



Knowledge, Attitude, and Practices (KAPs) of Type 2 Diabetes Patients Regarding the Consumption of Artificial Sweeteners in Zahedan, Iran: A Cross-sectional Study

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Abstract

Background: Knowledge and attitude are the main indicators of awareness about the use of artificial sweeteners.

Objectives: This study aimed to evaluate the knowledge, attitude, and practices (KAPs) of patients with type 2 diabetes mellitus (T2DM) in relation to the consumption of low-calorie artificial sweeteners.

Methods: In this descriptive-analytical study, 400 diabetic patients admitted to the diabetes clinic of Bu-Ali hospital in Zahedan were selected by the census method. After recording the demographic characteristics, we assessed participants' knowledge and attitude through a researcher-made questionnaire. Also, the subjects' practices were evaluated based on their nutritional behaviors. The answers were marked as good, moderate, and poor.

Results: The knowledge and attitude of the study population were 39% and 34.8%, respectively at the 'poor' level, 58% and 58.3% at the 'moderate' level, and 3% and 7% at the 'good' level. There was a significant relationship between patients' knowledge, attitude and their demographic indicators ($p < 0.001$). Moreover, 8% of patients reported side effects after taking artificial sweeteners, and 20.2% of patients used artificial sweeteners in their pure form beside food.

Conclusion: The findings showed that half of the diabetic patients had moderate knowledge and attitude concerning the consumption of artificial sweeteners. They had limited information about low-calorie sweeteners, which affected their nutritional behaviors so that almost half of the subjects did not consume any sweeteners. It has been suggested that appropriate educational programs be designed and implemented to overcome this information gap.

Keywords: Knowledge, Attitude, Practice, Artificial Sweetener, Type 2 Diabetes Mellitus

1. Background

Increasing people's awareness is an effective factor in preventing metabolic disorders, especially diabetes and its adverse effects. Knowledge and attitude are the main indicators of awareness that researchers in the fields of nutrition, medicine, and cultural studies investigate in different population groups.¹ Improving nutritional status is predicated on many factors such as lifestyle and diet.² Modifying one's eating behaviors is an important

step toward preventing non-communicable diseases as well as reducing and controlling disease complications. In this context, nutrition education is an effective practical method to promote nutritional knowledge, public awareness, and, ultimately, public health.³ Being one of the most common metabolic diseases in the world, type 2 diabetes mellitus (T2DM) refers to the condition in which insulin production or the body's ability to use insulin is reduced.⁴ In 2017, with 8.9% of its adult

population affected with T2DM, Iran ranked second in the number of diabetic patients in the Middle East.⁵ The intensified prevalence of diabetes and metabolic syndrome and people's increased awareness have resulted in the popularity of low-calorie artificial sweeteners.⁶ Medical nutrition therapy is essential in controlling the metabolism of food in diabetic patients. Since they trigger a sweet aftertaste without increasing blood sugar, dietary supplements, including low-calorie sweeteners are commonly used instead of sugar by diabetic patients.⁷

Although the original artificial sweetener, saccharin, was initially developed to address sugar shortages in the Second World War. At present, the main purpose of artificial sweetener use has changed to the reduction of calories. The general artificial sweeteners include saccharin, aspartame, cyclamate, and acesulfame.⁸ Food and Drug Administration (FDA) has approved the usage of six artificial sweeteners: acesulfame-K, advantame, aspartame, neotame, saccharin, and sucralose.⁹ Artificial sweeteners are used as food additives to replace sugar; they are even sweeter than sugar and have few or no calories.¹⁰ Although artificial sweeteners appear to be an excellent alternative, recent research has shown that their long-term use can alter glucose metabolism.¹¹ Thus, the consumption of artificial sweeteners is associated with an increased risk of weight gain, obesity, and T2DM.¹² Developments of diabetes and obesity, on the one hand, and the promotion of people's nutritional and health awareness, on the other hand, are effective in increasing the demand for non-nutritive sweeteners.⁶ Knowledge, positive attitude, and healthy behaviors are crucial in the treatment of patients with T2DM. The three elements of knowledge, attitude, and practice (KAP) are interdependent in the process of learning. Thus, if the level of one factor increases, the other two factors are positively affected. Treating diabetes could vary depending on the economic and cultural circumstances and nutritional habits of vulnerable groups.¹³

Nutrition education based on people's needs and the tendency to learn about healthy diets can be helpful for susceptible individuals.¹⁴ Salih and Sadiq reported that 70% of patients with T2DM were well aware of the use of artificial sweeteners; 52% of these people included artificial sweeteners in their diet, and 79% of them took 5 to 10 artificial sweetener tablets daily.¹⁵ In the study by Logue et al, although the subjects received compounds like saccharin and aspartame as artificial sweeteners, they were hesitant whether to continue using these low-calorie sweeteners despite their widespread safety. Overusing low-calorie sweeteners in foods, especially beverages could give rise to some adverse effects; hence, it is reasonable to reduce their consumption. In practice, however, this approach may be difficult to implement since people are usually attached to the innate or natural taste of sweets.¹⁶ Regarding the consumption of low-calorie artificial sweeteners, researchers have reported mixed results, which can affect the knowledge and nutritional behaviors and, subsequently, the general awareness of vulnerable groups,

especially patients with T2DM. Therefore, given the rising number of patients with T2DM in southeast Iran, it seems that addressing the KAPs of diabetic patients concerning using these sweeteners can prove rewarding.

2. Objectives

Evidently, the results of such studies can be employed to develop nutritional and counseling interventions as well as effective health education techniques. Meanwhile, due to the fact that few studies have been conducted on this topic in southeast Iran. This research was designed to explore the relationship between the use of artificial sweeteners and KAPs in diabetic patients admitted to the diabetes clinic of Bu-Ali hospital in Zahedan, Iran.

3. Methods

3.1. Study Design and Subjects

This cross-sectional, descriptive-analytic study was performed in 2019 on 400 T2DM, who were recruited based on the following formula:

$$n = \frac{\left(z_{1-\alpha/2}\right)^2 p(1-p)}{d^2} = \frac{(1.96 * 1.96)(0.5 * 0.5)}{0.05 * 0.05} = 384.16$$

$$Z_{1-\alpha/2} = 1.96, p = 0.5, d = 0.05$$

Previous studies have reported a 50%-80% awareness of using artificial sweeteners in diabetic patients.^{15,17} In order to consider more samples, patients' awareness was estimated at 50%. The above formula suggested a sample size of 384 participants based on the acceptable ratio and accepted error of the results of the sample against community was determined. However, we finalized the sample size at 400 individuals so as to account for possible attrition. The study population was admitted to the diabetes clinic of Bu-Ali hospital in Zahedan. The subjects were recruited by census method between June and December 2019.

3.2. Inclusion/Exclusion Criteria

The inclusion criteria included Iranian citizenship, having T2DM, age over 18, and informed consent to participate in the study. On the other hand, the exclusion criteria included non-Iranian citizenship, failure to complete the questionnaire, lack of willingness to participate in the study, a history of major surgery, chronic gastrointestinal diseases, celiac diseases, and other illnesses affecting dietary habits.

3.3. Data Collection

Participants' KAPs were assessed based on the study objectives and using a researcher-made questionnaire, whose validity and reliability were confirmed. Specifically, patients' knowledge and attitude were considered poor, moderate, and good. As for their practices, the subjects were scored quantitatively according to their replies to the questions. The questionnaire had two parts: the first

part dealt with demographic information (age, gender, occupation, level of education, family size, and duration of T2DM), and the second part covered questions related to KAP. Also, based on the objectives of the study protocol, the validity of the questionnaire was examined and approved by three experts. In terms of content, the questions were classified under three dimensions of KAP. To ensure that the study subjects understand the questions, we explained them to 20 diabetic patients who were not part of the samples but had been admitted to the abovementioned clinic. These individuals completed the pre-test. Subsequently, the biased questions were corrected or omitted (pilot study).

The second part of the questionnaire consisted of three sections: knowledge (18 items), attitude (9 items), and practice (13 items). It should be added that questions 2, 4, and 6 in the knowledge section were scored zero (“I don’t know”), 1 (“Rarely”), 2 (“Sometimes”), and 3 (“Always”); the rest of the questions related to this section were scored zero (“I don’t know”), 1 (“Always”), 2 (“Rarely”), or 3 (“Sometimes”). A total knowledge score of 37-48, 12-36, and 0-11 indicated good, moderate, and poor awareness, respectively. The attitude component was scored 2 (“I agree”), 1 (“I disagree”), or zero (“I have no idea”). A total attitude score of 14-18, 5-13, and 0-4 represented good, moderate, and poor attitude, respectively. Finally, in the practice section, 8 questions required yes or no answers, and the rest had four options or required descriptive answers. Finally, the number and percentage of answers were extracted.

3.4. Statistical Analysis

Data were analyzed in SPSS-21 using descriptive statistics, including mean and standard deviation for quantitative data as well as frequency and percentage for qualitative data. Additionally, chi-square test was employed to determine the relationship between different variables. $P < 0.05$ was considered statistically significant.

4. Results

The study population consisted of 189 (47.3%) male and 211 (52.8%) female patients. The mean age of male and female participants was 50 ± 11.5 (24-80) and 48 ± 11 (25-77) years, respectively. The level of knowledge had no significant relationship with age, gender, and family size ($P = 0.09$). According to the level of literacy, most of the subjects had a university education and also occupation women mainly were housewives (Table 1).

Knowledge was found to have a significant relationship with the level of education ($\chi^2 = 92.216$, $P < 0.001$), occupation ($\chi^2 = 81.57$, $P < 0.001$), and duration of diabetes ($\chi^2 = 9.697$, $P = 0.046$).

As can be seen, the number of patients having a moderate level of knowledge and attitude was higher, yet almost more than one-third of the patients had a poor status in this regard. In addition, there was a significant relationship between knowledge and attitude ($P = 0.002$). Regarding the

Table 1. General Characteristics of Participants

		Number	Percent
Gender	Male	189	47.25
	Female	211	52.75
Age (y)	20-30	23	5.75
	31-40	79	19.75
	41-50	125	31.25
	51-60	114	28.5
	61+	59	14.75
Education	Illiterate	104	26
	Elementary school	59	14.75
	High school	94	23.5
	Academic education	143	35.75
Occupation	House wife	148	37
	Laborer	60	15
	Employee	86	21.5
	Self-employed	43	10.75
	Student	19	4.75
	Retired	26	6.5
	Unemployed	18	4.5
Family Size	2	23	5.75
	3	64	16
	4	110	27.5
	>4	203	50.75
History of Type 2 Diabetes	<5 years	208	52
	5-10 years	152	38
	>10 years	40	10
Information Resources	Physicians	86	21.5
	Friends and acquaintances	55	13.75
	Mass media	36	9
	Books and magazines	8	2
	No resources	36	53.75
Awareness of artificial sweeteners		55	13.7
Saccharin		30	7.5
Aspartame		8	2
Acesulfame potassium		7	1.8
Sucralose		18	4.5
Other artificial sweeteners: None			70.5

consumption of artificial sweeteners in diabetic patients, we also found a positive significant relationship between knowledge and attitude scores ($P < 0.001$ and $r = 0.76$) (Table 2).

The results proposed that attitude could have a significant relationship with gender ($\chi^2 = 4.562$, $P = 0.01$), age ($X^2 = 24.471$, $P = 0.01$), level of education ($\chi^2 = 95.449$, $P < 0.001$), family size ($\chi^2 = 14.425$, $P = 0.025$), occupation ($\chi^2 = 84.723$, $P < 0.0001$), and duration of diabetes ($\chi^2 = 16.037$, $P = 0.003$).

Nutritional Behavior of Patients indicated only 8.7% of them used artificial sweeteners prior to the diagnosis of diabetes. Only 8% of them had side effects from the above compounds (Table 3).

The results showed that 13 (3.3%) and 68 (17%) patients used artificial sweeteners in the form of powder and liquid,

Table 2. Frequency Distribution of the Status of Knowledge and Attitude in the Study Population

	Poor	Moderate	Good	Total
Knowledge	156 39%	232 58%	12 3%	400 100%
Attitude	139 34.8%	233 58.3%	28 7%	400 100%

respectively.

Also, 50 (12.5%), 16 (4%), and 15 (3.8%) patients had used artificial sweeteners for less than 2 years, 2-5 years, and over 5 years, respectively. On the other hand, 319 (79.8%) patients reported not generally using low-calorie sweeteners. The results showed that the majority of patients never used artificial sweeteners (Figure 1).

A small number of patients (32; 8%) experienced the side effects of sugar substitutes. Also, most of the patients 319 (79.8%) did not use artificial sweeteners.

5. Discussion

The results of our study illustrated that the knowledge and attitude of diabetic patients were mostly moderate with respect to the consumption of sugar substitutes. However, a considerable percentage of participants exhibited poor awareness and attitude, and further investigation needs to be undertaken in this area. Moreover, just a few participants possessed good knowledge and attitude, which implies the lack of knowledge and information in the study population about the use of low-calorie supplements or artificial sweeteners. On the other hand, a significant relationship occurred between patients' level of knowledge and their attitude.

Nayaka and Jain reported that sugar substitutes should not be prescribed for diabetic patients without full knowledge of their content and proper consumption. Therefore, preventing long-term side effects associated with these sweeteners requires raising awareness in diabetic patients. They indicated that 80% of patients used artificial sweeteners in the form of tablets, especially for drinking tea, and only 16% of patients felt well after taking artificial sweeteners; the rest, however, used these

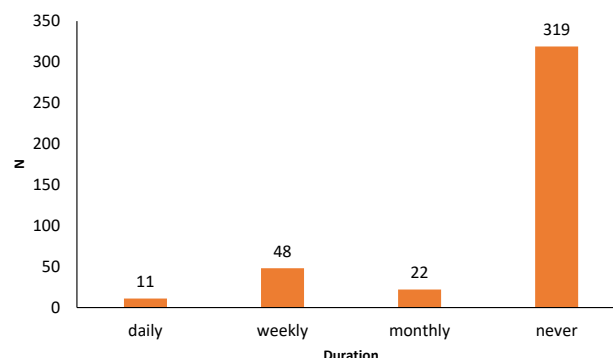


Figure 1. Frequency Distribution of Duration of Using Artificial Sweeteners in the Study Subjects

products merely because of their physician's prescription.¹⁷ Nutritional knowledge can be positive and helpful, provided that its implementation entails a good nutritional status. Conversely, if inappropriate, it may lead to poor nutrition.¹⁸ It has also been noted that over half of patients with T2DM are well aware of the use of artificial sweeteners.¹⁵ Raising awareness can motivate patients to change and improve proper eating behaviors.¹⁹ On the other hand, it has been pointed out that patients with T2DM well aware of the health benefits and risks of sugar substitutes tended to include them in their diets in order to control their blood sugar and reduce its complications.¹⁷

The present study demonstrated that attitude has a significant relationship with age, level of education, occupation, family size, and duration of disease in diabetic patients ($P < 0.05$). Thus, the highest number of patients with good knowledge and attitude had an academic education. These results are consistent with those of Maayeshi et al, who reported a positive relationship between nutritional awareness and the level of education.²⁰ Other findings support that several factors such as age, level of education, and gender affect nutritional KAP.²¹ The ecological systems theory states that human behavior depends on the interaction of various environmental factors and personal characteristics such as genetics, gender, and age.²² Elementary education has also been

Table 3. Frequency Distribution of Participants' Practices in Relation to the Consumption of Artificial Sweeteners

Question	Description		Total No. (%)
	Yes No. (%)	No No. (%)	
Had you used artificial sweeteners before you were diagnosed with diabetes?	31 (7.8)	369 (92.3)	400 (100)
Have you taken medication to treat diabetes?	400 (100)	0 (0)	400 (100)
Do you use artificial sweeteners in pure form, with drinks, or with food?	81 (20.2)	319 (79.8)	400 (100)
Did you have any of the following side effects after using artificial sweeteners? (Headache, nausea, weight gain, stress, high blood sugar)	32 (8)	368 (92)	400 (100)
Have you ever changed the artificial sweeteners you use because of their brand?	3 (0.8)	397 (99.2)	400 (100)
Do you use foods that contain artificial sweeteners such as diet ice cream, diet milk, and diet candies?	81 (20.2)	319 (79.8)	400 (100)
Do you control your blood sugar during using artificial sweeteners?	41 (10.2)	359 (89.8)	400 (100)
Have you measured your blood sugar before using artificial sweeteners?	38 (9.5)	362 (90.5)	400 (100)

observed to be significantly associated with a low KAP score in diabetic patients. This may be explained by the fact that educated people have greater access to informative educational sources and materials. It has been emphasized that educated people have better access to important educational and practical resources.²³

Awareness is a necessity for the effective implementation of medical treatment.²⁴ Several factors mutually affect a person's eating habits; hence, they cannot be studied separately.²⁵ It has also been reported that there is a positive and direct relationship between awareness and attitude regarding food security in Iranian households so that mothers' increased nutritional knowledge could lead to an improvement in attitudes and food security.²⁶ Arguably, promoting the health of a society necessitates consideration of its citizens' attitudes. It should be stressed that attitude is the most important determinant of nutritional behaviors. Nevertheless, KAP changes based on demographic and socioeconomic conditions.²⁷

The results of a study in Pakistan confirmed that conducting a proper training program can positively influence people's attitudes toward diabetes and its treatment process.²⁸ There is evidence that an individuals' KAPs in relation to a healthy diet and continued physical activity ameliorate as their level of education increases.²⁹

In terms of occupation, government employees had the highest scores of awareness and attitude in the present study. Furthermore, the highest scores of knowledge and attitude occurred in patients who had a history of diabetes for more than ten years. It seems that government employees, being part of the middle class, have relatively better access to information sources on diabetes; moreover, by increasing age, this group of patients pays special attention to enhancing their physiological and psychological health. Thus, their relatively better nutritional awareness and attitude are justifiable. However, more extensive research is required on this topic. Several reports indicate basic education in diabetes can help control blood sugar and promote the quality of life of patients.^{30,31}

The results of the present study showed that diabetic patients received their medication mainly through tablets; moreover, most patients did not use low-calorie artificial sweeteners before diabetes diagnosis. They began taking them owing to the recommendations of physicians and paramedics. In performing nutritional interventions for diabetic patients, it is important to administer FDA-approved supplements, which are mostly healthy, alongside drug therapy.

Meanwhile, inappropriate consumption of sugar substitutes may entail complications such as obesity, diabetes, and cancer.¹⁷ It has been noted that most patients take artificial sweeteners without adequate awareness of their content and characteristics.¹⁷ Non-nutritive sweeteners are found in a variety of supplements and medications, and their use is controversial and has prompted many concerns about their safety. They are taken by different people, including obese and thin,

diabetic, and non-diabetic individuals as well as adults and children. Extensive marketing, advertising, and increased health awareness have led to their wide popularity.²³ This heightened awareness among population groups is key in fighting metabolic disorders, particularly diabetes and its complications. Knowledge and attitude are the main indicators of awareness that should be studied in different population groups with varying racial and cultural backgrounds.¹

Although there is limited data regarding diabetic patients' KAP in relation to the usage of artificial sweeteners, it is possible to enhance and correct their supplementation pattern and, consequently, enhance consumer health by promoting FDA-approved sugar substitutes and their benefits.¹⁷ In keeping with our findings, Saito et al. observed that most patients began taking artificial sweeteners after being diagnosed with diabetes.⁷ We also noted that most patients did not experience side effects such as headache, nausea, weight gain, and stress after consuming artificial sweeteners. It has been reported that most subjects did not experience the side effects of sugar substitutes, including nausea and headache, and more than half of them were aware of the side effects of taking aspartame.³²

Regarding the practices of diabetic patients, it was revealed that most patients did not use any sweeteners; more specifically, those who used them would often do so in pure form with drinks or with food. In line with our findings, Salih and Sadiq stated that more than half of patients with diabetes included artificial sweeteners in their diet in the form of tablets.¹⁵ Another study also found that most people with diabetes took artificial sweeteners in the form of tablets, and that was only because of their physician's recommendation.¹⁷ It seems that factors such as the level of education and financial status have affected the consumption pattern of artificial sweeteners in our study population. Although more than half of patients in our study were unfamiliar with artificial sweeteners, others who used these products had adhered to FDA recommendations, which are generally recognized as safe including six non-caloric artificial sweeteners: saccharin, acesulfame K, aspartame, neotame, sucralose, and stevia.³³

Most public hospitals in Iran do not provide proper diabetes education programs, and it seems that the existing programs are not desirable and effective. Additionally, the awareness of the general population about diabetes is still insufficient in Iran and there must be an urgent need to implement appropriate interventions in this area.³⁴ In another study on patients with T2DM, the levels of good KAP were 61.41%, 50.44%, and 52.23%, respectively; it was also indicated that people's KAP grew better as diabetes progressed, which reinforces the findings of our study. Therefore, training before the onset of diabetes complications should be a priority for newly diagnosed patients as well as patients with low KAP levels.³⁵ The limitations of this study include its small number of samples and its cross-sectional nature, which hindered a chronological assessment of the results. It was therefore

Research Highlights

What Is Already Known?

The intensified prevalence of diabetes increased awareness have resulted in the popularity of low-calorie artificial sweeteners. Regarding the consumption of low-calorie artificial sweeteners, researchers have reported mixed results, which can affect the knowledge and nutritional behaviors of diabetes patients. It seems that addressing the KAPs of diabetic patients concerning using these sweeteners can prove rewarding.

What This Study Adds?

Our findings revealed significantly poor levels of knowledge and attitude in the study population, considering the relationship between these two indicators suggests that fostering patients' nutritional awareness can help modify their attitude and practice toward low-calorie sweeteners.

difficult to infer a basic relationship between different parameters. Hence, more studies with larger sample sizes need to be undertaken in the form of interventions whereby patients' status is continuously monitored.

6. Conclusion

Whereas our findings revealed significantly poor levels of knowledge and attitude in the study population, considering the relationship between these two indicators suggests that fostering patients' nutritional awareness can help modify their attitudes toward low-calorie sweeteners. This change in perspective could subsequently be translated into better health outcomes, even though it requires other educational, clinical, economic, and cultural interventions, as well. As for diabetic patients' practices, it is crucial to overcome the gap in their behaviors regarding the need to independently control and monitor the status of their biochemical and clinical indicators, which calls for the implementation of support programs and clinical counseling in parallel with the acquisition of health and nutrition skills. It is also recommended that more extensive studies be conducted on larger populations and with longer follow-ups to obtain more conclusive results. Nevertheless, further studies are required to understand the factors affecting KAP in the patients.

Authors' Contributions

MK and FM performed the conception and design of the research; HE and FR performed and prepared tools and facilities for the field study; AD conducted statistical analysis; MK and FM drafted and participated in manuscript writing and revision.

Conflict of Interest Disclosures

The authors declare that they have no conflicts of interest.

Ethical Approval

This research was approved by the Ethics Committee of Zahedan University of Medical Sciences (R.ZAUMS.REC.1398.254) on November 12, 2019.

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