

# Epidemiology of Type-I Diabetes and its Economic Burden on Society

ALIA LIAQAT<sup>1</sup>, SADAF NAZ<sup>2</sup>, MUHAMMAD ABDUR REHMAN KHADAM<sup>3</sup>

## ABSTRACT

**Background:**-Type 1 diabetes (T1D) is an autoimmune disorder characterized by the destruction of pancreatic beta cells. Immunological, genetic and environmental factors are involved in the pathogenesis of T1D. The incidence of type I diabetes (T1D) is increasing at an alarming rate in the whole world. An epidemiological survey is required to get the better picture of disease frequency and vulnerable population.

**Objectives:**-The current study was designed to identify the risk factors and economic burden of T1D on society in Lahore, Punjab, Pakistan.

**Methods:** The epidemiological study was carried out from January 2016 to June, 2016 and 40 visits were made in public sector hospitals. A total of 150 (Male=77, Female=73) patients were included in the study; their gender, age, age of diagnosis, duration of T1D, Body Mass Index (BMI), family history, physical activity, education, medication cost and income.

**Results:**-Patients with T1D of different age groups were 0-5 years (Males=24.67%, Female=12.333%), 6-10 years (males=22.5%, female=31.5). Highest number of T1D patients was recorded in age group < 10 years (Male= 53.24, female=56.16). Maximum number of patients were diagnosed with T1D at age less than 10 years (Males = 66.23%, Females = 58.9%). BMI data showed that 53.25% of males and 60.27 of females were underweight (BMI < 18). Maternal positive history of T1D was observed to be the strong predictor of disease onset (Males = 51.9%, Females = 43.8%). Most of the patients were with duration of 0-5 years (male=63.63, female=67.12) than other groups while lowest number were observed in disease duration of more than 10 years (male=19.48, female=13.69). No significance was found between family history and BMI (P > 0.05). BMI was independent of gender, diagnosis and physical activity (P > 0.05).

**Conclusion:**The study demonstrated that T1D is a chronic disease effecting health of children and young adults, causing huge direct as well as indirect economic losses to the society. However, there is a need of a large scale systematic survey to get the clearer picture of disease incidence and susceptible population.

**Keywords:**Diabetes mellitus, Type-I diabetes, BMI

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## INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disease in which body fails to maintain concentration of blood glucose level<sup>1</sup>. There are three types of diabetes, noninsulin dependent diabetes mellitus (NIDDM), insulin dependent diabetes mellitus (IDDM), and gestational diabetes mellitus (GDM)<sup>2</sup>. Type-1 diabetes (T1D) is insulin dependent type<sup>3</sup> which is characterized by destruction of pancreatic B-cells. Type 2 diabetes (T2D) is characterized by disorders of secretion of insulin and its action (Bellamy et al., 2009). Type 1 diabetes (T1D) is an autoimmune disorder characterized by the damage of insulin-

Email: [alialiaqat6@gmail.com](mailto:alialiaqat6@gmail.com) cell: 03338916201

producing cells of pancreas, which results in high glucose level i.e. hyperglycemia. It is a chronic illness with no known cure. T1D occurs most often in children and young adults. There is evidence that this disease can be passed from one generation to the next, thus it has a genetic component to it. The cause of T1D is unidentified. Development of the disease is the result of interactions between immunological, genetic, and environmental factors. The disease is associated with severe problems that runs the quality of life of individuals. T1D patients mostly have two types of complications; acute (characterized by quick manifestation and cure) and chronic (may take years or decades to develop). These complications may lead to serious disabilities or death).

Close relatives like, first and second degree relatives are documented to be a risk factor for T1D. Human genome has almost identified 18 regions associated with T1D risk<sup>4</sup>. The most significant genes

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<sup>1</sup>M.O. Primary and Secondary Health Care Punjab, Medicine Department. Allied Hospital,

<sup>2</sup>Ph.D. Scholar, Institute of Microbiology, University of Agriculture, Faisalabad,

<sup>3</sup>Third Year MBBS (PMC).

Correspondence to Dr. Alia Liaqat

which contribute to T1D vulnerability are located on chromosome number 6<sup>5</sup>.

The incidence of T1D is growing worldwide, both in low and high incidence populations<sup>6</sup>. Geographically, incidence rate of T1D varies conspicuously in children all over the world. The lowest yearly incidence rate is reported in Europe, with a frequency of 3.2/100,000 in children under the age of 14 years (The European ACE Study Group 2006) whereas the highest incidence rate was reported in Finland, amounting to 63/100,000 in 2007<sup>7</sup>. In China, the incidence rate of T1D is lower. In children of age 0-14 years with T1D, the incidence rate is estimated at 0.5 per 100,000. The incidence rate of T1D was low in south Asia as compared to Europe. Studies showed that, in south Asian incident rate of T1D in children was nearly equal to that of UK till 1999. In south Asia, Incidence rate of T1D was low but an excess of T2D is present which apparently shift from diagnosis of T1D to T2D from 2000 to onwards<sup>8</sup>. Studies have shown that moving from a low incidence area to a high incidence region is associated with an increase in incident rate, documenting the influence of environmental factors<sup>7</sup>.

## MATERIAL AND METHODS

The epidemiological study was carried out from January 2016 to June 2016 and 40 visits were made in public sector hospitals. A total of 150 (Male=77, Female=73) patients were included in the study; their gender, age, age of diagnosis, duration of T1D, Body Mass Index (BMI), family history, physical activity, education, medication cost and income. Data was analyzed by GraphPad Prism 6 and SPSS version 18.

According to WHO criteria (2008), patients were included in the study, on the basis of the symptoms i.e. autoimmune response, beta cell destruction, increased thirst, unexplained weight loss, urine volume, coma in very severe cases

## RESULTS

A total of 700 patients with both T1D and T2D visited hospitals during the course of present study. Out of 700, 150 (Male=77, Female=73) were of T1D. The overall estimated incidence of T1D among all diabetic patients was 21.42%. Demographic data is shown in table-I. Correction of BMI with other demographic characteristics of patients (Table-II). Correlation of annual disease management cost with demographic characteristics of patient (Table-III).

Table-I: Management of T1D patients

Parameter	Male	Female
Physical activity	73.7%	78%
Increased frequency of Urination	75%	71.2%
<b>Parent's education</b>		
Illiterate	41.5%	31.5%
Primary	13%	13.7%
Middle	18.2%	26%
Intermediate	19.5%	23.3%
Graduation and above	07.8%	05.5%
<b>Diet</b>		
Grains	44.1%	32.1%
Carbohydrates	01.2%	01.4%
Proteins	06.5%	01.2%
Fats	05-2%	01.2%
Frits/salads	42.8%	43.8%
<b>Meals/day</b>		
1 item	14.5%	06.8%
2 items	59.7%	65.5%
3 items	09.0%	11.0%
4 items	06.9%	05.5%
5 items	10.4%	09.6%
<b>Visit to physician</b>		
Weekly	09.1	10.0
Bimonthly	68.8	71.2
Monthly	22.1	19.2

Table-II: Correction of BMI with other demographic characteristics of patients

Parameter	95% confidential interval	P-value
Gender	0.036610849- 1.920)	0.970
Duration	-0.280(-1.533 - 0.973	0.660
Diagnosis	-0.004(-0.153 - 0.146	0.963
Family history	-0.409(-1.194 - 0.375	0.304
Annual cost	-3.049(0.000- 0.000	0.989
Physical activity	0.879(-3.086 - 1.327	0.432

Dependent variable: BMI

Table III: Correlation of annual disease management cost with demographic characteristics of patient

Parameter	95% confidential interval	P-value
Duration	-752.123(-5501.437-3997.191)	0.755
Family income	-1768.224(-10109.054-6572.606)	0.676
Physical activity	5833.686(1300.896-10366.477)	0.012*

Dependent variable: Annual cost

\*The significant association annual T1D cost with family income.

## DISCUSSION

Diabetes mellitus (DM) with onset in childhood represents one of the most frequent chronic diseases in children and young adults. The incidence of type I diabetes (T1D) is increasing at an alarming rate in the

whole world<sup>9</sup>. However, a large variation in the TID incidence rate has been reported worldwide<sup>10</sup>.

The current study revealed that the risk of onset of TID increases with growing age. There was a progressive increase in the number of TID patients from 0 to 10 years of age. However, the highest numbers of TID patients were seen in children with an age of more than 10 years. In line with our observations, the study conducted in European population revealed that the incident of TID is higher in age group > 10 years. Moreover, the incidence of disease was least in children aged 0-4 years which increased in children between the ages of 5 to 9 years (Diamond project group, 2006). A follow-up study conducted in Europe and North America showed that the TID was more common in people aged 15-29 years than in people aged 0-14 during 1930s. Nevertheless, the trend of disease is reversed in 1970s with higher number of patients in younger age group. In contrast, the previous study demonstrates that rate of TID as a function of age at onset increased to 6.3%, 3.1% and 2.4% in children aged 0-4 years, 5-9 years and 10-14 years respectively, suggesting most obvious augmented incident rate in group under 5 years of life<sup>11</sup>.

The current investigation also reported an almost equal incidence of TID in both male and female patients. However, in contrast to the finding of current study, the research conducted in European, Japanese and North American population showed a Sexual dimorphism with more female diabetic patients than males. However, in line with our observation, they showed increased incident of TID in girls aged more than 12 years<sup>12</sup>. Moreover, a multicenter survey conducted in 248 centers across Germany and Australia showed that TID is more common in population greater than 20 years of life with higher prevalence in females<sup>13</sup>.

The incident of TID is highest in underweight children followed by normal and overweight children in local human population in the present investigation. The research conducted and supported the finding of current study. They reported that the age of patients diagnosed with TID had a lower BMI than the reference population in all age groups at diagnosis. Furthermore, a countrywide survey conducted in German/Austrian population showed that the lower BMI in females leads to TID. However, the complications associated with TID results in increased BMI in female patients at later stages of disease<sup>13</sup>. Contrary to our observations, the previous study conducted in Norwegian population which showed that higher BMI in childhood independently increased the risk of TID at later ages.

The current study reported a strong association of family history with incidence of TID in the local human population. However, the maternal history of diabetes increases the risk of disease in children. In line with our observations the study conducted in Bangladesh showed that Type-I diabetes was associated with the family history of diabetes mellitus among one-fifth of the respondents (Karim, 2014).

The present investigation demonstrates that TID was diagnosed before 10 Years of age in majority of the patients. The diagnosis of TID patients was lower between the ages of 10 and 20 years and very few cases of TID were reported in Patients of more than 20 years of age. A recent study conducted in European population also reported the diagnosis of TID at a younger age<sup>11</sup>.

In the current study, the annual treatment cost was found to be significantly associated with family income. The average annual cost was 35537 PKRs (338.65 US\$) per TID patient. During 2010, the annual cost for TID was \$23,137 (17,288 to 28,986) in U.S. However, the estimated economic cost per person was \$700 annually regardless of diabetes status (Tao et al., 2010). There are about 1.1 million reported patients of TID in US and the estimated present value of their expected lifetime medical direct and indirect costs is \$134.7 billion (98.0 billion to 171.4 billion) and \$290.2 (212.7 billion to 367.7 billion), respectively (Tao et al., 2010). Furthermore, a recent population based survey showed that TID patients in youngest age groups and on insulin replacement therapy have six to sevenfold higher direct cost than non-diabetic people (Singh, 2011). In addition, a survey conducted by health professionals to rate family burden of TID patients showed that the economic burden in two-parent families was significantly lower than that of single-parent families<sup>12</sup>.

## CONCLUSION

In conclusion, the present study validates that TID is a chronic disorder affecting health of children and young adults and causing huge direct as well as indirect economic losses to the society. However, there is a need of a large scale systematic survey to get the clearer picture of disease incidence and susceptible population.

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