

# Association of Sweet Drinks and Fast-Food Consumption with Gestational Diabetes Mellitus Among Bangladeshi Women

Arifa Zannat<sup>\*1</sup>, Arifur Rahman<sup>2</sup>, Rifat Hasan Shammi<sup>3</sup>, Aparajita Roy<sup>4</sup>

<sup>1</sup> Dental Surgeon, Lopa Dental Care, Mohammadpur, Dhaka

<sup>2</sup> Department of Community Medicine, Jalalabad Ragib Rabeya Medical College, Sylhet

<sup>3</sup> Public Health Professional, Shamoli, Dhaka

<sup>4</sup> Department of Community Medicine, Rajshahi Medical College, Rajshahi



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## \*Correspondence to:

Dr. Arifa Zannat



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**ABSTRACT: Background:** Diabetes is a pandemic disease, with an estimated 425 million people suffering from various types by 2017. Bangladesh, one of the top ten countries with diabetes, faces significant social, demographic, and epidemiologic changes. Gestational Diabetes Mellitus (GDM) is a public health crisis, affecting 20.9 million live births and affecting 85.1% of cases. Bangladesh is working to improve maternal and child health care, but its GDM prevalence rate is about 10%. **Methods:** This six-month observational Case control study was conducted among the pregnant women of Dhaka; Bangladesh who were came for antenatal care in BSMMU and BIRDEM 2 hospitals. Women who were pregnant for more than 24th weeks were included as samples. A pre-tested, validated, semi-structured questionnaire was utilized to collect data from 242 patients. **Results:** Maternal age is a significant risk factor for gestational diabetes mellitus (GDM), with the likelihood extending with increasing maternal age. GDM is less common in lower age groups starting from 17 years and highest in the age group starting at 31 years and above. GDM rate is higher in women from higher income families and those with a history of GDM in previous pregnancy. Sleep time is also a significant cofactor, with women with GDM having less sleep than those without GDM. The habit of taking sweet drinks has a significant relationship with GDM, with 66.1% reporting carbonated beverages, 82.6% frequenting tea, and 28.1% having energy drinks. Dietary patterns, particularly fast foods, are also associated with increased risk of GDM. **Conclusions:** The study reveals age, sleep time, and dietary patterns significantly influence gestational diabetes mellitus risk. Consumption of sweet drinks, fast foods, and processed meats also contributes.

**Keywords:** Sweet drinks, Fast food consumption, Statistical Package for the Social Sciences (SPSS).

## Article at a glance:

**Study Purpose:** The aim of this study was to find the relationship between changed food patterns (Consumption of sweet drinks and fast foods) and GDM in our society.

**Key findings:** Dietary patterns, specially consumption of sweet drinks and fast foods showed significant relationships with GDM.

**Newer findings:** Maternal age, number of pregnancies, higher income family, asthma, high blood pressure, sleeping time have relationship with GDM.

**Abbreviations:** WHO: World Health Organization, SPSS: Statistical package program for social science, OR: Odds ratio, NCD: Non-communicable Diseases, CI: Confidence interval, GDM: Gestational diabetes mellitus, IDF: International Diabetes Federation.

## INTRODUCTION

Diabetic mellitus is a catastrophic non-communicable disease, affecting 425 million people globally, with 80% of the burden in low- and middle-income countries. It causes blindness, lower limb amputation, kidney failure, heart attacks, and stroke, and is projected to become the seventh leading cause of death by 2030.<sup>1</sup> Gestational Diabetes Mellitus (GDM) is a significant public health concern due to its

significant adverse health outcomes, including high blood pressure, preeclampsia, and birth defects. 1 in 7 births is affected, with the majority occurring in low and middle-income countries with limited access to maternal care. GDM prevalence in Bangladesh is 9.7% and South Asia is 11.7%.<sup>1</sup> GDM develops when body fails to respond to insulin, causing glucose levels to rise due to imbalance between insulin and hormones during pregnancy. Various factors increase risk of developing GDM including high blood pressure, pre-

diabetes (when blood sugar was elevated but not high enough to mark as diabetes), maternal age and weight, family history of diabetes, hormonal problems like polycystic ovary syndrome(PCOS) etc.<sup>2-5</sup> Studied shows that nonwhite ethnicity like Hispanic, oriental, middle east and sub-continental women have higher risk of developing GDM.<sup>6</sup> Low socioeconomic status women, older mothers, those with a family history of diabetes, mothers with high BMI, and those who smoke are at higher risk for gestational diabetes.<sup>1</sup> Studies indicate that healthy dietary habits and food selection significantly reduce the risk of gestational diabetes, with 60% of GDM sufferers consuming pre-gravid cola.<sup>5</sup> GDM is also common in women who take more simple carbohydrates and less fruits and vegetables.<sup>5</sup> Urbanization and sedentary lifestyles have led to a significant increase in gestational diabetes prevalence, with a worldwide epidemic. In developing countries, prevalence rates range from 6% to 14%. This increases the risk of type 2 diabetes and other complications, escalating the public health crisis.<sup>7</sup>

## METHODS

It was an observational Case-control study. The study population were the pregnant women for more than 24<sup>th</sup> weeks of Dhaka, Bangladesh who came for antenatal care in BSMMU and BIRDEM 2

hospitals. Approval from the Ethical Review Committee of NSU was obtained before the commencement of the study. Consulting with the guide and reviewing the previously published literature, the questionnaire was developed for the study. Informed written consent was taken from the respondents before data collection, by briefing the purpose of the study. The Sample size of this study was 242, which was selected purposively. Case inclusion criteria were Pregnant women (From 24<sup>th</sup> weeks of pregnancy) diagnosed with gestational diabetes mellitus & Control inclusion criteria were Pregnant women ((From 24<sup>th</sup> weeks of pregnancy), who were not diagnosed with GDM. Six months, from July to December 2018, were dedicated to this investigation. Convenient sampling was used for the sampling process. Face-to-face interviews were done using a semi-structured (closed-ended) questionnaire. The descriptive statistics were used to summarize the continuous variables and frequency distribution to summarize the categorical variables. The sample database was checked by double entry. SPSS software was used for all the data analysis. Chi-square test and independent sample t-test were applied for the bivariate analysis. Logistic regression was applied to estimate odds ratio for identifying potential covariates associated with depression.  $P < 0.05$  was considered as statistical significance.

## RESULTS

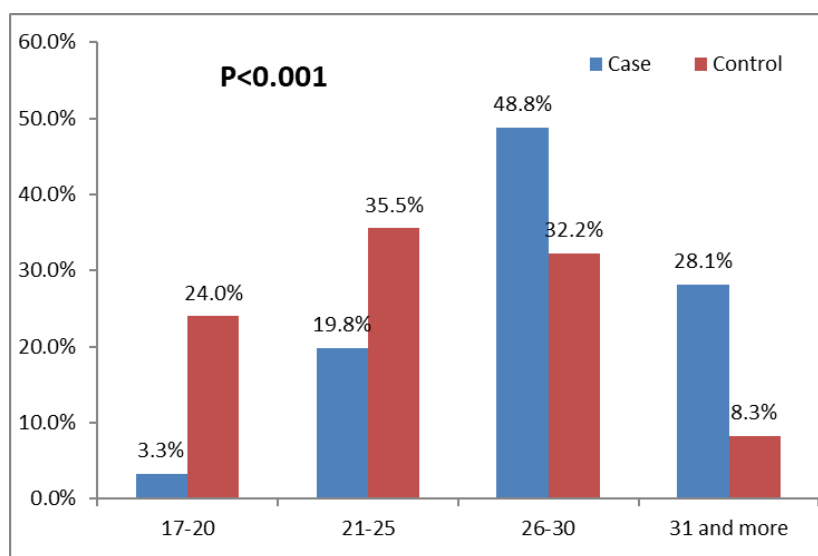


Figure 1: Age distribution of pregnant women in GDM

Figure 1 showing that GDM was increased with increasing age of women. The risk of GDM was

less in the lower age group. In this study only 3.3% of cases were from the lowest age group (17-20). The

percentage increased with increase in age. Women of (21-25) years of age were 19.8%, women of (26-30) years of age were 48.8% of the total cases. From this

study we can say that increasing maternal age was significantly associated with the Risk of GDM ( $p<.001$ ).

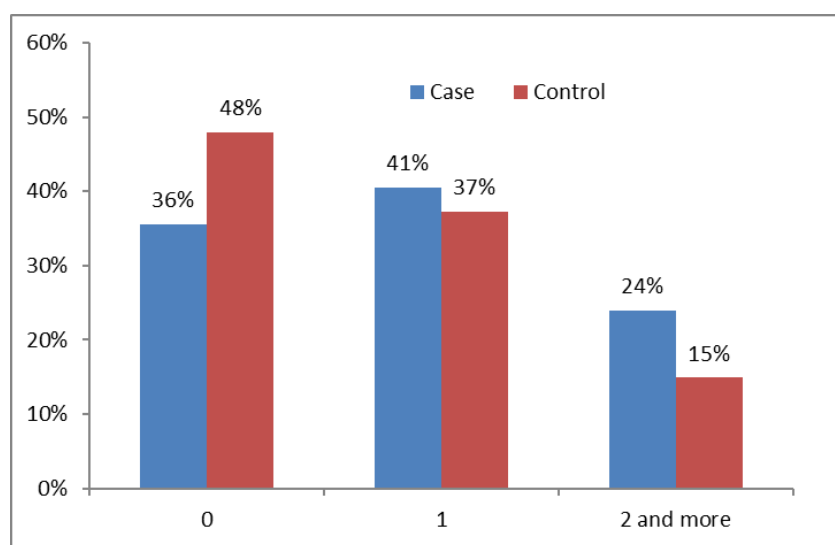


Figure 2: Distribution of number of pregnancies

Figure 2 shows that the risk of GDM increases with the increasing number of pregnancies. 36% of cases were affected during their first pregnancy while

65% of cases were affected during their second or more pregnancies.

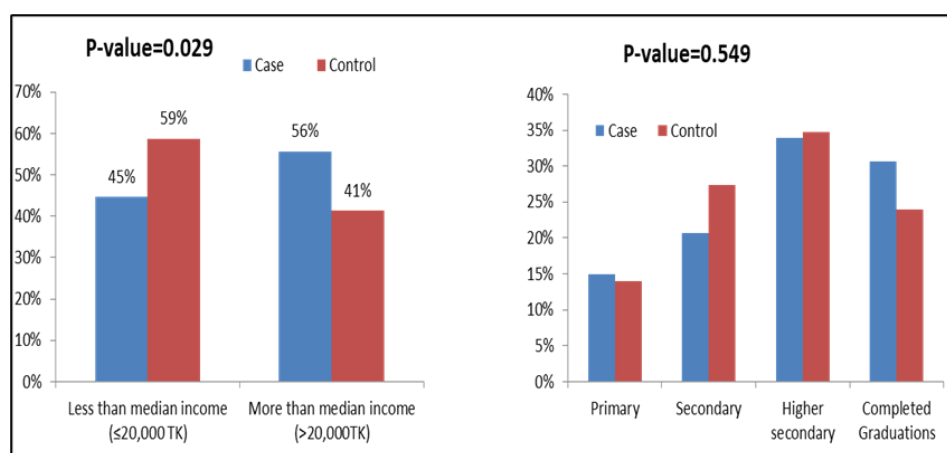


Figure 3: Monthly income of the family Husband's education level

Figure 3 showing GDM was more common among the group with more than median income ( $>20000$  tk). Husbands' educational status might

increase monthly family income, which may influence the risk of GDM development.

Table 1: History of Illness

History of illness of pregnant women	Case =121	Control =121	Unadjusted OR (95% CI)	p-value
<b>Previous history of gestational diabetes</b>				
Yes	67(55.4)	2(1.7)	47.39(11.03-203.56)	P<0.001
No	54(44.6)	119(98.3)	Ref.	
<b>High blood pressure</b>				
Yes	40(33.1)	7(5.8)	4.86 (1.99-11.83)	P<0.001

No	81(66.9)	114(94.2)	Ref.	
<b>Asthma</b>				
Yes	9(7.4)	5(4.1)	1.44 (0.44-4.63)	P<0.001
No	112(92.6)	116(95.9)	Ref.	
<b>Heart diseases</b>				
Yes	4(3.3)	2(1.7)	1.34 (0.19-8.7)	0.784
No	117(96.7)	119(98.3)	Ref.	

Table 1 showing the history of GDM in previous pregnancy was also common among cases.55.4%, (P<0.001). The odds of GDM in the second pregnancy with a previous history were 47.39 times higher than GDM free first pregnancy. (47.39

(11.03-203.56), p<0.001). This table also shows that, the odds of GDM were 4.86 (P<0.001) times higher in women with history of high blood pressure and 1.44 (P< 0.001) times higher in women with a history of asthma.

**Table 2: History of family illness and behavioral characteristics**

History of illness in the family	Case =121	Control =121	Unadjusted OR (95% CI)	p-value
<b>High blood pressure</b>				
Yes	39(32.2)	16(13.2)	1.91 (0.94-3.89)	0.073
No	82(67.8)	105(86.8)	Ref.	
<b>Heart diseases</b>				
Yes	8(6.6)	8(6.6)	0.84 (0.28-2.51)	0.765
No	113(93.4)	113(93.4)	Ref.	
<b>Asthma</b>				
Yes	3(2.5)	7(5.8)	0.20 (0.04-1.06)	0.059
No	118(97.5)	114(94.2)	Ref.	
<b>Physical activity level</b>				
Never	86(71.1)	92(76)	Ref.	
rarely	14(11.6)	22(18.2)	0.68(0.33-1.42)	0.303
Sometimes	21(17.4)	7(5.8)	3.21(1.3-7.93)	0.012*
<b>Sleeping hours</b>				
<7 hours	71(58.7)	33(27.3)	Ref.	
>8 hours	50(41.3)	88(72.7)	0.26(0.15-0.45)	P<0.001*

Table 2 shows that sleeping hours have a significant relationship with GDM. The odds of GDM were 0.26 (0.15-0.45. P<0.001) times lower in women who slept more than 8 hours than women who slept

less. However, a history of family illness of high blood pressure, heart disease, asthma has no significant relationship with GDM.

**Table 3: Consumption of Sweet Drinks**

Variables	Case=121	Control=121	Unadjusted OR (95%CI)	p-value
<b>Carbonated beverage</b>				
Yes	80(66.1)	63(52.1)	1.79 (1.09-3.08)	0.027*
No	41(33.9)	58(47.9)	Ref.	
<b>Coffee</b>				
Yes	47(38.8)	37(30.6)	1.44 (0.87-2.45)	0.178
No	74(61.2)	84(69.4)	Ref.	
<b>Tea</b>				
Yes	100(82.6)	85(70.2)	2.01(1.10-3.71)	0.024
No	21(17.4)	36(29.8)	Ref.	

<b>Sweet drinks</b>				
Yes	94(77.7)	90(77.7)	1.01 (0.54-1.83)	0.987
No	27(22.3)	31(22.3)	Ref.	
<b>Energy drinks</b>				
Yes	34(28.1)	18(14.9)	2.23 (1.18-4.23)	0.014*
No	87(71.9)	103(85.1)	Ref.	

Table 3 Showing significant association between drinking carbonated beverage, tea, and energy drinks. The odds of GDM were 1.79 (P=0.027) higher in women who consume carbonated beverages. The odds of GDM were 2.01 (P= 0.024)

times higher in women who consume tea and the odds of GDM were 2.23 (P=0.014) times higher in women who consume energy drinks. However, drinking coffee or other sweetened drinks does not show significant relationship with GDM.

**Table 4: Consumption of Fast Foods**

Variables	Case =121	Control =121	Unadjusted OR (95 % CI)	p-value
<b>Eating out</b>				
Yes	71(58.7)	77(63.6)	0.81 (0.43-1.36) Ref.	0.429
No	50(41.3)	44(36.4)	Ref.	
<b>Eating heavy oily food</b>				
Yes	83(68.6)	78(64.5)	1.24 (0.70-2.50) Ref.	0.496
No	38(31.4)	43(35.5)	Ref.	
<b>Processed food</b>				
Yes	88(72.7)	71(58.7)	1.88 (1.09-3.22) Ref.	0.220
No	33(27.3)	50(41.3)	Ref.	
<b>Ice-cream</b>				
Yes	62(51.2)	56(46.3)	1.22 (0.74-2.02) Ref.	0.441
No	59(48.8)	65(53.7)	Ref.	
<b>Cheesy food</b>				
Yes	46(38)	39(32.2)	1.29(0.76-2.19) Ref.	0.346
No	75(62)	82(67.8)	Ref.	
<b>Fried food</b>				
Yes	92(76)	76(62.8)	1.87 (1.07-3.28) Ref.	0.026*
No	29(24)	45(37.2)	Ref.	
<b>Chocolate</b>				
Yes	48(39.7)	49(40.5)	0.96 (0.56-1.61) Ref.	0.898
No	73(60.3)	72(59.5)	Ref.	

Table 4 and 5 showing Dietary patterns, especially fast foods, showed significant relationships with GDM in this study. The odds of GDM were 1.87[1.87 (1.07-3.28) odds, p= 0.026\*] times higher in women who consumed home-made fried foods than women who did not. The odds of GDM were 17.4 (p=0.029) folds higher in women who consume chewing gums than who do not. The odds of GDM were 1.75 (p=0.042) times higher in women who consume Indian and Chinese take away foods than

women who do not. Pastries consumers women showed the odds of GDM 2.08(p=0.005) times higher than women who do not. The odds of GDM were 2.14 (p=0.013) times higher in women who consume processed meat like sausages, frozen nuggets. However, consumption of heavy oily foods, cheesy foods, sweets, fast foods like burgers, chips, chocolate and ice cream did not show any significant relationship with GDM.

**Table 5: Consumption of fast foods**

Variables	Case=121	Control =121	Unadjusted OR (95% CI)	p-value
<b>Chips</b>				
Yes	47(38.8)	34(28.1)	1.62 (0.94-2.78)	0.078
No	74(61.2)	87(71.9)	Ref.	
<b>Chewing gum</b>				
Yes	21(17.4)	9(7.4)	2.61 (1.14-5.90)	0.023*
No	100(82.6)	112(92.6)	Ref.	
<b>Eating sweet</b>				
Yes	96(79.3)	87(71.9)	1.50 (0.83-2.71)	0.179
No	25(20.7)	34(28.1)	Ref.	
<b>Fast food</b>				
Yes	62(51.2)	53(43.8)	1.38 (0.81-2.23)	0.247
No	59(48.8)	68(56.2)	Ref.	
<b>Indian/Chinese food</b>				
Yes	48(39.7)	33(27.3)	1.75 (1.02-3.01)	0.042*
No	73(60.3)	88(72.7)	Ref.	
<b>Pastries</b>				
Yes	71(58.7)	49(40.5)	2.08 (1.25-3.48)	0.005*
No	50(41.3)	72(59.5)	Ref.	
<b>Red meat</b>				
Yes	106(87.6)	115(95)	0.37 (0.14-0.98)	0.04
No	15(12.4)	6(5)	Ref.	
<b>Processed meat</b>				
Yes	39(32.2)	22(18.2)	2.14 (1.17-3.86)	0.013
No	82(67.8)	99(81.8)	Ref.	

**Table 6: Factors associated with GDM**

Socio-demographic characteristics	Adjusted OR	95% CI for OR		P-value
		LC	UC	
<b>Age</b>				
17-20 y	Ref.			
21-25 y	5.28	1.16	24.06	.032*
26-30 y	9.24	1.97	43.30	.005*
31 y and more	15.16	2.56	89.91	.003*
<b>Number of pregnancies</b>				
0	Ref.			
1	.77	.32	1.87	.561
2 and more	1.74	.57	5.35	.332
<b>Monthly income</b>				
Less than median income (<20,000 TK)	Ref.			
More than median income (>20,000TK)	1.48	0.67	3.30	.333
<b>Husband's education</b>	Ref.			
Primary				
Secondary	6.96	1.84	26.32	0.003*
Higher secondary	4.19	1.24	14.09	0.020*
Completed Graduations	4.18	1.12	15.56	0.035*

Table 6 demonstrates that showing that GDM was increased with increasing age of women.

The risk of GDM was less in the lower age group. This study shows women of (21-25) years age group

had 5.28 times higher risk for GDM than women below this age. Women of (26-30) years had 9.24 times higher risk than others and women who

belong to 31 years or more age group had 15.16 times higher chances of GDM than others.

**Table 7: Factors associated with GDM**

Characteristics	Adjusted OR	95% CI for OR		P-value
		LC	UC	
Current illness				
High blood pressure (ref: No)	4.53	1.60	12.85	0.002*
Asthma (ref: No)	1.54	0.36	6.48	0.164
Behavioral characteristics				
Physical activity level (ref: Never)				
rarely	.67	.25	1.85	.495
Sometimes	1.91	.59	6.19	.587
Sleeping hours (ref: ≤7 hours)	.23	.11	.48	.001*
Sweet Drinks				
Tea				
Yes	1.56	0.63	3.84	0.333
No	Ref.			
Energy drinks				
Yes	2.89	1.0	28.14	0.045*
No	Ref.			

Table 7 shows that women who had reported high blood pressure as a current illness had 4.53 (0.002) times higher risk of GDM than normal pregnant women. And women who slept for less than 7 hours per day have 0.23 times the risk of having GDM than women who slept 8 hours or more per day.

Women who drink tea had 1.56 times more chance to have GDM than women who do not drink tea. Women who drink energy drinks have 2.89 times more chance of having GDM than women who do not drink tea.

**Table 8: Factors associated with GDM**

Characteristics	Adjusted OR	95% CI for OR		P-value
		LC	UC	
<b>Fast food</b>				
<b>Processed food</b>				
Yes	1.17	.54	2.56	
No	Ref.			
<b>Chips</b>				
Yes	0.88	0.36	2.13	0.776
No	Ref.			
<b>Chewing gum</b>				
Yes	1.99	0.65	6.13	0.230
No	Ref.			
<b>Indian/Chinese food</b>				
Yes	0.61	0.23	1.61	0.319
No	Ref.			
<b>Pastries</b>				
Yes	1.40	0.63	3.08	0.407
No	Ref.			
<b>Unhealthy food</b>				
<b>Red meat</b>				



Yes	.21	.05	.88	0.407
No	Ref.			
<b>Processed meat</b>				
Yes	1.12	0.38	3.27	0.839
No	Ref.			

## DISCUSSION AND CONCLUSIONS

Maternal age is an important risk factor for gestational diabetes mellitus. In this study age appeared as a significant cofounding factor. Our study shows the chances of GDM increasing with maternal age. GDM was less common in the lower age group starting from 17 years, and with cumulative rate, the GDM rate was highest in the highest age group starting at the age of 31 years and above. A Study conducted in Queen Mary Hospital Hong Kong also described age as an important factor for GDM.<sup>8</sup> There was a significant difference and positive correlation in the prevalence of GDM, increasing from 1.3, 2.5, 6.2, 10.3, 21.7, and 31.9%, respectively, from the youngest to the oldest cohort ( $P < 0.001$ ).<sup>1</sup> Another study of the Tibah University of medical sciences showed the same. The incidences of a positive OGCT and GDM increased significantly with increasing maternal age from 20.0% to 2.2%, respectively, in women aged  $\leq 25$  years to 37.8% and 14.7%, respectively, in women aged  $> 35$  years ( $p = 0.02$  and  $p = 0.009$ , respectively).<sup>1</sup> The number of pregnancies had also appeared as an important cofounding factor in this study. Among the 242 sample, GDM was highest in women who were pregnant for the second or more time ( $p = 0.008$ ). In the USA a retrospective longitudinal study showed that, the rate of recurrence of GDM in the pregnancy subsequent to the index pregnancy was found to be 35.6% (95% CI = 31.9–39.3%).<sup>9</sup>

This study showed GDM rate was higher in women who belonged to a comparatively higher income family. (55.4%,  $p = 0.029$ ) And husband's higher education was also related to income. History of GDM in a previous pregnancy was also common among cases. 55.4%, ( $P < 0.001$ ). This study showed that asthma was common in 2.5% of cases. And 32.2% [with odds of 1.91 (0.94-3.89),  $p = 0.073$ ] of cases reported High blood pressure as current illness. Another study conducted in Canada showed, that hypertension in pregnancy was then identified in matched pairs of mothers with gestational diabetes or without it, all of whom had singleton live births in Quebec.<sup>10</sup> Out of a total of 63,438 couples analyzed,

44.4% of mothers were diagnosed with gestational diabetes during pregnancy.<sup>10</sup> This study showed that sleeping time has a significant relationship with GDM. Women with GDM have shown to have less sleeping time than women who do not have GDM. Women who slept less than 7 hours a day are 58.7% of total cases. A study conducted in USA also showed that pregnant women experience significant sleep disturbances that are associated with increased risk of GDM and unfavorable pregnancy outcomes.<sup>11</sup> Pregnant women with increased SDB risk, frequent snoring, and sleep duration of  $< 7$  h/night have increased risk of developing GDM.<sup>11</sup> That study results showed, increased likelihood of gestational diabetes mellitus (GDM) was found in subjects with increased SDB risk (odds ratio 3.0 [95% CI 1.2–7.4]), SS (2.4 [1.0–5.9]), SDB/SS (3.4 [1.3–8.7]), and frequent snoring (3.4 [1.3–8.8], after adjustment for BMI).<sup>11</sup>

This study showed that the habit of taking a sweet drink has a significant relationship with GDM. Five types of sweet or sugar drinks were frequently asked to be cases. 66.1% ( $p = 0.027$ ) reported for carbonated beverages. 82.6% ( $p = 0.024$ ) were frequent users of tea. 28.1% ( $p = 0.014$ ) have energy drinks. The other two drinks coffee (38.8,  $p = 0.178$ ) and sweetened drinks (77.7%,  $p = 0.987$ ) did not show significant relationships. A study conducted by Harvard School of Public Health, Brigham and Women's Hospital, has found that drinking more than 5 servings of sugar-sweetened cola a week before pregnancy appears to significantly elevate the risk (22% more chance) of developing diabetes during pregnancy.<sup>12</sup> Dietary pattern specially some fast foods showed significant relationships with GDM in this study. 58.7% ( $p = 0.429$ ) cases reported for eating out. 68.6% ( $p = 0.49$ ) likes to eat heavy oily and spicy foods. 72.7% ( $p = 0.22$ ) took frozen processed foods. 51.2% ( $p = 0.44$ ) cases consume ice cream. 38% ( $p = 0.34$ ) consumed cheesy foods like pasta. 76% [1.87 (1.07-3.28) odds,  $p = 0.026^*$ ] consumed home-made fried foods. 39.7% ( $p = 0.89$ ) consumed chocolates. 38.8% ( $p = 0.078$ ) consumed chips. 17.4% [odds 2.61 (1.14-5.90),  $p = 0.029^*$ ] reported for consumption of chewing gums. 79.3% ( $p = 0.179$ ) ate different sweet items available in the market.



51.2% consumed fast foods like burger, French fries etc. 39.7% [odds 1.75,  $p=0.042^*$ ] ate Indian or Chinese takeaway foods. Pastries were consumed by 58.7% (odds 2.08 (1.25-3.48),  $p=0.005^*$ ) of cases. Processed meat like sausages, frozen nuggets were consumed by 32.2% [with odds of 2.14 (1.17-3.86)  $p=0.013^*$ ]. The findings of Chen *et al.*, in this issue of Diabetes Care somewhat extend our understanding of possible dietary factors associated with increased risk of GDM.<sup>13</sup> Western dietary pattern was associated with increased risk of gestational diabetes mellitus before and after adjustment for confounders (OR = 1.97, 95% CI: 1.27–3.04, OR = 1.68, 95% CI: 1.04–2.27).<sup>14</sup> A study conducted in Iran revealed that fast food consumption in women of reproductive age was found to have undesirable effects in the prevalence of GDM.<sup>15</sup> After adjustment for confounders, the OR (95% CI) for GDM for total fast food consumption was 2.12 (1.12–5.43) and for French fries it was 2.18 (1.05–4.70).<sup>15</sup> Women with GDM significantly more frequently consumed white bread, white rice, sausages/frankfurters and fast-foods, while they consumed wholegrain bread, milk, sour dairy products, fruit and vegetables.<sup>16</sup>

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### Authors' Contributions

MAAM: Research and questionnaire design, data gathering, analysis, and interpretation, manuscript authoring, and article drafting. NNR and ZF: Analysis strategy, interpretation and analysis of data, paper authoring, and article drafting. SSZ: Writing and editing manuscripts. MNS: Oversight. After revisions, all writers gave their approval for publication.

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**Conflict of interest:** None declared.

**Ethical approval:** The study was approved by the thesis review committee of the Department of Public Health, North South University. Informed

written/voluntary consent was taken from the participants.

**Consent for publication:** Taken.

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