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## RESEARCH ARTICLE

# PREVALENCE OF TYPE 2 DIABETES IN NORTH-EAST INDIA: A REVIEW

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**ABSTRACT**

**Background:** Globally, it is accepted that Diabetes is one of the most threatening public health issue which has become pandemic. There is rise in the prevalence of Diabetes in all parts of the World, India being one the country to have high prevalence to suffer from Diabetes next to China. Numerous factors cause diabetes, however, environmental being the most important risk factor to cause diabetes. Many studies have shown that human gene also play its important role in causing diabetes, 50 percent of diabetes patient have their family or parents suffering from diabetes. High prevalence of diabetes is found among the overweight and obese people, those who are inactive in their lifestyle.

**Objective:** The presents study will be focusing on Type 2 diabetes with an aim of finding the prevalence in all the states of North East, India

**Methods:** The present paper consists of works which were published during the year 2010 to 2017, a period of eight years.

**Result:** According to the study conducted by Indian Council of Medical Research (ICMR) India Diabetes Study reported that in blood sugar level of >140 mg/dl the urban women show the highest blood glucose level (9.4%) in both Mizoram and Tripura which is followed by Manipur with (8.8%) and Sikkim with (7.8%) whereas in case of men the highest blood glucose level can be seen in Nagaland (11.1%) followed by Mizoram and Sikkim with (10.7%). There is high prevalence of Type2 diabetes among the overweight and obese group. In some states male show higher prevalence and in other female show higher.

**Summary:** Type 2 Diabetes mellitus is affected both by gene and environment, person with parental history of diabetes have a higher prevalence. Various lifestyle plays important role in relation to the conversion of type2 diabetes. People who are physically inactive are more prone to suffer from diabetes than people who are physically active. It is necessary to conduct more screening for prevalence of diabetes and its risk factors in North East region, as very few data were available.



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## INTRODUCTION

Diabetes is a group of chronic diseases characterized by hyperglycaemia resulting from defects in insulin secretion, insulin action, or both. The chronic hyperglycaemia of diabetes is associated with long-term damage, dysfunction, and failure of different organs, especially the eyes, kidneys, nerves, heart, and blood vessels (American Diabetes Association 2010). Long-term complications of diabetes include retinopathy with potential loss of vision; nephropathy leading to renal failure; peripheral neuropathy with risk of foot ulcers, amputations, and Charcot joints; and autonomic neuropathy causing gastrointestinal, genitourinary, and cardiovascular symptoms and sexual dysfunction.

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Patients with diabetes have an increased incidence of atherosclerotic cardiovascular, peripheral arterial and cerebrovascular disease. Hypertension and abnormalities of lipoprotein metabolism are often found in people with diabetes. The number of people living with diabetes has nearly quadrupled since 1980 to 422 million adults, that is 1 person in 11 (World Health Day 2016). Diabetes can be of two types in general they are Type 1 diabetes (T1D) and Type 2 diabetes (T2D). Type 1 diabetes case, formerly called juvenile-onset or insulin-dependent diabetes, is rare and it accounts for 5 to 10 out of 100 people who have diabetes. The presents study will be focusing on Type 2 diabetes since it is very common.

### Type 2 Diabetes Mellitus (T2DM)

Type 2 diabetes ranges from predominantly insulin resistance with relative insulin deficiency to predominantly an insulin secretory defect with insulin resistance.

T2DM can develop at any age. However, it is most common in adult. This form of diabetes, which accounts for 90-95% (American Diabetes Association 2010) of those with diabetes, previously referred to as non-insulin-dependent diabetes, type 2 diabetes, or adult-onset diabetes, encompasses individuals who have insulin resistance and usually have relative (rather than absolute) insulin deficiency. At least initially, and often throughout their lifetime, these individuals do not need insulin treatment to survive. There are probably many different causes of this form of diabetes, although, the specific etiology of the disease is not known. Most patients with this form of diabetes are obese, and obesity itself causes some degree of insulin resistance. Patients who are not obese by traditional weight criteria may have an increased percentage of body fat distributed predominantly in the abdominal region. Many people are unaware that they have diabetes, with a number around 183 million. Type 2 diabetes mellitus (T2DM) represents > 90% of the cases (Lyssenko, *et al.,* 2013).

**Risk Factors**

Diabetes may be caused by different factors while environment or life style plays great role, however, almost 50% of the Diabetic patients have at least one of their parents or family members affected with the disease (American Diabetes Association 2010). Till now the genes responsible have not been isolated but a strong correlation exists. Stress of our life like frequent quarrelling, live threatening, work pressure etc. are also found to be strongly related with diabetes due to the released hormones called adrenaline and cortisol. Both genetic and environmental factors have tremendous capacity to increase blood glucose (Chhajer, 2009). Many studies have elaborated the associations between several risk factors and occurrence of T2DM. Body mass index (BMI), lipids, smoking, physical inactivity, low education, dietary patterns, vitamin D deficiency, family history, and recently specific genes polymorphisms are the most frequently documented risk factors for developing T2DM (Valdes *et al.,* 2007; Lyssenko, 2008). Many longitudinal studies have reported that increased BMI is a strong risk factor for T2DM (Meisinger *et al.,* 2002; Almdal *et al.,* 2008). A strong positive association between obesity and T2DM is found both in men and women (Skarfors *et al.,* 1991). In one of the study smoking cigarette is associated with small increase in diabetes and alcohol consumption with decrease risk of diabetes. Being overweight or obesity was the single most important predictor of diabetes. Lack of exercises, a poor diet, current smoking and abstinence from alcohol use were all associated with a significantly increased risk of diabetes (Frank *et al.,* 2001). Several prospective studies reported that current smoking is a risk factor for developing T2DM (Yeh *et al.,* 2010). The association between smoking and T2DM was stronger for heavy smokers ≥ 20 cigarettes/day compared with light smokers or former smokers (Nagaya *et al.,* 2008). In addition some studies found an increased risk of T2DM the first 2-3 years after smoking cessation (Hur *et al.,* 2007). Type- 2 diabetes is produced by both genetic and environmental factors. It is learnt from the study that genes are thought to play major role in the etiology of type 2 diabetes. On the other hand, sedentary life style is considered as a main risk factor for DM-II. Prolonged television watching as a surrogate marker of sedentary lifestyle, was reported to be positively associated with diabetes risk in both men and women. Moderate and vigorous physical activity was associated with a lower risk of T2DM (Krishnan *et al.,* 2009).

Physical activity plays an important role in delaying or prevention of and reducing insulin resistance, and indirectly by beneficial changes in body mass and body composition (Hamman *et al.,* 2006). development of T2DM in those at risk both directly by improving insulin sensitivity Genetic factors that determine body fat distribution and glucose metabolism have to be fully elucidated for the better understanding of the biochemical and molecular mechanisms behind the aetiopathogenesis of diabetes. In one of the study among the Muslim population of Manipur, it was observed that most of the patients with diabetes were found to have stress and it was identified as one of the risk factor of diabetes (Nilupher, *et al.,* 2016). T2DM is a complex multifactorial disease in which multiple genetic variants interact with environmental factors to trigger the disease The lifetime risk (at age 80 years) for T2DM has been calculated to be 38% if one parent had T2DM. If both parents are affected, the incidence of T2DM in the offspring is estimated to approach 60% by the age of 60 years (Stumvoll *et al.,* 2005). The sex differentials in the cardiovascular risk among diabetic patients of Manipur was observed 55.6% females have controlled glycaemia as compared to males (24.5%) which contrasts with the risk for cardiovascular disease with major proportion of males (59.%) being at high risk as compared to females (19%) (Mary, *et al.,* 2014). Lifestyle interventions have been effective in the improvement of cardiovascular risk factors and the benefits are proportionally higher among those at high risk for cardiovascular disease (Watkins, 2003). At every level of risk factor, diabetic subjects have twofold higher risk (Laakso, 2010), and the risk for disease increases over time with the accumulation of unfavourable metabolic factors (Smith, 2007).

**Prevalence**

There are many study conducted by different scholars on prevalence of diabetes, physical activity of a person have a strong relation in prevalence of diabetes. Overweight and obese people are more prone to have type2 diabetes in overall than the normal people. In 1980, the prevalence was highest in high-income countries (5.2%) and lowest in low-income countries (3.3%). By 2014, the prevalence in low income countries has become higher (7.4%) than in high-income (7.0%) countries. In the WHO regions, the prevalence is highest in the Eastern Mediterranean region (13.7%) and lowest in the African region (7.1%) (IDF, 2015). The largest number of deaths due to high blood glucose has occurred in upper middle-income countries. Almost one-half of all deaths attributable to high blood glucose are premature - before the age of 70 years (Roglic, 2016). In Palestine, T2DM seems to be a serious health problem among the population with a prevalence rate of around 9% - 12% (Husseini *et al.,* 2009). WHO projects that diabetes will be the 7th leading cause of death in 2030 (Mathers, *et al.,* 2006). Earlier study on different regions of India have reported that the prevalence was the highest in Hydrabad (16.6%), followed by Chennai (13.5%), Bengaluru (12.4%), Kolkata (11.7%), New Delhi (11.6%) and Mumbai (9.3%) (Mohon, *et al.,* 2009). Later a report from Indian Council of Medical Research of Indian Diabetes Study (The Indian Council of Medical Research (ICMR), 2016) has accepted that Chandigarh reported to be the Highest in prevalence of diabetes at 13.6 percent, followed by Punjab at 9.8 percent. It is a matter of major concern that Indians develop type2 diabetes at a younger age than the western population. They also develop diabetes with minor weight gain.

Type 2 diabetes mellitus among adolescents and youth has become increasingly common. The development of the disease at a young age predisposes the patients to develop the chronic long term complications at a relatively young age and serve morbidity and early mortality occur in the most productive years of life (Ramachandran *et al.,* 2010).

Top ten countries/territories for number of people with diabetes (20-79 years) IDF Diabetes Atlas, 2015.

| Sl No. | Country/territory | Number of people with diabetes |
|---|---|---|
| 1. | China | 109.6 million |
| 2. | India | 69.2 million |
| 3. | United States of America | 29.3 million |
| 4. | Brazil | 14.3 million |
| 5. | Russian Federation | 12.1 million |
| 6. | Mexico | 11.5 million |
| 7. | Indonesia | 10.0 million |
| 8. | Egypt | 7.8 million |
| 9. | Japan | 7.2 million |
| 10. | Bangladesh | 7.1 million |

## MATERIALS AND METHODS

Works of previous finding reported during the period 2009-2017 by different authors were collected from different secondary sources. The content analysis of their findings and conclusions drawn by them were thoroughly analyzed**.**

Key word: "Diabetes study in + State"
Search engine: Google, Google Scholar, NCBI PUBMED

## RESULTS

### Prevalence of type 2 diabetes in North-East India

It is known fact that the prevalence of type 2 diabetes increases all over India and it was also noted that the prevalence was increasing over the years in North-East population. According to the report of diabetes study by ICMR, the prevalence of type 2 diabetes in different states of North-Eastern India differs. We have found a wide regional variation in the prevalence of diabetes and pre diabetes in India, with Meghalaya having the lowest diabetes prevalence (The Shillong Times, 2016). The prevalence of diabetes among the Khasi and Jaintia tribal inhabitants in the urban areas of Meghalaya calculated on the basis of the data generated through the random household survey was 11.2 percent (Don, *et al.,* 2012). Another study have shown that a high prevalence of type 2 diabetes among the adults in Guwahati, Assam in north eastern part of India (Shekhar, *et al.,* 1999), prevalence of diabetes also increases with increasing trend in age. Even in such a background, the population living in the cities has high prevalence of diabetes (Shekhar, *et al.,* 1999). Therefore people living in different parts of India seem to possess an identical risk of diabetes if exposed to urban life style. India has the largest number of diabetics in the world with a 3.8 percent in rural and 11.8 percent in urban adults.

### Women and Men (>140 mg/dl)

The urban women show the highest blood glucose level 9.4 in both Mizoram and Tripura which is followed by Manipur with (8.8%) and Sikkim with (7.8%) while the least is found among the rural women of Meghalaya (4%) whereas in case of men the highest blood glucose level can be seen in Nagaland (11.1%) followed by Mizoram and Sikkim with (10.7%), the least is seen in rural males of Meghalaya.

### Women and Men (>160 mg/dl)

While considering the category of blood glucose level (>160 mg/dl) it is observed that the highest level is found among urban women of Tripura (5.8%) and the least is found in Rural women of Meghalaya with only (1.6%), again for men the highest blood glucose level is seen among the urban men of Sikkim (6.4%) trailed by men of Nagaland (5.7%) and inhabitants of urban and followed by urban males of Tripura (5.4) while the least is observed among the rural male of Sikkim. In all the cases men and women of urban show the higher blood glucose level as compared to rural men and women. Owing to changes in food habit and the adaptation to sedentary life style with easy availability of all needs required for livelihood, people become more inactive. People living in urban prefer to easy going and comfort living that makes no chance to expend the calorie intake that they consumed. Hence, the converted glucose has not been sufficiently utilized resulting to increase in blood glucose level. These are the main reason people living in urban more prone to suffer the chronic diseases like Diabetes, Obesity, Hypertension etc. the disease like diabetes. It is interesting to know that in all the state wise comparison of Northeast, Population of Tripura and Mizoram found to be higher in both the blood glucose level (>140 mg/dl and >160 mg/dl respectively) and the lowest is found among the rural male and females of Meghalaya. The highest prevalence of diabetes was found among the Muslim population of Manipur and Naga population has the least prevalence (Ahsana, *et al.,* 2013).

The prevalence of diabetes is also more among the meat eaters. Muslim show highest percentage of overweight diabetes individuals. The Assamese population the prevalence of diabetes was higher among the obese person than the overweight peer group. The prevalence of diabetes is highly related with body weight, the prevalence increases with increase in body weight. The study conducted in Dibrugarh town, Assam a random screening of diabetes for 12 years and above it was observed that out of the total 2411 sampled the prevalence of diabetes was 9.71%, the factors for increasing in the prevalence of diabetes is physical inactiveness (Medhi, 2017). It was also observed in their study that person suffering from diabetes is increasing day by day and diabetes becomes life threatening disease. Meghalaya, one of the hilly state of North East India, it was reported there is high prevalence of diabetes among the Khasi and Jantia population of Meghalaya (Don, *et al.,* 2012) however, the study was based on hospital survey, and diabetic camp. The prevalence of diabetes increases with increase in age, a work from Arunachal Pradesh have reported high prevalence of diabetes and rise in blood sugar level among the age group of 40 years and above it was also found that the prevalence was higher among the female than male. Majority of the participants (97%) were diagnosed with diabetes after 40years of age (Forhad, *et al.,* 2014). It was observed that frequency of diabetic cases was highest in the age group 50-59 years with prevalence of 32.19% in male and 39.07% in female (Ramachandran, 2010). The overall prevalence of diabetes in Arunachal Pradesh according to the study conducted among 1370 samples is 19.78%. According to INDIAB study5.2 % of prevalence of diabetes and 12.8% of prediabetes was found in Arunachal (The Arunachal Time, 2016).

**Table 1. State wise blood glucose level of North-East India (NFHS)**

| States | Women (>140 mg/dl) | | | Men (>140 mg/dl) | | | Women (>160 mg/dl) | | | Men (>160 mg/dl) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Urban | Rural | Total | Urban | Rural | Total | Urban | Rural | Total | Urban | Rural | Total |
| Arunachal Pradesh | 4.8 | 4.8 | 4.8 | 6.2 | 8.1 | 7.6 | 2.1 | 1.7 | 1.8 | 2.8 | 3.5 | 3.3 |
| Assam | 7.2 | 4.9 | 5.2 | 7.6 | 6.4 | 6.6 | 4.1 | 2.1 | 2.4 | 4.9 | 3 | 3.3 |
| Manipur | 8.8 | 6.8 | 7.6 | 9.1 | 9.4 | 9.3 | 3.7 | 2.6 | 3 | 4 | 4.5 | 4.3 |
| Meghalaya | 5.1 | 4 | 4.3 | 7.9 | 6 | 6.4 | 2.5 | 1.6 | 1.8 | 5 | 2.3 | 2.9 |
| Mizoram | 9.4 | 7.3 | 8.6 | 10.7 | 9.6 | 10.3 | 4.6 | 2.9 | 3.9 | 5 | 3.5 | 4.4 |
| Nagaland | 7.1 | 7.3 | 7.2 | 11.1 | 8.8 | 9.7 | 2.7 | 2.9 | 2.8 | 5.7 | 4 | 4.7 |
| Sikkim | 7.8 | 6.1 | 6.7 | 10.7 | 7.5 | 8.9 | 3.5 | 2.6 | 2.9 | 6.4 | 1.9 | 3.8 |
| Tripura | 9.4 | 7 | 7.7 | 8.9 | 9.9 | 9.6 | 5.8 | 3.2 | 4 | 5.4 | 4.4 | 4.7 |

**Table 2. State wise Diabetes Prevalence**

| Sl. No | State | Title | Author | Year | Population | Sample size | Result In % |
|---|---|---|---|---|---|---|---|
| 1 | Manipur | Risk Factor for Diabetes in Different Populations of Manipur | Ahsana Shah and Mohammad Afzal | April 4, 2015 | Muslim | 72 | 32.58 |
| | | | | | Meitei | 32 | 25.58 |
| | | | | | Naga | 24 | 20.00 |
| 2 | Manipur | Diabetic cardiomyopathy in Manipur | Rothangpui, SachinDeba Singh, Premchand Singh, Lallan Prasad, Romeo K.Singh, and Salam Ranabir | 2011 Jul-Sep; 15 | RIMS | 100 | 40.00 |
| 3 | Manipur | Prevalence of diabetes and hypertension and association with various risk factors among different Muslim populations of Manipur, India | Ahsana Shah and Mohammad Afzal | 2013 Dec 19 | Sheikh | 143 | 23.21 |
| | | | | | Syed | 17 | 10.49 |
| | | | | | Pathan | 42 | 14.05 |
| | | | | | Moghul | 19 | 18.45 |
| | | | | | Meitei | 43 | 14.68 |
| | | | | | Naga | 30 | 10.17 |
| 4 | Assam | Study of Prevalence of Type 2 Diabetes Mellitus and Hypertension in Overweight and Obese People | Abhijit Mandal | 2014 Jan-Mar | Assamese | 300 | Overweight- 15.5 Obese- 20.2 |
| 5 | Assam | Prevalence of type 2 Diabetes mellitus in Dibrugarh town, Assam | R. P. Medhi , B. B. Sutar | January, 2017 | Dibrugarh | 2411 | 9.71 |
| 6 | Meghalaya | Prevalence of diabetes amongst the Khasi and Jaintia population of Meghalaya | Don Syiem | January 2012 | Khasi | | 9.89 |
| | | | | | Jaintia | | 12.5 |
| 7 | Arunachal Pradesh | Prevalence of diabetes mellitus amongst rural hilly population of North Eastern India and its relationship with associated risk factors and related co-morbidities | Forhad Akhtar Zaman and Anita Borang | 2014 Jul-Dec | Upper Siang district of Arunachal Pradesh | 1370 | 19.78 |
| 8 | Tripura | 9% prevalence of diabetes in persons above 30 among survey population | Department of Endocrinology, Diabetes and Metabolism of CMC | April 2009 | Khowai district of Tripura | 144 | 9.00 |
| 9 | Sikkim | Sikkim reports highest number percent of diabetes, hypertension as per NPCDCS screening | Joseph Alexander | October 12th, 2013 | Sikkim | 127,393 | 13.67 |

A survey conducted by a team of doctors from the Christian Medical College (CMC) Vellore and doctors of Tripura and Australia in Jhowai district Tripura, revealed a 9% prevalence of diabetes in person above the age of 30 among the survey population. According to the report based on the screening done under National Program for Prevention and Control of Cancer Diabetes, Cardiovascular Disease and Stroke (NPCDCS), the screening found that 13.67% people among those screened had diabetes, out of total 127393 people screen, 17414 persons have suspected cases of diabetes (Joseph Alexandra, 2013). Exercise is an important measure of primary and secondary prophylaxis in type II diabetes and it also helps regulate blood sugar in these patients (Esteghamati, 2008).

## Summary

Diabetes is found more prevalent among the people who are physically inactive, overweight and obese. Diabetes currently affect more than 69.2 million people and India had 8.7% as per the 2015 data living with diabetes. Of these, it remained undiagnosed in more than 36 million people. In North East the prevalence of diabetes is rising and still most are unaware and undiagnosed. The prevalence of diabetes rises with age, there is no significant difference between male and female as in some states males are higher and in some females are higher. Type 2 Diabetes is also strongly associated with hypertension, alcohol consumption and food habit. While observing globally, nationally and state wise a similar risk factors associated to type 2 diabetes were found while the prevalence vary. There is variation on prevalence maybe because of different lifestyle, environment, food habit, gene factor and different awareness received in different places. Some people already aware of such disease and they live under control while some never had and they remain undiagnosed.

## Suggestion

Future researcher must carried out more studies on type 2 diabetes with association to genes so that the correlation of

genes with diabetes will be well known in North East India also. In North Eastern states of India local alcohol were very common, people depends on local more than foreign liquor. In order to know the significant association there need to conduct a scientific research in different alcohol consumption with Type 2 diabetes. So far no study have been carried out exclusively on food habit and gene association. Since people of North East India consume rice as the staple food there must be high chances of getting diabetes due to high consumption of high carbohydrates. Since there is dramatic changes in lifestyle, people need to get more awareness on such life threatening disease. The study of diabetes is still very few while the prevalence is increasing day by day, there is need of immediate intervention and in-depth study in North East India.

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