ORIGINAL ARTICLE

# Nutritional risk factors for gestational diabetes mellitus

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## Abstract

**Background:** Gestational diabetes mellitus (GDM) has been observed to be associated with increased perinatal morbidity and mortality. GDM is becoming a public health concern globally as well as in India with fast increasing trend. It affects approximately 14% of all pregnancies. Studies on the association of food items having high glycaemic index with GDM risk are sparse. Most of the literature has focused on typical risk factors like advanced maternal age, family history of diabetes mellitus, history of abortions, previous history of GDM. **Objective:** To assess the risk of developing GDM in pregnant women consuming food items with high glycemic index. **Material and Methods:** A hospital based case control study was conducted in Lady Hardinge Medical College and associated hospital with a sample size of 104 (52 cases & 52 controls). For dietary history a validated quantitative food frequency questionnaire was used. The usual pattern of eating during days, weeks and months were asked. The data was compiled and analysed in SPSS version 12. **Results:** Total 30.8% cases and 13.5% controls gave history of consuming food items having high glycaemic index more frequently (at least once daily). The odds ratio of developing GDM was 2.86(CI -1.06-7.70) among the cases who were taking high glycaemic foods more frequently in comparison to those who were taking occasionally. **Conclusions:** Risk of developing GDM in high glycemic foods consumers is high. Simple measures like changing dietary patterns, consuming food items with low glycaemic load can contribute significantly in prevention of GDM.

## Key Words

Diabetes mellitus; gestational diabetes; high glycemic foods; risk factors of gestational diabetes

## Introduction

According to WHO projections India will have maximum number of patients with diabetes (57.2 million) by the year 2025 (1). Gestational diabetes mellitus (GDM), which is defined as the onset or recognition of glucose intolerance during pregnancy, (2) is associated with an increased risk of perinatal morbidity and mortality. GDM is becoming a public health concern globally as well as in India with fast increasing trend. It affects approximately 14% of all pregnancies (3). GDM affects not only the mother but has impact on the baby too, simultaneously affecting two generations. Studies on the association of food items having high glycaemic index with GDM risk are sparse. Most of the literature has focused on typical risk factors like advanced maternal age, family history of diabetes mellitus, history of abortions, previous history of GDM etc. (4). The studies often have an inadequate control and lack of statistical power, resulting in inconclusive evidence for determinants of GDM in developing countries including India.

In the management of gestational diabetes mellitus, diet has been recognized to have an important role. There is considerable evidence to show that better control of blood sugar prevents or delays the debilitating complications of diabetes (5). The use of carbohydrate both in terms of quantity as well as quality in diabetic diet, has always been a key therapeutic issue (6). The amount of total carbohydrate recommended for the diabetic diet has

varied significantly over the years (7). The glycemic index is a relative measure of the blood glucose response to a given amount of carbohydrate that represents the quality of the carbohydrate that is eaten. The glycemic index is defined as the incremental area under the glucose response curve following the intake of 50 g of carbohydrate from food compared with the glucose area generated from a similar amount of white bread or glucose (8). Food items with high glycemic index peak the blood glucose level very fast. Several large-scale, observational studies indicate that the long-term consumption of a diet with a high glycemic load (GL= GI x dietary carbohydrate content) is a significant independent predictor of the risk of developing type 2 diabetes (6, 7) and cardiovascular disease (8). The higher the GL, the greater the expected elevation in blood glucose and in the insulinogenic effect of the food.

Non modifiable risk factors such as past history of GDM, family history of DM, increasing maternal age have already been identified however the impact of diet, lifestyle and other modifiable risk factors has not yet been adequately analyzed.

## Aims & Objectives

1. To assess the risk of developing GDM in pregnant women consuming food items with high glycemic index.

## Material and Methods

This was a case control study carried out from November 2012 to March 2014 at Lady Hardinge Medical College & Smt Sucheta Kripalani Hospital (SSKH). Lady Hardinge Medical College is a tertiary level medical institute. Its maternity wing is a referral centre for high risk pregnant women of Delhi and the neighboring regions. A huge number of antenatal women attend its antenatal clinics every day. On an average 150-200 pregnant women come in a single ANC OPD. There are four OPDs in a week. Nearly 50-100 deliveries occur daily in the hospital.

The study population comprised of all pregnant women of >24 weeks of gestation who reported to ANC clinic of SSK Hospital and those who had already undergone to Glucose Challenge Test (GCT) at the time of enrolment. Those having positive GCT were subject to oral glucose tolerance test (OGTT) for confirmation of GDM. Pregnant women having abnormal OGTT were taken as cases while controls were selected randomly from the population of pregnant women having normal GCT.

For the purpose of this study, the OGTT results were interpreted using American Diabetic Association (ADA) criteria. In this the subject should remain seated and should not smoke throughout the test. 100 gm oral glucose is given. And the blood sample is taken before glucose load and at 1hour, 2 hour, 3 hour. The cut off for fasting plasma glucose = 95 mg/dl, 1 hour = 180 mg/dl, 2 hour = 155 mg/dl and 3 hour = 140 mg/dl. Two or more abnormal values of the venous plasma glucose concentrations confirms the diagnosis for GDM.

**Risk factors studied:** The major risk factors were age, parity, obesity, family history of known diabetes mellitus and diet. A semi structured interview schedule was designed for recording information. The interview schedule was made in local language and pretested adequately before use. It included information on socio-demographic characteristics and other issues relevant to risk factors. For dietary history a validated quantitative food frequency questionnaire was used. The usual pattern of eating during days, weeks and months was asked. This questionnaire has already been evaluated in previous studies in Kerala and Gujarat. A complete general physical and obstetric examination of the subjects was carried out. Laboratory investigations relevant to the study were recorded e.g. haemoglobin, random blood glucose, glucose challenge test, glucose tolerance test.

With two sided confidence level of 95%, Power- 80%, Ratio of cases to controls 1, Prevalence of family history of diabetes in developing GDM in normal population 12% (out of all major risk factors it has the minimum prevalence according to existing literature in India) (16) and assumed OR of Family history for developing GDM = 4, the sample size was calculated to be 52 cases and same number of controls were taken using Epi-Info software.

Ethical clearance for the study was given by the Institutional Ethical Committee and informed consent taken from study subjects before commencement of the study. Data was adequately coded and analysed using SPSS version 12. Odds ratio was used to compare strength of association between cases and controls. Independent T test was applied to compare quantitative variable

## Results

Though prospective cohort study is more appropriate to establish epidemiological causation of risk factors in GDM, we preferred hospital based

case control study to avoid time and resource constraints. All the GDM cases recorded during the study period were enrolled in the study which might have reduced selection bias of cases in the study. A total of 104 subjects were enrolled in the study, 52 each in case and control groups. In the present study GDM has been found to be more common (>75%) in the age of 25 years or more. The mean age of the women having GDM was higher (28.90 ± 4.56 years) than the Non GDM group (24.25±4.14 years). Majority of cases (40.4%) belonged to 25-30 years of age followed by 38.5% in age group >30 years and 21.2% in age group <25. Maximum controls i.e. 48.1% were in<25 years group and 11.5% in >30 years. The mean age among controls was 24.25±4.14 (Table 1).

According to modified Kuppuswamy scale most of the cases (71%) belonged to upper and upper middle socio-economic class and among controls majority belonged to (46.2%) upper lower socio economic status (Table 2).

The maternal age of 25 and above was found to have more than double (OR=2.27 to 7.75)) risk of developing GDM in comparison to < 25 years of age. The upper and middle socioeconomic class had higher risk of GDM in comparison to lower socio economic class of pregnant women. The high glycemic food consumption also found to have higher risk of having GDM in comparison to low glycemic load (OR=2.86) (Table 3).

Total 30.8% cases and 13.5% controls gave history of consuming food items having high glycaemic index more frequently (at least once daily), while only 13.5% of controls took such foods more frequently. The odds ratio of developing GDM was 2.86 among the cases who were taking high glycaemic foods more frequently in comparison to those who were taking occasionally (Table 4)

## Discussion

Substantial evidence from epidemiologic and clinical studies supports the fact that diet influences glucose homeostasis and that modification of diet can lower the risk of diabetes. Dietary fibre and types of carbohydrate have received particular interest due to their impact on postprandial glucose and insulin responses. (13) Studies on the role of dietary factors in the development of GDM are sparse. In our study we examined the role of pre pregnancy intake of food items with high glycaemic index with the risk of GDM.

Zahng et al (14)(1992-1998) conducted a hospital based prospective cohort study in United States of America to examine whether pre-gravid dietary fiber consumptions from cereal, fruit, and vegetable sources and dietary glycemic load were related to gestational diabetes mellitus (GDM) risk. Each 10-g/day increment in total fiber intake was associated with 26% (95% CI 9–49) reduction in risk; each 5-g/day increment in cereal or fruit fiber was associated with a 23% (9 –36) or 26% (5– 42) reduction, respectively. Dietary glycemic load was positively related to GDM risk. Multivariate relative risk for highest versus lowest quintiles was 1.61 (1.02–2.53) (P for trend 0.03). The combination of high–glycemic load and low–cereal fiber diet was associated with 2.15-fold (1.04–4.29) increased risk compared with the reciprocal diet.

Our study has shown that women consuming diet of high glycaemic load had high risk of GDM (R-3.13 and or-2.86 respectively). The results are comparable to study by Zahnget al (14).

Modifiable factors include excess adiposity, physical activity, and diet. 15 Dietary components associated with GDM risk include macronutrients, micronutrients, and individual foods, such as refined carbohydrates, saturated and trans-fats, heme iron, and processed meats. (15) Whereas studying individual nutrients may lead to the understanding of important biological mechanisms, assessment of dietary patterns offers a comprehensive and complimentary approach and may be more applicable to clinical and public health interventions. Analyses of overall food patterns also account for any interactions or synergistic effects among individual foods or nutrients. If dietary patterns beneficially affect GDM risk, it would be important to disseminate such information to women of reproductive age.

A study by Zhang et al assessed pre-pregnancy dietary patterns derived by factor analysis and the risk of GDM. (16) A prudent pattern identified by the data was positively correlated with fruit, green leafy vegetables, poultry, and fish, whereas a Western pattern was correlated with increased intakes of red meat, processed meat, refined grains, sweets, French fries, and pizza. Adherence to the prudent pattern was significantly associated with a reduced risk of GDM in a comparison of those in the highest quintile with those in the lowest quintile (RR: 0.72; 95% CI: 0.55, 0.93). Similarly, those in the lowest quintile of adherence to the Western pattern

compared with the highest quintile had a significantly lower risk of GDM (RR: 0.61; 95% CI: 0.45, 0.84). Findings from this analysis suggested that both consumption of healthy foods and avoidance of unhealthy foods were associated with a reduced risk of GDM and are consistent with our results presented here.

The glycemic index is a measure of carbohydrate quality and is directly correlated with glucose absorption and an increase in insulin after eating a food or meal. Both have been associated with hyperglycemia and hyper insulinemia (17) as well as incident GDM in the NHS II cohort. (14)

Further research is required to know whether improving one's dietary pattern adherence during pregnancy is associated with a lower risk of GDM. These results suggest that clinical and public health efforts to encourage healthy diet patterns for women of a reproductive age might yield benefits in the reduction of GDM risk in a future pregnancy.

Although the exact mechanisms by which high-glycemic index diets may alter the risk of diabetes are unclear, 2major pathways have been proposed. (18, 19) First, the same amount of carbohydrates from high-glycemic-index foods, by definition, produce higher blood glucose concentrations and a greater insulin demand than do low-glycemic index foods. It is possible that chronically increased insulin demand results in pancreatic exhaustion that can result in glucose intolerance. (19) Second, high-glycemic-index diets may directly increase insulin resistance.

Carbohydrates with a higher glycemic index are absorbed quickly and can raise blood glucose concentrations rapidly, whereas carbohydrates with a lower glycemic index break down more steadily and have a gradual glucose rise. (20)Consistent with this expectation, our data showed a positive relation between the maternal dietary glycemic index and GDM.

The potential mechanisms of the benefits of a low-GI diet may be due to the reduction in the rise of the postprandial blood glucose level, which in turn reduces hyper insulinemia (21) and oxidative stress. (22) A low-GI diet that reduces postprandial glucose spikes may therefore represent a logical and healthy way of eating during pregnancy benefiting the future health of the offspring.

## Conclusion

On the basis of the results we conclude that the dietary glycemic index, a measure of the type of carbohydrate in the maternal diet, influences the outcome of pregnancy and has utility for predicting the maternal metabolic response during pregnancy.

## Recommendation

So the simple measures including lifestyle modification like consuming low glycemic food items can have important role in prevention of GDM. Further in depth follow up studies are also recommended to justify the association between dietary intake and GDM.

## Limitation of the study

Because of the small sample size and hospital based setting the result of the study may not be generalized to the community.

## Relevance of the study

However the study is relevant from academic point of view as there is scarcity of literature on role of diet in GDM and undertaking appropriate preventive measures for development of GDM.

## Authors Contribution

SS: Conception and design, acquisition of data, analysis and interpretation of data, drafting the article, revising it critically, final approval of the version. TKR: Conception and design, analysis and interpretation of data, drafting the article, revising it critically, final approval of the version. RD: Conception and design, analysis and interpretation of data, drafting the article, revising it critically, final approval of the version. AS: Conception and design, drafting the article, revising it critically, final approval of the version.

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## Tables

### TABLE 1 AGE-WISE DISTRIBUTION OF AGE CASES AND CONTROLS

| Age( in completed years) | Cases No (%) | Controls No (%) |
|---|---|---|
| **<25** | 11(21.2) | 25(48.1) |
| **25-30** | 21(40.4) | 21(40.4) |
| **>30** | 20(38.5) | 6(11.5) |
| **Total** | 52(100.0) | 52(100.0) |
| **Mean age ±SD** | 28.90±4.56 | 24.25±4.14 |

### TABLE 2 DISTRIBUTION OF STUDY SUBJECTS ACCORDING TO SOCIO-ECONOMIC STATUS

| Socioeconomic class | Cases No (%) | Controls No (%) |
|---|---|---|
| **Upper** | 18(34.6) | 2(3.8) |
| **Upper middle** | 19(36.5) | 9(17.3) |
| **Lower middle** | 11(21.2) | 15(28.8) |
| **Upper lower** | 2(3.8) | 24(46.2) |
| **Lower** | 2(3.8) | 2(3.8) |
| **Total** | 52(100.0) | 52(100.0) |

**TABLE 3 THE ODDS RATIO (OR) FOR DIFFERENT RISK FACTORS IS SHOWN IN THE FOLLOWING TABLE**

| Risk factors for GDM | OR(95% CI) |
|---|---|
| **Maternal age 25-30 years vs<25 years** | 2.27(0.68-5.77) |
| **Maternal age >30years vs<25 years** | 7.75(2.39-24.06) |
| **Upper vs lower socio economic status** | 56.25(9.27-341.06) |
| **Middle vs lower socio economic status** | 7.50(2.30-24.44) |
| **Dietary factors High glycaemic load vs low glycaemic load** | 2.86(1.06-7.70) |

**TABLE 4 DISTRIBUTION OF STUDY SUBJECTS ACCORDING TO CONSUMPTION OF FOOD ITEMS HAVING HIGH GLYCEMIC INDEX**

| Frequency of intake of food items with high GI | Cases No.(%) | Controls | OR(95% CI) |
|---|---|---|---|
| **More frequently** | 16(30.8%) | 7(13.5%) | 2.86(1.06-7.70) |
| **Less frequently** | 36(69.2%) | 45(86.5%) | 1 |
| **Total** | 52(100.0) | 52(100.0) | |