.0%)	3 (20.0%)	
Between 1 and 3 minimum wages	33 (32.0%)	25 (28.4%)	8 (53.3%)	
Above 3 minimum wages	30 (29.2%)	26 (29.6%)	4 (26.7%)	
Reported height (m)				
Mean ± SD	1,64 ± 0,08	1,62 ± 0,06	1.75 ± 0.08	**<0.001**
Current weight reported (kg)				
Mean ± SD	64.7 ± 12.0	63.0 ± 11.4	74.4 ± 11.4	**0.001**
BMI (kg/m²)				
Mean ± SD	24.0 ± 4.1	23.9 ± 4.2	24.4 ± 3.6	0.658
BMI categorization – n (%)				0.408
Low weight (BMI < 18.5 kg/m²)	7 (6.8%)	7 (8.0%)	0	
Eutrophic (18.5 ≤ BMI < 25.0 kg/m²)	65 (63.1%)	56 (63.6%)	9 (60.0%)	
Overweight (BMI ≥ 25.0 kg/m²)	31 (30.1%)	25 (28.4%)	6 (40.0%)	
Physical activity (minimum of 30 minutes) – n (%)				0.765
Sedentary	33 (32.0%)	29 (33.0%)	4 (26.7%)	
Once or twice a week	24 (23.3%)	21 (23.9%)	3 (20.0%)	
Three or more times a week	46 (44.7%)	38 (43.1%)	8 (53.3%)	

Legend: DM1: type 1 diabetes melittus; BMI: body mass index; SD: standard deviation; kg: kilogram; m: meter; #: Student's t test for independent samples with normal distribution and Pearson's chi-square test for categorical variables.

Among the 103 participants with DM1 in the study, 68 (66%) were diagnosed with the disease for more than 10 years, 8 (7.8%) were diagnosed for 6–10 years, 18 (17.5%) for the past 1–5 years, 4 (3.9%) between 6 months and 1 year, and 5 (4.8%) were diagnosed for less than 6 months. Regarding nutritional follow-up, 53 volunteers (51.5%) frequently followed up with a nutritionist, 40 (38.8%) consulted a nutritionist only at the time of diagnosis and currently do not, and 10 (9.7%) never consulted a nutritionist.

Regarding eating habits, 57 (55.3%) said they ate without guilt and with pleasure, whereas 40 (38.8%) said they ate out of fear of experiencing episodes of hypoglycemia or hyperglycemia. Figure 1 shows the volunteers' relationship with food, and Figure 2 shows the frequency of food refusal in individuals with DM1 due to disease concern.
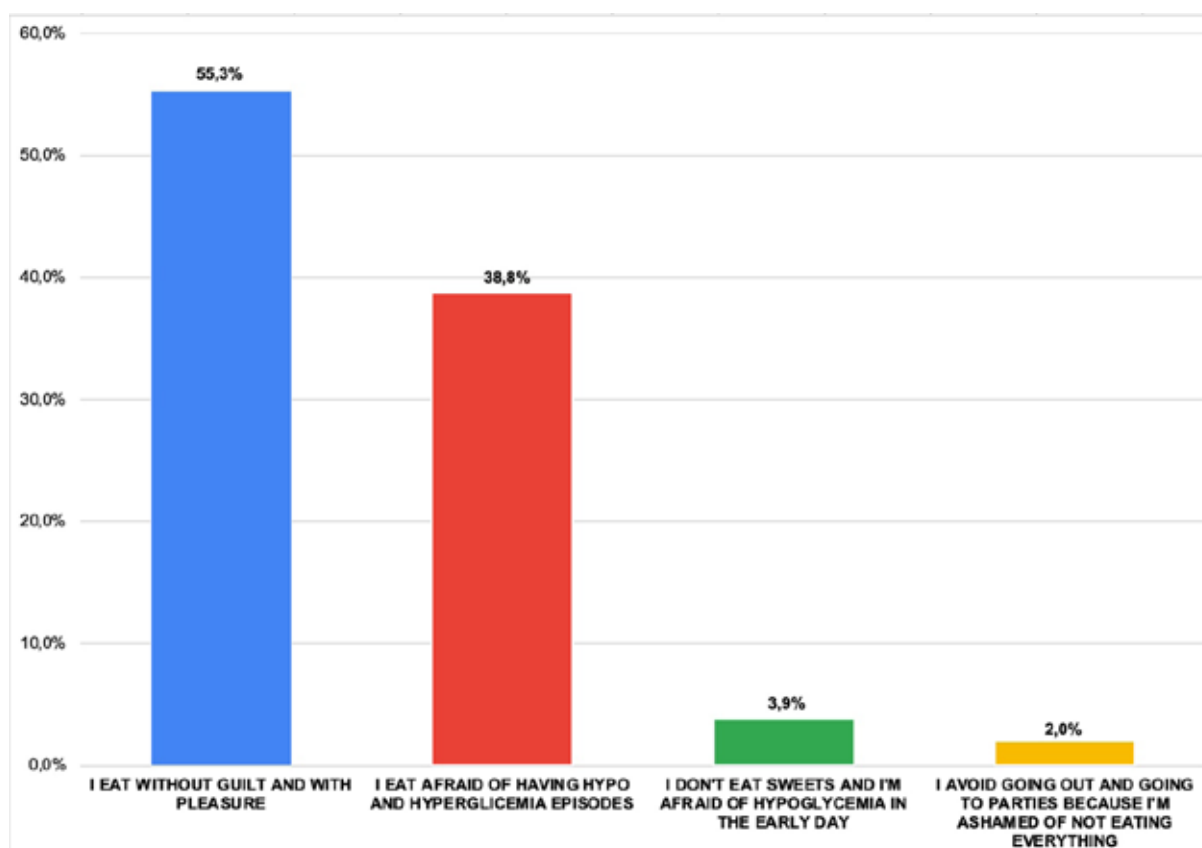

Figure 1. Relationship between the disease and eating actions in individuals with DM1 (2022).
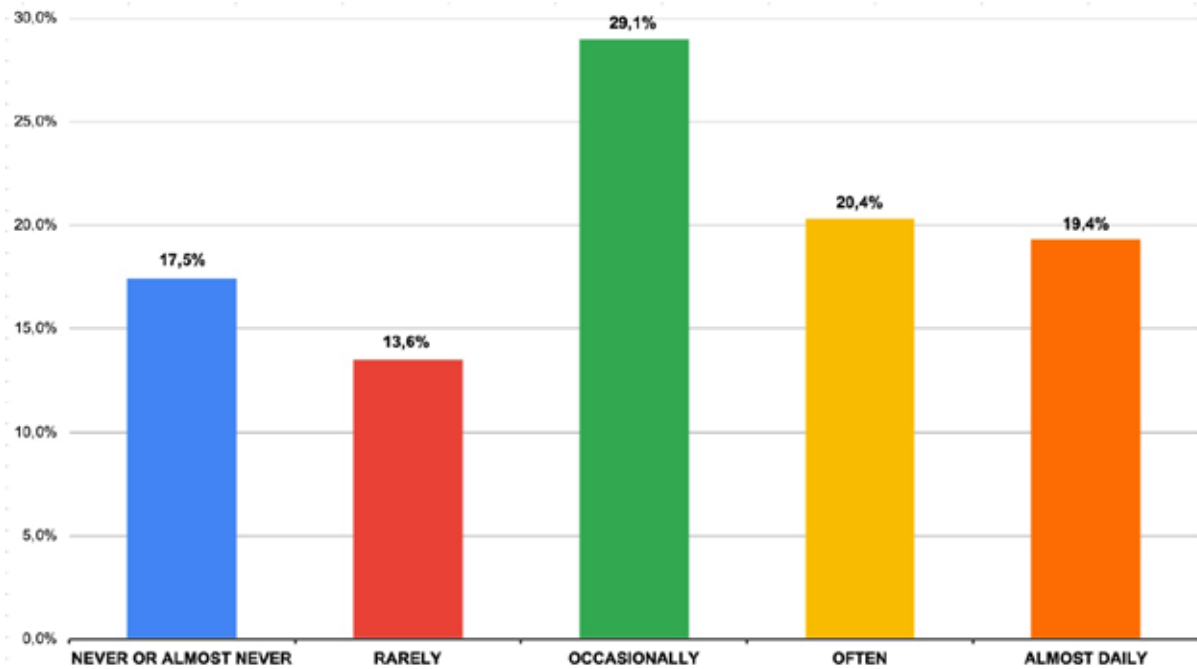Legend: DM1: type 1 diabetes mellitus.

Figure 2. Frequency of food refusal owing to disease concern in individuals with DM1 (2022).
Legend: DM1: type 1 diabetes mellitus.

However, based on the relationship between disease and food in participants with DM1, 71 people (68.9%) said they felt like eating when they were anxious, worried, or tensed; 36 volunteers (35%) said they felt like eating when they were scared; 67 volunteers (65%) said they ate more than usual when food tasted good; 52 (50.5%) said they try to eat less than they would like to eat; and 89 (86.4%) said they made insulin dose adjustment before eating more than they usually would.

When asked about how they quantified their food, 46 volunteers (44.7%) said they used carbohydrate counting (or list of substitutions) as a guide and quantified their food or read labels; 26 volunteers (25.2%) said they used carbohydrate counting as a guide, but they knew the diet well enough and therefore managed to eat the right amount without having to quantify or read labels; 21 (20.4%) said they ate the same amount at each meal, but did not quantify or use carbohydrate counting; and only 10 (9.7%) said they ate enough to satisfy themselves, without following any pattern of type or amount of food.

In the analysis of quality of life in adults with DM1 using the DQOL-Brazil, which presents a 5-point scale and being closer to 1 indicates better quality of life; the Global Score and score in each domain of the questionnaire are presented in Table 2. The highest values were observed in the "satisfaction" and "diabetes-related concerns" domains.

Table 2. Mean health-related quality of life according to the DQOL-Brazil questionnaire in adults with DM1 (2022)

Domains	Score Mean ± SD	95%CI
Satisfaction	2.59 ± 0.94	2.40 − 2.77
Impact	2.21 ± 0.76	2.06 − 2.36
Social/vocational concerns	2.23 ± 1.01	2.03 − 2.43
Diabetes-related concerns	2.46 ± 0.88	2.29 − 2.63
GLOBAL SCORE	**2.36 ± 0.75**	**2.22 − 2.51**

Legend: DM1: type 1 diabetes mellitus; SD: standard deviation; 95%CI: confidence interval at the 95% level.

Both correlation analysis and DQOL-Brazil validation studies showed a positive correlation between all domains and the overall score of the questionnaire *(P<0.001)* (Table 3). In the correlation analysis with other study variables, only age had a negative correlation with the overall score (r=−0.239; *P*=0.015) and with the domains "impact" (r=−0.271; *P*=0.006), "social/vocational concerns" (r=−0.363; *P*<0.001), and "diabetes-related concerns" (r=−0.209; *P*=0.034). However, no correlation was observed with weight, sex, and BMI.

Table 3. Correlation coefficient of the DQOL-Brazil questionnaire in adults with DM1 (2022)

Domains	Satisfaction	Impact	Social/vocational concerns	Diabetes-related concerns
Satisfaction	-	0.686	0.522	0.603
Impact	0.686	-	0.609	0.672
Social/vocational concerns	0.522	0.609	-	0.657
Diabetes-related concerns	0.603	0.672	0.657	-
GLOBAL SCORE	0.886	0.899	0.753	0.774

Legend: DM1: type 1 diabetes mellitus; DQOL: Diabetes Quality of Life Measure; Pearson correlation test (r value). All correlations were P<0.001.

DISCUSSION

This study demonstrated that the occurrence of disease can compromise the quality of life in patients with DM1, particularly with advancing age. Age showed a negative correlation with the global DQOL-Brazil score; therefore, the greater the age, the worse the quality of life in this population. The domains "impact," "social/vocational concerns," and "diabetes-related concerns" showed higher absolute values in the questionnaire. Moreover, this study showed that approximately 39% volunteers said that they ate with fear of glycemic changes and would also refuse food owing to disease concerns, suggesting that there is a need to pay attention to these aspects.

Nutritional therapy for DM1 control is important as 9.7% volunteers had never been to a nutritionist, whereas 38.8% had consulted only upon diagnosis and currently do not undergo nutritional monitoring. Santos and Freitas[20]

highlighted the importance of professional nutritionists in the treatment of DM1 because adequate nutritional therapy is considered the basis for the treatment and control of DM.

In this study, most volunteers (55.3%) reported eating without guilt and with pleasure. According to Alvarenga et al.,[16] some patients reported "fear of feeling hungry," since intense hunger can be associated with both hypoglycemia and hyperglycemia.

In a study carried out by Moura et al.,[21] approximately half of the patients had difficulties following the diet, with the main complaints being eating less, eating what they do not like, and changing meal times, which may justify not changing the diet and weight, despite improvements in food quality.

Nutritional therapy for diabetes is complex. Studies on diabetic patients have shown that the presence of feelings, such as anger, reasoning difficulties, psychological discomfort, worry, anxiety, discouragement, deprivation of pleasure, susceptibility to criticism from another person, and denial of disease, can influence adherence to the diet plan.[21,22]

In the present study, 2% volunteers said that they "avoid going out and going to parties because they are ashamed of not eating everything," and 4% said that they "don't eat sweets and are afraid of hypoglycemia at dawn." According to the study by Moura et al.,[21] the educator must establish a dialogue to identify sources of motivation and difficulties and encourage behavioral changes. Collet et al.,[23] in their study, analyzed self-care for the management of the disease and realized that the patient had to deal with feelings triggered by lifestyle changes, and upon receiving support from the family, the patient developed self-awareness, necessary for controlling the disease.

Regarding how they quantify food, 46 volunteers (44.7%) in the present study said

that they used carbohydrate counting (or list of substitutions) as a guide and that they usually quantify how much they eat and/or have the habit of reading labels. The carbohydrate counting meal plan is a nutritional strategy that can be associated with the drug treatment for DM according to the official guidelines of the SBD.[3] Alvarenga et al.[16] demonstrated that the flexibility in food choices becomes easier for patients with DM1 who use carbohydrate counting because the individual can control the glycemic response based on the amount of carbohydrates consumed, regardless of its type or source.

Castro et al.,[24] however, expressed that the quality of food is the most important to attain positive effects of a diet, and it is always important to maintain good sources of fiber-rich carbohydrates, in addition to lipids and proteins, present in the diet of individuals with DM. These challenges indicate the need to change the strategies used for diabetes education, considering the patients' reality, preferences, and cultural barriers that can influence their care.[3] Therefore, it is important that a patient be accompanied by a nutritionist who is also able to assess the behavioral characteristics that may affect disease control.

It is currently known that DM1 can negatively impact health-related quality of life, suggesting multidisciplinary strategies to be followed for this population. The average score of each domain and the global score of the DQOL-Brazil questionnaire in the present study were similar, although slightly worse in absolute values compared to the results of a study that validated the questionnaire in the Brazilian population with DM1.[19] In this validation study,[19] the average scores found were the global score (2.04), "satisfaction" (2.08), "impact" (2.04), "social/vocational concerns" (1.94), and "diabetes-related concerns" (2.02). Among all, the domain "social/vocational concerns" presented the greatest

difference compared to the score observed in the present study, showing that the interviewees of this current research were more concerned about social relationships, indicating a worse quality of life in this regard.

Maciel et al.[25] described that the quality of life is an eminent human notion and is associated with the degree of satisfaction related to the family, love, social and environmental life, and with existential aesthetics itself. Studies indicate that it is important to emphasize the importance of building and maintaining social support network.[26] The SBD recommends that one should consider individualized treatment in relation to the response level of each patient as well as social and family support and psychosocial factors that affect an individual's self-management ability.[3]

Similar to the DQOL-Brazil[19] validation study, the present study showed a positive correlation between all domains and the overall score ($P < 0.001$). These positive correlations demonstrate that DM1 treatment requires a multidisciplinary approach. Santos and Freitas[20] state that the integration of a multidisciplinary team in the development of interdisciplinary group activities, in addition to individual and family guidance as well as the use of strategies that encourage changes in the population's eating habits and lifestyle, are important for patients with DM owing of their influence on glycemic control.

One of the strategies used by a multidisciplinary team is health education, a continuous process that must be initiated immediately after diagnosis.[27,28] The need for a better understanding of the feelings and behaviors of people with diabetes can contribute to redimensioning the healthcare model.[21] In the study by Santos and Freitas,[20] the authors also found that the participants received medical and nutritional guidance related to their condition, but socioeconomic and cultural factors, personal aspects, and access to health services also influence self-care.

This study has few limitations, such as convenience sampling, and sample size difference between male and female respondents, which hinders a possible comparison by sex, in addition to using self-reported rather than direct measurement of weight and height. Even so, it is important to describe the relationships between eating actions and quality of life in patients with DM1, allowing health professionals to devise strategies contributing to disease control and good quality of life in this population.

By understanding how patients with DM1 relate to food and disease control, and identifying feelings and concerns that can impair the quality of life of these individuals, this study allows, as practical implications, that health professionals can plan individualized treatments, aiming at a change in eating behavior. The approaches of nutritional therapy and lifestyle changes for patients is as important as drug treatment. In addition to treatment, care for health, food, and behavior are important for the prevention of this disease. Diabetes education is an essential factor in guiding the treatment and prevention of DM1. Such patients have greater autonomy and control of the disease, which promotes a better quality of life.

CONCLUSION

The present study demonstrated the impact of disease on the quality of life of patients with DM1, particularly with advancing age. Furthermore, the feelings of fear, anxiety, guilt, and insecurity of these individuals associated with DM1 seem to impact the act of eating in this population, which can further aggravate their quality of life. Therefore, the treatment of DM1 needs to be multidisciplinary, with

special attention paid to behavioral issues that can influence the diet of these patients. New studies are needed to investigate how nutritional education strategies can promote behavioral changes and contribute to disease control.

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