RESEARCH PAPER

Cross sectional study on the nonnutritive sweetener consumption and its association with socio-demographic characteristics among Saudi pregnant women

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Abstract

The nonnutritive sweeteners (NNS) were manufactured as food additive to deliver sweetness without the allied high caloric content of sugar. The purpose of this cross-sectional study was to explore the preference of NNS and its connotation with socio-demographic characteristics among Saudi pregnant women. Data was collected using a structured questionnaire. Chi-square test was used to observe the association between categorical variables. A total of 327 pregnant women were recruited. Only 8% of the women reported to have gestational diabetes. Almost 67% of participants preferred normal sugar over NNS, and >50% who consume NNS preferred stevia over others. Almost 35% of the participants who do not consume NNS believed that it is abnormal and have unsafe chemical components. Reduced calories (37.21%), followed by useful for diabetics (20.93%) are the two significant reasons reported by the participants behind its consumption. An association has been found between the consumption of NNS, a package of sweetened refreshments, low-calorie juices, or artificially sweetened tea and education and income. The frequency of white sugar as a sweetening option is high among the pregnant women. These outcomes engender the requisite for further investigation to examine the usefulness of nutritional advice among pregnant women attending maternal clinics.

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Introduction

A growing concern about health and improved food awareness as well as the increased rate of various diseases has occasioned consumers to refrain from various forms of fat, salt, or sugar consumption. A maximum of 10% of daily total calories from added sugar has been recommended by the Dietary Guidelines Advisory Committee (Dietary Guidelines Advisory Committee, 2015), and the World Health Organization (WHO) recommended a reduction to 5% of the total energy consumption for further health benefits (WHO, 2015).

Saccharose as well as products containing saccharose is characterized by a fast absorption of glucose in the blood. A sedentary lifestyle and too much consumption of sugar lead to health issues. Nonnutritive sweeteners (NNS) or sugar substitutes are a great alternative for those who consider replacing glucose in their diet (Pope *et al.*, 2014). Saccharin, aspartame, acesulfame potassium, neotame, sucralose have been approved and considered as safe for humans by the United States Food and Drug Administration authority (Hanin *et al.*, 2018). Aspartame is 180–200 times sweeter than sucrose (Chattopadhyay *et al.*, 2014) and studies have revealed that it has both favorable and detrimental effects on the lifestyle and metabolism of diabetic people who depend on it (Hanin *et al.*, 2018). Furthermore, saccharin is 300 times sweeter than sucrose. Sucralose is a very intense sweetener and it is 600 times sweeter than sugar. Moreover, acessulfame potassium and neotame are 200 and >700 times sweeter than sucrose, respectively (Chattopadhyay *et al.*, 2014). In stevia leaves, stevioside, dulcoside A, rebaudioside A and rebaudioside C are the major sweetener components, which is many times sweeter than sucrose (Erkucuk *et al.*, 2009). The consumption of larger amounts of NNS has produced conflicting reports. A research study conducted by Suez *et al.* indicated that the regular consumption of NNS changed glucose tolerance by altering the gut flora (Suez *et al.*, 2014). Another study had shown that saccharin consumption in mice subjects resulted in reduced hyperinsulinemia, decreased insulin resistance, and improvement in the overall control of blood sugar compared with control subjects (Bailey *et al.*, 1997).

The epidemiology of diabetes during pregnancy remains unknown in several countries. A recent report from Saudi Arabia estimated the occurrence of pregestational and gestational diabetes mellitus (GDM) in Riyadh to be 4.3% and 24.3%, respectively (Wahabi *et al.*, 2016). However, to our information, the prevalence of NNS consumption among pregnant women in Riyadh has not been previously investigated. So, this study intends to explore the preference of NNS and its connotation with socio-demographic characteristics (SDC) among Saudi pregnant women in Riyadh, Saudi Arabia.

Materials and methods

Study design

In this study, a descriptive cross-sectional approach was used to assess the cognizance regarding the knowledge, attitude, and practice among Saudi pregnant women about the use of NNS. A total of 350 pregnant women were randomly interviewed, of which 327 filled the form completely. Sample size of 310 with 5% margin of error and 95% of confidence interval was predicted using the prevalence (28.1%) of moderate artificial sugar consumption mentioned by Mohamed *et al.* (2013).

Inclusion criteria

All Saudi pregnant women who were ready to fill the questionnaire form and the ability to properly understand relevant information were involved in this study.

Exclusion criteria

Non-pregnant and active smokers were not allowed to take part in the study.

Institutional Review Board Statement

The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Ethics Committee for Scientific Research and Post Graduate Studies at the College of Science, King Saud

University, Saudi Arabia (reference: KSU-HE-19-63). Informed consent was obtained from all subjects involved in the study.

Data collection
A pilot study was conceded to confirm the reliability and validity of the questionnaire, which was developed to examine the knowledge, attitude and practice among Saudi pregnant women regarding the use of NNS. To assure the validity and reliability of the content of questionnaire, the researcher sent it to few nutritional experts to give their views as regards the clarity of the questionnaire phrases. After reviewing the phrases and conducting adequate modification, the final questionnaire was approved. Participants were conversed via a structured questionnaire prepared by the research team, which was filled following the consent from the participants. The first segment of the study involved socio-demographic information, such as age group,

qualification, monthly income of the family, height, weight, and month of pregnancy, and the second segment assessed the knowledge, attitude, and practice of NNS. Questions with multiple alternatives were included in the survey form, wherein the participants were asked to tick their appropriate response. The data from all participants were gathered, evaluated, and presented in this study.

Statistical analysis
Data were analyzed using the SPSS 22.0 (SPSS Inc., Chicago, IL, USA) and were presented as frequencies and percentages. Chi-square test cross tabulation was used to observe the connotation between categorical variables. All P values were two-tailed, and P values < 0.05 were considered significant.

Results
Sociodemographic characteristics of the Saudi pregnant women

Table 1. Socio-demographic characteristics of the study participants

Variables	Classification	Frequency	Percentage
Age group	Under 20 years old	4	1.2
	From 21–25 years old	45	13.8
	From 26–30 years old	124	37.9
	From 31–40 years old	120	36.7
	>40 years old	34	10.4
Education	Illiterate	0	0
	High School	6	1.8
	Senior Secondary	64	19.6
	Bachelors	218	66.7
	Postgraduate studies	39	11.9
Income (SR)	<5000	34	10.4
	5001–10000	98	30
	10,001–15,000	102	31.2
	15001–20000	40	12.2
	>20,000	53	16.2
Gestational month	First	76	23.2
	Second	24	7.3
	Third	23	7.0
	Fourth	37	11.3
	Fifth	32	9.8
	Sixth	30	9.2
	Seventh	26	8.0
	Eighth	24	7.3
	Ninth	55	16.8
Do you have gestational diabetes	Yes	26	8
	No	301	92

Table 1 shows the sociodemographic characteristics (SDC) of the pregnant participants. The majority (n = 244, 74.62%) of the participants (pregnant women)

were 26–40 years old, and only 4 (1.2%) pregnant women were under 20 years old. Only 34 (10.4%) pregnant women were over 40 years old.

Table 2. Knowledge, attitude, and practice about nonnutritive sweeteners among Saudi pregnant women

Parameters	Variables	Frequency	Percentage
What kind of sweetener do you use in your food	Normal sugar (NS)	218	66.7
	NNS	22	6.7
	Both NS and NNS	47	14.4
	Other	6	1.8
	Nothing	34	10.4
Do you consume nonnutritive sweeteners (diet sweeteners)	Yes	32	9.8
	Sometimes	110	33.6
	No	185	56.6
What is the reason behind not using nonnutritive sweeteners	I do not like the taste	42	22.70
	NNS are abnormal and have chemicals	36	19.46
	Not safe	29	15.68
	I do not care much about calorie	74	40
	Other	4	2.16
If you use nonnutritive sweeteners which of the following sweeteners do you use	Saccharin	9	6.33
	Aspartame	2	1.41
	Sugar Alcohols	3	2.11
	Sucralose	1	0.70
	Stevia	75	52.82
	None of the above	20	14.08
	I do not know	32	22.55
Do you use diet chocolate or diet soft drinks	Yes	33	10.1
	Sometimes	106	32.4
	No	188	57.5
Since the beginning of pregnancy, how many times have you eaten nonnutritive sweeteners, a package of sweetened refreshments, low-calorie juices, or artificially sweetened tea	I never took it	154	47.1
	5 times during pregnancy	73	22.3
	6-10 times during pregnancy	31	9.5
	11–15 times during pregnancy	7	2.1
	Once a week	44	13.5
	1-5 times/ week	18	5.5
During pregnancy, how many times have you consumed gum without sugar (eg, extra gum)	I did not take it at all	161	49.23
	1–3 times during the months of pregnancy	62	18.96
	4–6 times during the months of pregnancy	46	14.06
	1time per day	42	12.8
	2 times per day	10	3.05
	3times a day	6	1.8
Do you care about reading the food label attached to the products whether it contains added NNS	Yes	83	25.4
	Sometimes	152	46.5
	No	92	28.1
Do you think nonnutritive sweeteners are safe to consume and have health benefits	Yes	43	13.1
	No	142	43.4
	I do not know	142	43.4
If the answer is yes, what are the benefits that you think exist in NNS	Delicious taste	1	2.33
	Reducing calories	16	37.21
	Useful for diabetics	9	20.93
	Reducing weight	10	23.25
	Reduce calories, beneficial for diabetes and reduce weight	6	13.95
	I do not know	1	2.33
Do you advise others to consume nonnutritive sweeteners	No	161	49.2
	Yes to control blood glucose	77	23.5
	Yes, to lose weight	89	27.2
Do you think that there is a relationship between nonnutritive sweeteners and dizziness and nausea during pregnancy	Yes	71	21.71
	No	190	58.10
	I do not know	66	20.18

Where NS- normal sugar; NNS- nonnutritive sweetener

Table 3. Chi-square test for the relationship between the consumption of nonnutritive sweeteners and diet chocolate or diet soft drink with socio-demographic characteristics

SDC	Variables	Consumption of NNSs			Consumption of DC or SD		
		Yes (n = 32)	Sometimes (n = 110)	No (n = 185)	Yes (n = 33)	Sometimes (n = 106)	No (n = 188)
Age	Under 20	0(0)	1(0.9)	3(1.6)	0(0)	1(0.9)	3(1.6)
	20−25	2(6.2)	15(13.6)	28(15.1)	3(9.1)	15(14.2)	27(14.4)
	26−30	14(43.8)	38(34.5)	72(38.9)	11(33.3)	45(42.5)	68(36.2)
	30−39	13(40.6)	43(39.1)	64(34.6)	15(45.5)	32(30.2)	73(38.8)
	>40	3(9.4)	13(11.8)	18(9.7)	4(12.1)	13(12.3)	17(9.0)
Chi-sq			3.807			5.106	
P value			0.874			0.746	
Education	Intermediate	0(0)	4(3.6)	2(1.1)	0(0)	4(3.6)	2(1.1)
	Secondary	4(12.5)	25(22.7)	35(18.9)	3(9.1)	22(20.8)	39(20.7)
	Graduate	25(78.1)	73(66.4)	120(64.9)	27(81.8)	66(62.3)	125(66.5)
	PG studies	3(9.4)	8(7.3)	28(15.1)	3(9.1)	14(13.2)	22(11.7)
Chi-sq			9.014			7.268	
P value			0.173			0.297	
Income (SR)	<5000	3(9.4)	10(9.1)	21(11.4)	3(9.1)	12(11.3)	19(10.1)
	5001−10000	8(25)	35(31.8)	55(29.7)	8(24.2)	33(31.1)	57(30.3)
	10001−15000	12(37.5)	31(28.2)	59(31.9)	7(21.2)	37(34.9)	58(30.9)
	15001−20000	3(9.4)	18(16.4)	19(10.3)	3(9.1)	12(11.3)	25(13.3)
	>20,000	6(18.8)	16(14.5)	31(16.8)	12(36.4)	12(11.3)	29(15.4)
Chi-sq			4.204			12.52	
P value			0.838			0.129	

Chi-square test cross tabulation has been used for the relationship between significant variables and demographic characteristics. *P* value ≤ .05 was considered statistically significant. SDC = socio-demographic characteristics; Chi sq value= chi square value; NNS =nonnutritive sweetener; DC= diet chocolate ; SD= diet soft drink

Table 4. Chi-square test for the relationship between the frequency of consumption of nonnutritive sweeteners, a package of sweetened refreshments, low-calorie juices, or artificially sweetened tea with socio-demographic characteristics

SDC	Variables	Frequency of consumption of NNS, a package of sweetened refreshments, low-calorie juices, or artificially sweetened tea					
		Never (n = 154)	1−5 times (n = 73)	6−10 times (n = 31)	11−15 times (n = 7)	Once/week (n = 44)	1−5 times /week (n = 18)
Age	Under 20	3(1.9)	0(0)	0(0)	0(0)	1(2.3)	0(0)
	20−25	19(12.3)	11(15.1)	3(9.7)	1(14.3)	9(20.5)	2(11.1)
	26−30	57(37)	32(43.8)	10(32.3)	3(42.9)	14(31.8)	8(44.4)
	30−39	58(37.7)	25(34.2)	15(48.4)	2(28.6)	16(36.4)	4(22.2)
	>40	17(11)	5(6.8)	3(9.7)	1(14.3)	4(9.1)	4(22.2)
Chi-sq				12.525			
P value				0.897			
Education	Intermediate	1(0.6)	2(2.7)	0(0)	1(14.3)	2(4.5)	0(0)
	Secondary	28(18.2)	16(21.9)	7(22.6)	0(0)	12(27.3)	1(5.6)
	Graduate	106(68.8)	42(57.5)	23(74.2)	6(85.7)	28(63.6)	13(72.2)
	PG studies	19(12.3)	13(17.8)	1(3.2)	0(0)	2(4.5)	4(22.2)
Chi-sq	25.452*						
P value	0.044						
Income (SR)	<5000	13(8.4)	10(13.7)	3(9.7)	2(28.6)	6(13.6)	0(0)
	5001−10000	50(32.5)	18(24.7)	8(25.8)	4(57.1)	17(38.6)	1(5.6)
	10,001−15,000	53(34.4)	20(27.4)	13(41.9)	0(0)	7(15.9)	9(50)
	15001−20000	13(8.4)	11(15.1)	4(12.9)	0(0)	9(20.5)	3(16.7)
	>20,000	25(16.2)	14(19.2)	3(9.7)	1(14.3)	5(11.4)	5(27.8)
Chi-sq				32.228*			
P value				0.041			

Chi-square test cross tabulation has been used for the relationship between significant variables and demographic characteristics. *P* value ≤ .05 was considered statistically significant. SDC = socio-demographic characteristics, Chi sq = chi square value

Table 5. Chi-square test for the relationship between attitude toward reading the food labels and socio-demographic characteristics

SDC	Variables	Yes (n = 83)	Sometime(n= 152)	No (n = 92)
Age	Under 20	1(1.2)	3(2)	0(0)
	20−25	15(18.1)	15(9.9)	15(16.3)
	26−30	31(37.3)	59(38.8)	34(37)
	30−39	29(34.9)	58(38.2)	33(35.9)
	>40	7(8.4)	17(11.2)	10(10.9)
Chi-sq value			5.708	
P value			0.680	
Education	Intermediate	1(1.2)	5(3.3)	0(0)
	Secondary	17(20.5)	31(20.4)	16(17.4)
	Graduate	55(66.3)	94(61.8)	69(75)
	PG studies	10(12)	22(14.5)	7(7.6)
Chi-sq value			7.689	
P value			0.262	
Income (SR)	<5000	9(10.8)	15(9.9)	10(10.9)
	5001−10000	25(30.1)	42(27.6)	31(33.7)
	10,001−15,000	18(21.7)	57(37.5)	27(29.3)
	15001−20000	11(13.3)	17(11.2)	12(13)
	>20,000	20(24.1)	21(13.8)	12(13)
Chi-sq value			9.772	
P value			0.281	

Chi-square test cross tabulation has been used for the relationship between important variables and demographic characteristics. $P \leq 0.05$ was considered statistically significant. SDC = socio-demographic characteristics.

Majority of our participants (n = 218, 66.7%) were college graduates, and only 39 (11.9%) pregnant women had postgraduate degrees. None of the women were found to be illiterate. The monthly income for most of the participants (n = 102, 31.2%) ranged between 10,001 and 15,000 Saudi riyal, and only 34 (10.4%) participants had a family income <5,000 Saudi riyal. Seventy-six (23.2%) participants were in the first month of pregnancy, and only 26 (8%) participants reported to have gestational diabetes mellitus (GDM).

Knowledge, attitude and practice about non-nutritive sweetener among Saudi pregnant women.
Table 2 shows the knowledge, attitude, and practice about NNS among Saudi pregnant women. It has been found that 218 (66.7%) participants preferred normal sugar over NNS, and 47 (14.4 %) participants consumed both normal sugar and NNS. Almost 34% of the participants responded to have occasionally consumed NNS, and 56.6% of the participants did not like it. Upon querying the participants as regards their attitude toward NNS, almost 35% of them felt that NNS were abnormal and had unsafe chemical components, whereas 40% of the subjects stated that they do not care much about the calorie consumption,

therefore they use normal sugar instead of NNS. More than 50% of the participants preferred stevia over other NNS, and 57.5% pregnant women did not use diet chocolate or soft drinks. One hundred fifty-four participants (47.1%) have stated that they did not consume any NNS, package of sweetened refreshments, low-calorie juices, or artificially sweetened tea. One hundred fifty-two (46.5%) participants mentioned that they only occasionally check the food label attached to the products, whereas 83 (25.4%) reported that they frequently check the food label. Only 43 (13.1%) women believed that NNS have health benefits, whereas others either feel it unsafe or stated that they have no idea about the safety of NNS. Reduced calories (37.21 %), followed by helpful in reducing weight (23.5%) and useful for diabetics (20.93%) are the significant reasons reported by the participants behind its consumption. A big number (n= 161; 49.2%) of the participants does not advise patients to consume NNS, whereas 77 (23.5%) and 89 (27.2%) pregnant women believed that it can be used to regulate the blood glucose level and lose weight, respectively. More than 50% of the subjects reported that they do not cogitate any connection between NNS and dizziness and nausea during pregnancy.

Association between the non-nutritive sweetener consumption and diet chocolate or diet drink with socio-demographic characteristics

Table 3 depicts the association between the NNS consumption and diet chocolate or diet drink with SDC. No association has been found between the NNS consumption, diet chocolate, or soft drinks and SDC.

Association between the non-nutritive sweetener consumption, a package of sweetened refreshments and low-calorie juices with socio-demographic characteristics

Table 4 shows the association between the NNS consumption, a package of sweetened refreshments and low-calorie juices with SDC. An association has been stated between NNS consumption, a package of sweetened refreshments, low-calorie juices, or artificially sweetened tea, and education and income.

Association between attitude toward reading the food labels and socio-demographic characteristics

Table 5 reveals the relationship between attitude toward reading the food labels and SDC. No association has been found between the attitude toward reading the food labels and SDC.

Discussion

This cross-sectional study intends to explore the preference of NNS and its connotation with SDC among 327 Saudi pregnant women in Riyadh, Saudi Arabia. The imbalance between energy consumed and energy expended, excessive consumption of fatty food, especially saturated fats, along with sugary foods and sedentary lifestyle are the determinants responsible for various diseases. The healthier food choices of customers increase the necessity of low-calorie products. The NNSs can be of synthetic (artificial sweeteners, e.g., saccharin and aspartame) or natural (e.g., stevia) origin, and they provide a higher concentration of sweetness per unit weight than sucrose, without any nutritive benefits. It is a great substitute for those looking to supplant glucose in their diet. They are added by individuals as tabletop sweeteners to hot beverages, such as coffee or tea, and used in various food products, such as

sugar-free sweets, yogurt, chewing gum, soft drinks, popsicles, several baked products, cookies, and even in non-food products ranging from toothpaste to electronic cigarettes and medicines (Al-Hasan and Al-Qudsi, 2020). As compared to 1999–2000, the consumption of NNS among children and adults increased to 200% and 54%, respectively (Sylvetsky *et al.*, 2017). In a study on a weight-loss maintainer group, the weight maintenance was related with the use of curtailed calorie foods and beverages, which should be reminiscent of NNS knowledge (Phelan *et al.*, 2009). A decreased body weight has been noticed in randomized controlled trials, where sugar has been substituted with NNS (Sylvetsky and Rother, 2018; Miller and Perez, 2014). Though, the study findings on the efficacy of NNS are inconsistent. The adverse health effects of NNS consumption has also been reported mostly based on animal studies (Erkucuk *et al.*, 2009; Mourad and Noor, 2011). The long-term ingestion of aspartame has caused stimulation in oxidative stress in a rat model (Mourad and Noor, 2011). Furthermore, long-term sorbitol ingestion has caused cataract and neuropathy (Ota *et al.*, 2013). Garland *et al.* (1993) have reported that saccharin has been shown to cause negative effects in rats, such as depressed growth; anemia; vitamin A, iron, and folate deficiency; and elevated vitamin E (Garland *et al.*, 1993).

GDM is a type of diabetes diagnosed in the second or third trimester of pregnancy, which was not clearly overt diabetes prior to gestation. Women with GDM are at risk of pre-eclampsia and their babies are at risk of congenital anomalies, such as ventricular septal defect, neural tube defects, and caudal regression syndrome, macrosomia, hyperbilirubinemia, hypoglycemia, and perinatal mortality (Horvath *et al.*, 2010). In the present study, the prevalence of GDM was 8%. In a latest study by Alsaedi *et al.* (2020) in Jeddah, the prevalence of GDM in the population was 19.6%. In another study in Madinah, Saudi Arabia, the prevalence of GDM was reported to be 16.2% (Alfadhli *et al.*, 2015). The elucidations for the higher frequency of GDM in Saudi women could likely be credited to the growing

incidence of obesity, type II diabetes, and the custom of Saudi women to conceive at an older age (Alfadhli *et al.*, 2015). Differences in maternal age, weight, BMI, blood pressure as well as differences in the study design and methodology and the difference in American Diabetes Association (ADA), World Health Organization (WHO) and International Association of Diabetes and Pregnancy Study Groups (IADPSG) criteria are the determining factors accountable for the prevalence rate differences. In this study, most of the participants aged between 26 and 40 years and appropriate pregnancy age might be the explanations for the leser prevalence rate of GDM. After delivery, almost 95% of the maternal glucose level comes back to normal, although they are at a peril of developing type II diabetes later in their life (Herring and Oken, 2011). As compared with developing countries, the incidence of GDM in developed countries has been found to be lower, which may be attributed to the better healthcare systems and higher education level in developed countries (Alsaedi *et al.*, 2020).

Among the variety of sweetening options (white sugar, brown sugar, fruit sugar, coconut sugar, honey, NNS) that are available in the Saudi market, white sugar was the most commonly used sweetening option among the participants. Similar results have been reported previously (Gosadi *et al.*, 2020; Mohamed *et al.*, 2013). Curtailing the sugar consumption is suggested to avoid too much weight gain during pregnancy, and the most common way to decrease sugar intake is the use of NNS which has been considered safe during pregnancy if consumed below the acceptable daily intake level suggested by the United States Food and Drug Administration (USFDA) (Fitch and Keim, 2012). In some studies, no association has been observed between maternal AS consumption and birth weight of infant (Gillman *et al.*, 2017; Maslova *et al.*, 2013), although other study reported higher birth weight infants at 1 year of age (Azad *et al.*, 2016) and an increased risk of childhood obesity (Zhu *et al.*, 2017). Al-Qudsi and Al-Hasan (2019) advised to eliminate artificial sweeteners from the diet of pregnant and lactating mothers. Sedová *et al.* (2007) mentioned that early life exposure to a sucrose-rich diet in rats occasioned in distinct responses to long-term postnatal high-sucrose feedings, and their offspring exhibited greater adiposity and liver triglyceride.

The present study further explored the SDC of NNS users and the association between SDC and NNS. Results reveal that no association has been observed between the consumption of NNS, diet chocolate, or soft drinks and SDC, such as age, education, and income. Mullie *et al.* (2012) also did not found any connotation between either educational level or income with artificially sweetened beverage consumption. Education and income have been found to be connected with the occurrence of NNS consumption, a package of sweetened refreshments, low-calorie juices, with SDC. In a study by Drewnowski and Rehm, the low-calorie sweetener consumers in every product category were more likely to be women, 45–65 years old, college graduates, and with greater household incomes (Drewnowski and Rehm, 2015). They reported that the consumption of low-calorie sugar increases with age, higher income, and education. Similarly, in this study also, the NNS consumption, diet chocolate, or soft drinks and the rate of consumption of NNS, a package of sweetened refreshments, low-calorie juices, increased with age, and the consumption was highest in the 26–39 years age group in university-level, educated, pregnant women.

Nutrient labeling is envisioned to assist patrons to make better selections about the product in terms of ingredients and nutritional content, as labeling is the chief source of communication between food business operators and consumers. It is very significant for consumers to notice and understand the labels. In this study, 25.4% reported that they frequently check the food label, whereas 46.5% women mentioned that they only occasionally check the food label attached to the products. In a survey based assessment on the awareness of food labels, 23% of the participants mentioned that they frequently buy food products after reading the labels on the packages (Jadapalli and Somavarapu, 2018). Over the past few years, diet-

related health problems have dramatically increased. Labeling assists the consumers in the management of medical conditions, such as obesity, diabetes, hypercholesterolemia, or allergy, and intolerance to any food item. Unlike this study where no association has been observed between attitude toward reading the food labels and SDC, such as age, education, and income, a previous study stated that higher educational levels lead to greater search activity (Schaninger and Sciglimpaglia, 1981). To our knowledge, this study was the first to explore the preference of NNS among Saudi pregnant women in Riyadh, Saudi Arabia.

Conclusion

In conclusion, among the pregnant women, the prevalence of consumption of white sugar as a sweetening option is high. In this study, the consumers who consume NNS preferred stevia over others and others were afraid to use NNS because they feel that they have unsafe chemical components. These outcomes engender the requirement for a more elaborate research covering large geographical areas on the preference of NNS among Saudi pregnant women and explore the usefulness of nutritional advice among pregnant women attending maternal clinics.

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