Dietary intake and risk of Diabetes: a Study in Bengalee young adult females

Ingestão alimentar e risco de Diabetes: um estudo em mulheres adultas jovens de Bengala

Ingesta alimentaria y riesgo de Diabetes: un estudio en mujeres adultas jóvenes de Bengala

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ABSTRACT
The rate of diabetes is increasing alarmingly across the globe irrespective of age, sex and like and India is not an exception. Recently, dietary intake has received great attention as a modifiable risk factor for type 2 diabetes mellitus (T2DM). In this backdrop an attempt has been made to find out the relationship of dietary intake pattern with various indicators of T2DM. The risk of developing T2DM of 36 consented Bengalee young adult individuals aged between 18-24y, residing in and around Kolkata, were assessed anthropometrically and also by using Indian Diabetes Risk Score (IDRS). Dietary intake was assessed using a validated food frequency questionnaire (FFQ) and comparison was made in dietary intake between the risk groups. Corelation of dietary intake and risk of developing T2DM was checked. P<0.05 was considered as significant. 75% of the participants was obese in terms of BMI, 78% had central obesity in-terms of WC and more than 80% of the volunteers had moderate-high risk of T2DM when assessed using IDRS. It has been observed in the present study that consumption of milk and milk products, animal foods, roots and tubers, and fruits was low among high-risk groups. It has also been noticed that intake of energy dense fast food was higher among individual in high-risk group.
Keywords: IDRS, fast food, non-communicable diseases, physical inactivity.

RESUMO
A taxa de diabetes está aumentando de forma alarmante em todo o mundo, independentemente da idade, do sexo e da afinidade, e a Índia não é uma exceção. Recentemente, a ingestão alimentar tem recebido grande atenção como um fator de risco modificável para o diabetes mellitus tipo 2 (T2DM). Nesse contexto, tentou-se descobrir a relação do padrão de ingestão alimentar com vários indicadores de DM2. O risco de desenvolver DM2 em 36 indivíduos adultos jovens de Bengala com idade entre 18 e 24 anos, residentes em Calcutá e arredores, foi avaliado antropometricamente e também por meio do Indian Diabetes Risk Score (IDRS). A ingestão alimentar foi avaliada por meio de um questionário validado de frequência alimentar (FFQ) e foi feita uma comparação da ingestão alimentar entre os grupos de risco. A correlação entre a ingestão alimentar e o risco de desenvolver DM2 foi verificada. P<0,05 foi considerado significativo. 75% dos participantes eram obesos em termos de IMC, 78% tinham obesidade central em termos de CC e mais de 80% dos voluntários tinham risco moderado-alto de DM2 quando avaliados pelo IDRS. No presente estudo, observou-se que o consumo de leite e derivados, alimentos de origem animal, raízes e tubérculos e frutas era baixo entre os grupos de alto risco. Também foi observado que a ingestão de fast food com alta densidade energética foi maior entre os indivíduos do grupo de alto risco.

Palavras-chave: IDRS, fast food, doenças não transmissíveis, inatividade física.

RESUMEN
La tasa de diabetes está aumentando de forma alarmante en todo el mundo, independientemente de la edad, el sexo y la afinidad, y la India no es una excepción. Recientemente se ha prestado gran atención a la ingesta dietética como factor de riesgo modificable de la diabetes mellitus de tipo 2 (DMT2). En este contexto, se ha intentado averiguar la relación entre el patrón de ingesta dietética y varios indicadores de DMT2. El riesgo de desarrollar DMT2 de 36 adultos jóvenes bengalíes de entre 18 y 24 años, residentes en Calcuta y sus alrededores, fue evaluado antropométricamente y también mediante la Puntuación India de Riesgo de Diabetes (IDRS). La ingesta dietética se evaluó mediante un cuestionario validado de frecuencia de alimentos (FFQ) y se comparó la ingesta dietética entre los grupos de riesgo. Se comprobó la correlación entre la ingesta dietética y el riesgo de desarrollar DMT2. P<0,05 se consideró significativo. El 75% de los participantes eran obesos en términos de IMC, el 78% presentaban obesidad central en términos de PC y más del 80% de los voluntarios presentaban un riesgo moderado-alto de DMT2 al ser evaluados mediante la IDRS. En el presente estudio se ha observado que el consumo de leche y productos lácteos, alimentos de origen animal, raíces y tubérculos, y frutas era bajo entre los grupos de alto riesgo. También se ha observado que la ingesta de comida rápida hipercalórica era mayor entre los individuos del grupo de alto riesgo.

Palabras clave: IDRS, comida rápida, enfermedades no transmisibles, inactividad física.
1 INTRODUCTION

Diabetes mellitus, a metabolic disorder, is a condition defined by hyperglycaemia and improper metabolism of carbohydrate as a result of insufficient secretion and/or action of insulin (American Diabetes Association, 2004). The prevalence of diabetes is increasing alarmingly across the globe and T2DM is accounting for 90% of all cases of diabetes. India, the diabetic capital of world, is having ever rising number of populations living with diabetes. India ranked second in terms of peoples living with diabetes (74 million) and the number is further predicted to rise about 70% (125 million) by 2045 (IDF, 2021). It has been reported that along with older adults and elderly population, the incidence of T2DM is also increasing among adolescents and young adults in India (Amutha, 2012). T2DM is a multifactorial chronic metabolic disorder which is associated with non-modifiable factors (genetic, age) as well as modifiable factors (un-healthy diet pattern, physical inactivity (Chatterjee, 2015), obesity (Banerjee, 2014), smoking). Among other modifiable risk factors, diet has a significant role to play in occurrence and progression of T2DM (Ehab, 2017). And along with quantity, quality of nutrients has a specific role in relation to diabetes (Bardhan, 2021; Bhattacharjee, 2017). It has been reported that lifestyle intervention including dietary modification can prevent the development of T2DM and intake of certain foods and dietary factors are associated with T2DM risk. Food patterns that are rich in fruits and vegetables are found to have a protective effect against metabolic disorders whereas fried foods, processed foods, and unhealthy beverages enhance the risk of developing diabetes (Cao, 2022). Adolescents and young adults generally stepped into higher educational institution and started spending a reasonable time away from home and parents and experience numerous transitions in eating behaviours which may cause a number of health abnormalities including obesity, diabetes and more (Salameh, 2014). Most of the previous studies in this area have been carried out on older adults and elderly population and information about role of dietary intake on the risk of T2DM in Bengalee young adults are limited. In this backdrop an attempt has been made to find out the relationship of dietary intake with the risk of developing T2DM in Bengalee young adults.
2 METHODOLOGY

Data for the present study were collected from Bengalee young adults after getting the required consent. 36 consenting individuals in the age group of 18-24y residing in and around Kolkata, West Bengal with no prior self-reported disease history constituted the study participants’ set. Information about age (y), sex, ethnicity, socioeconomic status (SES) (Ayoub, 2023), and physical activity (FAO, 2005) was collected in a predesigned schedule. BH (cm) was measured using anthropometric measurement set to the nearest 0.1 cm. BW (kg) was measured using a weighing scale to the nearest 0.1 kg, with subjects in socially acceptable minimal clothing. WC (cm) and HC (cm) were measured using non-stretchable measuring tape to the nearest 0.1 cm. WC was measured midway between the lower ribs and the iliac crest and HC was measured at the largest circumference around the buttocks. BMI (kg.m$^{-2}$), WHR and WHtR were calculated (Savolainen, 2017). Information about two modifiable risk factors – WC (cm) and level of physical activity and two non-modifiable risk factors - family history with regard to diabetes and age was recoded to identify the risk scenario of developing T2DM based on IDRS (Mohan, 2005). The study group was then categorised as low risk group (score < 30), moderate risk group (score 30-50) and high-risk group (Score ≥ 60). Data about dietary intake were recorded using a validated FFQ which included frequency and quantity (amount and portion) of daily food intake over last 12 months (Motswagole, 2020). Daily consumption of different food between the risk groups was compared. Corelation between the intake of different dietary factors and various risk factors for developing T2DM was assessed.

3 RESULTS

Socio-demographic and anthropometric profile of the participating individuals has been presented in table 1 and 2 respectively. Total 36 females residing in urban areas of greater Kolkata participated in the present study.
Table 1: General information of the participating volunteers

<table>
<thead>
<tr>
<th>Variables</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>Female</td>
</tr>
<tr>
<td>Age (Y)*</td>
<td>20.2 ± 1.06</td>
</tr>
<tr>
<td>Physical activity level*</td>
<td>1.55 ± 0.24</td>
</tr>
<tr>
<td>Socio-economic status (%)</td>
<td></td>
</tr>
<tr>
<td>Upper and Upper-middle</td>
<td>11 (31)</td>
</tr>
<tr>
<td>Lower-middle</td>
<td>8 (22)</td>
</tr>
<tr>
<td>Upper-lower and Lower</td>
<td>17 (47)</td>
</tr>
<tr>
<td>Family history with regard to diabetes (%)</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>28</td>
</tr>
<tr>
<td>No</td>
<td>72</td>
</tr>
</tbody>
</table>

* AM ± SD
Source: collected by the research scholars/authors

Table 2: Physical and physiological profile of the participants

<table>
<thead>
<tr>
<th>Variables</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body height (cm)*</td>
<td>153.0 ± 15.20</td>
</tr>
<tr>
<td>Body weight (kg)*</td>
<td>70.9 ± 25.49</td>
</tr>
<tr>
<td>BMI (kg.m(^{-2}))*</td>
<td>28.44 ± 6.77</td>
</tr>
<tr>
<td>WC (cm)*</td>
<td>92.1 ± 17.96</td>
</tr>
<tr>
<td>HC (cm)*</td>
<td>104.6 ± 15.89</td>
</tr>
<tr>
<td>WHR*</td>
<td>0.88 ± 0.07</td>
</tr>
<tr>
<td>WHtR*</td>
<td>0.61 ± 0.16</td>
</tr>
<tr>
<td>IDRS*</td>
<td>44.4 ± 12.5</td>
</tr>
</tbody>
</table>

* AM ± SD
Source: collected by the research scholars/authors

The average age of the participants was 20.2 years and most of them was belonging to upper-lower socioeconomic status. Among all the participants 28% recorded to have family history with regard to diabetes. The mean value of BMI and WC of the study participants were 28.44 (kg.m\(^{-2}\)) and 92.1 cm respectively. Mean IDRS was 44.4 which indicated that the study participants were at moderate risk of being diabetics.

Scenario of overall adiposity and abdominal adiposity of the volunteers in terms of BMI and WC have been presented in figure 1. From figure 1 it could be observed that only 17% of the participants were belonging within normal weight category and more than 80% of the participating individuals was either overweight or obese. And when considering WC more than 75% of the total participants found to have central obesity.
Figure 1: Scenario of overall adiposity and abdominal adiposity

<table>
<thead>
<tr>
<th>(a) BMI (kg.m(^{-2}))</th>
<th>(b) WC (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal weight 17%</td>
<td>Normal 22%</td>
</tr>
<tr>
<td>Over weight 8%</td>
<td>Over weight 78%</td>
</tr>
<tr>
<td>Obese 75%</td>
<td>Central obesity 78%</td>
</tr>
</tbody>
</table>

Source: collected by the research scholars/authors

Distribution of the study participants into the risk groups of T2DM depending on score obtained in IDRS has been presented in figure 2.

Figure 2 revealed that more than 65% of the participating individuals was at moderate risk of developing diabetes whereas only 17% had low risk.

Dialy estimated average consumption of major food groups and frequency of consumption of different energy-dense junk foods in a month have been compared between the three risk groups for T2DM and presented graphically in figure 3 and 4 respectively. Figure 3 revealed that individuals in high risk group consume more cereals than other two groups where as consumption of milk and milk products, animal foods, fruits and roots and tubers were low among individuals in high-risk group. Table 4 showed that
consumption of all kind of energy dense junk food except soft drink was high among individuals in high-risk group.

Figure 3: Comparison in consumption of dietary factors between three risk groups

![Figure 3](image)

Source: collected by the research scholars/authors

Figure 4: Comparison in frequency of consumption of junk foods between the risk groups

![Figure 4](image)

Source: collected by the research scholars/authors

Relationship of daily average intake of food groups and frequency of consumption of junk foods with risk factors for developing T2DM; BMI, WC and IDRS value has been presented in table 3 and 4 respectively. Results (table 3) indicated that consumption of pulses was positively significantly correlated with indicators of T2DM (WC and IDRS
Whereas, consumption of animal foods was inversly correlated with risk of T2DM. However, no other food groups showed any significant correlation with the risk of developing T2DM in the present study. Table 4 revealed that frequency of consumption of junk food in a month was significantly associated with two most effective surrogate markers of T2DM; WC and BMI. Although in case of IDRS no significant corelation was found.

Table 3: Relationship between dietary intake and risk factors for T2DM

<table>
<thead>
<tr>
<th>Daily average consumption as per Food groups (g.d⁻¹)</th>
<th>IDRS</th>
<th>WC</th>
<th>BMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereals</td>
<td>0.13</td>
<td>-0.13</td>
<td>-0.15</td>
</tr>
<tr>
<td>Pulses and legumes</td>
<td>0.46*</td>
<td>0.32*</td>
<td>0.24</td>
</tr>
<tr>
<td>Roots and tubers</td>
<td>-0.19</td>
<td>-0.23</td>
<td>-0.28</td>
</tr>
<tr>
<td>Vegetables</td>
<td>-0.04</td>
<td>-0.01</td>
<td>-0.10</td>
</tr>
<tr>
<td>Fruits</td>
<td>-0.28</td>
<td>0.08</td>
<td>0.15</td>
</tr>
<tr>
<td>Oil</td>
<td>0.16</td>
<td>0.01</td>
<td>0.24</td>
</tr>
<tr>
<td>Meat, fish, egg</td>
<td>-0.49**</td>
<td>-0.21</td>
<td>-0.24</td>
</tr>
<tr>
<td>Milk and milk products</td>
<td>-0.27</td>
<td>-0.04</td>
<td>-0.15</td>
</tr>
</tbody>
</table>

*P<0.05, **P<0.01
Source: collected by the research scholars/authors

Table 4: Relationship between frequency of consumption of energy dense junk food and risk factors for T2DM

<table>
<thead>
<tr>
<th>Energy dense junk foods consumption frequency (number of times per month)</th>
<th>IDRS</th>
<th>WC</th>
<th>BMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweets and desserts</td>
<td>0.32</td>
<td>0.39*</td>
<td>0.53**</td>
</tr>
<tr>
<td>Soft drink</td>
<td>0.14</td>
<td>0.28</td>
<td>0.44*</td>
</tr>
<tr>
<td>Fried foods and snacks</td>
<td>0.28</td>
<td>0.47*</td>
<td>0.32</td>
</tr>
<tr>
<td>Fast foods</td>
<td>0.19</td>
<td>0.57**</td>
<td>0.45*</td>
</tr>
</tbody>
</table>

*P<0.05, **P<0.01
Source: collected by the research scholars/authors

4 DISCUSSION

In the present study the relationship of dietary intake with risk indicators of T2DM among Bengalee young adults was assessed. Early detection of people at risk is an effective approach to prevent and reduce further progression of T2DM. However biochemical tests are expensive and are not always available in clinical and epidemiological practice, hence anthropometric indices are used as surrogate markers for screening of T2DM and associated disorders (Banerjee, 2014; Banerjee, 2017; Bhattacharjee, 2015; Banerjee, 2017, Banerjee, 2018). 78% of the participating volunteers in the study had abdominal obesity and the mean WC value was 92.1 cm. It has been reported in a study conducted on adolescent girls in India that WC was positively
associated with impaired fasting glucose and cut off values $\geq 80.3$ cm can predict prediabetes (Pandeya, 2017). Another study also reported high prevalence of glucose intolerance among adolescent girls with central obesity (Ranjani, 2013). 75% of participants in the present study was categorised as obese ($\text{BMI} \geq 25$) and the mean BMI value ($28.44 \text{kg, m}^{-2}$) is indicating that the study group is at higher risk for incidence T2DM. It has been observed in previous studies that obesity at younger age is closely related with future onset of T2DM and the association is more prominent in females than in males. Which may be explained by [i]early onset of puberty and subsequent insulin resistance [ii] increased physical inactivity (Banerjee, 2015), and [iii] greater fat mass among females than in males. IDRS is another simple and cost-effective tool used to identify people who are at risk of developing T2DM. IDRS was reported to has sensitivity and specificity of 61.33% and 56.14% respectively among those with score more than 70 (Kaushal, 2017). Another study reported sensitivity and specificity of 95.12% and 28.95% respectively among those with scores more than 60 (Dubeja, 2017). Majority of the volunteers in the present study had moderate risk of developing T2DM, similar results have also been found in a previous study where it has been reported that 78% of total participants was at moderate risk (Sahai, 2017). Individuals with high-risk category in the present study had a higher consumption of cereals and a lower consumption of fruits, meat, fish, egg, milk and milk products compared with those at low and moderate risk. In line with the present findings, a study has reported that dietary pattern that included high consumption of milk and milk products, fruits and vegetables and meat can reduce the risk of developing T2DM (Moromoto, 2012). Another study in young adults suggested that consumption of dairy products was inversely associated with insulin resistance (Agarwal, 2017). However, it is important to mention that consumption of all the food groups by the study participants in the present study irrespective of any risk score was below than that recommended and most of the participants did not include all the food groups from home made daily diet. A study carried out among adolescents in Kolkata has also found the tendency of in-adequate consumption of home made healthy foods. It is due to the fact that as a result of rapid shift in family lifestyle and work schedule, the trend of consuming ready to eat fast food and junk food has been increasing substantially among young adults (Beigrezaei, 2019). In accordance with a study that has reported that majority of young adults with mean age of 20years mostly consumed energy dense ready to eat foods (Salameh, 2014), the present study also showed that almost 70% of the participants eat any type of junk foods at least twice in a week. The trend of eating
junk food was more frequent among high-risk group and fried foods and snacks was found to be the most commonly consumed junk food item in the study individuals. Panipuries, a street food originated in Indian subcontinent, is a famous and most liked snack among all the age groups especially among adolescents and young adults. Junk foods in the present study was characterised as intake of sweets and desserts, carbonated drink and juices, noodles, high protein and refined carbohydrate based fast foods, chips, and fries like samosa, panipuries and chats. This kind of foods contain excess energy, saturated fats and sugar that in turns lead to obesity over time. In the present study it has been found that consumption of energy dense junk foods was positively associated with increased risk of T2DM in-terms of WC and BMI. With the exception of red meat and processed meat, foods in junk food pattern in present study contained most of the foods that have been mentioned as western dietary pattern or unhealthy dietary pattern in previous studies (Beigrezaei, 2019; Jannasch, 2017) which was reported to increase the risk T2DM significantly.

5 CONCLUSION

The difference in consumption of fast and junk foods across the three different risk groups were more prominent than intake of different food groups obtained from home-made daily diets. And the results of the study support the evidence that more frequent consumption of energy dense fast foods are linked with the risks of diabetes. However, the results based on small sample size required further investigations with higher number of study individuals to explore more accurate relationships.

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