Volume 25 Issue 04, 2022 ISSN: 1005-3026 https://dbdxxb.cn/ Original Research Paper

TYPE 2 DIABETES MELLITUS: ITS PERSPECTIVE AND CHALLENGES AMONG THE YOUTHS

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Abstract

Diabetes is an iceberg disease. Chronic hyperglycemia, from whatever cause, leads to a number of complications – cardiovascular, renal, neurological, ocular and others such as intercurrent infections. The number of people falling prey to this deadly disease is increasing at an alarming rate. Particularly, the increasing number of children and adolescents with Type 2 diabetes, which is generally an adult onset form of the disease, is raising a problem of worry in the society. In this paper, an attempt has been made to study the prevalence of Type 2 diabetes among the youths of Assam based on data collected on 280 diabetic patients whose age at onset of the disease was below 25 years. The study suggests that the prevalence of Type 2 diabetes can be prevented by maintaining normal body weight, adopting healthy nutritional habits like a high intake of dietary fibre and avoiding sweet foods, smoking and diabetogenic drugs like oral contraceptives.

Keywords: Diabetes Mellitus, Type 2 diabetes, Youth.

1. Introduction

Once regarded as a single disease entity, Diabetes Mellitus, commonly known as diabetes is now seen as a heterogeneous group of diseases. The underlying cause of this disease is identified as the defective production or action of insulin, a hormone that controls glucose, fat and amino acid metabolism. Characteristically, diabetes is a long term disease with variable clinical manifestations and progression. It leads to a number of serious health complications such as cardiovascular diseases, renal disease, neurological disorder, and others intercurrent infections.

There are about 285 million people in the world who are affected by diabetes. In 2015, an estimated 1.6 million deaths all over the world were directly caused by diabetes. The World Health Organization has projected that diabetes will be the seventh leading cause of death in 2030. And as of India, it has become the "Diabetes Capital of the World" with over 60 million diabetics in the country that is projected to be at least double by 2030. The country ranks second between China (90 million) and USA (24 million). About 17% of the population of the country have diabetes and about 77 million are considered to be pre-diabetic, which refers to those

Submitted: 03/12/2022 **Accepted**: 24/12/2022

individuals who have higher than normal blood glucose levels, but not high enough to categorize them as diabetic. The number of deaths due to diabetes in India was 3.46 lakhs in 2015 which accounts for 3.3% of all deaths that year (Global Burden of Disease Report, 2015). In case of Assam, 4% of its total population is identified as diabetic. These figures are increasing alarmingly day by day.

Especially, the increasing number of children and adolescents with Type 2 diabetes, which is generally an adult onset form of the disease, is raising concern among the health professionals. Type 2 DM in children has recently been recognized as a potential public health problem in North America (Fagot, 2000). Previously an adult onset disease, type 2 diabetes mellitus is now being diagnosed more and more in childhood and adolescence. (Tieh and Drimane, 2013). Diabetes, one of the leading chronic diseases in childhood, affects more than 1,90,000 youth aged less than 20 years in the U.S. (Pettitt, et al., 2014).

Many studies have been undertaken to study the prevalence of type 2 diabetes among the youths in different parts of the world. However, in the Indian context the number of such studies is very few. Thus, in this paper, an attempt has been made to study the impact of type 2 diabetes among the youths of Assam.

2. Materials and Methods

The data required for the present study have been collected from the hospital based records of diabetic patients for the last 10 years (2010-2019) who visited the Assam Medical College and Hospital (AMCH) for their treatment. From these, we have selected only those cases where the age of the patients were 25 years or less at the onset of the disease and the number of cases were found to be 280. The data contains information such as age at onset, present age, sex, economic status, family history of diabetes, height, weight, systolic and diastolic BP, clinical classification, lifestyle modification, diet and exercise. A portion of the collected data is shown at the beginning of the analysis.

For the purpose of analysis, the following methodologies were adopted.

2.1. Wald Wolfowitz Run Test

At the very beginning, we have tested for randomness in the dataset using the Wald Wolfowitz Run Test.

The hypotheses of interest here are:

H_0 : The sequence is random.

H_1 : The sequence is not random.

Let, U = no. of runs = $r_1 + r_2$

Then using critical values of U (or p-value) we can take decision accordingly. When sample size n is large (n≥25), we can use approximate test for U in Wald Wolfowitz Run test,

$$E(U) = \frac{2n_1n_2}{n_1+n_2} + 1$$

$$V(U) = \frac{2n_1n_2(2n_1n_2-n_1-n_2)}{(n_1+n_2)^2(n_1+n_2-1)}$$

$$Z = \frac{U-E(U)}{\sqrt{V(U)}} \quad \ldots\ldots\ldots\ldots (2.1)$$

Since it is a two tailed test, we have to reject H_0 with α, if $|Z| > Z_\alpha$ or p-value < $\frac{\alpha}{2}$.

2.2. Test for normality

The normality of the data is tested using the normal probability plot.

2.3. Test for single proportion

Suppose p_0 is the assumed proportion.

To test $H_o : p = p_0$ vs $H_1 : p \neq p_0$

The test statistic is

$$Z = \frac{\hat{p}-p_0}{\sqrt{p_0(1-p_0)/n}} \sim N(0,1) \qquad \ldots\ldots\ldots\ldots\ldots\ldots(2.2)$$

where, $\hat{p}$ = estimated proportion,

p_0 = assumed proportion.

Reject H_0 if $|Z| > Z_{\alpha/2}$.

2.4. Odds Ratio

Let us define, X : exposure
X = 1, if exposed
= 0, if unexposed

Y : disease status
Y = 1, if with the disease
= 0, if without the disease

Thus, odds ratio is defined as

$$OR = \frac{pr(X=1/Y=1)/pr(X=0/Y=1)}{pr(X=1/Y=0)/pr(X=0/Y=0)}$$

$$= \frac{p_{00}p_{11}}{p_{01}p_{10}} \qquad \ldots\ldots\ldots(2.3)$$

where, p_{oo} is the probability that a randomly selected person does not have the risk and also does not have the disease, p_{11} is the probability that a randomly selected person have both the risk and the disease. Similarly, p_{01} and p_{10} are defined.

To test the hypotheses: H_0: OR = 1 or H_0: log OR =0
against H_1: OR>1 H_1: log OR > 0

We have the test statistic,

$$Z = \frac{log\widehat{OR}}{SE(\log\widehat{OR})} \sim N(0,1) \qquad \ldots\ldots\ldots(2.4)$$

where, $$SE(\log\widehat{OR}) = \sqrt{\frac{1}{a}+\frac{1}{b}+\frac{1}{c}+\frac{1}{d}}$$

reject H_0 if $Z > Z_\alpha$

2.5. Logistic Regression

The most widely used model for predicting risk, R, for exposure, X, is logistic regression model.

Logistic regression is the most suitable model where the dependent variable (here response) is dichotomous. In such cases, dependent variable is observed as 0 or 1.

We have, R = risk of disease in the population due to exposure X

where, X: exposure
X = 1, if exposed
= 0, otherwise.

Then, logit (logistic integrated transformation) of $\hat{R}$ is given by-

$$\hat{\lambda} = log\frac{\hat{R}}{1-\hat{R}} = \beta_0 + \beta_1 X \quad \text{........ (2.5)}$$

$$or\ \hat{R} = \frac{1}{1+e^{-(\beta_0+\beta_1 X)}} \quad \text{....... (2.6)}$$

Thus, the logistic model can be written either in form (2.5) or (2.6).

Define, R_1 = chance (risk) of disease in exposed group,

R_2 = chance (risk) of disease in unexposed group,

ω_0 = odds of disease to no disease in exposed group,

ω_1 = odds of disease to no disease in unexposed group.

Then,

$$\omega_0 = \frac{R_0}{1-R_0} = \beta_0$$

$$\omega_1 = \frac{R_1}{1-R_1} = \beta_0 + \beta_1$$

$$\therefore OR = \frac{(R_1/1-R_1)}{(R_0/1-R_0)} = \frac{\omega_1}{\omega_0} = \frac{R_1(1-R_0)}{R_0(1-R_1)}$$

$$log_e OR = log\frac{(R_1/1-R_1)}{(R_0/1-R_0)}$$

$$log_e OR = log\frac{R_1}{1-R_1} - log\frac{R_0}{1-R_0}$$

$$=\beta_0 + \beta_1 - \beta_0 \quad = \beta_1$$

i.e., $log_e OR = \beta_1 \quad \Rightarrow OR = e^{\beta_1}$

We reject the null hypotheses $H_0 : log_e OR = 0$ or $H_0 : \beta_1 = 0$, if 0 is not included in the interval (A,B), say.

All the analysis have been done using the IBM SPSS software.

3. Analysis and Results

A portion of the collected data in shown in the table below:

Table 3.1.: Collected Data

Sl.no	Age at Onset	Present age	Sex	Economic status	Height	weight	Clinical classification	Life style modification	diet	exercise
1	17	17	M	Low	161	37	Type 1	yes	no	yes
2	23	23	M	Medium	165	64	Type 2	yes	yes	yes
3	14	16	F	Low	163	50	Type 1	no	no	no
4	20	24	M	High	175	73	Type 2	yes	yes	yes

5	15	15	M	Low	169	35	Type 2	yes	yes	yes
. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
280	14	15	F	Low	160	38	Type 1	no	no	no

3.1. Test of randomness:

First of all let us see whether the collected data is random or not. For this we shall use the run test on our data with runs being male and female young diabetic patients. The runs are considered as-
111001000101…
Here, 1 stands for female young diabetic patients and 0 stands for male young diabetic patients.
The hypotheses of interest are H_0: the data is random. vs H_1: the data is not random.
Let us fix, $\alpha = .01$

Table 3.2.: Wald Wolfowitz runs test

Item	Sex
Test Value[a]	1
Cases < Test Value	115
Cases >= Test Value	165
Total Cases	280
Number of Runs	136
Z	-.066
Asymp. Sig. (2-tailed)	.947

a. Median

We have to reject H_0 if p-value < $\alpha/2$, i.e., if p-value < .005
From table 3.2 we have the p-value = .947. So, we fail to reject H_0 and thus we may conclude that the data is random.

3.2. Test of normality:

For the test of normality, we use the data for present age. For this we use Normal P-P plot (using SPSS) as shown in the figure 3.1

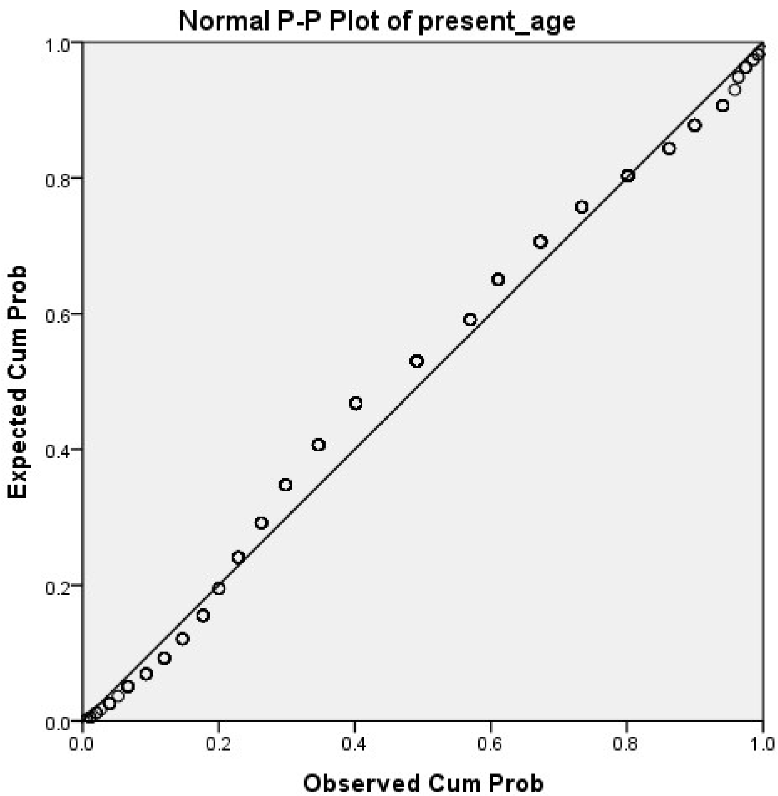

Fig 3.1: Normal Probability Plot

From the Fig.3.1 above, it can be said that the data is drawn from a normal population and this ensures the validity of Z-test, t-test in our analysis.

3.3. Test of single proportion w.r.t. sex:

Previous studies have claimed that female diabetic patients are less than those of males. To test whether this claim is true or not, we have conducted the test of proportion in our data as discussed below.

Define, p = proportion of female young diabetic patients

p_0 = given proportion = 1/2

We set our hypotheses as:

H_0: $p = p_0 = ½$ vs H_1: $p < 1/2$

If we define, X = 1, if female

= 0, if male

Then X~Ber(p)

Now, $\hat{p}$ = estimated proportion of female young diabetic patients = 115/280 = 0.41

We have, $Z = \frac{.41-.5}{\sqrt{.5(1-.5)/280}} = -3$

Since, Z < -1.645, therefore we reject H_0 to accept H_1 and we can infer that the number of female diabetic patients are less than their male counterparts.

3.4. Inference with odds ratios:

3.4.1. OR for association between sex and family history of diabetes:

Claim: chance of being in positive family history group is more among female

Define, X: sex   Y: family history

X = 1, if female   Y = 1, if +ve

= 0, if male   = 0, if –ve

We have the following table 3.3 which is the cross table of sex and family history of diabetes.

Table 3.3.: Sex * family history of diabetes

Sex	**Family history of diabetes**		**Total**
	Y=1	Y=0	
X=1	43	72	115
X=0	49	116	165
Total	92	188	280

Here,

$$OR = \frac{odds\ of\ positive\ family\ history\ to\ negative\ family\ history\ of\ diabetes\ among\ females}{odds\ of\ positive\ family\ history\ to\ negative\ family\ history\ of\ diabetes\ among\ males}$$

We are to test, H_o: OR = 1   or H_o: $\log_e$ OR = 0

H_1: OR > 1   or H_1: $\log_e$ OR > 0

Using formulae (2.3) and (2.4), we obtain the odds ratio and its significant value as follows:

OR = 0.60/0.42 = 1.42 and

Z = 1.80 > 1.645

Thus, we reject H_0 and conclude that there is a significant association between sex of the patient and family history of diabetes and the chance of having positive family history of diabetes is 42 % more among female young diabetic patients than their male counterparts.

And the odds of having positive family history of diabetes among female young diabetic patients are 6:10 and for males it is 4:10.

3.5.1 OR for association between type 2 diabetes and socio economic status of the patients.

Here, we consider the low economic status group as the reference category to find the odds ratios.

$$OR = \frac{odds\ of\ type\ 2\ diabetes\ to\ other\ types\ of\ diabetes\ in\ exposed\ group}{odds\ of\ type\ 2\ diabetes\ to\ other\ types\ of\ diabetes\ in\ unexposed\ group}$$

We are to test, H_o: OR = 1   or H_o: $\log_e$ OR = 0

H_1: OR > 1   or H_1: $\log_e$ OR > 0

Using formulae (2.3) and (2.4), we obtain the odds ratios and its significant values which are shown in the following table:

Table 3.4.: Table for computing ORs and its significance for economic status

Socio-economic status	**Type 2 diabetes**	**Other type of diabetes**	**OR**	**Z-value**

Low	36	94	1	
Middle	79	65	3.17	7.51
High	3	3	2.61	1.14

Here, the value of Z is significant only for the middle class group. The chance of having type 2 diabetes is 3.17 times more among the middle class people in comparison to the low class people. But though the chance of having type 2 diabetes is 2.61 times more among the high class people in comparison to the low class people but this result is not statistically significant.

3.6 Prediction of risk with logistic regression:

Let us define, Y: type of diabetes
Y = 1, if type 2
= 0, otherwise
X_1: diet maintenance
X_1 = 0, if yes
= 1, if no
X_2: regular exercise
X_2 = 0, if yes
= 1, if no
X_3: life style modification
X_3 = 0, if yes
= 1, if no
X_4: BMI
X_4 = 0, if 18 - 24.9
= 1, if <18.5
= 2, if >25
We have the logistic model as:

$$\hat{\lambda} = log\frac{\hat{R}}{1-\hat{R}} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4$$

The SPSS output for the values of the coefficients are:
β_0 = -1.580
β_1 = 0.423
β_2 = -0.301
β_3 = 1.489
β_4 = 0.092

$$\therefore \hat{\lambda} = log\frac{\hat{R}}{1-\hat{R}} = -1.580 + 0.423X_1 - 0.301X_2 + 1.489X_3 + 0.092X_4$$

Now a person with lowest risk (i.e., X_1 = 0, X_2 = 0, X_3 = 0, X_4 = 0) have

$$\therefore \hat{\lambda} = log\frac{\hat{R}}{1-\hat{R}} = -1.580$$

and odds = ω_0 = $e^{\hat{\lambda}}$= 0.206
and a person with highest risk (i.e., $X_1 = 1$, $X_2 = 1$, $X_3 = 1$, $X_4 = 2$) have

$$\therefore \hat{\lambda} = log\frac{\hat{R}}{1-\hat{R}} = 0.215$$

and odds = $\omega_1 = e^{\hat{\lambda}}$ = 1.239

$$\therefore OR = \frac{0.206}{1.239} = 6.02$$

Thus, the chance of getting type 2 diabetes for a person in the highest risk group is 6 times as likely as that of a person in the lowest risk group.

4. Findings and Discussions

In this paper, an attempt has been made to study the prevalence of type 2 diabetes among the youths of Assam and the extent of the effects of its related complications on the youths. For this we carried out an empirical study on 280 young diabetic patients whose ages were below 25 years at the onset of the disease out of which 165 (59 %) were male and 115 (41 %) were female. The key findings of the study are discussed below.

The proportion of female young diabetic patients (.41) was found to be significantly lower than their male counterpart (.59) which is in conformity with earlier studies done by Paula A Diaz et. al (2015).

The chance of having the type 2 diabetes mellitus was found to be 3 times more among the middle class people than those of the lower socio economic class people and it was found to be statistically significant. However, the statistical significance of the difference between the higher socio economic class people and the lower socio economic class people could not be established.

Also, we tried to compare two groups of diabetic people, the 1st with no diet maintenance, no regular exercise, no life style modification and obesity and the 2nd with maintenance of diet, regular exercise, modification of life style and normal BMI and found that the 1st group has 6 times more chance of having type 2 diabetes than the 2nd group of diabetic people.

The study revealed that 36.1 % of the young diabetic patients have type 2 diabetes, which is commonly seen in the elderly people and is a lifestyle disorder. The young people getting type 2 diabetes has raised a problem of worry in the society. However, the type 2 diabetes can be prevented by maintaining normal body weight, adopting healthy nutritional habits like a high intake of dietary fibre and avoiding sweet foods, smoking and diabetogenic drugs like oral contraceptives. According to a recent study on diabetes in New York, plant based diets are low in saturated fats, rich in photochemicals, high in fibre and can be beneficial for diabetes as it may improve glycemic control, cholesterol and leads to weight loss in people with type 2 diabetes.

Further from the analysis of the data, it was found that the lowest age at onset of diabetes was 2 years. So awareness about the disease needs to be spread to the society including the children. This may be done either by arranging awareness programs by govt., NGOs or by imparting knowledge about diabetes, its effects and measures of prevention in the educational institutions starting from the primary school level. We feel that by doing so many people can be saved from falling prey to this deadly disease and thereby reduce the burden of the disease in the society.

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