ORIGINAL ARTICLE

Prevalence of diabetes and its correlates in urban population of Pakistan: A Cross-sectional survey

Jamal Zafar,[1] Danish Nadeem,[2] Shahzad Ali Khan,[3] Mudassar Mushtaq Jawad Abbasi,[4] Faisal Aziz,[5] Shabana Saeed[6]

Abstract

Objective: To determine the prevalence of diabetes mellitus and its associated risk factors in urban population.

Methods: The cross-sectional study was carried out at four union councils of Rawalpindi, Pakistan, from May to September 2014, and comprised members of the general public.A questionnaire was administered to obtain information about demographic characteristics and risk factors. Anthropometric and blood pressure measurements were obtained from the participants. Venous blood samples were taken for measuring glycated haemoglobin. SPSS 20 was used for data analysis.

Results: Of the 404 participants, 181(44.8%) were men and 223(55.2%) were women. The overall mean age was 42.3±13 years. Overall prevalence of diabetes was 133(32.9%) and that of pre-diabetes was 151(37.4%). The prevalence of diabetes was 203(50.3%) in 50-65 years age group and 143(35.4%) among obese subjects. Diabetes was significantly associated with increasing age (35-49 years ($p<0.05$); 50-65 years ($p<0.01$), positive parental ($p<0.05$) and sibling ($p<0.05$) history of diabetes, hypertension ($p<0.01$) and central obesity ($p<0.05$).

Conclusion: The prevalence of diabetes and pre-diabetes was very high. Prevalence increased with increasing age and body mass index. Major independent risk factors were increasing age, central obesity, and family history of diabetes and hypertension.

Keywords: Diabetes mellitus, Prevalence, Risk factors. (JPMA 66: 922; 2016)

Introduction

Diabetes Mellitus (DM) is the major cause of mortality and morbidity in developed as well as in developing countries. According to the World Health Organisation (WHO), DM will be the seventh leading cause of mortality by the year 2030.[1] It is estimated that 347 million people worldwide have diabetes.[2] Large variation in the prevalence of DM among different populations and ethnic groups has been reported.[3] Developing countries do not only have the highest prevalence of DM, they would also experience increase in its prevalence in the next 25 years.[4] South Asia has a high prevalence of DM with India at the top. The number of patients with diabetes in India is expected to increase to 79.4 million by2030.[5] Pakistan as a developing country is also bearing a progressive rise in the burden of diabetes. Despite of this fact, limited data is available on the prevalence of DM in Pakistan. National level DM prevalence surveys showed the prevalence of DM at 13.9% in Sindh and 13.14% in Punjab.[5,6] A survey conducted in 2007 among Pakistani adults revealed an overall prevalence of glucose intolerance in 22% in urban and17.1% in rural areas.[7] Since then, no other population-based study on DM has been carried out. In addition, previous surveys and studies did not use the latest American Diabetic Association (ADA) criteria to diagnose the DM. The current study was conducted to estimate the prevalence of DM in urban population of Pakistan by using the latest ADA diagnostic criteria using glycated haemoglobin (HbA1c). To the best of our knowledge, no other prevalence study has yet used HbA1c as a diagnostic criterion in Pakistan. Another aim of this study was to determine the most common demographical and biological risk factors associated with DM in the urban population of the country.

Subjects and Methods

The cross-sectional study was carried out in four union councils of Rawalpindi, Pakistan, from May 25 to September 31, 2014, and comprised members of the general public.

As in last five years no study has been done in Pakistan, so the prevalence of 16.6% reported by a 2013 study in India was used to calculate the sample size.[8] Alpha error of 5% and design effect of 1.8 was applied to determine the sample size. Multistage cluster sampling was used to

[1,2]Shaheed Zulfiqar Ali Bhutto Medical University, Pakistan Institute of Medical Sciences, Islamabad, Pakistan, [3,4]Health Services Academy, Islamabad, Pakistan, [5]Institute of Public Health, College of Medicine & Health Sciences, UAE University, UAE, [6]Department of Medical Sciences, Pakistan Institute of Engineering and Applied Sciences, Islamabad, Pakistan.

Correspondence: Danish Nadeem. Email: dnadeem55@yahoo.com

select the participants. Four union councils were randomly selected out of 37. Four clusters were taken randomly from these four union councils. The union council was divided into equal clusters of towns and one town was randomly selected from each union council. Each town consisted of 60 households. The participants were selected from each household.

The participants aged 18-65 years were included. Those suffering from kidney failure, mental illnesses or who were on steroid therapy were excluded. Pregnant women were also excluded.

Ethical approval for the survey was taken from the Institutional Review Board (IRB) of Hanif Hospital. The information regarding the importance, objectives and rational were disseminated to the four selected union council members through printed leaflets, posters and banners. Meetings were conducted with influential people and with the councillors of those union councils. Informed consent was taken from each participant. The participants diagnosed with DM, if required, were referred to the Pakistan Institute of Medical Sciences (PIMS) for further clinical examination.

Data was collected by four teams, each consisting of a doctor and a phlebotomist.

A questionnaire was developed with the help of public health experts, medical specialists and researchers to collect information on gender, age, education level, dietary habit, occupation, personal and family medical history, and lifestyle risk factors. The questionnaire was translated into Urdu and pilot-tested prior to data collection.

Clinical examination was performed, which included height, weight, waist circumference, hip circumference and blood pressure (BP). Body weight was measured to the nearest 0.1kg by digital machine. Height was measured to the nearest 0.1cm by using stadiometre. Hip girth was measured at the maximum circumference of the buttocks with the removal of extra clothing, and waist circumference was taken midway between the iliac crest and lowermost margin of the ribs by non-stretchable measuring tape. Body mass index (BMI) was calculated as weight (kg) /height (metre)^2. In accordance with the WHO criterion, subjects with a BMI of 25-29.9kg/m^2 were categorised as overweight, and those with a BMI of 30kg/m^2 as obese.[9]

BP was taken by a calibrated sphygmomanometer. The average of three readings was taken as the final reading.

Venous blood samples were taken for measuring the HbA1c level. HbA1c was measured by chemiluminescentmicroparticle immunoassay (CMA) for the quantitative determination of percentage HbA1c in human whole blood on the ARCHITECT I system (Architect I 4100 Modular 12, Abbott Laboratories). This method has been certified by National Glycohaemoglobin Standardisation Programme (NGSP) and standardised with the Diabetes Control and Complications Trial (DCCT).

According to ADA criterion, subjects having HbA1c $\leq$ 5.7% (39mmol/mol) were considered as non-diabetic, between 5.7% (39 mmol/mol) to 6.4% (46 mmol/mol) as pre-diabetics and $\geq$ 6.5% (47mmol/mol) as diabetics.[10]

Analysis was performed by using SPSS 20. Prevalence of diabetes was estimated for the overall participants and for subgroups according to age, gender and other related variables.

The association of diabetes with risk factors was estimated with univariate logistic regression (ULR) analysis. Variables significantly associated with diabetes ($p<0.05$) in ULR were entered into a step-forward multiple logistic regression model to adjust for confounders. P=0.05 and confidence interval (CI) of 95% were considered statistically significant for both univariate and multivariate analyses.

Results

Of the 404 participants, 181(44.8%) were males and 223(55.2%) were females. The overall mean age was 42.3±13 years. Age of 145(35.9%) participants was between50-65 years, 130(32.2%) between 35-49 years and of 127(31.4%) between18-34 years. Besides, 321(79.7%) participants were married, 212(52.5%) educated above tenth grade and 175(43.3%) had a household income of Rs10,000 to Rs30,000 (Table-1).

Moreover, 54(13.4%) subjects were smokers, 155(38.4%) were hypertensive and 74(18.3%) had heart disease. In addition, 323(80%) participants had central and 264(65.3%) had truncal obesity. About 121(30%) subjects were obese and 250(61.9%) were overweight. The crude prevalence of diabetes was 133(32.9%) and pre-diabetes was 151(37.4%). Age-adjusted prevalence of diabetes was 109(26.9%) (Table-1).

Crude prevalence of diabetes was 139(34.5%) in women (and 125(30.9%) in men ($p>0.05$). The age-adjusted prevalence of diabetes was 103(25.4%) in men and 115(28.6%) in women. The prevalence of diabetes substantially ($p<0.001$; ptrend < 0.001) increased with age and was 203(50.3%) in the age group of 50-65 years. The

Table-1: Descriptive statistics of baseline characteristics of study participants (N=404).

Characteristics	Frequency	%
Demographic characteristics		
Gender		
Male	181	44.8
Female	223	55.2
Age in years		
18-34	127	31.4
35-49	130	32.2
50-65	145	35.9
Marital Status		
Married	322	79.7
Unmarried	61	15.1
Widow/Divorced	21	5.2
Education status		
Illiterate	55	13.6
Primary(1-5 grade)	59	14.6
Middle(6-9 grade)	61	15.1
> Matric	212	52.5
Conventional	17	4.2
Employment Status		
Govt. Employee	61	15.1
Private Employee	61	15.1
Self-Employee	80	19.8
Un-employed	84	20.8
Laborer	12	3.0
Any other	106	26.2
Income (PKR)		
<10000	118	29.2
10,000 - 30,000	175	43.3
31000 - 50,000	72	17.8
> 50,000	39	9.7
Smoking status		
Smokers	54	13.4
Physical activity		
Exercise	105	26.0
History of Diabetes		
Positive parental history of diabetes	161	39.9
Positive siblings history of diabetes	88	21.8
Co-morbid conditions		
Heart Disease	74	18.3
Hypertension	155	38.4
Anthropometric measurements		
Central Obesity	323	80.0
Truncal Obesity	264	65.3
Body Mass Index (kg/m^2)		
Normal	33	8.2
Overweight	250	61.9
Obese	121	30
Diabetes status		
Diabetes	133	32.9
Pre-diabetes	151	37.4

Central Obesity: Waist circumference $\geq$ 90 cm in males and ? 80 cm in females according to World Health Organization (WHO). Truncal Obesity: Waist hip ratio> 1.0 for males and > 0.85 for females according to WHO. Diabetes: HbA1c $\geq$ 6.5%(47 mmol/mol), Pre-diabetics:HbA1c5.7% - 6.4% (46 mmol/mol) according to American Diabetic Association (ADA).
Smoker: Individual having smoked at least 100 cigarettes in life time.

Table-2: Univariate logistic regression analysis of Diabetes with characteristics and risk factors (N=404).

		With Diabetes		
Characteristics	**N**	**n (%)**	**OR (95% CI)**	**P**
Overall	404	133 (32.9)	---	---
Demographic characteristics				
Gender				
Male	181	56 (30.9)	1	
Female	223	77 (34.5)	1.18 (0.77 - 1.79)	0.445
Age in years				
18 - 34	127	16 (12.6)	1	
35 - 49	130	44 (33.8)	3.54 (1.88 - 6.71)	0.000
50 - 65	145	73 (50.3)	7.03 (3.79 - 13.03)	
Income (PKR)				
< 30, 000	293	100 (34.1)	0.82 (0.51 - 1.31)	0.41
> 30, 000	111	33 (29.7)	1	
Smoking status				
Non smoker	350	118 (33.7)	1	
Smoker	54	15 (27.8)	1.32 (0.70 - 250)	0.389
Exercise				
No	299	102 (34.1)	1	
Yes	105	31 (29.5)	0.81 (0.50 - 1.31)	0.390
Salad				
No	163	52 (31.9)	1	
Yes	241	81 (33.6)	0.93 (0.61 - 1.61)	0.720
History of Diabetes				
Parental history of diabetes				
Negative	243	68 (28.0)	1	
Positive	161	63 (39.1)	1.58 (1.03 - 2.41)	0.033
Sibling with history of diabetes				
Negative	316	88 (27.8)	1	
Positive	88	45 (51.1)	2.71 (1.67 - 4.40)	0.000
Co-morbid conditions				
Heart Disease				
No	330	104 (31.5)	1	
Yes	74	29 (39.2)	1.40 (0.83 - 2.36)	0.205
Hypertension				
No	249	55 (22.1)	1	
Yes	155	78 (50.3)	3.75 (2.31 - 5.51)	0.000
Anthropometric measurements				
Central Obesity				
No	81	7 (8.6)	1	
Yes	323	126 (39.0)	6.76 (3.02 - 15.15)	0.000
Truncal Obesity				
No	140	34 (24.3)	1	
Yes	264	99 (37.5)	1.87 (1.18 - 2.96)	0.008
Body Mass Index (kg/m^2)				
Normal	33	4 (12.1)	1	
Overweight	250	86 (34.4)	3.80 (1.29 - 11.17)	0.015
Obese	121	43 (35.4)	4.01 (1.32 - 12.12)	0.014

Central Obesity: Waist circumference $\geq$ 90 cm in males and $\geq$ 80 cm in females according to World Health Organization (WHO). Truncal Obesity: Waist hip ratio> 1.0 for males and > 0.85 for females according to WHO. Diabetes: HbA1c $\geq$ 6.5%(47 mmol/mol), Pre-diabetes:HbA1c5.7% - 6.4% (46 mmol/mol) according to ADA.
Smoker: Individual having smoked at least 100 cigarettes in life time.
OR: Odds Ratio, CI: Confidence Interval.
P value < 0.05 and 95% CI were considered as statistically significant.

Table-3: Adjusted multiple logistic regression analysis of diabetes with risk factors (N=404).

Risk factors	With Diabetes		
	AOR	95% CI	P
Age (years)			
19 - 34 years	1		
35 - 49 years	2.29	1.14 - 4.58	0.019
50 - 65 years	4.23	2.09 - 8.54	0.000
Parental history of diabetes			
Negative	1		
Positive	1.66	1.002 - 2.76	0.049
Siblings with history of diabetes			
Negative	1		
Positive	1.81	1.03 - 3.19	0.040
Central Obesity			
No	1		
Yes	3.72	1.55 - 9.93	0.003
Hypertension			
No	1		
Yes	2.60	1.60 - 4.22	0.000

AOR: Adjusted Odds Ratio, CI: Confidence Interval.
P value < 0.05 and 95% CI were considered as statistically significant.

diabetes was significantly associated with parental and sibling history of DM (p<0.05). The prevalence of DM was 143(35.4%) in obese (p<0.05) and 139(34.4%) in overweight (p<0.05) participants, whereas it was 158(39%) (p<0.001) and 151(37.5%) (p<0.05) among those who had central and truncal obesity, respectively. No significant association (p>0.05) was seen in the prevalence of DM with smoking and eating salad. The DM was more prevalent (p>0.05) in adults with low physical activity as compared to those who were involved in exercises. Hypertension (HT) was significantly associated with DM (p<0.01). Approximately half of the hypertensive subjects were diabetic as well. Almost 101(25%) of the diabetic subjects were classified as hypertensive. Unlike HT, DM was insignificantly associated (p>0.05) with heart disease (Table-2).

Significant risk factors for diabetes were: increasing age (35-49 years [odds ratio: 2.29, p<0.05]; 50-65 years [OR: 4.23, p<0.01]), parents (OR: 1.66, p<0.05) and siblings (OR: 1.81, p<0.05) history of diabetes, central obesity (OR: 3.72, p<0.05) and HT (OR: 2.60, p<0.01).

Discussion

It is assumed that diabetes prevalence rate is rising in Pakistan. Although the current study was carried out in only Rawalpindi, it is presumed that the results reflect the overall situation in the urban regions of Pakistan because it was a population-based study which employed random sampling method. Our study revealed that the prevalence of diabetes among the participants was 32.9%, which is higher than the earlier studies done in Pakistan. National diabetic survey conducted by Shera et al. has shown that the overall impaired glucose intolerance IGT) was 22% in urban and 17.1% in rural areas.[7] Hence, the prevalence of diabetes is greater in our study; however several studies have reported similar high prevalence rates in different parts of the world. Survey in different Gulf Arab states reported high prevalence of DM, e.g.25.7% in Bahrain.[11] Another Indian study revealed a high prevalence rate of 34.7%.[12] Similarly, the prevalence of pre-diabetes in our study population was also high, i.e.37.4%. Our pre-diabetes results were comparable with a survey in China which reported its prevalence at 50.1%.[13]

Compared to previous studies in Pakistan, this study used new diagnostic criteria according to ADA guidelines; we used the HbA1c test for diagnosing the diabetes and pre-diabetes. In the previous national level studies and small surveys, this test was not used so the prevalence of diabetes could be underestimated. This same test was used for a national level survey done in China.[13] Various studies have demonstrated that change in the lifestyle due to urbanisation is one of the main factors in the rapid rise in the prevalence rate of DM in recent years.[14] The mean age of this study's population was 45 years. Age is an important determinant in causing the IGT. Our studies reported that the diabetes prevalence increased with age and the highest prevalence rate was found in subjects with age range of 50-65 years. The same trend was found in studies done in India.[15] A worldwide estimate for the prevalence of diabetes in 2030 predicts that in developing countries, diabetes would be more prevalent in individuals in the age group of 45-64 years.[16]

In our study, although the prevalence of DM in women was more than in men (34.5% vs 30.9%), the difference was not statistically significant (p>0.05). Our results are in line with the results of National survey in 2007 conducted by Shera et al.[7] They reported (IGT) in 20.5% of women and 15.9% of men, majority being in the age group of 45-54 years. However, their studied population included samples from both urban and rural areas. In a study done in a small urban population by Zafar et al., the prevalence of diabetes was found to be more in women.[17] Hence, the ratio between both genders varies among populations studied, possibly due to different distributions of risk factors.

The study, like others, revealed a strong association between diabetes prevalence and positive family history. This finding is in concurrence with numerous

previous studies which reported a very strong association of family history with diabetes type 2 (DMT2) incidences. A meta-analysis of the studies on the association of family history and DM conducted by Harrison AT[18] found that individuals with a family history of diabetes had two to six times the risk of diabetes compared with those with a negative family history of the disease. Annis et al. found that the incidence of diabetes increased with the number of relatives having the disease.[19] It is now well-known factor that DMT2is a disease with very strong genetic influences and one of the strongest risk factors. Although it is a "non-modifiable" risk factor, family history can be utilised as a very important screening tool for early diagnosis of DM and may be used to identify high risk individuals to warrant early interventions for delaying or preventing complications of DM which will lessen the socio-economic burden of the disease.

The prevalence of diabetes was higher among individuals who had high BMI. This study involved individuals living in an urban area, where people by virtue of unhealthy eating patterns and sedentary lifestyle had high BMI and hence had a high rate of DM. A study found that in urban South Asian population the risk of diabetes was significant with a BMI of >23 kg/m^2.[20] In our study, it was seen that not only high BMI, but central obesity was the strongest factor associated with diabetes. There is increasing evidence that central obesity increases DM risk. Several studies have shown that Asians, particularly Indian Asians, are more susceptible to have DM than the Western population despite having relatively low level of BMI. This may be due to the presence of central obesity in them leading to insulin resistance syndrome (IRS).[21] It was reported by McKeigue et al. that in South Asians, increase in waist-hip ratio was associated with a rise in DM.[21] Our survey also showed that almost 80% of the population had abdominal obesity and majority of them either were suffering from DM (39%) or had pre-diabetes (34%).

In our survey, 38.4% of the participants had HT and DM was present in 50% of them. This close association was also demonstrated in several other studies, where it was reported that diabetes and HTwere co-prevalent in around 42-60% of patients.[22]

As this was a quantitative study, its result can be generalised to the population living in the cities of Pakistan. Limitations of this study included smaller sample size due to limited resources and inclusion of only urban population.

Conclusion

A very high prevalence of DM and pre-diabetes was found because of urbanisation, ageing and population growth. A national survey encompassing both urban and rural population is needed to determine the actual prevalence. The most import risk factors recognised were age, central obesity and family history of diabetes. HT was strongly associated with the diabetes. A timely national programme for prevention, early diagnosis and to address the modifiable risk factors is a need of the hour to lessen the socio- economic burden of the disease.

Acknowledgement

We are grateful to the team of Hanif Hospital, Mr. Adeel Raza Gondal and Dr. Khizzer Pervaiz for assistance in the data collection process.

Disclosure: No.

Conflict of Interest: Authors have no conflict of interest.

Funding Sources: We have no funding agency it was self sponsored.

References

1. Global status report on noncommunicable diseases 2010. Geneva: World Health Organization, 2011.
2. Danaei G, Finucane MM, Lu Y, Singh GM, Cowan MJ, Paciorek CJ et al. National, regional, and global trends in fasting plasma glucose and diabetes prevalence since 1980: systematic analysis of health examination surveys and epidemiological studies with 370 country-years and 2.7 million participants. Lancet. 2011;378:31-40.
3. King H, Rewers M. Global estimates for prevalence of glucose intolerance. Diabetes Care. 1993;16:121-5.
4. 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; 14:1-85.
5. 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. Diabet Med. 1995; 12:1116-21.
6. Shera AS, Rafique G, Khwaja IA, Baqai S, Khan IA, 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.
7. Shera AS, Jawad F, Maqsood A. Prevalence of diabetes in Pakistan. Diabetes Res Clin Pract. 2007;76:219-22.
8. Shah A, Afzal M.Prevalence of diabetes and hypertension and association with various risk factors among different Muslim populations of Manipur, India. J Diabetes Metab Disord. 2013; 12:52.
9. World Health Organization (WHO) Redefining Obesity and Its Treatment. International Association for the Study of Obesity and International Obesity Task Force. International Diabetes Institute: Melbourne: Health Communications; 2000. The Asia Pacific Perspective.
10. International Expert Committee International Expert Committee report on the role of the A1c assay in the diagnosis of diabetes. Diabetes Care. 2009;32:1327-34.
11. King H, Rewers M. Global estimates for prevalence of glucose intolerance. Diabetes Care. 1993;16:121-25.
12. Joshi SR, Saboo B, Vadivale M, Dan SI, Mithal A, Kaul U, et al. Prevalence of diagnosed and undiagnosed diabetes and

hypertension in India-results from the Screening India's Twin Epidemic (SITE) study. Diabetes Technol Ther. 2012;12:8-15.
13. Yu Xu, Limin W, Jiang,H, Yufang,B, Mian L, Tiange W. et al. Prevalence and Control of Diabetes in Chinese Adults JAMA. 2013;310:948-59.
14. Ramachandran, C. Snehalatha, D. Dharmaraj, M. Viswanathan. Prevalence of glucose intolerance in Asian Indians: urban-rural difference and significance of upper body adiposity. Diabetes Care. 1992;15:1348-55.
15. Ramachandran A, Jali MV, Mohan V, Snehalatha C, Viswanathan M. High prevalence of diabetes in an urban population in south India. BMJ. 1988;297:587-90.
16. 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.
17. Zafar J, Bhatti F, Akhtar N, Rasheed U, Bashir R, Humayun S.et.al. Prevalence and risk factors for diabetes mellitus in a selected urban population of a city in Punjab. J Pak Med Assoc. 2011;61:40-7.
18. Harrison TA, Hindorff LA, Kim H, Wines RC, Bowen DJ, McGrath BB, et al. Family history of diabetes as a potential public health tool. Am J Prev Med. 2003;24:152-9.
19. Annis AM, Caulder MS, Cook ML, Duquette D. Family history, diabetes, and other demographic and risk factors among participants of the National Health and Nutrition Examination Survey 1999-2002. Prev Chronic Dis. 2005; 2:19.
20. Snehalatha C, Viswanathan V, Ramachandran A. Cut-off values for normal anthropometric variables in Asian Indian adults. Diabetes Care. 2003; 26:1380-4.
21. McKeigue PM, Shah B, Marmot MG. Relation of central obesity and insulin resistance with high diabetes prevalence and cardiovascular risk in South Asians. Lancet. 1991; 337:382-6.
22. Moore WV, Fredrickson D, Brenner A, Childs B, Tatpati O, Hoffman JM, et al. Prevalence of hypertension in patients with type II diabetes in referral versus primary care clinics. J Diabetes Complications. 1998; 12:302-6.