Study of Some Risk Factors Associated with Type 2 Diabetes Mellitus among Adults in a Rural Area – A Case-Control Study

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ABSTRACT

Introduction: The risk factors heretofore specified in the development of type 2 diabetes in the urban population cannot fully apply to rural inhabitants. To halt type 2 diabetes, it is necessary to study recent risk factors associated with diabetes.

Objective: To study some risk factors and their strength of risk with type 2 diabetes Mellitus among subjects in the rural area.

Methods: It was a community-based case-control study undertaken at the Rural Health Training Centre and the rural field practice area.

Results: The mean age of the subjects was 55.48 ± 12.33 years. Independent risk factors for diabetes mellitus were Nonalcoholic fatty liver disease (AOR=7.44, 95%CI=2.18–14.52), Family history of diabetes (AOR=3.94, 95%CI=1.19–13.05), Physical inactivity (AOR=2.98, 95%CI=1.88–4.72), Vegetable consumption less than 3 times/week (AOR=2.88, 95%CI=1.76–4.73), Moderate depression (AOR=6.98, 95%CI=3.56–13.70).

Conclusions: This research concludes that diabetes a disease of the affluent is increasing rapidly among the lunch-bucket workers as a result of a 6.98-fold rise in the risk of moderate depression, 7.44-fold rise in the risk of NAFLD, 2.88-fold decrease in vegetable consumption combined with a 2.98-fold increase in physical inactivity. Considering this the policymakers should impose a high amount of taxes on junk food and propose health warnings on food packaging. Advertisement related to the sale of junk food should be banned on television and routine physical exercises should be promoted. Management of depression at PHC would result in a decrease in the incidence of diabetes mellitus. These important risk factors should be given attention as they provide the potential for reversing the epidemic of diabetes in the country.

Key Words: Diabetes Mellitus, Family history of diabetes, NAFLD, Moderate depression, Sugar-sweetened beverages, Metabolic equivalent

INTRODUCTION

Diabetes is one of the major causes of premature illness and unacceptable deaths worldwide and is indeed one of the most challenging health problems of the 21st century. Therefore, control of diabetes is a priority as a part of the United Nations Sustainable Development Goal 3 to ensure reduction of premature mortality from non-communicable diseases by one third in all countries.¹ Type 2 Diabetes Mellitus was previously seen mainly in middle-aged and elderly people while nowadays it is increasing frequently in young people.² It is of greater concern if the epidemic shifts to children it could have serious consequences on the health of the nation.

The situation of diabetes in India has worsened in the last decades as diabetes, which was known to be an epidemic in urban areas have been found to increase rapidly in rural areas too.³ A rapid transition from agricultural labour towards a business economy has led to a decline energy expenditure, even in rural India. Morbidity and mortality can be reduced by secondary prevention through early detection and treatment of chronic complications but to stop the occurrence of disease it is essential to focus on primordial and primary preventive measures and determine the risk factors for incident diabetes.⁴ So, when there is a rapid upsurge of type 2 diabetes mellitus in both urban and rural areas, it is imperative to identify the factors predisposing to the development of the disease, which affects one out of every five Indians.^{5,6}

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Rural Indians have limited access to quality health care and this may have a devastating impact on personal as well as national financial security and economic growth. As human behaviour and lifestyle have changed since the past decade, the risk factors have also changed. None of the studies has assessed such multiple risk factors for diabetes among rural patients with diabetes. Because of the deficiencies of the previous studies, we conducted a case-control study to study some risk factors and their association with type 2 diabetes mellitus and also to study the association of some hypothesized risk factors with type 2 diabetes mellitus among the study subjects.

METHODOLOGY

Study Setting

The case-control study was undertaken at the Rural Health Training Centre and the rural field practice area under the administrative control of the Department of Community Medicine. According to 2011 census, the total population of the study area was 115,696 distributed in RHTC town with a population of 23,517 and adjacent 51 villages with a population of 92,179.⁷

Sample size

Stat Calc procedure of Open Epi version 3.03 was used to calculate the sample size according to the specifications: 95% confidence level; 90% power; an allocation ratio of controls to cases of 1, assumed level of risk (odds ratio) = 2.0; and 26% of controls exposed taking physical inactivity.⁸ as the risk factor. Using Fleiss with CC component of statistical software Open Epi 3.03 the required number of cases and controls were 212 in each group. The total sample size was 424. 20% extra samples were included in the study considering the presence of confounding factors, to increase the power of the study, composite factors and refusal to incorporate in the study. Hence a total of 260 cases and the same no of control were included in the study. The total sample size became 520.

Operational definition of study variables

Smokers: Tobacco use in any form such as smoked or chewing daily in the previous six months. Tobacco content of Indian beedis, cigarettes and cheroots was calculated and converted into cigarettes for comparability.⁹⁻¹⁰

Passive Smoking: Spouse or any other member in the family regularly smokes in the subject's presence.¹¹

Physical activity: MET min was calculated according to the STEPS protocol.¹²

a) Recommended (Sufficiently active): Adults doing 150 minutes of moderate-intensity physical activity throughout

a week, including activity for work, during transport and leisure time, OR 75 minutes of vigorous-intensity physical activity or an equivalent combination of moderate and vigorous-intensity physical activity achieving at least 600 MET-minutes.

b) Low (Inactive): Activity is reported but not enough to meet the WHO recommendations.

Consumption of fruit and vegetables: A nutrition card was shown with some examples of local fruit and vegetable and subjects were asked for the number of days they ate fruit and vegetables in a typical week. Subjects were categorized into daily consumers, 3-6 times weekly and less than 3 times weekly.⁴

Sugar-sweetened beverages: Coke, Pepsi, cola with sugar, other carbonated beverages with sugar, and juices with sugar was asked and subjects were categorized into daily consumers, 3-6 times weekly and less than 3 times weekly.¹³

Egg consumption: Subjects were categorized into 2 groups as those consuming ≥ 5 eggs/ weeks and those consuming < 5 eggs/ weeks considering total egg consumption, including eggs in mixed dishes and recipes.¹⁴

Depression: Depression was assessed according to Beck depression inventory (BDI).¹⁵

NAFLD: Abnormal liver function test with ALT values > 31 IU/L for males and > 20 IU/L for females OR transabdominal ultrasound report showing fatty liver in patients with little or no alcohol consumption.¹⁶

Ethical considerations

Before the start of the study, the details of the methodology and clinical evaluation procedure was reviewed and approved by the Department of Community Medicine and also the Institutional ethical committee. (Approval No.CM/P.7/434/2014).

Data Collection

For the present case-control study newly diagnosed (incident) cases (figure 1) were selected as cases so that temporal sequence of exposure and disease was easier to assess among incident cases. Old cases have a long course of the disease as a result risk factor under study may develop simultaneously along with the course of the disease. Recall of past events in personal histories and remembering relevant exposure tend to be more accurate in incident cases compared to old (prevalent) cases. Controls were selected on a contemporaneous basis with cases to minimize potential bias because of differential socioeconomic state and environmental exposure. Before starting the interview procedure, a good rapport was built with the subjects under study. The objectives of the study were explained and queries regarding the study procedure were solved. Face to face interview was carried out in

the local language (Marathi/Hindi). The household head and family members were informed about the survey and its purpose, importance and use of participating individuals themselves in the study were explained. Data was collected using WHO STEPS Instrument (Core and Expanded version 3.1). Necessary changes were made in the questions to fit them into the local context. To maintain privacy, information was collected maintaining utmost privacy as per the convenience of respondents.

Statistical analysis

Statistical analysis was carried out with the help of statistical software Epi Info, Version 7.2 (Atlanta, Georgia, USA). Means were tested with t-test and proportion with chi-square test and Fisher's exact test. The initial analysis included a comparison of the frequencies of demographic variables and risk factors among cases and controls.

The association of dependent and independent variables was evaluated using bivariate and multivariate logistic regression. Crude (unadjusted) odds ratio (OR) was computed to assess the strength of association between risk factors and diabetes Mellitus. Bivariate analysis was followed by multivariate analysis and only those variables which were significant in bivariate analysis were considered for multivariate analysis.

RESULTS

A total of 260 cases and 260 controls were included in the study and the final analysis was done on the data collected from these 520 study subjects.

Study Subjects

Table 1 shows the baseline characteristics of the 520 subjects. The mean age of the subjects was 55.48 ± 12.33 years and the median was 58. Furthermore, the highest number of study subjects were in the age group of 60 – 69 years 146 (28.07%) and the least 66 (12.69%) number of subjects were in the 30 – 39 years age group. Among the diabetic cases, 125 (48.07%) were male and 135 (51.92%) were female. Among the cases, 119 (45.76%) were unemployed, 26 (10.00%) were unskilled workers, 51 (19.61%) were semi-skilled workers, 6 (2.30%) were skilled workers, 50 (19.23%) were semiprofessionals and 8 (3.07%) were professionals.

Distribution of risk components

Table 2 gives information on the distribution of different risk components in cases and controls. The systolic blood pressure was significantly associated between diabetic cases and controls ($p < 0.0000001$). The cases were significantly less physically active with a mean MET-minutes per week of 357.07 ± 260.25 compared to controls 465.53 ± 265.55

($p < 0.000003$). The mean value of other parameters did not show any significant difference between diabetes and control groups.

Risk factors: bivariate analysis

Tables 3 and 4 show the results of bivariate analysis using the Chi-square test to determine the relation of each variable being examined. The odds of developing type 2 diabetes was 2.11 times significantly ($p = 0.030$) higher in subjects who were alcohol drinkers compared to non-alcoholic. This positive association was dose-dependent, Daily alcohol drinkers (OR = 3.51, 95% CI = 1.38 – 8.91, $p = 0.005$) had a significantly higher odds of developing diabetes mellitus compared to non-alcoholic. Subject who consumed country liquor had a significantly higher risk (OR = 3.87, 95% CI = 1.54 – 9.71, $p = 0.002$) of developing diabetes mellitus compared to non-alcoholic. Subjects consuming 90 – 180 ml alcohol (OR = 2.99, 95% CI = 1.15 – 7.71, $p = 0.017$) had a significantly higher odds of developing diabetes mellitus compared to non-alcoholic. Subjects smoking cigarettes and beedi had higher odds of developing diabetes mellitus compared to nonsmokers. But the difference was not significant statistically. Subjects smoking more than 10 cigarettes per day had higher odds (OR = 5.49, 95% CI = 2.07 – 14.56) of developing diabetes mellitus compared to nonsmokers. This difference was highly significant statistically ($p = 0.0001$). Subjects who had smoked for more than 20 years (OR = 2.77, 95% CI = 1.20 – 6.39, $p = 0.012$) had significantly higher odds of developing diabetes mellitus compared to nonsmokers. Subjects exposed to passive smoking had higher odds (OR = 3.56, 95% CI = 0.73 – 17.35) of developing diabetes compared to subjects who were not exposed. However, fisher's exact test revealed that the difference between passive smoking and the risk of diabetes mellitus was not statistically significant (0.175).

Subjects with Nonalcoholic fatty liver diseases had higher odds, 55.98 of developing diabetes and this association was significant statistically ($p < 0.0001$). The odds of developing type 2 diabetes was 2.19 times significantly higher in subjects who were overweight compared to subjects with normal BMI. The underweight subjects had significantly lower odds of developing diabetes mellitus as compared to normal subjects. The odds of developing type 2 diabetes were 9.87 times significantly higher in subjects with borderline clinical depression, 5.19 times significantly higher in subjects with moderate depression and 3.76 times significantly higher in subjects with mild mood disturbance compared to subjects who did not manifest any kind of depression.

Risk factors: A multivariate analysis

Table 5 illustrates the results of logistic regression analysis. After adjusting for all the other variables, we found a sevenfold increased strength of risk of type 2 diabetes mellitus

[AOR = 7.44 (2.18 – 14.52); $p < 0.001$] in participants who had nonalcoholic fatty liver disease compared to participants who did not manifest any steatosis. There was a sixfold increased strength of risk of type 2 diabetes mellitus [AOR = 6.98 (3.56 – 13.70); $p < 0.001$] in participants who had moderate depression compared to participants who did not manifest any kind of depression. A threefold increased risk of type 2 diabetes mellitus [AOR = 3.94 (1.19 – 13.05); $p = 0.024$] in a participant who has a family history of diabetes compared to those not having a family history of diabetes. A threefold increased risk of type 2 diabetes mellitus [AOR = 3.43 (CI = 1.76 – 6.68); $p < 0.001$] in participants with high systolic blood pressure than normotensive patients. A twofold increased strength of risk of type 2 diabetes mellitus [AOR = 2.98, (1.88 – 4.72); $p < 0.001$] in a participant who was physically inactive than a physically active participant. A twofold increased risk of type 2 diabetes mellitus in participants consuming vegetables less than three times in a week than a participant who consumed vegetables daily. A twofold increased risk of type 2 diabetes mellitus in overweight participants [AOR = 2.18 (1.30 – 3.66); $p = 0.002$] compared to participants with normal BMI.

DISCUSSION

The strength of this study is rooted in its case-control approach, which allowed us to study the strength of risk and association of some hypothesized risk factors with type 2 diabetes mellitus.

Level of education did not prove to be an independent risk factor for the development of diabetes mellitus in the multivariate analysis model compared to some of the studies which showed significant association in respect of their educational status.¹⁷ The semiprofessional workers had significantly higher odds of developing diabetes as compared to unemployed subjects. This association of diabetes with occupation could be due to the combined effect of physical inactivity in employees, owners of small businesses and work-related stress among these individuals. Similar findings were also reported in other study.¹⁸ The upper high socioeconomic class I and high-class II had significantly higher odds of developing diabetes as compared to poor class V. But multivariate analysis results showed that there was no significant difference between diabetic cases and controls in respect to their socioeconomic status. Socioeconomic status was not independently associated with diabetes. Probably this association acts through other variables like diet, BMI and physical inactivity. The results are consistent with other studies.¹⁹ Some studies have found an association between type of family and diabetes mellitus.²⁰ However, we were not able to find such association in the rural area.

The positive association between alcohol and diabetes was dose-dependent, daily alcohol drinkers, country liquor and

consuming 90 – 180 ml alcohol per day had a significantly higher odds of developing diabetes mellitus compared to non-alcoholic in contrast to some of the studies.^{19,20} This is probably due to the development of insulin resistance, which is a key factor in the pathogenesis of type 2 diabetes mellitus among heavy alcohol drinkers. Subjects who were labelled as smokers for more than 20 years and smoking more than 10 cigarettes per day had significantly higher odds of developing diabetes mellitus compared to nonsmokers in contrast to studies.²¹ Gradual and continuous exposure to smoking may contribute to the development of diabetes through alterations in fat distribution, which is associated with insulin resistance, and also through a direct toxic effect on pancreatic tissue.

Family history of diabetes mellitus was an independent risk factor for the development of diabetes mellitus. The findings are consistent with several other studies.^{14,22} Family history could act through environmental as well as genetic mechanisms. Environmentally there is a possibility of being exposed to a similar diet, physical activity, socioeconomic status etc. The genetic mechanism acts through specific genetic expressions. A strong association between parental heredity and the onset of type 2 diabetes cannot be denied due to the transmission of traits predisposing to insulin resistance, obesity and the accelerated loss of insulin secretory function β .²³ We could not analyze the family history of hypertension as an independent risk factor for the development of diabetes in contrast to studies.²¹

Nonalcoholic fatty liver diseases emerged as an independent risk factor for the development of diabetes mellitus. Excessive consumption of calories, saturated fat, carbohydrate and physical inactivity with overwhelming subcutaneous fat store leads to ectopic accumulation of fat at unnatural sites like the liver, increased liver fat leads to impaired insulin inhibition of glucose production and thereby hyperglycemia. Early suspicion and prediction will help us in minimizing the development of NAFLD and incident diabetes mellitus.²⁴

Physical activity was one of the strongest predictors of being inactive raising the risk of diabetes mellitus in our study similar to other studies.^{22,25} It proved to be an independent risk factor in the study as it has both immediate and long-term effects that favour glucose homeostasis. Physical activity leads to increased insulin-stimulated glucose uptake into active skeletal muscle, which accounts for 80% of insulin-stimulated glucose disposal. Long term effects of physical activity include improved insulin action, glycemic control, and fat oxidation and storage in skeletal muscle. In addition, physical activity may lead to changes in body fat distribution and loss in visceral fat, which is strongly associated with insulin resistance.²⁶

Multivariate analysis confirms that vegetable consumption less than 3 times per week is an independent risk factor for the development of diabetes. Similar findings were

shown by the study.²⁷ This may be due to the benefits of high vegetable intake as they have antioxidant and anti-inflammatory properties, magnesium content and low glycaemic index acting concurrently in lowering the risk of type 2 diabetes mellitus.²⁷ There was no association found between fruit intake and risk of type 2 diabetes mellitus in contrast to study.²⁸ In our setup, seasonal fruits available in farmer's houses and local food markets were custard apple, guava and sweet lime, grape and apple. We speculate that the high glucose content of fruit may impede the protective effect of antioxidants, fibre, and other anti-diabetic compositions of fruit.

Moderate depression emerged as an independent risk factor for the development of diabetes mellitus. The exact reason for the findings was unclear, but might be because inflammatory markers like cytokines interleukin-1 α ; interleukin-1 β , interleukin-2, interleukin-3, interleukin-6, tumour necrosis factor- α and C-reactive protein are elevated among depressed individuals and studies across the globe document that disturbance in the balance of deleterious cytokines and protective cytokines in an individual may induce oxidative damage and release of free radicals leading to progression of pancreatic β cells dysfunction, that has a role in aetiology of type 2 diabetes mellitus.^{29,30}

In the present study, subjects with systolic hypertension and diastolic hypertension had higher odds of developing diabetes compared to subjects with normal systolic blood pressure. Multivariate analysis also demonstrated that systolic blood pressure was an independent risk factor for the development of diabetes. Other studies have reported contrasting results.²⁵ Multivariate analysis also showed that there was a significant difference between diabetic cases and controls concerning BMI. This association between type 2 diabetes mellitus and obesity was probably the result of an increase in the levels of non-esterified fatty acids from deposited adipose tissue resulting in the development of insulin resistance.³¹

CONCLUSION

The risk factors of diabetes mellitus have regional and ethnic variations. The result of the present study in the rural area suggested a positive relationship of sociodemographic factors like occupation and high socioeconomic class with the incidence of diabetes mellitus. Strong genetic factors, alcohol use, physical inactivity, less vegetable consumption, mild mood disturbances, body mass index, waist circumference, systolic and diastolic hypertension emerged as strong risk factors in the present study. Modernization, limited physical activity, and, consequently, obesity were the triggering factors for the onset of diabetes. This study provides insight into the association between dietary patterns and diabetes mellitus.

The food industry is rampantly moving in rural parts of India, wherein eating outside food and junk food is promoted and vegetable consumption is not encouraged. Policymakers should consider imposing a high amount of taxes on junk food and propose health warning labels to be implemented on junk food packaging similar to the warning messages which appear on the packaging of cigarettes and other tobacco products. Advertisements related to the sale of junk food should also be banned on television. In developing countries, health promotion activity and awareness regarding NAFLD along with screening and follow-up should be included in the National Programme for prevention and control of Cancer, Diabetes, Cardiovascular Diseases and Stroke.

A good number of patients with diabetes were suffering from moderate depressive symptoms. This indicates that attention to the optimum management of depression in the primary care setting would result in an appreciable decrease in the occurrence of diabetes mellitus. The majority of cases of type 2 diabetes could be prevented by the adoption of a healthier lifestyle.

Authors Contribution: Dr. Ashwini Dongre and Dr. Inamdar IF were involved in the conception, designing, data analysis and drafting of the paper. Dr. Ashwini Dongre was involved in data collection, drafting and critical analysis of the paper. Dr. Gattani PL discussed and commented on the manuscript. All the authors have approved the final version of the article submitted.

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Table 1: Distribution of cases and controls according to sociodemographic characteristics

Characteristics of Subjects (n= 520)	Cases (%)	Controls (%)	Total (%)
Religion			
Hindu	162 (62.30)	177(68.07)	339 (65.19)
Muslim	67 (25.76)	47 (18.07)	114 (21.92)
Buddhist	28 (10.76)	36 (13.84)	64 (12.30)
Sikh	3 (1.15)	0 (0.00)	3 (0.57)
Type of family			
Nuclear	78 (30.00)	91 (35.00)	169 (32.50)
Joint	124 (47.69)	127 (48.84)	251 (48.26)
Three generation	58 (22.30)	42 (16.15)	100 (19.23)
Marital status			
Married	229 (88.07)	237 (91.15)	466 (89.61)
Unmarried	4 (1.53)	1 (0.38)	5 (0.96)
Widow/ Widower	27 (10.38)	22 (8.46)	49 (9.42)

Table 1: (Continued)

Characteristics of Subjects (n= 520)	Cases (%)	Controls (%)	Total (%)
Level of education			
Illiterate	133 (51.15)	178 (68.46)	311 (59.80)
Primary school	34 (13.07)	16 (6.15)	50 (9.61)
Middle school	25 (9.61)	17 (6.53)	42 (8.07)
High school	39 (15.00)	20 (7.69)	59 (11.34)
Intermediate	12 (4.61)	7 (2.69)	19 (3.65)
Graduate	14 (5.38)	16 (6.15)	30 (5.76)
Post graduate	3 (1.15)	6 (2.30)	9 (1.73)
Socioeconomic classification			
Upper high (I)	57 (21.92)	26 (10.00)	83 (15.96)
High (II)	41 (15.76)	33 (12.69)	74 (14.23)
Upper middle (III)	38 (14.61)	41 (15.76)	79 (15.19)
Lower middle (IV)	65 (25.00)	73 (28.07)	138 (26.53)
Poor (V)	59 (22.69)	87 (33.46)	146 (28.07)

Table 2: Distribution of different risk components in cases and controls

Variable	Cases	Controls	p value
Mean age in years (SD)	55.48 (12.33)	55.48 (12.33)	-
Mean Systolic Blood Pressure (SD)	133.87 (18.37)	120.28 (13.20)	<0.001
Mean Diastolic Blood Pressure (SD)	84.01 (9.83)	77.39 (8.91)	0.114
Mean MET-minutes per week	357.07 (260.25)	465.53 (265.55)	< 0.001
Mean Weight (SD)	63.6 (12.62)	57.78 (11.63)	0.189
Mean BMI (SD)	25.86 (4.32)	23.69 (4.49)	0.534
Mean Waist/hip ratio (SD)	0.95 (0.08)	0.95 (0.08)	-

SD=Standard Deviation

Table 3: Bivariate analysis showing association of risk factors with type 2 Diabetes Mellitus

Variable	Cases (%)	Controls (%)	Odds Ratio (95% CI)	χ^2 (df)	p value
Alcohol consumption					
Non-alcoholic	234 (90.00)	247 (95.00)	1 (Reference)	-	-
Alcoholic	26 (10.00)	13 (5.00)	2.11 (1.05 to 4.20)	4.68(1)	0.030
Smoking Status					
Non smokers	228 (87.69)	241 (92.69)	1 (Reference)	-	-
Smokers	32 (12.30)	19 (7.30)	1.78 (0.98 to 3.23)	3.67 (1)	0.055
Family history of Diabetes					
No	220 (84.61)	251 (96.53)	1 (Reference)	-	-
Yes	40 (15.38)	9 (3.46)	5.07 (2.40 to 10.68)	21.65 (1)	<0.001
Family history of hypertension					
No	238 (91.53)	255 (98.07)	1 (Reference)	-	-
Yes	22 (8.46)	5 (1.92)	4.71 (1.75 to 12.64)	11.29 (1)	<0.001
Tuberculosis					
No	254 (97.69)	258 (99.23)	1 (Reference)	-	-
Yes	6 (2.30)	2 (0.76)	3.04 (0.60 to 15.25)	-	0.285

Table 3: (Continued)

Variable	Cases (%)	Controls (%)	Odds Ratio (95% CI)	χ^2 (df)	p value
Gestational diabetes mellitus (GDM)					
No	132 (97.77)	135 (100.00)	1 (Reference)	-	-
Yes	3 (2.22)	0 (0.00)	7.15 (0.36 to 140.00)	-	0.247
MET –minutes/week					
Sufficiently active (≥ 600)	92 (35.38)	151 (58.07)	1 (Reference)	-	-
Inactive (< 600)	168 (64.61)	109 (41.92)	2.53 (1.77 to 3.60)	26.89 (1)	< 0.001
Dietary pattern					
Vegetarian	92 (35.38)	123 (47.31)	1 (Reference)	-	-
Mixed diet	168 (64.62)	137 (52.69)	1.63 (1.15 to 2.33)	7.62 (1)	0.005
BMI					
18.5–22.9 (Normal)	55 (21.15)	86 (33.07)	1 (Reference)	-	-
< 18.5 (Underweight)	10 (3.84)	35 (13.46)	0.44 (0.20 to 0.97)	4.22 (1)	0.039
≥ 23 (Overweight)	195 (75.00)	139 (53.46)	2.19 (1.46 to 3.28)	14.93 (1)	< 0.001
Waist circumference					
Normal	24 (9.23)	54 (20.76)	1 (Reference)	-	-
Action level 1	55 (21.15)	87 (33.46)	1.42 (0.79 to 2.56)	1.38 (1)	0.238
Action level 2	181 (69.61)	119 (45.76)	3.42 (2.00 to 5.83)	21.80 (1)	< 0.001
Waist hip ratio					
Normal	19 (7.30)	21 (8.07)	1 (Reference)	-	-
Abnormal	241 (92.69)	239 (91.92)	1.11 (0.58 to 2.12)	0.108 (1)	0.742

Table 4: Bivariate analysis showing association of hypothesized risk factors with type 2 Diabetes Mellitus

Variable	Cases (%)	Controls (%)	Odds Ratio (95% CI)	χ^2 (df)	p value
Passive smoking					
No	253 (97.31)	258 (99.23)	1 (Reference)	-	-
Yes	7 (2.69)	2 (0.77)	3.56 (0.73 to 17.35)	-	0.175
Parental Consanguinity					
No	184 (70.76)	198 (76.15)	1 (Reference)	-	-
Yes	76 (29.23)	62 (23.84)	1.31 (0.89 to 1.95)	1.93 (1)	0.164
Nonalcoholic fatty liver disease (NAFLD)					
No	102	253	1 (Reference)	-	-
Yes	158	7	55.98 (25.37 to 123.5)	-	< 0.001
Vegetable consumption					
Daily consumption	15 (5.76)	25 (9.61)	1 (Reference)	-	-
3-6 times weekly	143 (55.00)	177 (68.07)	1.34 (0.68 to 2.65)	0.74 (1)	0.387
Less than 3 times weekly	102 (39.23)	58 (22.30)	2.93 (1.43 to 6.00)	9.08 (1)	0.002
Fruit consumption					
Daily consumption	8 (3.07)	12 (4.61)	1 (Reference)	-	-
3-6 times weekly	142 (54.61)	160 (61.53)	1.33 (0.52 to 3.35)	0.37 (1)	0.542
Less than 3 times weekly	110 (42.30)	88 (33.84)	1.87 (0.73 to 4.78)	1.77 (1)	0.183
Sugar sweetened beverages					
Less than 3 times weekly	228 (87.69)	243 (93.46)	1 (Reference)	-	-
Daily consumption	5 (1.92)	1 (0.38)	5.32 (0.61 to 45.98)	-	0.114

Table 4: (Continued)

Variable	Cases (%)	Controls (%)	Odds Ratio (95% CI)	χ^2 (df)	p value
3-6 times weekly	27 (10.38)	16 (6.15)	1.79 (0.94 to 3.42)	3.26 (1)	0.071
Egg Consumption					
< 5 eggs/ week	155 (92.26)	130 (94.89)	1 (Reference)	-	-
≥ 5 eggs/ week	13 (7.73)	7 (5.10)	1.55 (0.60 to 4.02)	0.85 (1)	0.035
Levels of Depression					
Normal	168 (64.61)	237 (91.15)	1(Reference)	-	-
Moderate depression	70 (26.92)	19 (7.30)	5.19 (3.01 to 8.95)	40.38 (1)	<0.001
Borderline clinical depression	14 (5.38)	2 (0.76)	9.87 (2.21 to 44.04)	13.28 (1)	<0.001
Mild mood disturbance	8 (3.07)	3 (1.15)	3.76 (1.02 to 14.39)	4.28 (1)	0.038
Systolic blood pressure					
Normotensive	141 (54.23)	224 (86.15)	1(Reference)	-	-
Hypertensive	119 (45.76)	36 (13.84)	5.25 (3.42 to 8.05)	63.32 (1)	<0.001
Diastolic blood pressure					
Normotensive	141(54.23)	213 (81.92)	1(Reference)	-	-
Hypertensive	119 (45.76)	47 (18.07)	3.82 (2.56 – 5.70)	45.87 (1)	<0.001

Table 5: Risk factors of type 2 diabetes mellitus: Full model using Multivariate logistic regression

Variables	AOR	95% CI	Coefficient	S.E.	Z-Statistics	p value
Muslim religion	1.03	0.51 – 2.05	0.031	0.351	0.088	0.929
Unskilled worker	0.51	0.24 – 1.05	-0.673	0.370	-1.815	0.069
Semi-skilled worker	0.68	0.38 – 1.23	-0.371	0.296	-1.255	0.209
Semi professional	1.54	0.71 – 3.32	0.432	0.391	1.103	0.269
Upper high SES	1.81	0.90 – 3.64	0.595	0.356	1.670	0.094
High SES	0.64	0.32 – 1.27	-0.444	0.351	-1.266	0.205
Alcohol Consumption	1.51	0.61 – 3.71	0.417	0.457	0.912	0.361
NAFLD	7.44	2.18 – 14.52	1.964	0.417	6.114	<0.001
Family history of Diabetes	3.94	1.19 – 13.05	1.372	0.610	2.248	0.024
Family history of hypertension	1.15	0.24 – 5.35	0.143	0.783	0.182	0.855
Physical inactivity	2.98	1.88 – 4.72	1.094	0.234	4.664	<0.001
Vegetable consumption less than 3 times/ week	2.88	1.76 – 4.73	1.060	0.252	4.198	<0.001
Mixed diet pattern	1.37	0.77 – 2.46	0.321	0.295	1.088	0.276
Moderate depression	6.98	3.56 – 13.70	1.944	0.343	5.662	<0.001
Borderline clinical depression	11.30	0.98 – 64.55	2.425	0.888	2.728	0.060
Mild mood disturbances	3.17	0.61 – 16.28	1.155	0.834	1.384	0.166
BMI (Overweight)	2.18	1.30 – 3.66	0.783	0.263	2.979	0.002
Waist circumference (Action level 2)	1.62	0.95 – 2.75	0.482	0.271	1.780	0.075
Systolic blood pressure	3.43	1.76 – 6.68	1.234	0.339	3.633	<0.001
Diastolic blood pressure	1.54	0.82 – 2.89	0.432	0.321	1.344	0.178

Diabetes status (case/control) was considered binary dependent variable and adjusted odds ratio (AOR) was calculated with their 95% confidence limits.

Figure 1: A Flowchart of selection of Cases and Controls.