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Prevalence and Determinants of Diabetes among Women of Reproductive Age in Northeast India

Wahengbam Bigyananda Meitei*[1] and Sagolsem Roshan Singh[2]

Abstract: There is an acute dearth of studies on diabetes among women of reproductive ages. With relatively poor socioeconomic and healthcare delivery system, Northeast India remains the most unexplored region of the country. The study aims to determine the prevalence and associated risk factors of diabetes among women of reproductive age in Northeast India. The study used data from the fourth round of the National Family Health Survey conducted in 2015-16. Descriptive statistics and regression analysis were used to assess the determinants of diabetes. The prevalence of diabetes among the eight northeastern states ranged from 1.78 percent to 4.40 percent. Except for Manipur, all other states have at least one district with a high prevalence of diabetes among women of reproductive age. Women who drink alcohol, having a higher body mass index, and living in households with higher wealth quintile and urban places are more likely to suffer from diabetes. But women consuming a mixture of vegetarian and non-vegetarian food occasionally and non-fried foods are less likely to suffer from diabetes. Therefore, with today's rapidly growing urbanization, proper maintenance in food habits and sedentary habits among the household with higher wealth quintile and control in behavioural activities such as drinking alcohol will be the key to decreasing the burden of diabetes.

Keywords: Diabetes, Food habits, Northeast India, Reproductive age, Body mass index.

Introduction

Globally, the non-communicable disease is the leading cause of death. Almost 67 percent of all deaths are due to non-communicable diseases (Mote, 2016). The burden of non-communicable diseases like diabetes is no longer the disease of wealthy developed nations (Mohan et al., 2017). Every fifth diabetic case in the world is an Indian, and thus India is called the capital of diabetes (Joshi & Parikh, 2007). The distribution of the burden of diabetes in India is heterogeneous (Arora et al., 2010; Anjana et al., 2017). The prevalence of diabetes in India ranged from 6 percent to 12 percent in urban and 2 percent to 3 percent in rural place of residence (Ramachandran et al., 2001; Sadikot et al., 2004). According to Chennai Urban Rural Population Study (CUPS), the age-standardized prevalence of diabetes is 12 percent (Mohan et al., 2003; Mohan et al., 2006). And, according to International Diabetes Federation in South-East Asia, there were 69.1 million cases of diabetes in India in 2015, with a prevalence of 8.7 percent among adults (20 to 79 years). By 2040, the figure is expected to increase to 123.5 million (International Diabetes Federation, 2015). The socioeconomic burden due to diabetes in India is highest globally (Shashank et al., 2008). Diabetes is also a risk factor for various other diseases like cardiovascular, renal and atherosclerotic vascular disease (Baba et al., 1997). The rapid change in lifestyle associated with urbanization combined with inevitable high genetic risks and behavioral risk factors may be the possible risk factor for the disease

* Corresponding Author
[1] Research Scholar, International Institute for Population Sciences, Mumbai, Email: bigyanandawahengbam@gmail.com
[2] MPhil in Population Studies, International Institute for Population Sciences, Mumbai. Email: roshan.sagolsem1990@gmail.com

(Ramachandran et al., 1999; Mohan et al., 2008). A rise in living standards leading to increased sedentariness and the cheap availability of calorie-rich fatty-fast foods to all sections of people alike are also a few reasons for the increase in the prevalence of diabetes worldwide (Gupta, 2006; Reddy et al., 2007; Diamond, 2011). A Japanese study on intake of rice and type 2 diabetes among Japanese women reveal that high consumption of white rice is associated with an increased risk of diabetes (Nanri et al., 2010; Hu et al., 2012). In Ayurveda, diabetes management includes diet, behaviour and herbal modalities (Elder, 2004). Despite the increasing burden of prevalence of diabetes, most people are less concerned about its prevention. Since there is no cure for diabetes, we should take preventive measures as early as possible.

Considering the distinct biological, sociocultural, and ethnicity, Northeast Indians are vulnerable to various lifestyle diseases, particularly diabetes (Tungdim et al., 2014). Northeast India consists of eight smaller Indian states viz. Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and Sikkim. The healthcare system and socioeconomic conditions in northeast India are relatively poor compared to other developed Indian states, due to which all the eight states of Northeast India were included among the eighteen high focused states under the National Rural Health Mission (Kumar, 2005; Singh et al., 2012; Albert et al., 2015; Saikia & Das, 2016). There is an acute dearth of studies related to the prevalence and determinants of diabetes among women of reproductive ages. Thus, keeping in mind the lacunae in the healthcare sectors in northeast India and studies related to diabetes among women of reproductive age, an attempt is made in this paper to determine the prevalence and associated risk factors of diabetes among the women of reproductive age in northeastern states of India.

Data and Methodology

It is a cross-sectional study that uses data from the fourth round of the National Family Health Survey (NFHS) conducted in 2015-16. It is a large-scale multi-round survey conducted in a representative sample of households across India (IIPS & ICF, 2017). The survey was conducted by the International Institute for Population Sciences, Mumbai, under the Ministry of Health and Family Welfare, Government of India. The survey collected information on several indicators of maternal and child health. Apart from this, the survey also collected the Clinical Anthropometric and Biochemical (CAB) information's which included the measurement of anthropometric parameters, blood glucose level and blood pressure (http://rchiips.org/nfhs/). The study population consists of 97,013 women of reproductive age (15 to 49 years).

Measurements

Outcome and Predictors: The fourth round of the NFHS collects information on an individual's blood glucose level (IIPS & ICF, 2017). The one-time capillary blood glucose was measured using a handheld blood glucometer (Prenissl et al., 2019). The definition of fasting taken for the measurement of blood glucose is: those participants who have not eaten or drank anything besides water for not less than 12 hours from the interview. Thus, those participants who are diagnosed with diabetes, having blood glucose reading greater than 200 mg/dL (if not fasted) and having blood glucose readings greater than 126 mg/dL (if fasted), is classified as diabetic (Sacks et al., 2011).

The survey also collected information on the frequency of intake of nine food groups. Of the nine food groups, four come under vegetarian food items (milk, pulses or beans, dark green leafy vegetables and fruits), three under non-vegetarian food items (eggs, fish and meat) and the remaining two are the intakes of fried food and aerated drinks. This information's are used to construct the variable food habits. The study also included behavioural risk factors such as smoking status, drinking status, and tobacco consumption status. Further, individual-level characteristics like the level of education, body mass index, and household-level characteristics like wealth quintile and place of residence was also included in the study as predictors of diabetes.

Statistical analysis: The main interest of our study was to determine the prevalence of diabetes and how the risk factors are associated with the underlying characteristics of diabetes among women of reproductive age. This general interest implies a descriptive method. Chi-Square analysis was used to check the significance of the prevalence of diabetes by different risk factors. Further, logistic regression was used to assess the determinants or risk factors of diabetes among women of reproductive ages.

Ethical Statement: Ethical statement is not required as the study used the secondary data available in the public domain.

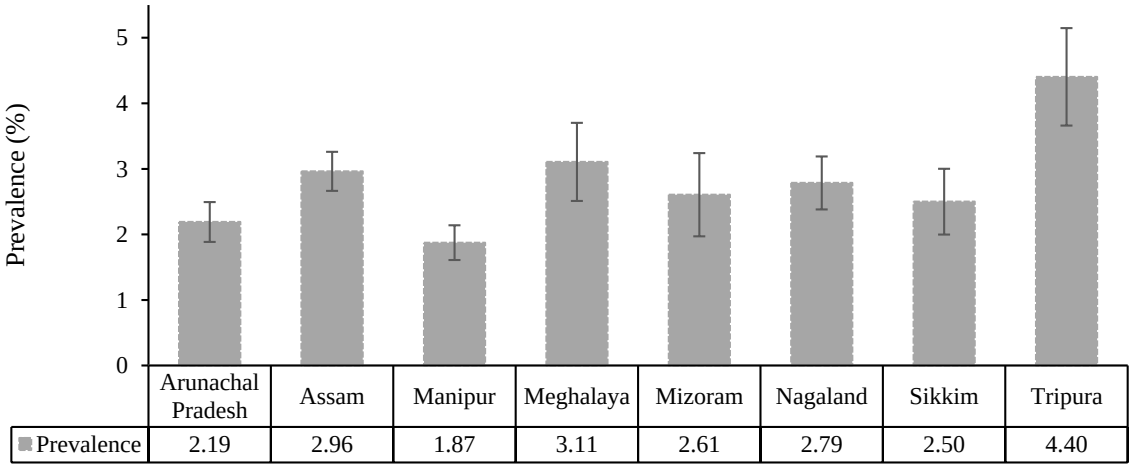
The whole analysis is done using STATA (version 16) using appropriate sampling weights.

Results

Prevalence of diabetes among women in reproductive age

Figure 1 presents the comparison of the prevalence of diabetes among women of reproductive age in Northeast states of India. The prevalence of diabetes among the northeastern states ranges from 1.78 percent to 4.40 percent. The prevalence of diabetes among women of reproductive age is highest in Tripura with 4.40 percent followed by Meghalaya (3.11 percent), Assam (2.96 percent) and Nagaland (2.79percent). And Manipur is the state with the lowest prevalence of women in reproductive age with diabetes (1.87 percent) followed by Arunachal Pradesh (2.19 percent).

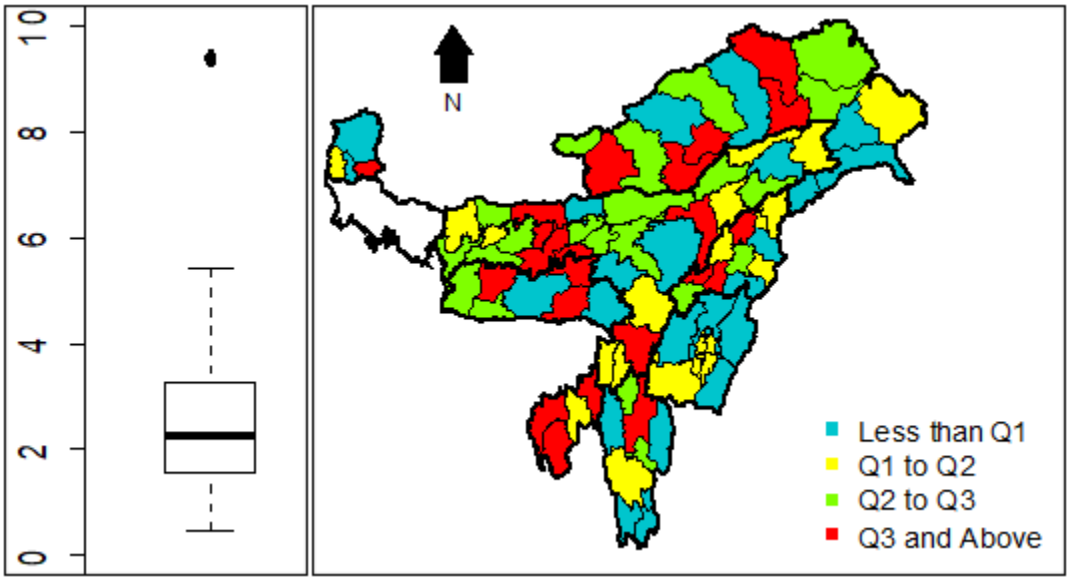
Figure 1: Prevalence of diabetes among women of reproductive age in northeast India



	Arunachal Pradesh	Assam	Manipur	Meghalaya	Mizoram	Nagaland	Sikkim	Tripura
Prevalence	2.19	2.96	1.87	3.11	2.61	2.79	2.50	4.40

Figure 2 shows the distribution of prevalence of diabetes among women of reproductive age across all districts of northeastern states. The box plot in the left panel of Figure 2 shows the distribution of prevalence of diabetes among women of reproductive age in 86 districts of Northeast India. It shows a right-skewed distribution, i.e., a higher proportion of districts are among the lower prevalence group, with some other districts having exceptionally higher prevalence. Further, the distribution of prevalence of diabetes among the districts is grouped into four based on the three quartiles. The four groups are mapped on the right panel of Figure 2. The three points separating the distribution of prevalence of diabetes are the first quartile (Q1 = 1.56 percent), second quartile (Q2 = 2.25 percent) and third quartile (Q3 = 3.24 percent). The districts for which its prevalence is less than Q1 have low prevalence. In comparison, districts with prevalence greater than Q3 are grouped as districts with high prevalence. And the districts between Q1 and Q3 is named as districts with mild prevalence. Except for Manipur, all other northeast states have districts with a high prevalence of diabetes among women of reproductive age. The box plot shows that one district named "Kamrup Metropolitan" of Assam has an exceptionally high prevalence of diabetes among women of reproductive age (9.43 percent).

Figure 2: Prevalence of diabetes among women of reproductive age by districts



Note: The white portion in the map is not included in the analysis as it is not part of northeast India.

Table 1 shows the distribution of the prevalence of diabetes among women of reproductive age. Compared to the prevalence of diabetes among women who never drink alcohol (2.15 percent; 95% CI = [1.76, 2.55]), the prevalence of diabetes among women who ever drink alcohol is 2.75 percent (95% CI = [2.59, 2.91]). While the data does not show any statistical significance between diabetes among women of reproductive age and its smoking status and consumption of tobacco. Again, compared to the prevalence of diabetes among those having at least one vegetarian food item daily (2.61 percent; 95% CI = [2.45, 2.78]), the prevalence of diabetes among women who have at least one non-vegetarian food item daily is 2.59 percent (95% CI = [1.69, 3.50]). And, the prevalence of diabetes among women who have at least one vegetarian and one non-vegetarian food item daily is 3.79 percent (95% CI = [3.28, 4.30]). Compared to the prevalence of diabetes among those women consuming fried food occasionally (2.53 percent; 95% CI = [2.37, 2.70]), the prevalence of diabetes among those women consuming fried food every day is 2.98 percent (95% CI = [2.70, 3.27]). The prevalence of diabetes among women who have attained secondary schooling is 2.56 percent (95% CI =

[2.37, 2.75]) and among those who have attained higher education is 3.43 percent (95% CI = [2.86, 4.00]). Compared to the prevalence of diabetes among women with normal body mass index 18.5-24.9 (2.03 percent; 95% CI = [1.88, 2.18]), the prevalence of diabetes among women whose body mass index greater than 24.9 is 5.70 percent (95% CI = [5.22, 6.19]). As the household wealth quintile of the women increases, the prevalence of diabetes among the women in reproductive age also increases. Women belonging to the poorest household wealth quintile has the lowest prevalence of diabetes (1.66 percent; 95% CI = [1.37, 1.96]), while women belonging to the richest household wealth quintile has the highest prevalence of diabetes (4.43 percent; 95% CI = [3.79, 5.08]). The prevalence of diabetes among women of reproductive age is higher in urban areas (3.66 percent; 95% CI = [3.30, 4.01]) as compared to the women living in rural areas (2.27 percent; 95% CI = [2.12, 2.42]).

Table 1: Distribution of prevalence of diabetes among women of reproductive age

	N	Prevalence	95% CI		Chi-Square
Drinking Status					
Never Drink	87,438	2.15	1.76	2.55	8.30**
Ever Drink	9,575	2.75	2.59	2.91	
Smoking Status					
Never Smoked	94,602	2.68	2.53	2.84	1.20
Ever Smoked	2,411	3.09	1.74	4.44	
Tobacco Consumption Status					
Never Consumed	94,078	2.68	2.52	2.84	0.01
Ever Consumed	2,935	3.15	2.15	4.14	
Food Habits					
Occasionally/Weekly Veg. & Non-Veg	20,199	2.21	1.94	2.48	60.49**
At least One Veg. Daily	63,602	2.61	2.45	2.78	
At least One Non-Veg. Daily	1,519	2.59	1.69	3.50	
At least One Veg. & One Non-Veg. Daily	11,693	3.79	3.28	4.30	
Fried Food					
Occasionally	63,337	2.53	2.37	2.70	9.52**
Daily	33,676	2.98	2.70	3.27	
Level of Education					
Illiterate	17,696	2.48	2.20	2.76	22.69**
Primary	14,079	2.99	2.61	3.36	
Secondary	56,403	2.56	2.37	2.75	
Higher	8,835	3.43	2.86	4.00	
Body Mass Index					
Less than 18.5	13,519	1.90	1.62	2.18	618.31**
18.5 to 24.9	66,231	2.03	1.88	2.18	
Greater than 24.9	17,263	5.70	5.22	6.19	
Wealth Quintile					
Poorest	13,126	1.66	1.37	1.96	247.54**
Poorer	28,920	1.87	1.68	2.07	
Middle	26,023	2.64	2.39	2.88	
Richer	19,271	3.50	3.16	3.83	
Richest	9,673	4.43	3.79	5.08	
Place of Residence					
Urban	25,915	3.66	3.30	4.01	101.02**
Rural	71,098	2.27	2.12	2.42	

Note: * p-value < 0.05 & ** p-value <0.01; CI – Confidence Interval; Veg – Vegetarian Food Item.

Determinants of diabetes among women in reproductive age

Table 2 shows the adjusted effects of determinants of diabetes among women of reproductive age. Model I consider behavioural characteristics and associated food habits as the covariates. While Model II considers information on behavioural, individual-level and household-level characteristics altogether. Both Model I (OR = 1.81; 95% CI = [1.70, 1.94]) and Model II (OR = 1.80; 95% CI = [1.69, 1.92]) shows that women ever drink alcohol has a higher risk of suffering from diabetes than those never drink. Again, compared to women consuming vegetarian and non-vegetarian food items, women consuming at least one vegetarian food item daily (OR = 1.19; 95% CI = [1.07, 1.33]), and consuming at least one vegetarian and one non-vegetarian food item daily (OR = 1.67; 95% CI = [1.45, 1.92]) are more likely to suffer from diabetes. Compared to women who consume fried food occasionally, consuming fried food every day is more likely to suffer from diabetes (OR = 1.10; 95% CI = [1.01, 1.18]).

Table 2: Adjusted effects of determinants of diabetes among the women in reproductive age

	Model I				Model II			
	OR		**95% CI**		**OR**		**95% CI**	
Drinking Status								
Never Drink								
Ever Drink	1.81	**	1.70	1.94	1.80	**	1.69	1.92
Smoking Status								
Never Smoked								
Ever Smoked	1.17		0.92	1.50	1.01		0.79	1.29
Tobacco Consumption Status								
Never Consumed								
Ever Consumed	0.97		0.76	1.23	0.89		0.70	1.13
Food Habits								
Occasionally/Weekly Veg. & Non-Veg								
At least One Veg. Daily	1.19	**	1.07	1.33	1.11		1.00	1.24
At least One Non-Veg. Daily	1.24		0.89	1.73	1.18		0.85	1.65
At least One Veg. & One Non-Veg. Daily	1.67	**	1.45	1.92	1.42	**	1.23	1.63
Fried Food								
Occasionally								
Daily	1.10	*	1.01	1.18	1.09	*	1.01	1.13
Level of Education								
Illiterate								
Primary					1.03		0.89	1.18
Secondary					0.74	**	0.65	0.83
Higher					0.72	**	0.61	0.86
Body Mass Index								
Less than 18.5								
18.5 to 24.9					1.01		0.88	1.16
Greater than 24.9					2.45	**	2.11	2.83
Wealth Quintile								
Poorest								
Poorer					1.16		0.98	1.36
Middle					1.50	**	1.27	1.77
Richer					1.83	**	1.53	2.19
Richest					2.14	**	1.75	2.61
Place of Residence								
Urban								
Rural					0.89	*	0.81	0.98
Constant	0.02	**	0.02	0.02	0.02	**	0.01	0.02

Note: * p-value < 0.05 & ** p-value <0.01; OR - Odds Ratio; CI - Confidence Interval; Veg - Vegetarian.

Model II also provides a similar association between food habits and fried food consumption with diabetes. Compared to women who are illiterate, women who have attained secondary (OR = 0.74; 95% CI = [0.65, 0.83]) and higher (OR = 0.72; 95% CI = [0.61, 0.86]) level of education are less likely to suffer from diabetes. Again, women with body mass index greater than 24.9 (OR = 2.45; 95% CI = [2.11, 2.83]) are more likely to suffer from diabetes. Compared to women living in poorest household wealth quintile, women living in middle (OR = 1.50; 95% CI = [1.27, 1.77]), richer (OR = 1.83; 95% CI = [1.53, 2.19]) and richest (OR = 2.14; 95% CI = [1.75, 2.61]) household wealth quintile are more likely to suffer from diabetes. And compared to women living in urban areas, women living in rural areas are less likely to suffer from diabetes (OR = 0.89; 95% CI = [0.81, 1.98]).

Discussion

Diabetes is a lifestyle disease associated with various socioeconomic and behavioural lifestyle activities. It is one of the most prevalent non-communicable diseases imposing a significant public health concern in India (Mohan et al., 2017; Meitei & Ladusingh, 2019; Nanditha et al., 2019). Also, its prevalence differs widely across different socioeconomic and geographic regions of India (Arora et al., 2010; Anjana et al., 2017). The study highlighted a significant variation in the prevalence of diabetes among women of reproductive age across all states and districts in the northeastern states of India. Tripura has the highest prevalence of diabetes, while Manipur has the lowest. The study reveals that none of the districts of Manipur comes under the category of the high prevalence of diabetes (prevalence greater than Q3 = 3.24 percent). In comparison, all other states have at least one district that falls under the high prevalence of diabetes among women in reproductive age. Although, the distribution of prevalence of diabetes among the districts reveals higher proportion of districts belonging to the lower prevalence group (less than Q1 = 1.56 percent), with some districts having comparatively higher prevalence. Surprisingly, a district of Assam, “Kamrup Metropolitan” has exceptionally high prevalence of diabetes among women of reproductive age (9.43 percent). The situation is quite worrying. Thus, with all the knowledge and empirical evidence gained from the study, we fear that women of reproductive age living in this region face the burden of diabetes.

Several studies have articulated that behavioural risk factors such as smoking, drinking of alcohol, consumption of tobacco, obesity, and food habits are highly associated with this lifestyle disease (WHO, 2016). Obesity is one of the risk factors that have been marked as the inducer of diabetes both in developing and developed countries (Mohan et al., 2008). Urbanization too plays a very significant role in the increasing prevalence of diabetes. An increase in sedentariness and change in food habits due to rapid urbanization poses a severe threat to increase the risk of diabetes (Ramachandran et al., 1999; Gupta, 2006; Reddy et al., 2007; Diamond, 2011). Diabetes also imposes a severe socioeconomic burden individually and in the region where the prevalence is high (Rabi et al., 2006; Shashank et al., 2008). The study also reveals that an increase in behavioural risk factors such as drinking alcohol will increase the risk of diabetes among women of reproductive age. Consumption of fatty foods such as fried food regularly and a higher body mass index of greater than 24.9 also increases the risk of diabetes among women of reproductive age. However, the risk of diabetes among these women decreases as the level of education increases. This may be due to their increasing awareness as they become more educated. But unfortunately, those women coming from wealthy households and living in urban areas are more likely to suffer from diabetes due to the changes in their lifestyle and food habits with the rapid increase in urbanization.

What this study adds

The study focused on a population with a dearth of information available regarding the burden of diabetes. It shows a high prevalence of diabetes among women of reproductive age. The study also incorporates food habits as the risk factor of diabetes, which most studies based on Indian data do not consider. This may be due to the lack of data on food habits. But this study utilized the available data on food habits in NFHS and showed a significant relationship between food habits and diabetes among women of reproductive age. Most studies attempted to estimate the prevalence and determinants of diabetes focused on the general population. The studies of diabetes among women of reproductive age have been neglected for quite some decades. And, this study gives a new hope to reduce the burden of diabetes by looking at the new dimension of the study population.

Limitations

Despite the above merits, the study also has some limitations. The definition of diabetes used in the study is based on the random blood glucose level provided by the survey (IIPS & ICF, 2017). Also, the NFHS survey is a cross-sectional study from which causality cannot be established. India is a vast country, and the food habits of the Indians differ by region. Therefore, it is essential to discuss the diversity in food habits in such a study. But, unfortunately, the NFHS does provide information only for the specific food groups mentioned in the data and methodology section. It is also very important to consider the family history of diabetes as it has inevitable high genetic risks (Ramachandran et al., 1999). But, since the information on family history of diabetes was not collected in NFHS, the study could not address this particular factor.

Conclusion

The study findings suggest the likelihood of presence of the burden of diabetes among women of reproductive age in northeast India. Except for Manipur, all the other seven states have atleast one district having a high prevalence of diabetes (greater than Q3 = 3.24 percent). Women who drink and consume fried food daily or a mixture of vegetarian and non-vegetarian food daily have a higher risk of diabetes. Similarly, women with a higher body mass index, belonging to higher household wealth quintile and living in urban places are also at higher risk of suffering from diabetes. Since diabetes is a disease that cannot be cured and is among the leading cause of death in developing countries, the increasing burden of this disease among women of reproductive age will be a serious threat to the nation. Therefore, with today's rapidly growing urbanization, proper maintenance in food habits or sedentary habits among higher wealth quintile households and control in behavioural activities such as drinking alcohol will be the key to a healthy life.

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