Preeclampsia and risk of Diabetes in Indian Women

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Abstract

Background: Epidemiological data from high income countries suggests that women with preeclampsia are more likely to develop cardiovascular disease later in life. We aim to examine the association between preeclampsia during pregnancy and the risk of diabetes in Indian women.

Methods: Data from the cross-sectional survey of 124,385 women age 15-49 years included in India's third National Family Health Survey (NFHS-3, 2005-06) have been used. Self-reported symptoms suggestive of preeclampsia was obtained from 39,657 women who had a live birth in the five years preceding the survey. Diabetes status was self-reported. Association between symptoms suggestive of preeclampsia and diabetes was assessed using multivariable logistic regression models adjusting for diversified dietary intake, body mass index, smoking, drinking, TV watching, access to health care, age, education, employment status, religion, caste/tribe category, household wealth index, place of residence and geographic regions.

Results: The prevalence of diabetes was 1.8% (95%CI:1.5-2.0) among women with symptoms suggestive of preeclampsia in comparison to 1.1% (95%CI:1.0-1.4) in women with no preeclampsia symptoms. In the multivariable analysis, the likelihood of having diabetes was 1.7 times higher among women who reported preeclampsia symptoms (OR: 1.68; 95% CI: 1.39-2.04; $p<0.0001$) than those who did not even after controlling for diversified dietary intake, body mass index and sociodemographic characteristics of the mother.

Conclusion: Preeclampsia symptoms during pregnancy was strongly associated with the risk of diabetes in a large nationally representative sample of Indian women. A history of preeclampsia during pregnancy should alert clinicians to the need for preventative counseling and more vigilant screening for diabetes. Further research to verify accuracy of reporting of symptoms of pre-eclampsia is needed in Indian setting.

Keywords: preeclampsia; diabetes; women; India; NFHS-3

Introduction

The hypertensive disorders of pregnancy remain one of the most important causes of maternal and fetal morbidity and mortality all over the world. Preeclampsia, either alone or superimposed on preexisting hypertension, affects around 5 to 8% of all pregnancies (National High Blood Pressure Education Program Working Group (2000) and is responsible for approximately 50,000 maternal deaths annually (Stevens et al 2013). Preeclampsia is a common multisystem pregnancy disorder in which diagnosis is based on hypertension and proteinuria, affecting 3–5% of all pregnancies and severe cases constitute a serious threat to the mother and the fetus. This disorder is a major cause of prenatal and maternal morbidity and mortality worldwide (Bonney 2007; ACOG Committee on Obstetric Practice 2002; Buchbinder et al 2002). Although appropriate perinatal care has reduced the number and extent of poor outcomes, serious maternal and fetal morbidity and mortality still occur (Report of the American College of Obstetricians and Gynecologists' Task Force on Hypertension in Pregnancy 2013).

Recent studies in the West shows that women with pre-eclampsia have been noted to exhibit insulin resistance during pregnancy which is independent of obesity and glucose intolerance (Sierra–Laguado et al 2007; Parretti et al 2006). Studies done during pregnancy suggest that insulin resistance predates the development of preeclampsia, implying that insulin resistance may play a role in its etiology. The risk of preeclampsia also increases with increasing glucose intolerance (Vambergue et al 2002; Joffe et al 1998; Sermer et al 1995) and given the finding of insulin resistance in women with preeclampsia/gestational hypertension, and the association of preeclampsia with other disorders associated with insulin resistance in pregnancy, these conditions may be a marker of future diabetes risk, even in the absence of gestational diabetes mellitus.

A recent population-based study of >1 million women has found that women with preeclampsia or gestational hypertension have a twofold increased risk of developing diabetes after pregnancy (Feig et al 2013). Several other studies have clearly demonstrated that women with a history of preeclampsia have an increased risk of 2–4-fold cardiovascular diseases (CVD) (Ray et al 2005; Mongraw-Chaffin et al 2010; Roberts and Hubel 2010; Chen et al 2014) and type 2 diabetes later in life for the mother (Harskamp & Zeeman 2007; Yücesoy et al 2005; McDonald et al 2008; Lykke et al 2009; Kajantie et al 2009; Sugulle et al 2012), at least equalling the risk attributed to obesity and smoking. This situation is important to such an extent that led the American Heart Association, in 2011, to consider preeclampsia as a major risk factor for cardiovascular diseases, mainly hypertension, myocardial infarction, stroke, and diabetes (Report of the American College of Obstetricians and Gynecologists' Task Force on Hypertension in Pregnancy 2013; Mosca et al 2011).

There has not been any previous large-scale report concerning the association of preeclampsia with diabetes risk in a nationally representative Indian women. Therefore, the objective of this study is to examine the association between preeclampsia and diabetes risk in a large sample of Indian women by analyzing cross-sectional data from India's third National Family Health Survey (NFHS-3, 2005-06) which collected socio-demographic, maternal, dietary and lifestyle and chronic morbidity related information from 124,385 women residing in 109,041 households and covered regions comprising more than 99% of India's population.

Materials and Methods

Data

Cross-sectional data from India's third National Family Health Survey (NFHS-3) conducted during 2005-06 was used for this study. NFHS was designed on the lines of the Demographic and Health Surveys (available at www.dhsprogram.com) that have been conducted in many developing countries since the 1980s. NFHS has been conducted in India for three successive rounds, each at an interval of 5 years. NFHS-3 collected demographic, socioeconomic and health information from a nationally representative probability sample of 124,385 women aged 15–49 years residing in 109,041 households. The sample is a multistage cluster sample with an overall response rate of 98%. All states of India are represented in the sample (except the small Union Territories), covering more than 99% of the country's population. Full details of the survey have been published (IIPS and Macro International 2007).

To examine the association between symptoms of preeclampsia and risk of diabetes, we restricted the sample to only those women who had a live birth in the five years preceding the survey. We further restricted our analyses to data pertaining to the most recent birth, both to minimize recall bias. This resulted in a final sample size of 39,657 participants.

Outcome evaluation

The survey asked participants the question, 'Do you currently have diabetes?' with the response options of 'yes', 'no' and 'don't know'. However, neither data on physician-reported diagnosis of diabetes or fasting blood glucose was available in the NFHS-3 to verify a self-report.

Predictor variable

In NFHS-3, during the time of personal interview, several questions were asked to women related to health problems during pregnancy for the most recent live birth only (to account for recall lapse) in the five years preceding the survey. The question asked were: "During this pregnancy, did you have difficulty with your vision during daylight?" or "During this pregnancy, did you have swelling of the legs, body or face?" The response options were "yes", "no", and "don't know". According to the World Health Organisation's Integrated Management of Pregnancy and Childbirth guidelines for midwives and doctors on Managing Complications in Pregnancy and Childbirth (2000) and National Institute for Health and Care Excellences' (NICE) guidelines for management of hypertensive disorders during pregnancy (2010), women who reported difficulty with vision during daylight, and swelling of the legs, body, or face, were coded as having symptoms of pre-eclampsia in this study. However, it was not possible to confirm clinical diagnosis of these symptoms. Data on blood pressure and proteinuria during pregnancy, which are typical clinical diagnostic markers of preeclampsia (Roberts et al 2003), were not available in the NFHS-3. The survey was conducted using an interviewer-administered questionnaire in the native language of the respondent using a local, commonly understood term for all the health problems during pregnancy. A total of 18 languages were used with back translation to English to ensure accuracy and comparability.

Covariates

Dietary diversity, often used as a proxy for dietary intake is measured in accordance to WHO criteria described elsewhere (Agrawal et al 2015). Briefly, the WHO (2008) has identified 8 broadly defined food groups (grains, roots and tubers; legumes and nuts; dairy products; flesh foods; eggs; vitamin A-rich fruits and vegetables; and other fruits and vegetables), and suggests that individuals should eat from at least four food groups daily in order to achieve an adequately diversified dietary intake. Based on WHO criteria (WHO 2008), we created a dietary diversity score from women's self-reported frequency (daily, weekly, occasionally, or never) of their consumption of milk or curd, green leafy vegetables, other vegetables, fruits, pulses and beans, eggs, fish, and chicken or meat. For each food category, consumption of at least one food item from the category is worth 1 point; however, consumption of foods that fall into multiple categories (such as eggs, which are categorized both as flesh foods and eggs) is worth 2 points. A minimum of 4 points is necessary for an adequately diversified dietary intake (WHO 2008). However, as the NFHS-3 data do not contain consumption data for some of the WHO-defined categories (e.g. grains, roots and tubers), we have modified the score so that a dietary diversity score greater than or equal to three was considered to be an adequately diversified dietary intake, and less than three was considered inadequate. Dietary diversity at the time of the survey was taken as a proxy measure for dietary diversity during pregnancy.

In order to reduce the risk of unobserved homogeneity in our models, we included a variety of socio-demographic controls. The socio-demographic factors considered in the present analysis included age (15-29, 30-39, 40-49 years); education (no education, primary, secondary, higher); religion (Hindu, Muslim, Christian, Sikhs, Others); caste/tribe (Scheduled Castes, Scheduled Tribes, Other Backward Class, general category, missing caste); employment status (currently not working, working); wealth index (measured by an index based on household ownership of assets and graded as lowest, second, middle, fourth and highest) was computed using previously described methods; place of residence (urban, rural); and geographic regions (north, northeast, central, east, west, south). The biological and lifestyle factors included Body Mass Index (BMI) kg/m^2 (based on Indian adult population standard categories): ≤18.4 kg/m^2 (underweight), 18.5 to 22.9 kg/m^2 (normal), 23.0 to 24.9 kg/m^2 (overweight), ≥25 kg/m^2 (obese). In NFHS-3, participants were asked four yes/no questions on current use of cigarettes, pipes, other local tobacco smoking products, and snuff, chew, or other smokeless tobacco products. As a dichotomous measure of current tobacco use, we classified women as smokers if the response was 'yes' to smoking cigarettes, pipes, or other local smoking products. Studies found that smokers are insulin resistant, exhibit several aspects of the insulin resistance syndrome, and are at an increased risk for type 2 diabetes (Eliasson 2003; Xie et al 2009). Studies suggested that moderate alcohol consumption may reduce the risk of type 2 diabetes, on the other hand, binge drinking and high alcohol consumption may increase the risk of type 2 diabetes in women or men (Linda Kao et al 2001; Wannamethee et al 2002; Carlsson et al 2003), we constructed a dichotomous indicator of current alcohol use in the present analysis. Access to healthcare has been measured by a categorical indicator of type of healthcare facility used (public medical sector, NGO trust hospital or clinic, private medical sector, and other sources).

Statistical Analysis

Descriptive statistics were calculated with the use of standard methods. Differences in categorical variables were tested using Pearson's χ^2 tests. A p-value of <0.05 was considered statistically significant. Multivariable logistic regression analysis was restored to estimate the effect of symptoms suggestive of pre-eclampsia on self-reported diabetes risk, in unadjusted, partially adjusted and fully adjusted models. Multivariable models were adjusted for the above described health and lifestyle factors and socio-demographic characteristics of the mother. In the first logistic regression model, we examined the unadjusted association between preeclampsia symptoms, diversified dietary intake and diabetes risk independent of each other. In the second model, we adjusted for the above two factors along with BMI status in order to assess how much of the variance in this association was explained by BMI status. In the third model, we added lifestyle factors such as tobacco smoking, alcohol drinking, frequency of TV viewing and access to healthcare to our model. In the fourth and final model, we added socio-demographic characteristics in order to examine the association preeclampsia symptoms, diversified dietary intake and diabetes risk controlling for all the confounders discussed above.

As certain states and certain categories of respondents were oversampled, in all analyses sample weight was used to restore the representativeness of the sample (IIPS and Macro International 2007). Results are presented as odds ratios with 95% confidence intervals (OR; 95%CI). The estimation of confidence intervals takes into account design effects due to clustering at the level of the primary sampling unit. Before carrying out the multivariate model, the possibility of multicollinearity between the covariates we assessed. In the correlation matrix of covariates, all pair wise Pearson correlation coefficients were found <0.5, suggesting that multicollinearity did not affect the findings. All analyses in cluding the multiple logistic regression models were conducted using the SPSS statistical software package Version 19 (IBM SPSS Statistics, Chicago, Illinois, USA).

Ethical considerations

The NFHS-3 survey received ethical approval from the International Institute for Population Science's Ethical Review Board and Indian Government. Prior informed written consent was obtained from each respondent. The analysis presented in this study is based on secondary analysis of existing survey data with all identifying information removed.

Results

Table 1 presents the sample distribution, number and distribution of diabetes cases and prevalence of diabetes according to pre-eclampsia, diversified dietary intake and other factors among Indian women. Overall, 28.7% (n=11,361) women reported symptoms suggestive of preeclampsia during their last pregnancy and one-third of the women (31.1%) consumed an adequately diversified diet. 38% were underweight while 15% were either overweight or obese. Very few were current smokers (1.5%) or alcohol drinkers (2.3%), almost 68% had access to the private medical sector to obtain their health care and one third viewed TV almost every day. Most mothers (almost three-fourth) were aged 15-29 years, and almost half (47%) had no education, 70% not working. A majority of the mothers (four out of five) were identified as Hindu, and two-fifths belonged to a scheduled caste category. One fourth belonged to the household with poorest wealth. More than 70% of the mothers were residing in rural areas and 28% were residents of Central India.

Of the women reporting diabetes, two out of five also reported symptoms suggestive of eclampsia, more than four-fifths reported of inadequately diversified dietary intake, 18% were either obese or overweight; 2% was smoking tobacco; 5% drinks alcohol; half of them do not watch TV, one in three had access to public medical sector for healthcare needs, two-thirds (66%) were in the age group 15-29 years; half of them had no education; 77% were Hindus; 31% belonged to general class; 68% were not working, two-fifths belong to poorest wealth quintile, a majority resides in rural area whereas half resides in eastern India.

The prevalence of diabetes was 1.8% (95%CI:1.5-2.0) among women with symptoms suggestive of pre-eclampsia in comparison to 1.1% (95%CI:1.0-1.4) in women with no pre-eclampsia symptoms. A higher proportion of women with inadequate dietary diversity reported diabetes (1.3%) than those women with adequately diversified dietary intake (1.2%). Overweight (1.7%) or obese (1.4%) women had higher prevalence of diabetes those who were underweight (1.4%) and normal weight (1.1%). A higher proportion of current s tobacco smokers (1.7%) and current alcohol drinkers (2.6%) also reported diabetes compared to those who, respectively, do not currently smoke or drink. Women who had only access to other sources (5.1%) and NGO or Trust or Clinic (3.5) for health care had higher prevalence of diabetes. Women reporting viewing TV not at all or less than once a week reported higher diabetes (1.5%) than their counterparts. A higher proportion of women aged 40-49 reported diabetes (1.9%) compared to women aged 15-29 (1.2%). However, a higher proportion of women with no education (1.4%) reported diabetes compared to those with primary, secondary, or higher levels of education. Women belonging to Christian religion reported a higher diabetes and a higher proportion of women belonging to a scheduled tribe (1.9%) than those in a scheduled caste (1.4%), other backward class (1.0%) or general category (1.5%). Those in the poorest wealth quintile reported the highest diabetes (1.7%) compared to those in the other four wealth quintiles. Rural residence was also associated with increasing proportion of women reporting diabetes (1.4%) compared to urban residence (1.0%), and women living in eastern India (3.5%) reported diabetes than those in other regions.

Table 2 shows results of multivariable logistic regression analyses of the association between preeclampsia symptoms, diversified dietary intake and other factors on diabetes risk in unadjusted, partially adjusted and fully adjusted models. In the unadjusted analysis (Model 1), the likelihood of having diabetes was significantly higher among women who reported preeclampsia symptoms (OR: 1.71; 95% CI: 1.43-2.04; p<0.0001) than those who did not reported a preeclampsia symptom. Controlling for diversified dietary intake and body mass index (in Model 2) slightly attenuated the positive relationship between preeclampsia symptoms and diabetes (OR1.65; 95% CI: 1.38-1.98; p<0.0001). The positive association between preeclampsia symptoms and diabetes remained virtually unchanged (OR: 1.73; 95% CI: 0.43-0.72) when current tobacco smoking, alcohol drinking, frequency of TV viewing and access to healthcare were additionally controlled for in Model 3. The final model (Model 4) in Table 2 provides the fully adjusted model with the above factors and socio-demographic characteristics included. Jointly controlling for all of these factors, the positive association between symptoms suggestive of preeclampsia during pregnancy and diabetes (OR: 1.68; 95%CI: 1.39-2.04) remains strong and statistically significant.

Discussion

In this study, we examined the association between symptoms suggestive of preeclampsia during pregnancy and diabetes risk in a large, nationally representative sample of Indian women. In this study the symptoms of preeclampsia during pregnancy, was associated with almost a 2-fold increased likelihood of having diabetes even after controlling for several important confounding variables. These findings highlight a possible new risk factor for diabetes and support the need to counsel patients with hypertensive disorders during pregnancy regarding postpartum diabetes screening prevention.

The prevalence of cardiovascular disease (CVD) especially type 2 diabetes is increasing dramatically worldwide with the greatest rise in incidence occurring in adults under the age of 50, including young women (Chen et al 2014). Pregnancy is being regarded as a cardiovascular risk "stress test" and so more emphasis is being paid to past obstetric history (Pinto et al 2014). It is now quite established in western studies that a hypertensive disorder occurring during pregnancy, particularly preeclampsia, identifies a subset of women with increased risk of developing cardiovascular disease including diabetes. A recent large meta analysis found that women with a history of preeclampsia have an increased risk for subsequent ischemic heart disease, stroke, and venous thromboembolic events over 5 to 15 years after pregnancy (Bellamy et al 2007). Risk factors for preeclampsia, resembling those for atherosclerosis, are increasing in prevalence, stressing its importance as a future CVD predictor (Pinto et al 2014). The American Heart Association, the European Society of Cardiology therefore stated the importance of a pregnancy complicated by preeclampsia as a risk factor, recommending annual vigilance of blood pressure and metabolic factors as well as lifestyle modifications (Pinto et al 2014). The Portuguese Society of Cardiology has also introduced these recommendations in practice guidelines in 2011 (European Society of Gynecology 2011). The American College of Obstetricians and Gynecologists recommends a yearly assessment of blood pressure, lipids, fasting blood glucose, and body mass index after having a preeclampsia (Report of the American College of Obstetricians and Gynecologists' Task Force on Hypertension in Pregnancy 2013).

The pathway

Common pathogenic pathways may underlie the association between preeclampsia and the risk of diabetes. Firstly, each of these conditions is associated with insulin resistance (Ryan et al 1995; Parretti et al 2006; D'Anna et al 2006; Sierra–Laguado et al 2007; Legro 2009). Not only do women with preeclampsia have insulin resistance during pregnancy, several studies have also found higher levels of insulin resistance in women with a history of preeclampsia years after delivery, even after controlling for body mass index and excluding women with previous gestational diabetes mellitus (Fuh et al 1995; Soonthornpun et al 2009). Women with a history of preeclampsia also show manifestations of the metabolic syndrome years after delivery, a syndrome known for its association with insulin resistance (Sattar et al 2003; Ray 2004; Girouard et al 2007; Smith et al 2009). Other possible explanations for this cardiovascular profile include the following: (a) both cardiovascular disease and preeclampsia share risk factors including dyslipidemia, increased insulin resistance, hypertension, obesity, and endothelial dysfunction, turning pregnancy into a "stress test" with the development of hypertensive disorders during pregnancy identifying a woman destined to develop cardiovascular disease; (b) pregnancy, and especially preeclampsia, may induce permanent arterial changes—the proatherogenic stress of pregnancy, excessive in many women with preeclampsia, could activate arterial wall inflammation that fails to resolve after delivery, increasing the risk for future cardiovascular disease (Staff and Redman 2014; Chen et al 2014).

Randomized trials have shown that diabetes can be prevented or delayed in high-risk groups by a variety of lifestyle and therapeutic interventions (Diabetes Prevention Program Research Group 2002; Tuomilehto et al 2004). However, identifying at risk populations to screen for diabetes in a low resource setting such as India is a critical step in translating these findings into clinical practice (Feig et al 2008). Gestational diabetes is a major risk factor for the development of diabetes (Feig et al 2008) and thus women with this condition are an ideal population to target diabetes prevention strategies. Similarly, other disorders of pregnancy associated with insulin resistance, such as preeclampsia may heighten the propensity for women to develop diabetes in the years following pregnancy, and such women may also be suitable targets for diabetes prevention.

Previous follow up studies looked at the risk of developing type 2 diabetes in women with a history of preeclampsia and found a positive association between preeclampsia in pregnancy and diabetes in later life. In one study, women enrolled in the Mater–University of Queensland Study of Pregnancy between 1981 and 1984 who had preeclampsia at baseline were almost two times more likely to report having developing diabetes 21 y later (Callaway et al 2007). In a Danish cohort of women with preeclampsia or gestational hypertension, the risk of diabetes postpartum was also found to be increased over a median of 14.6 years (Lykke et al 2009). A third registry study of women with preeclampsia in Norway also found an increased risk of diabetes in women with preeclampsia, however follow-up was short, only 3.7 y, and the diagnosis of diabetes was made in women using medications for diabetes, possibly under-estimating the true incidence of diabetes (Engeland et al 2011).

Strength and Limitations of the study

To our knowledge, this is the largest nationally representative cross-sectional study of the population based association between preeclampsia symptoms and diabetes risk in an Asian population. Other strength of this study include our ability to adjust for obesity, which in itself is associated with insulin resistance, and is a well-known risk factor for the development of diabetes (Singh et al 2012) and preeclampsia (O'Brien et al 2003). One previous study was able to adjust for obesity and physical activity, and found the risk of developing diabetes to be significant (Caballero 2004).

There are several limitations to our study. First, most variables in the analyses (with the exception of anthropometrics) were self-reported, including a symptomatic rather than clinical measure of preeclampsia and diabetes; it is possible that self-reported data may suffer from recall bias. Although we cannot rule out the possibility of misclassification within this context, it is unlikely that we have missed severe preeclampsia or diabetes cases due to the generally clear manifestation of symptoms in severe cases. Second, due to the nature of the data, we could not identify the gestational onset of preeclampsia. Furthermore, family history, physical activity, glucose, and blood pressure measures are also known risk factors for diabetes which were not collected in the survey. We were, however, able to adjust for several other important confounding variables including socio economic and demographic factors and some lifestyle indicators and access to health care. From our data sources we could not differentiate type 1 from type 2 diabetes; however, given the mean age of the women was 26.4 y (±5.6SD), it is most likely that the majority of the women developed type 2 diabetes.

Conclusion

In summary, this study provides first empirical evidence that symptoms suggestive of preeclampsia during pregnancy were a strong predictor for risk of diabetes in a large nationally representative sample of Indian women. These findings have important implications for maternal and child health, especially given the increase in obesity-related diseases in this low resource settings. Therefore a history of preeclampsia during pregnancy should alert clinicians to the need for preventative counseling and more vigilant screening for diabetes and women should be encouraged to have a more rigorous follow-up and adopt a healthier lifestyle. Patient and healthcare provider education is also essential for the successful assessment and management of cardiovascular risk and prevention of the long term burden associated with preeclampsia which including diabetes. Awareness of a history of preeclampsia might allow the identification of cases not previously recognized as at-risk for CVD, allowing the implementation of measures to prevent the occurrence of these events. Further research to verify accuracy of reporting of symptoms of preeclampsia is needed in Indian setting.

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Table 1: Sample distribution, number and distribution of diabetes cases and prevalence of diabetes according to pre-eclampsia, diversified dietary intake and other factors among Indian women, 2005-06

	Sample size	Number of Diabetes cases	Distribution of diabetes cases	Prevalence of diabetes	Chi sq p value
	N[%]	N	%	%	
Total	39612	512	100.0	1.3	
Pre-eclampsia symptoms					<0.0001
No	28250[71.3]	304	59.5	1.1	
Yes	11361[28.7]	207	40.5	1.8	
Diversified dietary intake					0.193
Non adequate	27275[68.9]	362	70.7	1.3	
Adequate	12337[31.1]	150	29.3	1.2	
Body Mass Index					0.023
Underweight (≤18.5 kg/m^2)	14440[38.0]	208	41.8	1.4	
Normal (18.5-22.9 kg/m^2)	17833[46.9]	202	40.6	1.1	
Overweight (23.0-24.9 kg/m^2)	2766[7.3]	47	9.4	1.7	
Obese (≥25.0 kg/m^2)	2964[7.8]	41	8.2	1.4	
Current Tobacco smoking					0.259
No	39006[98.5]	501	98.0	1.3	
Yes	606[1.5]	10	2.0	1.7	
Drinks Alcohol					0.001
No	38690[97.7]	488	95.3	1.3	
Yes	911[2.3]	24	4.7	2.6	
Frequency of TV viewing					0.001
Not at all	17351[43.8]	260	50.9	1.5	
Less than once a week	449[11.3]	68	13.3	1.5	
At least once a week	4074[10.3]	46	9.0	1.1	
Almost everyday	13689[34.6]	137	26.8	1.0	
Access to healthcare					<0.0001
Public Medical sector	11313[31.3]	162	34.5	1.4	
NGO or Trust or Clinic	113[0.3]	4	0.9	3.5	
Private Medical Sector	24591[68.1]	298	63.4	1.2	
Other source	119[0.3]	6	1.3	5.1	
Age					0.001
15-29	29159[73.6]	339	66.3	1.2	
30-39	9408[23.8]	152	29.7	1.6	
40-49	1045[2.6]	20	3.9	1.9	
Education					0.064
No education	18758[47.4]	263	51.4	1.4	
Primary	5545[14.0]	75	14.6	1.4	
Secondary	12947[32.7]	155	30.3	1.2	
Higher	2361[6.0]	19	3.7	0.8	
Employment status					0.143
Currently not working	27665[69.9]	346	67.7	1.3	
Working	11886[30.1]	165	32.3	1.4	
Religion					0.035
Hindu	31248[78.9]	393	76.8	1.3	
Muslim	6472[16.3]	88	17.2	1.4	
Christian	811[2.0]	20	3.9	2.5	
Sikhs	513[1.3]	4	0.8	0.8	

Others	568[1.4]	7	1.4	1.2	
Caste/tribe					<0.0001
Scheduled caste	7938[20.1]	109	21.3	1.4	
Scheduled tribes	3740[9.4]	70	13.7	1.9	
Other backward class	15861[40.2]	155	30.3	1.0	
General category	10830[27.4]	158	30.9	1.5	
Missing caste	1085[2.8]	19	3.7	1.8	
Wealth index					<0.0001
Lowest	9553[24.1]	166	32.4	1.7	
Second	8588[21.7]	114	22.3	1.3	
Middle	7762[19.6]	102	19.9	1.3	
Fourth	7251[18.3]	80	15.6	1.1	
Highest	6458[16.3]	50	9.8	0.8	
Place of residence					0.001
Urban	10615[26.8]	104	20.3	1.0	
Rural	28997[73.2]	408	79.7	1.4	
Geographic Regions					<0.0001
North	5076[12.8]	48	9.4	0.9	
Northeast	1607[4.1]	30	5.9	1.9	
Central	11099[28.0]	91	17.8	0.8	
East	10031[25.3]	247	48.3	3.5	
West	5114[12.9]	31	6.1	0.6	
South	6684[16.9]	64	12.5	1.0	

Note: Number of women varies slightly for individual variables depending on the number of missing values

Table 2: Unadjusted and partially adjusted and fully adjusted odds ratios (ORs) and 95% confidence interval (95%CI) showing the association between pre-eclampsia, diversified dietary intake and other factors and diabetes risk among Indian women, 2005-06

	Unadjusted	Adjusted	Adjusted	Adjusted*
	OR[95%CI]	OR[95%CI]	OR[95%CI]	OR[95%CI]
Pre-eclampsia				
No [Ref]	1	1	1	1
Yes	1.71[1.43-2.04]	1.65[1.38-1.98]	1.73[1.43-2.09]	1.68[1.39-2.04]
Diversified dietary intake				
Non adequate [Ref]		1	1	1
Adequate	0.92[0.76-1.12]	0.91[0.75-1.11]	1.13[0.92-1.39]	1.07[0.86-1.33]
Body Mass Index				
Underweight (≤18.5 kg/m^2)		1.29[1.06-1.57]	1.24[1.01-1.52]	1.18[0.96-1.45]
Normal (18.5-22.9 kg/m^2) [Ref]		1	1	1
Overweight (23.0-24.9 kg/m^2)		1.50[1.09-2.07]	1.71[1.23-2.38]	1.96[1.40-2.75]
Obese (≥25.0 kg/m^2)		1.21[0.86-1.70]	1.41[0.98-2.03]	1.79[1.22-2.63]
Current Tobacco smoking				
No [Ref]			1	1
Yes			1.13[0.60-2.13]	0.89[0.47-1.69]
Drinks Alcohol				
No [Ref]			1	1
Yes			1.95[1.27-2.99]	1.34[0.83-2.16]
Frequency of TV viewing				
Not at all [Ref]			1	1
Less than once a week			1.03[0.77-1.37]	1.20[0.89-1.62]
At least once a week			0.79[0.57-1.11]	0.98[0.70-1.39]
Almost everyday			0.68[0.53-0.86]	1.09[0.81-1.48]
Access to healthcare				
Public Medical sector [Ref]			1	1
NGO or Trust or Clinic			2.11[0.74-6.00]	1.95[0.66-5.71]
Private Medical Sector			0.85[0.70-1.03]	0.88[0.72-1.09]
Other source			3.07[1.28-7.38]	2.79[1.14-6.79]
Age				
15-29 [Ref]				1
30-39				1.26[1.02-1.56]
40-49				1.41[0.88-2.27]
Number of Cases				34978

*Also adjusted for education, employment status, religion, caste/tribe status, household wealth index, place of residence, and geographic regions.
Note: [Ref] denotes reference category