Original Article

Prevalence and risk factors for diabetes mellitus in a selected urban population of a city in Punjab

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Abstract

Objective: To estimate the prevalence of diabetes mellitus (diagnosed and undiagnosed), impaired fasting glucose and possible risk factors for diabetes mellitus among Pakistani population.

Methods: This cross sectional study was performed in Rawalpindi which is one of the cities in Northern Punjab of Pakistan in July 2008. An area was selected in Rawalpindi city, with mixed population representative of almost all provinces with different socioeconomic groups. Three hundred and thirteen houses were selected through systematic random sampling technique and fasting blood glucose was obtained and subjects were labeled to have diabetes according to WHO criteria of diagnosing diabetes mellitus. The statistical analysis was performed by using Stata version 10.

Results: There were 1091 respondents who were selected after cleaning the data, among them 293 were males and 798 were females. Of the total 15.41% of the males and 12.31% of females were found to have diabetes mellitus. Thus making a total prevalence of 13.14%. Impaired fasting glucose (IFG) was found in 5.14% males and 5.78% females making a total prevalence of 5.61%. Over all (DM & IFG) was found to be 20.55% in males and 18.09% in females. The main risk factors identified were obesity, family history, hypertension and increasing age.

Conclusion: There is an increased prevalence of Type 2 diabetes in Pakistan and main risk factors identified were obesity, overweight, family history of diabetes mellitus, and hypertension.

Keywords: Diabetes Mellitus Impaired fasting glucose, Obesity, Family History, Hypertension, Age (JPMA 61:40; 2011).

Introduction

Diabetes mellitus is emerging as an epidemic all over the world.[1-3] It is one of the metabolic disorders which if not properly managed can lead to long term life threatening complications and premature deaths.[4-6] Moreover the cost involved in management of this disease and its complications is quite high.[7] There is 170% increase in the incidence of diabetes in developing countries as compared to 47% in developed countries.[8] Main reasons are population growth, ageing, urbanization, increased prevalence of obesity and physical inactivity.[9] Pakistan stands on number 6 among the Top Ten countries having increased burden of diabetes mellitus.[10]

Insufficient data is available regarding prevalence of diabetes in Pakistan. For the first time a phased nationwide prevalence study of DM in Pakistan was conducted in 1994 in both rural and urban areas of the four provinces.[11-13] The meta-analysis of these phased surveys were published in 2007.[14]

Small scattered local surveys have been carried out in different parts of the country. Additionally, the declining age for manifestation of diabetes presumably due to rising obesity, prompted us to study subjects from 12 years age and above.

One of the objectives of this cross sectional study was to determine the burden of diabetes mellitus in Northern Pakistan. Another objective for carrying out the survey was to observe the latest trends as for as prevalence of diabetes is concerned after the increased consumption of fast food and non alcoholic drinks in the society along with lack of physical activity in last few years. As more and more young persons are developing type 2 diabetes mellitus so another objective was to observe the prevalence of diabetes in the age group 12 years and above. The last objective of this study was to explore the possible risk association of diabetes mellitus and impaired fasting glucose.

Methodology

Dhoke Gujran is a relatively new housing scheme under the cantonment board. This is an area where people speaking different languages are gathered although majority of people are Punjabi speaking. So from this survey a generalization can be drawn by extrapolating this population to whole of Pakistan.

Population data of Dhoke Gujran was obtained. Houses were selected by systematic random sampling.

Sample size was calculated by a Biostatistician prior to the survey. In the light of previous prevalence studies[14,15] and with increasing prevalence of diabetes in Pakistan the estimated prevalence of diabetes mellitus was calculated as 9% and by applying the statistical formula, 313 houses were selected in Dhoke Gujran. By applying the statistical formula according to population and number of houses every 14th house was surveyed. On entering the street one house was selected by a draw and then after that, every 14th house was surveyed. If there was no person in any house, the next house was selected. At the end of the street right turn was taken and in this way the survey was completed.

The questionnaire was designed and laboratory was engaged and arrangements were made to maintain the cold chain for transferring the blood sample to the laboratory. Blood glucose was analyzed in serum by enzymatic in vitro testing using Roche/Hitachi 912 analyzer; Acn 767. Questionnaire was tested by a pilot survey and modifications were made in the questionnaire as found necessary.

All subjects of age 12 years and above were included in the study. There were 141 subjects below the age of 18 years and verbal informed consent was taken from the parents before taking blood samples.

Fasting blood glucose up to 126 mg/dl or more was taken as diabetes. Fasting blood glucose of 100 to 125 mg/dl was taken as impaired fasting glucose (IFG).

Diagnostic criteria used were according to the American Diabetes Association, 2007 guidelines. Fasting blood glucose upto 126mg/dl and above was taken as diabetes and levels between 101 and 125 mg/dl was impaired fasting glucose.[15] The same criteria are used by WHO for diagnosis of diabetes mellitus in epidemiological studies.[16]

The information regarding the survey, its significance that why it is being conducted was disseminated to the members of the household via posters, printed leaflets and banners prior to the survey and people were encouraged to take part in the survey. Two meetings were arranged one with influential women and second with councilors and influential men of the area. The study participants were asked to remain in a fasting because fasting blood glucose sample was required.

The subjects were questioned if they had been diagnosed with manifest diabetes and what drugs they were taking for achieving normoglycaemia. If there was any doubt on the diagnosis, the subject was excluded.

Eight teams carried out the survey for 7 days. A qualified doctor along with trained nurse as phlebotomist and a local social worker were the part of the team. Social worker had already carried out the survey of the house and head count. Baseline information's were entered into the Performa one night prior to survey by the social worker at the time of head counting.

Results of the blood tests were collected and a copy was forwarded to the patients and one copy was kept in record. For ethical reason diabetic patients were referred to their general practitioner for further management. Results were matched with Performa filled by the lady doctor and the data was entered by using the Stata version 10. Results were analyzed by the statistician. After cleaning the data 1091 subjects were found to be eligible for reporting.

There were 20 subjects who declared that they were Diabetic but their blood glucose was found to be normal. Among them three subjects were on diet alone, 15 were on diet control and Oral hypoglycemic agents. There were 2 subjects who were on insulin alone. So three subjects who were on diet control alone and having normal blood glucose values were excluded from the analysis because of the doubt in diagnosis and 17 were included in the analysis.

Same population was interviewed by already designed and pre tested detailed questionnaire to see the effects of various factors on blood glucose. Age, Sex, socioeconomic status and family history of diabetes was asked and entered in the questionnaire. BMI, waist circumference and Blood pressure were also recorded. Subjects were divided into four groups age wise i.e. (1) < 25 years (2) 25-50years (3) 51-75 years (4) 76 years and above. Socioeconomic status was defined by assigning income level to two categories i.e. (1) Low with income level (< / = 10,000) (2) Lower middle to high (10001 and above). Body mass index (BMI) was divided into four categories starting from less than 20kg/m^2 to more than 31kg/m^2. Waist circumference was also categorized into five groups starting from less than 30 inches to more than 46 inches.

Analysis was done by using Stata version 10. The chisquare test was used to measure the association among the different variables. It was used as a categorical variable. A p value less than 0.05 was considered significant. Mental Haenzal analysis for odds ratio was done for all variables by dividing the subjects into two categories (1) those having diabetes

(2) and those with impaired fasting glucose using 95% confidence interval (95%CI). Odds ratio was used to assess the odds of the disease in a given population comparing it with base line category in the same variable. Confidence interval (CI) provided the lowest and highest values of our estimate i.e. odds ratio. Univariate followed by bivariate analysis was made. Odds ratios were first calculated for diabetic and normal subjects as control and then for subjects with impaired fasting blood glucose and normal subjects as control.

Results

Out of 1091 subjects who reported, 293 were males (27%) and 798(73.14%) were females. Among males 15.41% and among females 12.31% had Diabetes Mellitus according to WHO criteria of diagnosing Diabetes Mellitus thus making a total prevalence of 13.14%. Impaired fasting glucose (IFG) was found in 5.14% of males and 5.78% in females making a total prevalence of 5.61%. Over all (DM & IFG) was found to be 20.55% in males and 18.09% in females.

Mean age of the study population was 36 ± 15.8 years. Age range was 12 to 80 years. Mean age for males was 40 ± 14.63 years (Variance: 214.029) and for females it was 35 ± 7.08 years (Variance: 50.118). Majority of the respondents (52.55%) were between 26 - 50 years of age followed by age group of ≤ 25 years (31.48%) (Table-1). It was observed that there was a rising trend in prevalence of diabetes and impaired fasting glucose as the age advanced with maximum prevalence in the age group 51-75. But thereafter there was a decline in the prevalence and these results were statistically significant ($P < 0.000$) indicating a strong association between the age and prevalence of impaired fasting glucose and diabetes mellitus.

Percentage of subjects with different BMI and waist circumferences are shown in Table-1. BMI and waist circumference had a positive association with IFG and DM and same was the case with both systolic and diastolic blood pressure. Physical activity was not

Table-1: Demographic characteristics of study subjects and observed values of risk factors and blood glucose.

Variable		Frequency	Percent	Total
Sex	Males	292	26.84	1088
	Females	796	73.16	
Age groups	<=25 years	339	31.48	1,077
	26 - 50 years	566	52.55	
	51 - 75 years	150	13.93	
	76 years & above	22	2.04	
Income in rupees	<= 10,000	470	89.69	524
	10,001 & above	54	10.31	
Blood glucose in mg/dl	below 101	884	81.25	1088
	101 - 125	61	5.61	
	126 & above	143	13.14	
Body Mass Index	<=20 |	239	26.29	909
	21 - 25	269	29.59	
	26 - 30 |	235	25.85	
	31 & above	166	18.26	
Waist circumference in inches	<=30	258	24.13	
	31 - 35	302	28.25	1069
	36 - 40	298	27.88	
	41 - 45	153	14.31	
	46 & above	58	5.43	
Diastolic BP mmHg	<=50	40	3.80	1053
	51 - 70 |	486	46.15	
	71 - 90 |	443	42.07	
	91 - 110 |	75	7.12	
	111 & above	9	0.85	
Systolic BP mmHg	<=100	374	35.42	1056
	101 - 150	617	58.43	
	151 -200	62	5.87	
	201 & above	3	0.28	

Table-2: Association of risk factors with impaired fasting glucose and diabetes mellitus.

Variable		Blood glucose level		X2 value	p value	Total
		IFG	DM			
				182.88	0.000	1077
Age groups	<=25 years	3 (0.88%)	4(1.18%)			
	26 - 50 years	37(6.54%)	72(12.72%)			
	51 - 75 years	17(11.33%)	59(39.33%)			
	76 years & above	4(18.18%)	7(31.82%)			
Sex	Males	15(5.14%)	45(15.41%)	1.877	0.391	1088
	Females	46(5.78%)	98(12.31%)			
Income in rupees	<= 10,000	24(5.11%)	66(14.04%)	7.5688	0.271	524
	10,001 & above	6(13.95%)	7(16.28%)			
Body Mass Index	<=20 |	6(2.51%)	11(4.60%)	54.7313	0.000	909
	21 - 25	7(2.60%)	39(14.50%)			
	26 - 30 |	16(6.81%)	38(16.17%)			
	31 & above	22(13.25%)	32(19.28%)			
Waist circumference in inches	<=30	5(1.94%)	7(2.71%)	147.1964	0.000	1069
	31 - 35	6(1.99%)	22(7.28%)			
	36 - 40	15(5.03%)	55(18.46%)			
	41 - 45	24(15.69%)	41(26.80%)			
	46 & above	11(18.97%)	14(24.14%)			
Physical activity	Going for walk	7(4.64%)	24(15.89%)	1.2103	0.546	1029
	Not going for walk	53(6.04%)	115(13.1%)			
Diastolic BP mmHg	<=50	2(5.0%)	0(0%)	68.3145	0.000	1053
	51 - 70 |	19(3.91%)	41(8.44%)			
	71 - 90 |	30(6.77%)	72(16.25%)			
	91 - 110 |	7(9.33%)	25(33.33%)			
	111 & above	3(3.33%)	0(0%)			
Systolic BP mmHg	<=100	10(2.67%)	20(5.35%)	73.9091	0.000	1056
	101 - 150	41(6.65%)	97(15.72%)			
	151 -200	10(16.13%)	21(33.87%)			
	201 & above	0(0%)	0(0%)			
Family H/O DM	Yes	20(4.45%)	77(17.15%)	14.0462	0.001	1023
	No	40(6.97%0	56(9.76%)			
One parent affected	Yes	9(3.81%)	38(16.10%)	17.9278	0.001	514
	No	17(6.37%)	49(18.35%)			
Two parents affected	Yes	4(9.30%)	14(32.56%)	15.0113	0.005	509
	No	22(4.85%)	72(15.86%)			
Siblings affected	Yes	10(8.26%)	43(35.54%)	39.9413	0.000	522
	No	16(4.05%)	50(12.66%)			
Relatives affected	Yes	12(4.41%)	50(18.38%)	9.3818	0.052	566
	No	18(6.41%)	42(14.95%)			
	Maternal	7(4.55%)	32(20.78%)	2.4414	0.295	294
	Paternal	5(3.57%)	20(14.29%)			

found to have any significant association with diabetes mellitus or IFG in our study. Family history of diabetes including one parent, both parents and siblings affected was strongly associated with having diabetes in the study subjects whereas history of diabetes among distant relatives either maternal or paternal was not significant (Table-2).

Our study showed a strong association of BMI and waist circumference with diabetes mellitus (Table-3).

Regarding monthly income no statistical difference was observed between diabetic and normal population in our study. Due to sparse data on income we made only two income groups one with income of up to 10,000 and other having income of 10,001 & above (Table-3).

With increasing values of both systolic and

Table-3: Association of risk factors with diabetes mellitus.

Variable		Normal	Diabetics	Odds ratio	P value	CI	Total
Age groups	<=25 years	332(98.81%)	4(1.19%)	1	-	-	1016
	26 - 50 years	457(86.39%)	72(13.61%)	13.08	0.000	4.62-37.05	
	51 - 75 years	74(55.64%)	59(44.36%)	66.18	0.000	18.55-236.13	
	76 & above	11(61.11%)	7(38.89%)	52.82	0.000	11.12-250.94	
Income in rupees	<= 10,000	380(85.2%)	66(14.80%)	1.0083	0.9755	0.5935-1.7129	494
	10,001 & above	40(83.33%)	8(16.67%)	1.15	-	0.52-2.57	
Body Mass Index	<=20 |	222((95.2%)	11(4.72%)	1	-		1088
	21 - 25	223(85.11%)	39(14.89%)	3.53	0.0002	1.74-7.14	
	26 - 30 |	181(82.65%)	38(17.35%)	4.24	<0.0001	2.07-8.66	
	31 & above	12(77.78%)	32(22.22%)	5.77	<0.0001	2.72-12.21	
Waist circumference in inches	<=30	246(97.23)	7(2.77%)	1	-	-	1008
	31 - 35	274(97.23%)	22(7.43%)	2.82	0.01	1.18-6.72	
	36 - 40	228(80.57%)	55(19.43%)	8.48	<0.0001	3.78-19.00	
	41 - 45	88(68.22%)	41(31.78%)	16.37	<0.0001	7.08-37.84	
	46 & above	33(70.21%)	14(29.79%)	14.91	<0.0001	5.61-39.62	
Diastolic BP mmHg	<=50	38(100%)	0(0%)	0.00	-	-	992
	51 - 70 |	426(91.22%)	41(8.78%)	1	-	-	
	71 - 90 |	341(82.57%)	72(17.43%)	2.19	<0.0001	1.45-3.31	
	91 - 110 |	43(63.24%)	25(36.76%)	6.04	<0.0001	3.27-11.16	
	111 & above	6(100%)	0(0%)	0	-	-	
Systolic BP mmHg	<=100	344(94.51%)	20(5.49%)	0.29	<0.0001	0.17-0.48	995
	101 - 150	479(83.16%)	97(16.84%)	1.00	-	-	
	151 -200	31(59.62%)	21(40.38%)	3.35	<0.0001	1.83-6.12	
	201 & above	3(100%)	0(0%)	0	-	-	
Family H/O DM	Yes	352(82.05%)	77(17.95%)	1.87	0.0009	1.29-2.71	979
	No	478(89.51%)	56(37.50%)	1	-	-	
H/O one parent	Yes	189(83.26%)	38(16.74%)	0.82	0.42	0.52-1.32	488
	No	201(80.40%)	49(19.60%)	1	-	-	
H/O both parents	Yes	25(64.10%)	14(35.90%)	2.8	0.0029	1.378082-5.689067	483
	No	360(83.33%)	72(16.67%)	1	-	-	
H/O Siblings	Yes	68(61.26%)	43(38.74%)	4.16	<0.0001	2.51-6.89	496
	No	329(86.81%)	50(13.19%)	1	-	-	
H/O relatives	Yes	210(80.77%)	50(19.23%)	1.25	0.33	0.80-1.97	534
	No	221(84.03%)	42(15.97%)	1	-	-	

diastolic blood pressure the odds of the disease were 11.65 and 42.91 times more as compared to normal subjects.

Patients in the age group 51-75 years had 25 times more frequently impaired fasting glucose compared to the younger subjects. Those with age 76 years and above had more impaired fasting glucose than younger subjects. Increasing BMI, higher values of both systolic and diastolic blood pressure were strongly associated with impaired fasting glucose.

Table-4: Association of risk factors with impaired fasting glucose.

Variable		Normal	IFG	Odds ratio	P value	CI	Total
Age groups	<=25 years	332(99.10%)	3(0.90%)	1	-	-	935
	26 - 50 years	457(92.51%)	37(7.49%)	8.9598	0.000	2.7000-29.732	
	51 - 75 years	74(81.32%)	17(18.68%)	25.423	0.000	6.6816-96.734	
	76 & above	11(73.33%)	4(26.67%)	40.2424	0.000	7.0578-229.45	
Income in rupees	<= 10,000	380(94.06%)	24(5.94%)	1	-	-	494
	10,001 & above	40(83.33%)	6(16.67%)	2.38	0.4489	0.92-6.15	
Body Mass Index	<=20 |	222(97.37%)	6(2.63%)	1	-	-	789
	21 - 25	223(96.96%)	7(3.04%)	1.16143	0.7909	0.3837-3.5151	
	26 - 30 |	181(91.88%)	16(8.12%)	3.27071	0.0109	1.2434-8.6031	
	31 & above	112(83.58%0	22(16.42%)	7.26785	0.000	2.7759-19.028	
Diastolic BP mmHg	<=50	38(95%)	2(5%)	1	-	-	915
	51 - 70 |	426(95.73%)	19(4.27%)	0.8474	0.8281	0.1898-3.7824	
	71 - 90 |	341(91.91%)	30(8.09%)	1.9725	0.0224	1.0887-3.5737	
	91 - 110 |	43(86%)	7(14%)	3.6499	0.0035	1.4392-9.2562	
	111 & above	6(66.67%)	3(33.33%)				
Systolic BP mmHg	<=100	344(97.18%)	10(2.82%)	1	-	-	918
	101 - 150	479(92.12%)	41(7.88%)	2.9444	0.0017	1.448-5.9854	
	151 -200	31(75.61%)	10(24.39%)	11.0967	0.0000	4.0920-30.092	
	201 & above	3(100%)	0(0%)				
Family H/O DM	Yes	352(94.62%)	20(5.38%)	0.6789	0.1689	0.3897-1.1827	900
	No	478(92.28%)	40(7.72%)	-	-	-	
H/O one parent	Yes	189(95.45%)	9(4.55%)	0.5630	0.1716	0.2443-1.2975	420
	No	201(92.20%)	17(7.80%)	-	-	-	
H/O both parents	Yes	25(86.21%)	360(94.2%)	2.6181	0.0870	0.8328-8.2304	418
	No	4(13.79%)	22(5.76%)	-	-	-	
H/O diabetes In Siblings	Yes	68(87.18%)	10(12.82%)	3.0238	0.0066	1.3048-7.0076	427
	No	329(95.36%)	16(4.64%)	-	-	-	
H/O diabetes in relatives	Yes	210(94.59%)	12(5.41%)	0.7015	0.3557	0.3294-1.4941	469
	No	221(92.47%)	18(7.53%)	-	-	-	

Family history of siblings being affected with the disease was closely associated with impaired fasting glucose as compared to single parent, both parents or relatives being affected (Table-4).

Discussion

This survey is different from other surveys conducted previously in Pakistan in two aspects. Firstly it has considered the age groups of the study participants from 12 years onwards while in National diabetes survey the participant were of 25 years and above.[11-14] Another study carried out at Karachi recruited age group of ≥ 20 years.[17] It is also different from other studies carried in the subcontinent where person ≥ 20 years were included in the study.[18] Studies in USA also included age group 20 and above.[19] Another prevalence study in UK also involved age group 20 years and above.[20] A prevalence study in British men included age group 40-59 at the time of entry in survey.[21]

Secondly it followed the new diagnostic criteria according to American Diabetes Association 2007 guidelines[15,16] for diabetes mellitus and impaired fasting glucose.

Out of 1091 persons surveyed, 293 were males (27%) and 798 (73.14%) were females. There were more

females in the survey as men had to go to their jobs.

Strangely males had more prevalence of DM than females i.e. 15.41% vs. 12.31% respectively. Our results are comparable to the results from a recently published survey[22] carried out in Chinese population where prevalence was 19.2%and 16.1% in urban areas and 14.2% and 13.8% in rural areas in year 2006 for men and women, respectively. A study from UK done from 1999-2002, showed rising trends in prevalence of DM for all men aged 25-70 years or older. The fraction of men diagnosed as diabetics doubled from 3.1% to 7.1%.[23] Another prevalence survey in England published in 2006 showed a male predominance.[24] As far as the situation in India is concerned, a recent article published in 2008 did not mention the gender difference for diabetes prevalence.[18]

According to Pakistan Statistical Bureau report[25] the total population of Pakistan in July 2008 was 162.37 million and the population above the age of 10 years was 116.48 million. If we extrapolate our survey results to whole population of the country than it is at this point crossing the WHO projected figure for 2025.[3]

If we compare our survey with the survey done by Shera et al, the prevalence of diabetes is much more in our survey but the impaired fasting glucose was less in our survey compared to IGT done by them, most likely because of use of different criteria and post glucose load blood level.[14] If we see worldwide prevalence, India had 31.7 million people with diabetes, China had 17.7 million and United States of America 17.7million people with diabetes in 2000. These figures are expected to rise up to 79.4 million for India, 42.3 million for China and 30.3 million for USA in the year 2030. Pakistan now ranks sixth will then be ranking 4th in the year 2030[8] but with prevailing situation according to our survey the situation is much worse than the estimated.

Risk factors Association with Diabetes Mellitus and Impaired Fasting Glucose:

It was observed in our study that diabetes and IFG prevalence increased with increasing age in both males and females. Maximum diabetics were found in the age group of 51-75 years in both males and females, whereas in the previous survey,[14] majority of diabetics belonged to the age group of 45- 54 years. A global estimate for 2030 predicts that in developing countries, majority of people with diabetes will be in the age range of 45 to 64. By 2030, it is estimated that the number of people with diabetes $\geq$ 64 years will be >82 million in developing countries and >48 million in developed countries.[8]

In our survey socioeconomic status did not show an impact on the prevalence of DM and IFG. The most possible explanation is unhealthy food and lack of exercise in both groups. Another reason could be that people are reluctant to disclose their monthly income making it difficult to have a true inference.

Our study has shown an increased association of high BMI with diabetes and impaired fasting glucose. This is in comparison to a study in Saudi population which has shown an increased association of diabetes and hypertension with BMI, starting at a BMI as low as 21 kg/mm^2.[27] Study on National Prevalence of diabetes in 2006 has also shown that obesity estimated by BMI + WHR in females is a relative risk for diabetes.[14]

Waist circumference is an important part of the metabolic syndrome leading to premature morbidity and mortality.[27] A study conducted in 2003 compared various indices including waist circumference (WC), BMI and waist hip ratio (WHR) for future risk of diabetes and cardiovascular diseases. The study has shown that weakest correlation was with WHR alone. WC showed the strongest correlation with fasting glycaemia except for men, where more close relation was found with BMI.[29] Hyperglycaemia after glucose load was strongly associated with BMI and WHR. The best cut-off points that suggested higher risk for type 2 DM were: For women: BMI: 29.2 kg/m^2, waist circumference (WC): 97 cm, waist to hip ratio (WHR): 0.91. For men: BMI 27.9 kg/m^2, WC: 99 cm, WHR - 0.97.[28]

Our study showed a stronger association between waist circumference and risk of diabetes as compared to BMI alone.

In our survey an increased association of family history of diabetes with risk of diabetes and impaired fasting glucose was observed. The same results were shown by Shera.et al that the relative risk for developing diabetes was more with family history.[14]

Both systolic and diastolic Blood Pressure had strong association with diabetes mellitus and impaired fasting glucose in our survey. Same is shown in another Pakistani study.[14]

Conclusion

Our study showed a higher prevalence of diabetes and impaired fasting glucose as compared to previous studies done in Pakistan. Important risk factors identified were obesity; hypertension, and family history of diabetes among siblings.

Acknowledgement

We are thankful to Eli Lilly Pakistan (Private) Limited for all financial support.

References

1. Passa P.Diabetes trends in Europe. Diabetes Metab Res Rev 2002; 18: S3-8.
2. Amos AF, McCarty DJ, Zimmet P. The rising global burden of diabetes and its complications: estimates and projections to the year 2010. Diabet Med 1997; 14: S1-85.
3. King H, Aubert RE, Herman WH. Global burden of diabetes, 1995-2025 - prevalence, numerical estimates, and projections. Diabetes Care 1998; 21: 1414-31.
4. Wannamethee SG, Shaper AG, Lennon L. Cardiovascular disease incidence and mortality in older men with diabetes and in men with coronary heart disease. Heart 2004; 90: 1398-403.
5. Roglic G, Unwin N, Bennett PH, Mathers C, Tuomilehto J, Nag S, et al. The burden of mortality attributable to diabetes: realistic estimates for the year 2000. Diabetes Care 2005; 28: 2130-5.
6. Mulnier HE, Seaman HE, Raleigh VS, Soedamah-Muthu SS, Colhoun HM, Lawrenson RA. Mortality in people with Type 2 diabetes in the UK. Diabet Med 2006; 23: 516-21.
7. Gadbsy R. Epidemiology of diabetes. Adv Drug Deliv Rev 2002; 54: 1165-72.
8. Wild S, Roglic G, Green A , Sicree R,. King H. Global prevalence of diabetes: estimates for the year 2000 and projections for 2030, Diabetes Care 2004; 27: 1047-53.
9. King H, Aubert RE,Herman WH. Global burden of diabetes, 1995-2025: prevalence, numerical estimates, and projections. Diabetes Care 1998; 21: 1414-31.
10. World Health Report 2003. World health Organization (WHO). 1211 Geneva 27, Switzerland 2003.
11. Shera AS, Rafique G, Khwaja IA, Ara J, Baqai S, King H. Pakistan national diabetes survey: prevalence of glucose intolerance and associated factors in Shikarpur, Sindh Province. Diab Med 1995; 12: 1116-21.
12. Shera AS, Rafique G, Khwaja IA, Baqai S, King H. Pakistan national diabetes survey: prevalence of glucose intolerance and associated factors in Baluchistan province. Diabetes Res Clin Pract 1999; 44: 49-58.
13. Shera A, Rafique G, Khwaja IA, Baqai S, Khan I, King H, et al. Pakistan national diabetes survey: prevalence of glucose intolerance and associated factors in North West Frontier Province (NWFP) of Pakistan. J Pak Med Assoc 1999; 49: 206-11.
14. Shera AS, Jawad F, Maqsood A. Prevalence of diabetes in Pakistan, Diabetes Res Clin Pract 2007; 76: 219-22.
15. Basit A, Hydrie M Z I, Ahmed K, Hakeem R. Prevalence of diabetes impaired fasting glucose and associated risk factors in a rural area of Baluchistan province according to new ADA criteria. J Pak Med Assoc 2002; 52: 357-60.
15. American Diabetes Association. Standards of medical care in diabetes-2007. Diabetes Care 2007; 1: S4-S5.
16. World Health Organization 1999. Definition, Diagnosis and Classification of Diabetes Mellitus and its Complications Report of a WHO Consultation Part 1: Diagnosis and Classification of Diabetes Mellitus. World Health Organization 1999.
17. Khowaja1 LA, Khuwaja AK, Cosgrove P. Cost of diabetes care in out-patient clinics of Karachi, Pakistan. BMC Health Services Research 2007; 7: 189.
18. Ramachandran A, Snehalatha C. Current scenario of diabetes in India. J Diabetes 2009; 1: 18-28.
19. Centers for Disease Control and Prevention (CDC).Prevalence of diabetes and impaired fasting glucose in adults - United States, 1999-2000. MMWR Morb Mortal Wkly Rep 2003; 52: 833-7.
20. Forouhi NG, Merrick D, Goyder E, Ferguson BA, Abbas J, Lachowycz K, Wild SH. Diabetes prevalence in England, 2001 - estimates from an epidemiological model. Diabet Med 2006; 23: 189-97.
21. Thomas MC, Hardoon SL, Papacosta AO, Morris RW, Wannamethee SG, Sloggett A, et al. Evidence of an accelerating increase in prevalence of diagnosed Type 2 diabetes in British men, 1978-2005. Diabet Med 2009; 26: 766-72.
22. Ning F, Pang ZC, Dong YH, Gao WG, Nan HR, Wang SJ, et al. Risk factors associated with the dramatic increase in the prevalence of diabetes in the adult Chinese population in Qingdao, China. Diabetic Med 2009; 26: 855-63.
23. Smith JP. Nature and causes of trends in male diabetes prevalence, undiagnosed diabetes, and the socioeconomic status health gradient. Proc Natl Acad Sci U S A 2007; 104: 13225-31.
24. Forouhi NG, Merrick D, Goyder E, Ferguson BA, Abbas J, Lachowycz K, et al.Diabetes prevalence in England, 2001 - estimates from an epidemiological model. Diabet Med 2006; 23: 189-97.
25. Social indicators of Pakistan, 2008. Government of Pakistan, statistics division Federal Bureau of Statistics. (Online) 2009 (Cited 2009 Nov 30). Available from URL: http://www.statpak.gov.pk/depts/fbs/publications.html.
26. Almajwal AM, Al-Baghli NA, Batterham MJ, Williams PG, Al-Turki KA, Al-Ghamdi AJ. Performance of body mass index in predicting diabetes and hypertension in the Eastern Province of Saudi Arabia. Ann Saudi Med 2009; 29: 437-45.
27. Koster A, Leitzmann MF, Schatzkin A, Mouw T, Adams KF, van Eijk JT, et al. Waist circumference and mortality. Am J Epidemiol 2008; 167: 1465-75.
28. ?opaty?ski J, Mardarowicz G, Szcze?niak G. A comparative evaluation of waist circumference, waist-to-hip ratio, waist-to-height ratio and body mass index as indicators of impaired glucose tolerance and as risk factors for type-2 diabetes mellitus. Ann Univ Mariae Curie Sklodowska Med 2003; 58: 413-9.