IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Prevalence Of Diabetes Mellitus And Its Risk Factor In Muniguda Block Of Rayagada District In Odisha: A Cross Sectional Study

[1]Smrutirekha Baral, [2, 1]Gyanaseni Dhar*,

[1]Research Scholar, School of Biological Sciences, AIPH University, Bhubaneswar, Odisha, India

[2]Assistant Professor, Department of Zoology, C.V. Raman Global University, Bhubaneswar, Odisha, India

Abstract: Purpose: Diabetes mellitus is a chronic metabolic disorder debilitating non- communicable disease (NCDs) which has emerged as a leading as a leading global health problem. The purpose of this cross-sectional study was to determine the prevalence of diabetes mellitus and its associated risk factor in Rayagada district of Odisha, India.

Materials and methods: The objective of the study was to explore about the factors affecting, the diabetes. Participants were selected from 2-3 laboratory of muniguda block of Rayagada. As the total sample size was 139 and aged between 30-80 years. Data was analyzed by SPSS (Statistical Package for the Social Sciences) software.

Results: The mean age was found to be 58.03± 12.16. In this study, the majority of the diabetic patient i.e., 69 (49.6%) belong to the age group of 55-65. The majority of the male patients were uneducated i.e., 63 (70%). 80 (57.55%) patients had a family history of diabetes. The majority of Non-vegetarian people had diabetes when compared to vegetarian people. The majority of male diabetic patients were smokers i.e., 55 (61%).

Conclusion: The present study identified that factors such as age, inadequate diet, family history, education, smoking, and alcohol consumption were the predisposing factors for diabetes.

Index Terms **-** Diabetes, Prevalence, Risk factor, Non- communicable disease.

I. INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder defined by excess of glucose in the blood stream (hyperglycemia). The hyperglycemic condition causes carbohydrate, lipid, fat metabolism disorder in the body, due to deficiency of insulin (Endris, Worede, and Asmelash 2019). Diabetes mellitus is a group of heterogenous disease defined by excess glucose in blood stream and glucose intolerance generating from deficiency of insulin secretion (Farmanfarma et al. 2020). The hyperglycemia of diabetes causes damage in most of the organs in the body such as kidneys, heart, kidney, eyes, nerves, and blood vessels. It increases high risk of early death and increase in developed country due to lifestyle and population structure (Farmanfarma et al. 2020). A person with prediabetes is recommended high risk of development of diabetes and its complication. The risk factor diabetes plays role in development of diabetes mellitus in most of the population such as: - age, obesity, imbalance of lipid (high density lipoprotein, low density lipoprotein,

cholesterol), inactive lifestyle (No exercise, lot of sitting and laying down) and genetic factor. Lipid imbalance in the body is correlated with micro vascular and macro vascular complication. Nephropathy, Retinopathy, Neuropathy are micro vascular complications and Ischemic heart disease, Stroke, Peripheral vascular diseases are macro vascular complication (Endris, Worede, and Asmelash 2019). Diabetes mellitus is a main cause of death rate and longevity, and it is a largest public health problem. Individuals with diabetes have 2-3 folds risk of death rate and correlated with increased death rate from infections, heart disease, cancer, kidney disease, stroke and liver disease (Lin et al. 2020). The prevalence rate of diabetes mellitus has been growing rapidly as reported by the International Diabetes Federation (IDF), 2017. 415 million people with diabetes throughout the world and it is expected that it rises to 693 million by 2045. The percentage of undiagnosed diabetes was 49.7%. 5 million deaths throughout the world in between the 20–99-year range. The number of diabetic people is higher in urban areas than the rural areas. 172 million people with diabetes in urban areas and 119 million in rural areas in 2015 (Farmanfarma et al. 2020). Diabetes mellitus is known as non-communicable disease and it leading to causes death on worldwide. In 2012, WHO reported that NCDs killed 38 million people. Diabetes mellitus is considered for NCD deaths about 1.5 million. High cholesterol, fasting plasma triglyceride increased and high blood pressure are the major risk factors of diabetes impaired with cardiovascular disease. Reduced sensitivity to insulin in a diabetic patient causes a high risk of cardiovascular disease (Balakumar, Maung-U, and Jagadeesh 2016). In 2013, 382 million people with diabetes and in 2035 it rises to 592 million. In 2019, 77 million individuals had diabetes in India, and it give rise to over 134 million by 2045. Prevalence of diabetes is increasing all over the world. In 2000 171 million people with diabetes, it rises to 366 million in 2030. In India it rises to around 15.1%, 31.7 million in 2000 to 79.4 million in 2030. 62 million people with diabetes and it can be increase up to 79.4million by 2025 in India (Hussain et al. 2020). Tribal population contribute 8.6% of the total population of India as per 2001 census. In India the prevalence of diabetes mellitus among different population is published to be 0.7-10% with a common prevalence of 5.9%. Prevalence of diabetes mellitus is increasing Both in rural and tribal population the rate of prevalence of diabetes mellitus increases rapidly. In India prevalence of diabetes mellitus among tribal are impaired by their small sample size and nonuniform in basis and describing population. The main driver of pandemic of diabetes is the quick epidemiological changeover correlates with dietary changes and lack of physical activity (Upadhyay et al. 2013). Prevalence of diabetes is high among adult population in the middle East and north Africa region. A large number of adults are diagnosed with diabetes mellitus in the Western pacific area. According to the etiology and genetics diabetes is classified into: -Type-1 diabetes, Type-2 diabetes, Gestational diabetes and other types of diabetes (Kharroubi and Darwish 2015). Deficiency of insulin secretion caused Type-1 diabetes. The risk of developing type-1 diabetes can be characterized by autoimmune processes occurring in the pancreatic islets and destruction of beta cells. Type-1 diabetes is otherwise known as insulin dependent diabetes or onset diabetes. Autoimmune damage of beta cells has several genetic variants and environmental factors. Non-insulin dependent diabetes is known as Type-2 diabetes or adult- onset diabetes, including individuals who have insulin deficiency (“Diagnosis and Classification of Diabetes Mellitus,” 2009) Gestational diabetes is detected during pregnancy. Gestational diabetes mellitus is described as glucose in tolerance during pregnancy and it affects both mother and the baby. Diabetes is not a problem of pregnancy, but it may be difficult for pregnancy. Various types of maternal and infant difficulties caused

by diabetes in pregnancy (Hussain et al. 2020). Type -2 diabetes mellitus and tuberculosis are present together difficulties at a higher degree. RNTCP: - the revised National tuberculosis control program suggests a more effective association between TB and Diabetes control programs management of diabetes and tuberculosis patients. Prediabetes is detected when the random blood glucose and fasting glucose levels are very low and those people who have diabetes with very high levels of random glucose level and fasting glucose level (Das et al. 2017). Type-2 diabetes mellitus and thyroid dysfunction belong to endocrine disorder. Both diabetes and thyroid diseases are autoimmune diseases. Diabetes control affected by presence of thyroid disorder (Hussain et al. 2019). 75% of adults with diabetes mellitus and have hypertension, insulin resistance occurred due to the hypertension. In united states, approximately 74.5million and 23.6 million adults affected by hypertension and diabetes. Primary prevention of diabetes such as: -life style changes, dietary changes, weight control, physical exercises (Long and Dagogo-Jack 2011).

II. METHODS

Study Area

Rayagada is the southern district of Odisha; in 1992 October it became a separate district. It consists mainly of tribal population such as: Kandha and Paraja. Rayagada district is divided into eleven blocks, and it covers 7,584.7 square kilometers. The primary occupation of the district is agriculture. The population of Rayagada in the 2011 census is 967,911. Males constitute 471,960 of the population and females 495, 951.

Study setting

The study was carried out in Muniguda block of rayagada district, Odisha.

Study design

The study is cross-sectional study that describes the prevalence of diabetes mellitus and its risk factor in rayagada district of Muniguda block in Odisha.

Sample size

The study was a cross-sectional study carried out in Muniguda block of Rayagada district. Using the nation-wide prevalence of diabetes in rural area, the range was 3.0% to 8.3% as per ICMR-INDIAB study (2008-2011) (Anjana et al. 2011). The maximum prevalence rate of 8.3% was used for estimating the sample size; allowable error as 5% and confidence interval as 95%, sample size was calculated [$N= Z^2p\ (1-p)]/\ d$]. The sample size was calculated to be 139

Selection criteria

Inclusion criteria: Middle Adult age group (30-70) those are impaired fasting glucose and diabetes.

Exclusion criteria: People who did not volunteer to participate in the study.

Study subject

To estimate the prevalence of diabetes mellitus and its risk factor in rayagada district of Muniguda block in Odisha.

Data collection

Data will be collected from 2-3 laboratory of Muniguda block of rayagada. Socio-demographic and

anthropological data are collected from diabetic people using standard questionnaire. All questions will be asked by the staff of the laboratory.

Questionnaire (Age, Gender, Smoking/Drinking, Fasting Level, after eating, education, Family History, Diet type). The following parameters will be collected: (i) Personal details which include name, age, sex, education status, diet type (vegetarian/ non-vegetarian), and family history. (ii) Blood sugar profile assessment, which includes fasting blood sugar and 2h postprandial blood sugar.

Data Analysis plane

All the analysis was done using SPSS (Statistical Package for the Social Sciences) software version 20. The descriptive statistics were reported using mean and standard deviation for the continuous variables, number and percentages for the categorical variables. P value less than 0.05 was considered as statistically significant.

Ethical consideration

Ethical approval of the study was sought from an institutive ethics committee of the Asian Institute of Public Health University (Approval No- ERC/ No: 2023-25). Confidentiality privacy was maintained throughout the study. Permission was taken from the higher authorities of the all institutions. Written consent form, which consists of all the information about my study taken from the diabetic patient.

III. RESULTS

There were 139 study participants, the mean age was found to be 58.03± 12.16. The majority 69 (49.9%) of the participants belonged to the age group of 55 and 65 years. In this study, the majority 89 (64.02%) were males while 50 (35.98%) were females (Table-1).

Table 1: Demographic characteristics of the study population

VARIABLE	NUMBER (139)	PERCENTAGE
Age group		
30-55	59	42.3
55-65	69	49.9
>75	11	7.8
Gender		
Male	89	64.02
Female	50	35.97

In the present study majority of the male 63 (70%) were uneducated while 31 (62%) were uneducated in females. The number of uneducated people higher than educated people (Table-2).

Table 2: Distribution of risk factors of the study population

VARIABLES	MALE NUMBER (%)	FEMALE NUMBER (%)
EDUCATION		
Educated	26 (29%)	19 (38%)
	63 (70%)	31(62%)
Uneducated		
DIET TYPE		
Non-Vegetarian	72 (80%)	40 (80%)
Vegetarian	17(19%)	10 (20%)
FAMILY HISTORY		
Yes	49 (56%)	31 (62%)
No/Unknown	40 (44%)	19 (38%)
CURRENT ALCOHOL USE		
Yes	23 (25%)	5 (10%)
No	66 (75%)	45 (90%)
CURRENT SMOKING USE		
Yes	55 (62%)	2(4%)
No	34 (38%)	48 (96%)
CURRENTLY USING ALCOHOLAND	12 (13%)	No

Out of the total study, population 112 (80.57%) took mixed types of diet i.e., both veg and nonveg, and 27 (19.42%) were vegetarians. Consumption of mixed type of diet was seen higher in males 72 (80.90%) compared to females 40(80%) also a higher number of males 17(19%) were vegetarians compared to females 10 (20%) (Table-2). The majority, that is, 80 (57.55%) participants had a family history of diabetes among them 49 (55%) were males while 59 (42.44%) had no family history or they were unaware of it (Table-2). In the present study, 57 (41.00%) and 28 (20.15%) were found to be using smoking and alcohol. Smoking and alcohol use was found to be higher among males (Table-2). In comparison to vegetarian, non-vegetarian were more (Figure-1(A) and uneducated were more than educated (Figure-1B).

Majority 56% of the male have family history (Figure-2(A). Majority 62% of the female have family history (Figure-2(B). Majority 75% of the male don't use alcohol and 25% of the male use alcohol (Figure-2C), majority 90% of the female doesn't use alcohol and 10% of the female use alcohol (Figure-2(D). Heavy alcohol consumption increased the risk of diabetes but moderate alcohol consumption lowers the risk of diabetes. Majority 62% of the male were smoker. In comparison to non-smoker, smokers were more in male (Figure-2E). Majority 96% of the female were non- smoker and the smokers were very less than non- smoker in female (Figure-2F). The present study identified factors such as age, smoking use, inadequate diet and alcohol consumption, mixed-type diet, and increased BMI which are predisposing factors for diabetes.

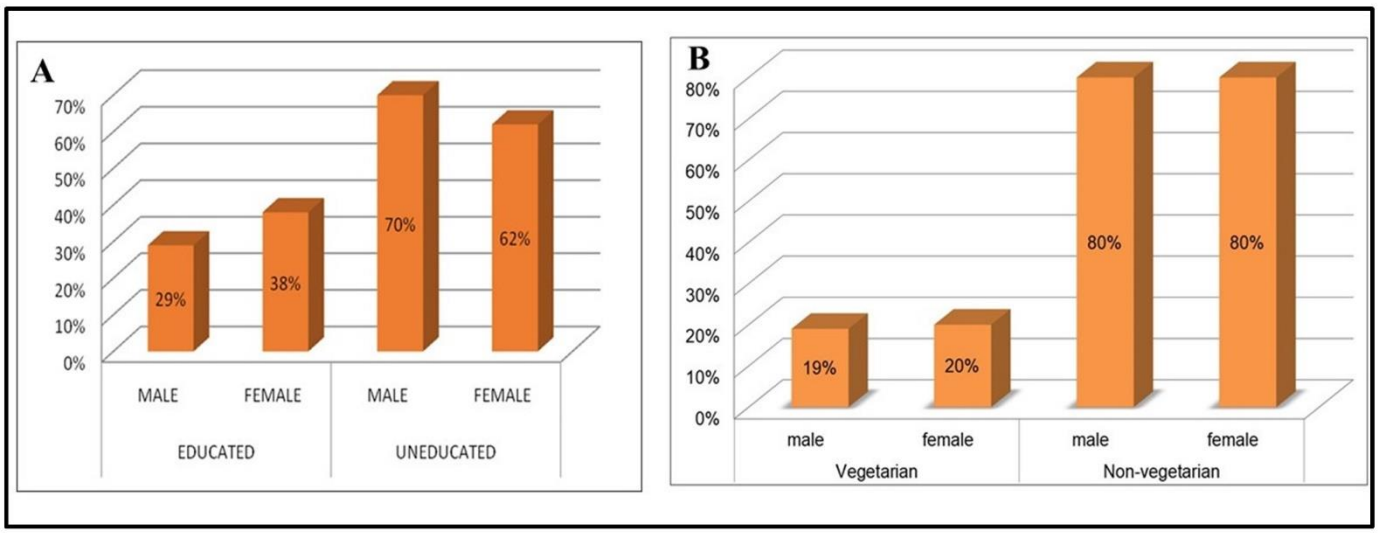

Figure 1: (A) Distribution of the Study population based on diet (B) Distribution of the study population based on education

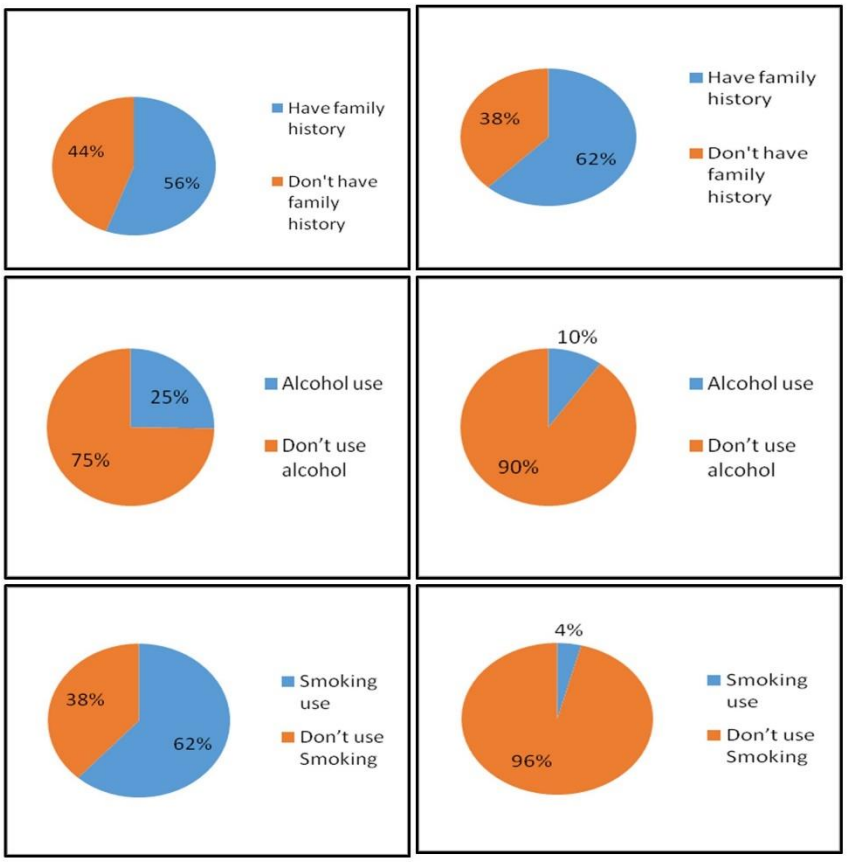

Figure 2:(A) Distribution of the study population according to the family history (MALE) (B) Distribution of the study population according to the family history (FEMALE) (C) Distribution of the study population based on alcohol consumption (MALE) (D) Distribution of the study population based on alcohol consumption (FEMALE) (E) Distribution of the study population based on smoking use (MALE) (F) Distribution of the study population based on smoking use (FEMALE).

IV. **DISCUSSION**

A number of factors contribute to diabetes. It has a substantial correlation with actions like using tobacco or alcohol, not exercising, and eating poorly (Hu et al. 2001). Age was discovered to be a significant risk factor for the development of Type 2 diabetes in the WHO-ICMR National NCD Risk Factor Surveillance Study (King, Aubert, and Herman 1998) and Indian Diabetic Risk Scoring System. As people get older, the

prevalence increases. The majority of diabetics in our study were between the ages of 55 and 65. The majority of the diabetic patients in the Rana et al. study on diabetic patients in a tertiary care hospital in central Gujarat were older than 50 (Rana et al. 2015). Nearly 61% of the study subjects smoked, 25% drank alcohol, and 74% did not. However, men were more likely to experience it than women. According to P. C. Gupta and Ray (2003), cigarette smoking is the main avoidable cause of diabetes (Gupta and Ray 2003). In a different survey conducted in Rajasthan by Mathur et al. (Mathur et al. 2018), 33.7% of the population was found to smoke. Heavy alcohol consumption has a variety of adverse metabolic effects, including increased calorie intake, obesity, elevated triglycerides, and aberrant glucose metabolism (Koppes et al. 2005). According to the Tripathy et al. study, 10.4% of diabetics also used alcohol (DeFronzo and Tripathy 2009). According to a research by Niti et al., 12.6% of participants had alcohol use disorders and 87.4% didn't. Obesity and overweight are caused by physical inactivity and a sedentary lifestyle, which also leads to the almost immediate onset of diabetes. These elements work in concert over time to significantly raise the risk of diabetes mellitus (Lee et al. 2012). In comparison to parents without a history of diabetes, children with one affected parent are more likely to get diabetes, and the risk doubles with two affected parents (Meigs, Cupples, and Wilson 2000). Strong evidence for the genetic component in the development of diabetes mellitus comes from the 80% concordance in monozygotic twins compared to 50% less in dizygotic twins (Vaag et al. 1995). According to a study conducted by Borah and Goswami in an Assamese tertiary care hospital (Borah and Goswami 2017). Positive family history was present in 17% of the research participants, which is quite comparable to the findings of a recent study. According to the Chennai Urban Population Survey, people with a positive family history were more likely to have diabetes (18.2%) than those without (10.6%) (Mohan et al., 2003). According to research by Dev et al. (2017) and Valliyot et al. (2014), 64.7% and 54.2% of study participants, respectively, had a family history of diabetes (Dev et al. 2017; Valliyot et al. 2014) . Diabetes patients that consume a lot of dietary fiber had lower insulin and blood glucose levels (McRae 2018). Increased consumption of fruits, vegetables, and whole grain cereals may help prevent diabetes, according to data from randomized controlled trials. Increased consumption of fruits and vegetables lowers HbA1c, improves weight management, and lowers the risk of developing diabetes (Jaacks et al., 2016). Only 20% of the women in the current study ingested more veggies daily. The majority of study participants did not eat enough fruit and vegetable servings. Numerous studies have demonstrated that adopting a vegetarian diet reduces the risk of developing diabetes. In a major community-based study on north India by tripathy et al., only 9.2% of the diabetics consumed 5 or more servings of fruits and vegetables per day (Tripathy et al. 2017). The entire plant food content of the Indian vegetarian dietary pattern did, however, decline as a result of the "Nutrition Transition" that followed urbanization. Foods like processed, fried, and refined carbs have taken its place. Obesity and diabetes were subsequently brought on as a result. According to a cohort study by Mari-Sachis et al., eating meat has been linked to the development of diabetes (Mari-Sanchis et al. 2016). In a study similar to this current study, Kumar et al. reported findings in which 51.2% of diabetics followed a non-vegetarian diet and 48.8% followed a vegetarian diet. In contrast to the current study, Niti et al. found that vegetarian participants had a greater prevalence of diabetes (82.1%). According to a study by Liu et al. (2004), those who consume a lot of green leafy or dark yellow veggies have a lower chance of developing diabetes (Mari-Sanchis et al. 2016).

CONCLUSION

The present study identified that factors such as age, inadequate diet, family history, education, smoking, and alcohol consumption were the predisposing factors for diabetes. In this study, the majority of the diabetic patient i.e., 69 (49.6%) belong to the age group of 55-65. The majority of the male patients were uneducated i.e., 63 (70%). 80 (57.55%) patients had a family history of diabetes. The majority of Non-vegetarian people had diabetes when compared to vegetarian people. The majority of male diabetic patients were smokers i.e., 55 (61%).

Acknowledgements

The authors thank all the physicians who participated in this study. The authors also thank Ethical committee of AIPH University for giving the opportunity for research.

CONFLICT OF INTERESTS

The authors declare no conflict of interest.

REFERENCES

- Anjana, RM, R Pradeepa, M Deepa, M Datta, V Sudha, R Unnikrishnan, A Bhansali, SR Joshi, PP Joshi, and CS Yajnik. 2011. "Prevalence of diabetes and prediabetes (impaired fasting glucose and/or impaired glucose tolerance) in urban and rural India: Phase I results of the Indian Council of Medical Research–INdia DIABetes (ICMR–INDIAB) study." Review of. *Diabetologia* 54:3022-7.
- Balakumar, Pitchai, Khin Maung-U, and Gowraganahalli Jagadeesh. 2016. "Prevalence and prevention of cardiovascular disease and diabetes mellitus." Review of. *Pharmacol Res* 113:600-9.
- Borah, Meghna, and Rohini Kanta Goswami. 2017. "Sociodemographic and clinical characteristics of a diabetic population at a tertiary care center in Assam, India." Review of. *J soc health diabetes* 5 (01):037-42.
- Das, Elina, Shritam Das, SK Kar, VS Yadav, and Tahziba Hussain. 2017. "Prevalence and risk factors of pre-diabetes and diabetes among patients with active TB disease attending three RNTCP centres in Odisha." Review of. *Int J Diabetes Dev Ctries* 37:141-7.
- DeFronzo, Ralph A, and Devjit Tripathy. 2009. "Skeletal muscle insulin resistance is the primary defect in type 2 diabetes." Review of. *Diabetes Care* 32 (Suppl 2):S157.
- Dev, Sathish, Timsi Jain, P Sivaprakasam, and Dinesh Raja. 2017. "Risk factor assessment and screening for diabetes in field practice area of a private medical college in Thiruvallur district of Tamil Nadu." Review of. *Int J Community Med Public Health* 4:2670-3.
- Endris, Toyba, Abebaw Worede, and Daniel Asmelash. 2019. "Prevalence of diabetes mellitus, prediabetes and its associated factors in Dessie Town, Northeast Ethiopia: a community-based study." Review of. *Diabetes Metab Syndr Obes: Targets Ther*:2799-809.
- Farmanfarma, KH Kalan, A Ansari-Moghaddam, I Zareban, and HA Adineh. 2020. "Prevalence of type 2 diabetes in Middle–East: Systematic review& meta-analysis." Review of. *Prim Care Diabetes* 14 (4):297-304.
- Gupta, Prakash C, and Cecily S Ray. 2003. "Smokeless tobacco and health in India and South Asia." Review of. *Respirology* 8 (4):419-31.
- Hu, Frank B, JoAnn E Manson, Meir J Stampfer, Graham Colditz, Simin Liu, Caren G Solomon, and Walter C Willett. 2001. "Diet, lifestyle, and the risk of type 2 diabetes mellitus in women." Review of. *N Engl J Med* 345 (11):790-7.
- Hussain, Tahziba, Braja Sundar Barik, Alok Ranjan Nayak, Shritam Das, Utkal Kishore Khadanga, VS Yadav, and Sanghamitra Pati. 2019. "Prevalence and predictors of thyroid dysfunction among

patients with type 2 diabetes mellitus attending a tertiary care hospital in an urban area of Bhubaneswar, Odisha." Review of. *Thyroid Res* 16 (1):26-35.

- Hussain, Tahziba, Shritam Das, Firdoush Parveen, Prashanti Samanta, Madhusmita Bal, VS Yadav, and Sanghamitra Pati. 2020. "Prevalence, risk factors and morbidities of gestational diabetes among pregnant women attending a hospital in an urban area of Bhubaneswar, Odisha." Review of. *Fam Med Prim Care Rev* 9 (10):5327.
- Kharroubi, Akram T, and Hisham M Darwish. 2015. "Diabetes mellitus: The epidemic of the century." Review of. *World J Diabetes* 6 (6):850.
- King, H, RE Aubert, and WH Herman. 1998. "Prevalence, numerical estimates, and projections." Review of. *Diabetes Care* 21:1414-31.
- Koppes, Lando LJ, Jacqueline M Dekker, Henk FJ Hendriks, Lex M Bouter, and Robert J Heine. 2005. "Moderate alcohol consumption lowers the risk of type 2 diabetes: a meta-analysis of prospective observational studies." Review of. *Diabetes Care* 28 (3):719-25.
- Lee, I-Min, Eric J Shiroma, Felipe Lobelo, Pekka Puska, Steven N Blair, and Peter T Katzmarzyk. 2012. "Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy." Review of. *The lancet* 380 (9838):219-29.
- Lin, Xiling, Yufeng Xu, Xiaowen Pan, Jingya Xu, Yue Ding, Xue Sun, Xiaoxiao Song, Yuezhong Ren, and Peng-Fei Shan. 2020. "Global, regional, and national burden and trend of diabetes in 195 countries and territories: an analysis from 1990 to 2025." Review of. *Sci Rep* 10 (1):14790.
- Long, Amanda N, and Samuel Dagogo-Jack. 2011. "Comorbidities of diabetes and hypertension: mechanisms and approach to target organ protection." Review of. *J Clin Hypertens* 13 (4):244-51.
- Mari-Sanchis, Amelia, Alfredo Gea, Francisco Javier Basterra-Gortari, MA Martinez-Gonzalez, Juan José Beunza, and Maira Bes-Rastrollo. 2016. "Meat consumption and risk of developing type 2 diabetes in the SUN project: a highly educated middle-class population." Review of. *PloS one* 11 (7):e0157990.
- Mathur, Medha, Navgeet Mathur, Omveer Singh, Jitendra Solanki, Pradeep Soni, Ashutosh Sarwa, Sawai Khatri, Yashpal Singh, and Vinod Sharma. 2018. "Demographic characters and factors favouring emergence of diabetes mellitus type two." Review of. *Int J Res Med Sci* 6:950-4.
- McRae, Marc P. 2018. "Dietary fiber intake and type 2 diabetes mellitus: an umbrella review of meta-analyses." Review of. *J Chiropr Med* 17 (1):44-53.
- Meigs, James B, L Adrienne Cupples, and PW Wilson. 2000. "Parental transmission of type 2 diabetes: the Framingham Offspring Study." Review of. *Diabetes* 49 (12):2201-7.
- Rana, Himanshu M, Parag Chavda, Chirag C Rathod, and Meera Mavani. 2015. "Socio-demographic and anthropometric profile of diabetic patients attending diabetes clinic in tertiary care hospital of Central Gujarat." Review of. *Natl J Community Med* 6 (04):554-7.
- Tripathy, Jaya Prasad, JS Thakur, Gursimer Jeet, Sohan Chawla, Sanjay Jain, Arnab Pal, Rajendra Prasad, and Rajiv Saran. 2017. "Prevalence and risk factors of diabetes in a large community-based study in North India: results from a STEPS survey in Punjab, India." Review of. *Diabetol metab syndr* 9 (1):1-8.
- Upadhyay, Ravi Prakash, Puneet Misra, Vinoth G Chellaiyan, Timiresh K Das, Mrinmoy Adhikary, Palanivel Chinnakali, Kapil Yadav, and Smita Sinha. 2013. "Burden of diabetes mellitus and prediabetes in tribal population of India: a systematic review." Review of. *Diabetes Res Clin Pract* 102 (1):1-7.
- Vaag, Allan, Jan Erik Henriksen, Sten Madsbad, Niels Holm, and Henning Beck-Nielsen. 1995. "Insulin secretion, insulin action, and hepatic glucose production in identical twins discordant for non-insulin-dependent diabetes mellitus." Review of. *J Clin Investig* 95 (2):690-8.
- Valliyot, Balakrishnan, Jayadevan Sreedharan, Sudha Balakrishnan Valliyot, and Jayakumary Muttappallymyalil. 2014. "Demographic parameters associated with Type 2 Diabetes Mellitus in North Kerala, India." Review of. *Am J Res Commun* 2 (9):39-48.