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Prevalence of Prediabetes in Lahore, Pakistan

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Abstract

This study is required to examine the prevalence of type II diabetes, prediabetes, and its risk factors in the Lahore district of Pakistan. 460 respondents who were 18 years of age and older were chosen for this study using the multistage cluster sampling technique. The World Health Organization's recommendations called for the analysis of diabetes and prediabetes using the Fasting Glucose Test. The percentages of people with diabetes and prediabetes were calculated. The impact of various risk variables on the prevalence of diabetes and prediabetes was examined using an ordinal logistic regression model, with the response variable consisting of three categories: normal, prediabetes, and diabetes. Akaike Criterion was used to determine the explanatory variables: age, education, monthly income, history of diabetes, knowledge of diabetes, fast food, and weight. Among the 460 respondents who participated in the sample, 30.86% had prediabetes, and 27.82% had diabetes. Age, previous diabetes history, and weight were the three most important risk factors for prediabetes. Our ordinal logistic model identified the most important diabetes risk factors as being age, education, monthly income, knowledge of diabetes, eating fast food, and weight.

Keywords

Prevalence, Prediabetes, Ordinal logistic regression model, Akaike information criterion.

1. Introduction

Diabetes is a condition that is brought on by high levels of blood sugar. The most prevalent kind of diabetes, with a 90% prevalence, is type II diabetes, according to the Nation Diabetes Survey Report (NDSR, 2017). Global Report on Diabetes (WHO, 2016) estimates that 422 million people worldwide had diabetes in 2014, about twice as many as there were in 1980 (108 million), with an increase of 4.7% to 8.5% among adults 18 and older. According to Shaw et al. (2010), there would be 642 million diabetic patients worldwide by the year 2040. According to the International Diabetes Federation (IDFD, 2015), between 2010 and 2030, the number of people with diabetes is predicted to increase in both underdeveloped and developed nations by 69% and 20%, respectively.

According to this study, it has been growing more quickly in average- and low-income countries. The prevalence of type II diabetes has been increasing over time, and ignorance has been a major factor.
Prediabetes is a stage of diabetes where blood sugar levels are higher than usual but not high enough to be classified as diabetic. A person with prediabetes can raise his blood

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sugar levels to a normal range by engaging in healthy activities and dietary habits, among other things. Nonetheless, if a person is diagnosed with diabetes, he will stay diabetic until his last breath and must see a doctor as directed. Hence, the prediabetes zone might be described as an alerting zone, and the diabetic zone as an alarm zone (IDF, 2015).

The World Health Organization (WHO) and the Diabetic Association of Pakistan collaborated to perform the first diabetes survey in 1994 and 1998. 7-11. According to Shera et al. (2010), 16.68% of females and 19.73% of males were diagnosed with diabetes or pre-diabetes. In 2014, a researcher looked into the 10% annual growth rate of diabetes in Lahore. In 2002, there were 5157 patients with diabetes, and by 2013, there were 60,823 patients, according to a study done by Services Hospital in Lahore. Diabetes is rising at a 10% pace in urban regions, compared to a considerably lower incidence in rural areas (Butt, 2014). As a result, this report highlights the prevalence of diabetes and prediabetes in Lahore as well as their risk factors.

The goals of this study are:

1. To create a multivariate model that predicts the prevalence of developing type II diabetes and prediabetes in Lahore given the various risk variables.
2. To determine the major contributing factor to prediabetes and type II diabetes in Lahore.
3. To look into how risk variables affect the onset of diabetes type II and prediabetes in various Lahore areas.

2. Methodology

2.1 Study area and sample size

We conducted the study in Lahore. There are 274 union councils in the district and division of Lahore, Punjab. According to the 2017 Census, there were 11,126,285 people living in the district (Population Census 2016). In this study, we use the Cochran formula for the determination of the sample size (Cochran, 1977). The Cochran formula is under:

$$n = \frac{Z_{\alpha}(1-P)}{\delta^2}$$

The prevalence of Type-II diabetes in the population is 16.98% in Pakistan (GROD, 2016).The Absolute error between the estimated and true population prevalence of Type-II diabetes is assumed to be 3.4% and the level of significance is 0.01% (GROD, 2016). The calculated sample size is n = 455 (rounded to the nearest 10^{th} is 460). This study would require a sample of at least 455 subjects to have a 3.4% absolute error with actual prevalence. However, we study total of 460 subjects to allocate an equal sample to each of the 10 clusters.

2.2 Multi-stage cluster sampling

Multi-stage cluster random sampling was used to collect the data. All 274 of Lahore's union councils were taken into account in the first stage of the study as clusters, and in the second stage, 10 of them—Gulshan Ravi A Block, Galgasht Colony, Jafria Colony, Gwalmandi, Daroghawala, Misrisha, Anarkali, Bostan Colony, Chungi, and Model Town—were chosen at random from the remaining 274 union councils Using a random

number table from each union council, households are chosen for the study's third stage. Then, we conducted surveys in the chosen households until 46 people, who were at least 18 years old, were included from each selected area (sample size 460). To gather data, a questionnaire is designed. Finally, using enumerators, we gather the data.

2.3 Statistical technique

Using an ordinal logistic regression model (Das et al, 2011) with the response variable divided into three categories—normal, prediabetes, and diabetes—the effect of various risk factors on the prevalence of diabetes and prediabetes was investigated. The Akaike Criterion (Bozdogan et al, 1987) was used to evaluate the explanatory variables based on age, education, monthly income, knowledge of diabetes, history of diabetes, and fast food intake.

3. Result and discussions

The Univarate analysis of the data is shown in Table 1. This Table illustrates that in the 15–34 age range, 10.9% of people have diabetes and 33.8% have prediabetes. This demonstrates that type II diabetes is more likely to develop in people of this age range. In the 35–54 age range, 48.5% of people have diabetes and 49.3% have prediabetes. 16.9% of people over 55 are prediabetic and 40.6% of those have diabetes. This demonstrates that the risk of developing diabetes or prediabetes is 50% for people aged 35 to 54. Table 1 shows that 64.8% of people with matriculated education or less have prediabetes and 83.6% have diabetes. Bachelor's degree holders have a lower risk of developing type II diabetes, with a frequency of only 5.5%, compared to those with higher levels of education. This demonstrates the direct correlation between schooling and type II diabetes and prediabetes. Those with less than $60,000 in monthly income had 78.9% of diabetic patients and 63.4% of prediabetes, whereas those with incomes over $60,000 have 1.6% type II diabetes and 4.2% are prediabetic. Research demonstrates that those in poverty have greater rates of prediabetes and type II diabetes. According to Table 1, a person has a 21.9% probability of developing type II diabetes and a 15.5% chance of developing prediabetes if both of their parents have the disease. A person with type II diabetes who is unaware of it has a 47.7% risk of developing diabetes mellitus and a 50% chance of developing prediabetes. According to Table 1, 8.6% of those who frequently eat desserts have diabetes, whereas 13.4% have prediabetes. Among people who weigh between 61 and 90 pounds, 61.7% have diabetes mellitus and 62% have prediabetes.

Model of logistics regression with prediabetes and diabetes as response variables were developed and Covariates with the lowest AIC and BIC and highest R2 among others were selected for further analysis. These covariates consisted of age, education, monthly income, history of diabetes, knowledge of diabetes, fast food, and weight. Table 2 shows the coefficients, standard errors, and p-values of covariates. This table is used to draw a logistic regression model.

Logistic model with prediabetes as a response variable:

$$\text{Log}(L) = \text{Log}(-1.01458 + 0.0222143*\text{Age} - 0.13772*\text{Education} - 0.323525*\text{Monthly Income} - 0.205767*\text{History of Diabetes} - 0.325701*\text{Knowledge of Diabetes} - 0.273877*\text{Fast Food} + 0.0264339*\text{Weight})$$

Logistic model with diabetes as a response variable:

Log (L) = Log (-2.29438 + 0.0632875*Age - 0.538932*Education +
0.791981*Monthly Income + 0.0437251*History of Diabetes –
0.774316*Knowledgeof Diabetes - 0.586586*Fast Food +
0.0328506*Weight)

Table 1: Socio demographic values of target population.

Characteristics	Count	%age	Normal		Prediabetes		Diabetes	
			count	%age	count	%age	count	%age
Age								
15-34	173	37.6	110	57.9	48	33.8	14	10.9
35-54	196	42.6	63	33.2	70	49.3	62	48.5
>55	91	19.8	17	8.9	24	16.9	52	40.6
Education								
Matric or under	298	64.8	99	52.1	92	64.8	107	83.6
Intermediate	106	23	57	30	35	24.6	14	10.9
Bachelors	46	10	27	14.2	12	8.5	7	5.5
Masters or above	10	2.2	7	3.7	3	2.1	0	0
Monthly income								
< 30,000	293	63.7	102	53.7	90	63.4	101	78.9
30,000-60,000	137	29.8	66	34.7	46	32.4	25	19.5
>60,000	30	6.5	22	11.6	6	4.2	2	1.6
History of Diabetes								
Mother	109	23.7	35	18.4	44	31	30	23.4
Father	72	15.7	33	17.4	26	18.3	13	10.2
Both	77	16.7	27	14.2	22	15.5	28	21.9
None	2022	43.9	95	50	50	35.2	57	44.5
Diabetes Knowledge								
Yes	219	47.6	2	43.2	70	9.3	67	52.3
No	241	52.4	108	56.8	72	50.7	61	47.7
Fast Food								
Never	204	44.3	60	31.6	63	44.4	81	63.3
Rarely	185	40.2	89	46.8	60	42.2	36	28.1
Often	71	15.4	41	21.6	19	13.4	11	8.6
Weight								
31-60	160	34.8	84	44.2	42	29.6	39	30.5
61-90	270	58.7	94	49.5	88	62	79	61.7
91-120	28	6.1	11	5.8	12	8.4	9	7
>120	2	0.4	1	0.5	0	0	1	0.8

In Table 2, Logit 1 represents the odd ratio of type II diabetes with normal blood sugar levels, and the constant coefficient -2.2948 represents the overall impact of diabetes on normal blood sugar levels when all explanatory factors are equal to zero. With coefficients of 0.06329, 0.04373, and 0.03285, respectively, age, diabetes history, and weight have a protective effect for diabetes. This demonstrates that the risk of diabetes will rise as these variables rise and vice versa. Moreover, fast food, education, monthly income, and knowledge of diabetes all negatively affect diabetes. The most crucial factors in the model of diabetes into normal are those whose p-value is close to 0.

When all the explanatory factors are zero, prediabetes has no overall effect on normal sugar levels, as indicated by the constant coefficient -1.0146 of logit 2, which is the odd

ratio of prediabetes regarding normal sugar level. With values of 0.02221 and 0.02643, age and weight are two characteristics that have a favourable effect on prediabetes. When one gets older and heavier, the likelihood of developing prediabetes rises. Education, Monthly Income, Diabetes History, Diabetes Knowledge, and Fast Food all have a detrimental effect on prediabetes. In the model of prediabetes into normal, the factors with p-values near 0 are the most significant and relevant variables.

Table 2: Fitted parameters of logistic model for lowest AIC model.

Predictor	Coefficients	Standard Error	P	OR
Logit 1: (2/0)				
Constant	-2.2948	0.96886	0.018	0.1008
Age	0.06329	0.01021	0	1.0654
Education	-0.5389	0.22928	0.019	0.5834
Monthly Income	-0.792	0.28383	0.005	0.4529
History of Diabetes	0.04373	0.11063	0.693	1.0447
Knowledge of Diabetes	-0.7743	0.27068	0.004	0.4610
Fast Food	-0.5866	0.21356	0.006	0.5562
Weight	0.03285	0.00978	0.001	1.0333
Logit 2: (1/0)				
Constant	-1.0146	0.80781	0.209	0.3625
Age	0.02221	0.00909	0.015	1.0225
Education	-0.1377	0.16204	0.395	0.8714
Monthly Income	-0.3235	0.21131	0.126	0.7236
History of Diabetes	-0.2058	0.09794	0.036	0.8140
Knowledge of Diabetes	-0.3257	0.23563	0.167	0.7220
Fast Food	-0.2739	0.17692	0.122	0.7604
Weight	0.02643	0.00856	0.002	1.0267

The estimated probabilities by using logistic model coefficients for monthly income, awareness of diabetes, and intake of fast food were determined and plotted as under. In Fig. 1, we can see that, in contrast to people with higher monthly incomes, for whom the probability of prediabetes increases until the age of 40 with a probability of 37.9% before slowly declining, the probability of prediabetes is rapidly declining among poor people with a monthly income of less than 30,000.

Figure 2 demonstrates the quick rise in prediabetes risk associated with knowledge of diabetes mellitus up to age 38 when there is a 38.2% chance of having the condition, and then a subsequent decline. While the likelihood of prediabetes in people who are unaware of it increases until the age of 50 (37% likelihood) and then declines over time. Figure 3 shows that among people who don't eat a lot of fast food, the likelihood of prediabetes increases until the age of 38 with a 38.3% probability, and then gradually declines. And those who consume a lot of fast food had a 35% chance of developing prediabetes by the age of 58.

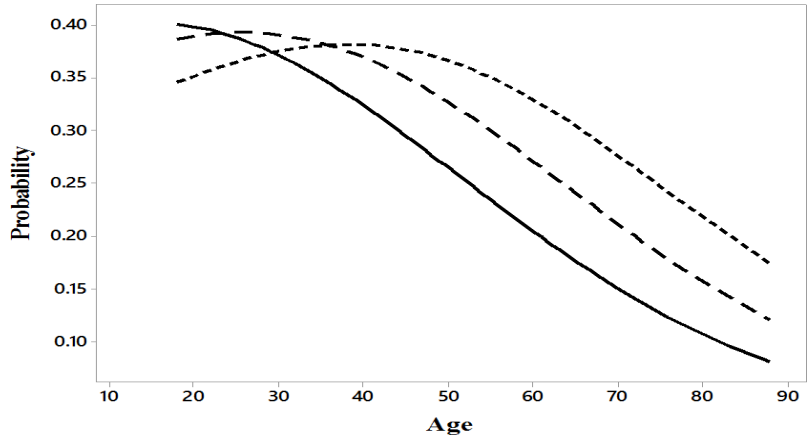

Figure 1: Scatterplot of the probabilities of prediabetes associated with monthly year.

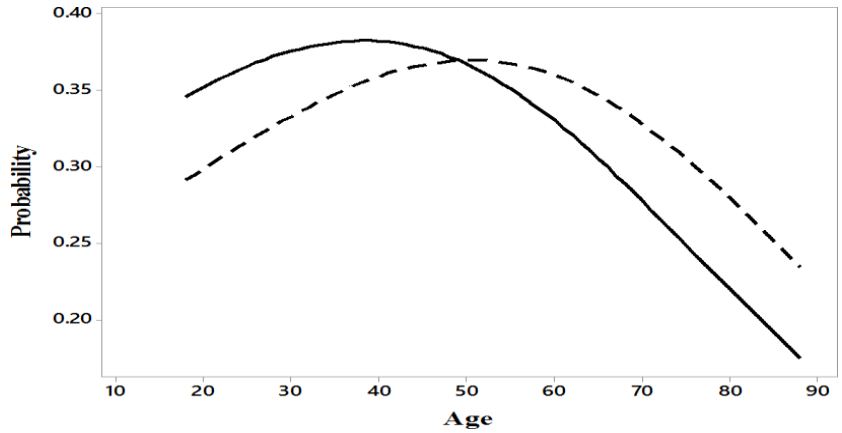

Figure 2: Scatterplot of the probabilities of prediabetes associated with knowledge of diabetes among people.

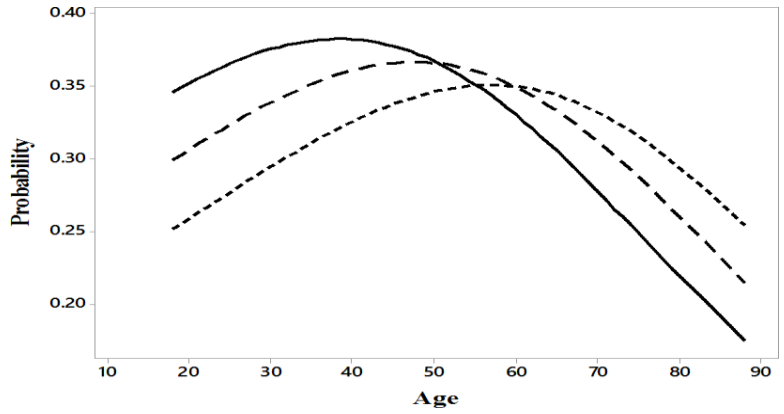

Figure 3: Scatterplot of the probabilities of prediabetes associated with theconsumption of fast food.

In this study, the risk factors for prediabetes and type II diabetes were identified. These risk variables include age, education level, monthly income, family history of diabetes, knowledge of diabetes, fast food consumption, and weight. Of the 460 respondents that participated in the sampled population, 30.86% of people had prediabetes, and 27.82% had

diabetes. It stated that adults aged 35 to 54 have a higher prevalence of prediabetes (49.3%) and diabetes (48.5%), as well as that people with low levels of education and low incomes (less than $30,001) are more likely to have both conditions. Also, it said that people with a maternal history of diabetes were more likely to develop type II diabetes (31% prevalence) and prediabetes (23.4% prevalence). According to estimates, 50.7% and 47.7% of people with prediabetes and diabetes, respectively, do not know about it.

4. Conclusion

The study's model demonstrates that the most important factors for diabetes are age, education, monthly income, knowledge of diabetes, fast food consumption, and weight, whereas the most important factors for prediabetes are age, history of diabetes, and weight. Very surprisingly it is observed in the study sample that people with prediabetes are more than compared with people who have diabetes.

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