ORIGINAL ARTICLE

Use of low calorie sweeteners among type 2 diabetic patients in an Asian population

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Abstract

Aims: To study the factors influencing the use of sweeteners among type 2 diabetic patients treated in a Singapore primary care centre

Methods: Four hundred and ninety-four participants were interviewed using a questionnaire in this cross-sectional study. They were assessed on their knowledge, perception and attitudes toward sweeteners. Data analysis was executed based on proportions and χ^2 test was used to assess differences.

Results: Gender, race and total household income were not statistically associated with sweetener usage. Factors which deterred sweetener use were perceived inconvenience and harm, embarrassment, cost and unacceptable taste. Sweetener usage was associated with acceptance and perception that sweetener could improve diabetic control. Of the 75.3% of patients who were users, 20.7% had good diabetic control (HbA1c < 7%), while among the 24.7% of non-users, 36.1% had good diabetic control (P = 0.002).

Conclusions: Of the study population, 75.3% had prior use of sweeteners. Sweeteners could be an adjunctive measure for patients to achieve diabetic control while adapting to a diabetic diet.

Key words: adjunctive measure, diabetes mellitus, primary care, sweetener

Introduction

Diabetes mellitus affects 9% of the Singapore's,population[1] and its prevalence is expected to rise further in view of the ageing population. It is a common chronic disease in primary care with a significant proportion managed at government polyclinics.

Dietary control remains the first-line management of type 2 diabetes mellitus. Rice, bread and noodles constitute the main staples in the diet for the majority of the local multiracial Asian population. To restrict caloric intake and to maintain sweetness in the food, sweeteners have been introduced into the diet of the local population over the past decades. Sweeteners are classified into nutritive or low calorie sweeteners (examples include aspartame) and sugar alcohol (polyols such as sorbitol).[2] Both have been approved by Singapore's health authority for sale and consumption in its natural state or as an additive in various food products such as snacks or beverages. Serious ill effects of low calorie sweeteners have been refuted in many studies,[3–9] although the cohorts in these studies tended to be small. These reports suggest that the amount of such sweeteners available in these products is safe for consumption.

Nonetheless, there is paucity of information on the use of such sweeteners in the Singapore population. Diabetic patients are a subset of the local population who are likely to use these low calorie sweeteners, which will be known as "sweeteners" for brevity in this article.

Objective

This study aimed to determine the factors influencing the use of sweeteners among type 2 diabetic patients treated in a district primary care center, in order to provide the medical professional with insight into diabetic patients' knowledge, perception, attitude and use of these sweeteners. Appropriate advice on their use could be incorporated into dietary counselling to optimize patient diabetic control.

Methods

This study uses a cross-sectional design to describe type 2 diabetic patients managed at a district primary care polyclinic in Pasir Ris in north-eastern Singapore. These patients were recruited on a consecutive case encounter basis. Their disease status was established from their medical record using a single HBA1c reading, or the average of two readings within 6 months prior to the study. In addition to this, the following information was also recorded from patients' histories:

• whether they were hypertensive;
• a recorded serum low density lipoprotein (LDL) within 6 months prior to recruitment to the study.
• history of stroke including cerebrovascular accident and/or transient ischaemic attack;
• history of ischaemic heart disease.

All study participants were either treated with hypoglycemic drugs or were using dietary controls. A participant was defined as having used a sweetener if they had taken an oral sweetener on at least one occasion in the past month, or declared themselves as current consumers.

A team of trained nurses administered the standardized structured questionnaire during face-to-face interviews after patients had given their written consent. Patients who refused consent were categorized as non-responders. Responses to this questionnaire have limited generalisability, as its validity and reliability were not evaluated. This study was not designed to establish the questionnaire as a measurement tool, but to explore the prevalence of low calorie sweetener use among the study population

Statistical analysis

The analysis was executed based on each question asked and no summary score was attempted. SPSS statistical software (V.11.0) was used in the data analysis. Proportions (%) were used to describe categorical variables and χ^2 test was used to assess differences. χ^2 test for trend was applied to test for trends. Statistical significance was defined as $p = 0.05$ and the results were presented as odds ratio (OR) with 95% confidence intervals (95% CI). The SingHealth Polyclinics Institution Review Board approved the study.

Results

Demographic profile of the study population

Four hundred and ninety-four type 2 diabetic participants, out of a total of 502 subjects in the sampling frame, participated in the study, constituting a response rate of 98.4% (see Table 1). The majority of users were in the 50–69 year age group and tended to have only reached a minimal educational level. The participants' genders, race and total household income were not statistically associated with sweetener usage.

While there was no statistical association between the duration of diabetes mellitus and the use of low calorie sweeteners, there was an association with HBA1c level and their use. Of the 75.3% of patients who were using low calorie sweeteners, only 20.7% had good diabetic control (defined as HbA1c of < 7%), whereas among the 24.7% who were not using them, 36.1% had good diabetic control (P = 0.002). Although the sweetener was noted to be associated with history of stroke, precaution should be exercised in this interpretation, as there were only three stroke subjects who were non-users. Other comorbidities such as lipid status, history of hypertension and coronary heart disease were not associated with sweetener usage.

Factors influencing the use of sweeteners among the diabetic patients

As noted in Table 1, 494 subjects, 75.3% (n = 372) of the study population, had used low calorie sweeteners at least once in the past month. The majority of subjects (71.7%) were prepared to substitute the use of refined sugar by these sweeteners (Table 2).

The main reasons given by non-users of low calorie sweeteners (Table 2) for not using them were: (i) they were inconvenient to use; (ii) they would cause harm; (iii) they might cause cancer; (iv) embarrassment in public; (v) they result in an unacceptable taste; or (vi) they taste different.

The main reasons given for sweetener use (Table 2) were: (i) perceived inability "to go without added sugar in beverages"; (ii) willingness to accept the habit of using sweetener instead of sugar; and (iii) perception that sweetener could improve diabetic control.

Discussion

In this study, the prevalence of type 2 diabetic patients using low calorie sweeteners was 75.3%. This was exclusive of the consumption of low calorie sweetener that might be present in canned or preserved food (which diabetics may be unaware of). By the use of a daily food diary, surveys in Germany[10] and Brazil[11] showed that use of low calorie sweeteners among the general population ranged from 35.9% to 72%, respectively. There is no comparable local or foreign prevalence report of sweetener use among diabetic patients, although it was noted that diabetics[11] in general had a much higher intake of sweeteners. In this study, sweetener usage was more prevalent among the 50–69 years age group and those with primary or no education. Their education status corresponded to the majority of adults in the 2000 local census[12] but sweetener use was prevalent in all age groups.

Patients with good diabetic control appeared to use low calorie sweeteners less. This could reflect a change in their behavior in terms of dietary preferences and taste discernment. Prochaska[13,14] divided behavior change into five stages; a diabetic patient could be in any of these stages when they had been advised to change their dietary habit from refined sugar to less sugar and eventually to total abstinence. The authors postulated that optimal diabetic control could be sustained if there was fundamental behavior and lifestyle modification among diabetic patients. This hypothesis is currently being tested in a sequel to this study. Although the subjects' lipid status and their comorbidities such as hypertension and ischaemic heart disease were not associated with sweetener use, the benefits of sweetener use among patients with such chronic diseases may be further evaluated with prospective studies.

Nonetheless, the use of sweeteners plays an important role as sugar substitutes in the interim period, as behavior modification takes time.[15] Such a role would tend to diminish as diabetic patients eventually adapt to their diabetic diet, thus reducing the use of sweeteners.

Likewise, low calorie sweeteners could possibly have been used as a caloric lowering measure to control metabolism-related diseases such as stroke and hyperlipidaemia, although this study was not designed to determine cause and effects of sweeteners.

The packaging of sweeteners in handy small containers or in small sachets by manufacturers would enhance the convenience of usage. However, such sweeteners were not readily available in "coffee shops" or beverage outlets in the local public housing estates, although they could be found in the more up-market cafés and restaurants. More sweetener-added beverages in multiple flavors are now easily available in the local markets and becoming more popular. As the public becomes more aware and accepting of sweeteners, the inconvenience and embarrassment associated with their direct use will likely diminish with time.

With an Asian diet largely dependent on rice and carbohydrate rich food, dietary counselling is a challenge to healthcare workers in managing their diabetic patients. Mutual understanding of a patient's dietary patterns and preferences and the healthcare professionals' goals in managing this disease is crucial for successful dietary counselling. Major treatment goals include achieving near-normal blood glucose and optimal serum lipid levels and attaining a reasonable body weight. This entails meal plans, which should be individualized to meet the needs of patients. The use of sweeteners could be incorporated into the meal plan as an adjunctive measure to achieve the treatment goal while satisfying the initial sweet cravings of some of these diabetic patients in the interim period of adjustment. This will cater to the group of diabetic patients who "could not go without sugar in beverages". The study showed that positive and negative perceptions of sweeteners could affect the use of sweeteners; 42.5% of study participants did not know whether sweeteners would cause harm. Family physicians and trained diabetic nurses should be aware of such perceptions and address concerns during patients' consultations as part of a holistic approach toward diabetic diet education.

Limitations

This cross-sectional study did not measure the quantum of intake of sweetener by the subjects, as memory recall of sweetener ingestion might not be reliable. The baseline profile of patients prior to the intake of sweetener, current diabetic pharmacological therapy in terms of the number and types of medications and lifestyle patterns were not taken into consideration in the analysis. This study also did not determine the potential adverse reactions of the users, as the investigators were not able to accurately assess such side-effects.

Conclusion

A total of 75.3% type 2 diabetic patients in this study had used sweeteners before. Perceptions of sweeteners by patients included that they would cause harm, (eg. cancer), that they were inconvenient to use and expensive, they had an unacceptable taste or tasted different. These perceptions could deter the use of the

low calorie sweetener in some patients. A receptive attitude included the perception that sweeteners could improve diabetic control and could be used as an adjunctive measure as diabetic patients modified their diet to achieve diabetic control.

Acknowledgments

References

1 Epidemiology and Disease Control Department. National Health Survey 1998. Singapore: Ministry of Health 1999, 5–9.
2 Franz MJ, Bantle JP, Beebe CA et al. Evidence-based nutritive principles and recommendations for the treatment and prevention of diabetes and related complications. Diabetes Care 2002; 25: 148–98.
3 Horwitz DL, McLane M, Kobe P. Response to single dose of aspartame or saccharin by NIDDM patients. Diabetes Care 1988; 11: 230–4.
4 Okuno G, Kawakami F, Tako H et al. Glucose tolerance, blood lipid, insulin and glucagon concentration after single or continuous administration of aspartame in diabetics. Diabetes Res Clin Pract 1986; 2: 23–7.
5 Nehrling JK, Kobe P, McLane MP et al. Aspartame use by persons with diabetes. Diabetes Care 1985; 8: 415–7.
6 Stern SB, Bleicher SJ, Flores A et al. Administration of aspartame in non-insulin dependent diabetics. J Toxicol Environ Health 1976; 2: 429–39.
7 Colagiuri S, Miller JJ, Edwards RA. Metabolic effects of adding sucrose and aspartame to the diet of subjects with non insulin-dependent diabetes mellitus. Am J Clin Nutrit 1989; 50: 474–8.
8 Thomas JA, Lin X. High intensity sweeteners: overview of safety and toxicology. Asia Pacific J Clin Nutrit 1995; 3: 327.
9 Tschanz C, Butchko HH, Stargel W et al. NutraSweet: an overview of metabolism, safety and usefulness. Asia Pacific J Clin Nutrit 1995; 3: 327.
10 Bar A, Biermann C. Intake of intense sweeteners in Germany. Zeitschrift Fur Ernahrungswissenschaft 1992; 31: 25–39.
11 Toledo Mc Ioshi SH. Potential intake of intense sweeteners in Brazil. Potential intake of intense sweeteners in Brazil. Food Addictives and Contaminants 1995, 2000; 12: 799–808.
12 Leow BG. Census of population 2000 – Geographical Distribution and Travel (Statistical Release 4). Singapore: Department of Statistics, 2000.
13 Prochaska JO, DiClemente CC. Transtheoretical therapy towards a more integrative model of change. Psychother Theory Res Pract 1982; 19: 276–87.
14 Jones H, Edwards L, Prochaska JO et al. Changes in diabetes self care behaviors make a difference in glycemic control: the Diabetes Stages of Change (DiSC) study. Diabetes Care 2003; 26: 732–7.
15 Tepper BJ, Hartfield LM, Schneider SH. Sweet taste and diet in type II diabetes. Physiol Behav 1996; 60: 13–8.

Table 1 - Demographic characteristics of users and non-users of sweeteners

Factors	n = 494	User n (%)	Non-user n (%)	P-value
Age (years)				
30–49	110	76 (20.4)	34 (27.9)	P = 0.047
50–69	290	230 (61.8)	60 (49.2)	
70 and above	94	66 (17.7)	28 (23.0)	
Highest education level achieved				
Primary and below	290	209 (56.2)	81 (66.4)	P = 0.047
Secondary and above	204	163 (43.8)	41 (33.6)	
Gender				
Male	212	160 (43.0)	52 (57.0)	P = 0.940
Female	282	212 (42.6)	70 (57.4)	
Race				
Chinese	295	220 (59.1)	75 (61.5)	P = 0.489
Malay	133	105 (28.2)	28 (23.0)	
Indian	55	38 (10.2)	17 (13.9)	
Others	11	9 (2.4)	2 (1.6)	
Duration of diabetes mellitus (nearest years)				
< 5 years	188	139 (37.4)	49 (40.2)	P = 0.492
5 < 10 years	107	85 (22.8)	22 (18.0)	
10 < 15 years	85	60 (16.1)	25 (20.5)	
15 years and above	114	88 (23.7)	26 (21.3)	
Combined household income in Singapore dollars				
< S$2000	273	202 (54.3)	71 (58.2)	P = 0.517
S$2000–4000	140	104 (28.0)	36 (29.5)	
> S$4000	38	32 (8.6)	6 (4.9)	
Not indicated	43	34 (9.1)	9 (7.4)	
Diabetic control (HBA1c in preceding 6 months)				
< 7%	121	77 (20.7)	44 (36.1)	P = 0.002
7 –< 9%	230	184 (49.5)	46 (37.7)	
≥ 9%	143	111 (29.8)	32 (26.2)	
Lipid status (LDL in mmol/L in preceding year)				
< 2.6	131	102 (27.4)	29 (23.8)	P = 0.626
2.6–3.4	159	116 (31.2)	43 (35.2)	
> 3.4	204	154 (41.4)	50 (41.0)	
History of hypertension				
Yes	309	237 (63.7)	72 (59.0)	P = 0.353
No	185	135 (36.3)	50 (41.0)	
History of ischaemic heart disease				
Yes	76	60 (16.1)	16 (13.1)	P = 0.423
No	418	312 (83.9)	106 (86.9)	
History of stroke				
Yes	41	38 (10.2)	3 (2.5)	P = 0.007
No	453	334 (89.8)	119 (97.5)	

Table 2 - Perception and attitude of users and non-users to sweeteners

Perception and attitude	n = 494	Users n (%)	Non users n (%)	P-value
"I can go without added sugar in beverage such as coffee and tea"				
Agree	341	253 (68.0)	88 (72.1)	P = 0004
Don't know	14	6 (1.6)	8 (6.6)	
Disagree	139	113 (30.4)	26 (21.3)	
"Use of sweetener will help my diabetic control"				
Agree	251	206 (55.4)	45 (36.9)	P = 0.000
Don't know	154	97 (26.1)	57 (46.7)	
Disagree	89	69 (18.5)	20 (16.4)	
"I am prepared to change my habit of using sugar to sweetener"				
Agree	354	295 (79.3)	59 (48.4)	P = 0.000
Don't know	16	6 (1.6)	10 (8.2)	
Disagree	124	71 (19.1)	53 (43.3)	
"It is embarrassing to use sweetener in public"				
Agree	64	45 (12.1)	19 (15.6)	P = 0.000
Don't know	41	17 (4.6)	24 (19.7)	
Disagree	389	310 (83.3)	79 (64.8)	
"Do you think that sweetener causes harm to your body?"				
Yes	55	43 (11.6)	12 (9.8)	P = 0.000
No	229	207 (55.6)	22 (18.0)	
Don't know	210	122 (32.8)	88 (72.1)	
"Do you think that sweetener can lead to cancer?"				
Yes	42	27 (7.3)	15 (12.3)	P = 0.000
No	202	179 (48.1)	23 (18.9)	
Don't know	250	166 (44.6)	84 (68.9)	
"Do you think that sweetener causes inconvenience?"				
Yes	97	72 (19.4)	25 (20.5)	P = 0.000
No	329	290 (78.0)	39 (32.0)	
Don't know	68	10 (2.7)	58 (47.5)	