

## Case Report

**Diabetes mellitus and foot ulcer: Always challenge to society**Alok Raghav<sup>1\*</sup>, Jamal Ahmad<sup>2</sup><sup>1</sup> Indian Institute of Technology Kanpur, India<sup>2</sup> J.N Medical College, Aligarh Muslim University, India.**Received** December 20, 2017; **Accepted** January 08, 2018; **Published** January 11, 2018

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**Abstract**

Diabetes mellitus and its associated complications are prime cause of morbidity and mortality in India, as the prevalence of diabetes mellitus is on its urge. This increase in prevalence rate of diabetes mellitus needs an economic burden assessment. Diabetes has emerged as major threat in Indian care setting. National and regional surveys strongly favor the increase burden of diabetes. The recent classification of diabetes and its associated complications are needed to be updated with time. The diagnostic criteria of various international bodies efforts to improve the definition and diagnosis of diabetes mellitus with time to time. Diabetes mellitus is an important and chronic public health problem around the globe. Variations are observed around the world contributing to rising in prevalence rate. The present work is an approach for adding knowledge of burden of diabetes and its associated complications in society with up-to date diagnostic and classification of diabetes mellitus.

**Keywords:** Diabetes Mellitus; hyperglycemia; non-communicable disease; global health; glucose.**Introduction**

Diabetes mellitus is a chronic metabolic disease arises due to insulin resistance and insulin insufficiency. Diabetes mellitus is characterized by prolonged hyperglycemia. In one of the study done by European Investigation in cancer and Nutrition (EPIC) delivers that consumption of >5 portions of fresh vegetables and fruits may decrease 10% risk of diabetes development [1]. Zimmet et al. in 1992 quoted “epidemic of diabetes” arises as economic burden and human suffering at an alarming rate [2]. The global prevalence of diabetes mellitus has been found to be

double from 2.8% in 2000 to 4.4% by 2030 [3]. The current prevalence rate of diabetes in India constituting adults (20-79 years) during 2015 was 8.7% according to International Diabetes Federation (IDF 2015) [4]. The economic burden per person with diabetes includes 94.9 US dollar in India [4]. Diabetes mellitus contribute economic burden, among which lower extremity micro-vascular complications contributes in increased toll of morbidity and mortality associated with diabetes mellitus. The common risk factors of diabetes mellitus include unhealthy food consumption, use of adulterated food, pesticides, consumption of alcohol, sedentary life style, physical inactiveness. Diabetes presents major threats and challenges to the patient’s healthcare systems and National financial assets. Furthermore, the impact of few complications and risk

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associated with diabetes results in patient's poverty and burden to national economic development program. Therefore and combinatorial approach including knowledge of cost-effectiveness and reducing diabetes related complications are necessary step for the upcoming society that will contribute in national economic burden. In India, the present policies are hindered by primarily two factors (i) extrinsic factors: include below focus on non communicable disease due to high priority on infectious and communicable diseases (ii) intrinsic factors: includes lack of sufficient data to rule out precise policies. These two factors discourage the management of diabetes in India and along with economic burden. The present review focuses on recent diagnostic criteria of diabetes mellitus, risk factors associated with it, economic burden associated with the micro-vascular complications particularly related to lower extremity amputations.

### Current prevalence in India

The first study in India related to Type 2 diabetes prevalence rate showed 2.1% and 1.5% in urban and rural population respectively. Table 1 showed the subsequent prevalence rate of diabetes in India cities wise. The previous literature on non-communicable diseases (NCDs) showed prevalence of 7.3% in urban areas, 3.2% pre-urban/slum and 3.1% in rural areas [5]. In the year 2000, India topped the outmost position with 31.7 million people with diabetes mellitus among other countries around the globe followed by China [20.8 million] and the United States (17.7 million) on second and third position respectively. Wild et al. clearly state the prevalence of diabetes mellitus to double globally from 171 million in 2020 to 366 million in 2030 with a maximum number of incidences in India [6].

Preliminary results obtained from a large population-based study conducted by Indian Council of Medical Research (ICMR), New Delhi, revealed that lower mass of population is affected by diabetes in states of Northern India showed in table 1. Chennai Urban Rural Epidemiology Study (CURES) established the undiagnosed-prevalence rate of 9.1%. Similarly, Amrita Diabetes and Endocrine Population Survey (ADEPS) showed a prevalence rate of diagnosed and undiagnosed as 9.0% and 10.5% respectively [7]. Kashmir Valley has undiagnosed diabetes prevalence rate of 4.25% [8]. The individuals who are undiagnosed for diabetes mellitus and left untreated are more prone to micro-vascular and macro-vascular

complications, thus it is strictly necessary to diagnose the precise and accurate prevalence rate of diabetes mellitus in Indian population. A study on the prevalence of diabetes in India study (PODIS) also reported the prevalence rate of diabetes in urban and rural population as 4.7% and 2.0 % respectively according to ADA criteria and 5.6% and 2.7% respectively according to WHO criteria [9].

Cities	Prevalence Rate (%)
Chandigarh	13.6
Tamil Nadu	10.4
Punjab	10.0
Tripura	9.4
Andhra Pradesh	8.4
Maharashtra	8.4
Karnataka	7.5
Gujarat	7.1
Mizoram	5.8
Assam	5.5
Jharkhand	5.3
Manipur	5.1
Arunachal Pradesh	5.1
Meghalaya	4.5
Bihar	4.3

**Table 1:** Prevalence of diabetes in major regions of India (21)

### Global economic burden of diabetes mellitus

Diabetes imposes a huge economic and social burden on the national healthcare system accounting for 11.6% of total healthcare expenditure budget in the World 2010. In 2010 diabetes management and treatment need 376 billion USD that will enhance up to 490 billion USD in 2030. Average expenditure per person to treat and manage diabetes mellitus and its associated complications required USD 703 globally in 2010. The disparity in healthcare expenditure between regions and countries is the prime cause for creating an imbalance in diabetes prevalence around the globe. A report of International Diabetes Federation (IDF) on the economic status of diabetes published in 2010, described that more than 80% of the worldwide healthcare expenditure spent in World's richest countries. Statistical figures on global healthcare expenditure on diabetes showed that the North American and Caribbean region spend alone USD214 billion in 2010, African region with USD1.4billion, United

States of America with USD198 billion and India with the expenditure of USD2.8 billion (International Diabetes Federation, 2010). In another report of IDF, North America, and Caribbean Region spent together a sum of USD310 billion (IDF Diabetes Atlas estimates of 2014 global health expenditures on diabetes).

Diabetes associated healthcare expenditure includes medications, supplies, hospital care, as well as treatment, investigations of secondary complications associated with diabetes mellitus such as nephropathy, retinopathy, neuropathy, amputation and cardiovascular disease. The presence and severity of complications, as well as co-morbidity conditions, are the most important determinants of treatment and monitoring costs as well as the need for hospitalization are important factors related to costs. Studies have already shown that the uneducated, unemployed people, especially those living in semi-urban or rural areas who cannot afford or do not have access to even bare minimum health care facilities, are likely to be diagnosed late, develop or have at presentation diabetes-related complications. Financial assets of Indian economy on healthcare lies in the hands of the private sector [10]. The socio-economic impact assessment of diabetes in India is vital for functioning of Indian economy for several reasons. Prime most reason is India being the diabetes capital of the World [11].

### **Economic burden in India**

A previous literature published in 2007 suggested sufficiency of USD 2.2 billion to treat all diabetes type 2 cases in India [12]. Second reason for concerning healthcare expenditure is that by 2025, the most population within the age group 45 to 64 years in developing countries will develop diabetes mellitus thereby threaten the economic productivity and stability. In India, a recent study showed total annual budget spent for diabetes care management was US \$227 in urban areas and US \$142 by rural areas [13]. There was an increase of 113% in total expenditure of annual budgets from 1998 and 2005 in urban section population. It is to be concluded that medical expenditure incurred by an patients with diabetes mellitus are 2 to 5 fold higher than expenditure made by the healthy person without diabetes. In India data suggest that 85-95% of health-care expenditure is borne by individuals from their household income [13]. For diabetes care management system the direct expenses consume 27-34% of household incomes of rural and urban people

while middle to high income population in rural and urban areas consume 5.0-12.6% and 4.8-16.9% of household income respectively [13]. Data also suggest that prevalence rate of abnormal hyperglycemic events in diabetes are almost double in high income group compared to low income groups [13]. The reverse trend was shown in prevalence of co-morbid cardiovascular risks and micro-and macro-vascular complications among the groups [13]. The two most prevalent landmark studies on economic burden of diabetes in India includes (i) The cost of diabetes in India (CODI) and (ii) Bangalore urban district (BUD) that showed occurrence of disabling complications and later age at diagnosis of diabetes were severely associated with lack of awareness, unemployment, lack of education and awareness [13]. According to CODI study, ambulatory care includes 65% cost, hospitalization 35% cost, therapy 31%, anti-diabetic

drug 17% [13]. In India over 70% population lives in rural area with extremely low awareness for chronic disease. The ratio of unknown to known diabetes incidences is 3.3:1 whilst the urban area has ratio of 1.8:1 [13]. In a study it was shown that economic burden of diabetes care in population in developing nations rising rapidly [13].

### **Current diagnostic criteria of diabetes mellitus**

Diabetes may be diagnosed on the basis of plasma glucose criteria using fasting plasma glucose [FPG] or the 2-h plasma glucose after 75-g oral glucose tolerance test (OGTT) or also on the basis of HbA1c criteria. The same test can be used for diagnosis of diabetes in individuals with pre-diabetes. The diagnosis of diabetes mellitus was made in accordance with the guidelines laid down by American Diabetes Association (ADA), 2016 as mentioned in table 2.

### **Epidemiology of diabetic foot disease**

The lifetime risk of developing diabetic foot ulcer in person with diabetes could be as high as 25%. The economic burden of diabetic foot complications is set to increase in future due to increase in contributory factors such as peripheral neuropathy and vascular disease. In one previously published study it has been shown that foot-care service and management can be associated with reduction in amputations events in patients with diabetes mellitus [14]. The lower limb complications in patients with diabetes mellitus include peripheral neuropathy, Charcot arthropathy, foot ulcers, infections,

multidrug resistance and lower extremity amputations [15]. In India the prevalence of diabetic foot ulcers in patients with diabetes mellitus is 3% compared to western population [15]. It is estimated that incidence of diabetes accounts for > 50% of amputations and of which 85% are of lower limb amputations in patients with diabetes mellitus belongs to foot ulcers [15].

<b>FPG <math>\geq</math>126 mg/dL (7.0 mmol/L). Fasting is defined as no caloric intake for at least 8 h.</b>
<b>OR</b>
<b>2-h PG <math>\geq</math>200 mg/dL (11.1 mmol/L) during an OGTT with 75 g anhydrous glucose.</b>
<b>OR</b>
<b>A1C <math>\geq</math>6.5% (48 mmol/mol).</b>
<b>OR</b>
<b>In a patient with classic symptoms of hyperglycemia or hyperglycemic crisis, a random plasma glucose <math>\geq</math>200 mg/dL (11.1 mmol/L).</b>

**Table 2:** Criteria for the diagnosis of diabetes

### **Economic burden in diabetic foot ulcer**

Sixty nine percent studies conducted in the field of diabetes included complications and their evaluation of the cost arising in the management. The number of diabetic complications per patients was found to be positively correlated with the patient’s healthcare expenditure [16-17]. A study from South India (Chennai) surveyed from 2008 and 2009 estimated that costs for patients without diabetes were 4,493 Indian Rupees (US Dollar 92.15) compared to patients with diabetes with complications (14,691.75 Indian rupees; US Dollar 301.32) [18]. Diabetic foot complication incurred highest expenditure of budget among the various complications associated with diabetes mellitus. It is estimated that patients with foot complications spent four times than the patients with no complications. Furthermore, patients with renal disorder, cardiovascular disorder and retinopathy spent three times more than the patients without complications [19].

### **Risk Factors for Diabetic Foot Ulcers**

Most common hazardous risk factors associated with the development of the diabetic foot ulcers includes auxiliary foot

deformity, diabetic peripheral neuropathy, microbiological infection, ulcerations and peripheral arterial disease. Furthermore, poor glycemic control also contributes more in the diabetic foot ulcers along with obesity and limited joints mobility. It is important to reduce the risk factors, for minimizing the economic burden associated with it [20].

### **Conclusion**

Diabetes mellitus is a major health concern to global population and is widely associated with several micro and macro-vascular complications. The prevalence rate of diabetes is increasing dramatically proving a serious threat to upcoming generations. This review focused on the major issues of economic burden of diabetes and its associated lower limb complications. The direct and indirect benefit of this work is to provide a gentle message to the welfare of mankind.

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