Editorial

The Burden of Diabetes in Pakistan: The National Diabetes Survey

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Diabetes Mellitus (DM) is now a leading cause of morbidity and mortality throughout the world. Diabetes is associated with high rates of hospitalization, blindness, renal failure and non-traumatic amputation[1]. The economic impact of DM is high and it is a major contributor to the escalating healthcare cost worldwide[2]. Diabetes is also one of the most common non-communicable diseases globally. Prevalence rates of DM vary considerably amongst different populations and ethnic groups surveyed[3]. Consistently high prevalence rates are now being reported from several developing countries[4]. The World Health Organization (W.H.O.) has estimated that the global number of people with diabetes will be more than double over the next 25 years and the developing world would bear an increasingly larger burden of disease in this period[5]. South Asia in particular is considered one of the areas of highest increase in projected numbers.

Several studies have shown that South Asian migrants and their offsprings have higher prevalence rates of DM than the native host populations[6,7]. Till recently, we had limited population data on prevalence of diabetes among the indigenous Pakistani population. In this issue of JPMA, Shera et al report the third phase of the Pakistan National Diabetes Survey, with prevalence rates of glucose intolerance and associated factors in North West Frontier Province (NWFP). In their first two surveys, prevalence of Type 2 DM among the adult population (>25 years) was 13.9% in Sindh and 8.6% in Baluchistan with a further 11.1% (men) and 13.4% (women) with impaired glucose tolerance (IGT) in the two provinces respectively[8,9]. While the household cluster sampling with voluntary OGTT may have a slight bias in population screening towards women and those with possibly a greater concern of DM, the results of the study are comparable to prevalence rates of DM in other South Asian populations. Shera et al report a prevalence rate of Type 2 DM in NWFP of 11.6% in adult women and 9.2% in adult men, with a further 9.3% of the female population and 9.7% of the male population having IGT. This and their previous survey show that despite geographical differences and cultural diversity amongst the ethnic groups in Pakistan, all carry a similarly high risk of DM and IGT. The high prevalence rates also confirm the need for concern regarding the already considerable and growing problem of DM in Pakistan.

In this report, a number of interesting observations can be made. For each known case of DM, there are approximately 2 cases of undiagnosed DM and 3 cases of IGT in the population. This makes a strong case for screening the population as established complications are often found at the time of delayed diagnosis. Screening should be done in population, age above 45 years old, as this group appears to carry an even higher risk. Most experts agree that screening can be undertaken with an overnight fasting blood glucose (FBG), using the American Diabetes Association criteria of FBG>126 mg/dl (repeated if abnormal) to diagnose DM. Impaired FBG (FBG 110 - 125 mg/dl) often correlates with IGT. These are important clinical entities, both as a risk for future DM and as a risk factor for coronary artery and macrovascular disease. The high rates of associated hypertension and central obesity noted in the study also confirm that some of the many facets of the insulin resistance syndrome are prevalent in the Pakistani population.

All three published reports of the Pakistan National Diabetes Survey show considerable increase in prevalence rates with increasing age, the single most important determinant of risk. As life expectancy increases in Pakistan, projected prevalence rates of DM will increase significantly. The urbanization of the population and adoption of increasingly sedentary lifestyle and westernized diets may also contribute to the increasing rates noted. This coupled with continuing high birth rate could potentially lead to an epidemic of diabetes. There would also be a corresponding increase in microvascular and macrovascular complications including end stage renal disease and coronary artery disease. The individual morbidity, effect on the family and cost to society will be increasingly high.

While we await the results of the fourth phase of the Pakistan Diabetes Survey from Punjab, there is an increasing need to conduct further studies to determine reasons why the population is subject to such high rates of DM and measures that can alleviate the long-term consequences. Does intra-uterine malnutrition and low birth weight contribute to later development of DM in this population? The benefits of an effective screening program need to be considered in relation to the costs of administrating the program and facilities to deal with the new cases detected must also be in place. National standards of care for people with DM should be agreed and implemented. Most importantly there is a need to educate

the population and health care providers regarding DM, as this will ultimately serve as the best hope in controlling the disease and its complications. A national strategy to reduce the burden of disease is required. This needs more resources to be earmarked for diabetes care. The task is challenging and the stakes of success and failure are high. In this battle there is not much time for delay.

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Original Articles

Pakistan National Diabetes Survey
Prevalence of Glucose Intolerance and Associated Factors in North West Frontier Province (NWFP) of Pakistan

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Abstract

Aim: To estimate the prevalence of non-insulin dependent diabetes mellitus (NIDDM) and impaired glucose tolerance (IGT) and their relationship with age and obesity in a population based survey in the rural areas of NWFP, Pakistan.

Setting: Three villages, Pawakai, Reghi and Jhagra in NWFP were the target areas.

Methods: Cluster sampling of 1035 adults aged 25 years and above (207 men, 828 women) was done. Oral glucose tolerance tests were performed and the diagnosis of diabetes and IGT was made according to WHO criteria. Height, weight and waist hip ratio of the study population were recorded. The Chi Square test was used to measure the association among the different variables. Basic demographic information from the subjects was collected by a physician using a standard questionnaire.

Results: The overall prevalence of NIDDM and IGT in both sexes was 11.1% and 9.4%. The sex specific prevalence of diabetes was 9.2% in men and 11.6% in women. Advanced age, positive family history of diabetes and obesity were associated with higher rates of diabetes. In both sexes high Waist Hip Ratio (WHR) was more closely associated with diabetes than was high Body Mass Index (BMI).

Conclusion: The prevalence of diabetes mellitus in rural areas of NWFP is high and almost similar to that of Sindh and Baluchistan (JPMA 49:206, 1999).

Introduction

The prevalence of non-insulin dependent diabetes (NIDDM) is increasing worldwide[1]. Studies on migrant South Asian Indian populations have reported a higher prevalence of NIDDM in comparison to the indigenous population of the Indian subcontinent or the natives of the host country[2-7]. A number of studies done on the indigenous population in the Indian subcontinent[8,9] are, however, not comparable as very few studies used the standardized WHO criteria for the diagnosis of diabetes mellitus[10]. Nevertheless, the indigenous population of Pakistan appears to have high prevalence rate of diabetes as reported in our earlier surveys conducted in the province of Sindh[11] (overall NIDDM 13.9%) and Baluchistan[12] (overall NIDDM 8.6%) which is comparable to the immigrant Asian population elsewher[13,14]. Earlier studies have shown that BMI and WHR are independent risk factors for NIDDM and IGT[15-19] and the relationship between obesity, hypertension and

glucose intolerance is also well documented[20,21].

This is the report of the third phase of the nationwide prevalence survey of diabetes that was conducted in the rural areas of Peshawar, NWFP Province.

Subjects and Methods

Study population

The survey was carried out on 1035 adults aged 25 years and above (207 men, 828 women) in three geographically defined villages, Pawakai, Reghi and Jhagra situated near Peshawar, the capital of NWFP Province. Cluster sampling was done in the three villages.

One month before the survey, a team of survey officers and local volunteers noted the names of those aged 25 years and above for each household included in the study. They also provided them with detailed information and printed leaflets emphasizing the significance of the study and encouraged them to participate in it.

Screening Procedure and Blood Sampling

All subjects were asked to attend the survey site on a specified day after an overnight fast of 10-14 hours. After registration, a fasting blood sample was drawn and each individual, excluding previously diagnosed diabetics, was given 82.5g of glucose monohydrate (equivalent to 75g anhydrous glucose) dissolved in 250 ml of water, which was consumed within a period of 5 minutes.

Height, weight and waist-hip ratio were recorded. Standing height and weight were measured with subjects in light clothing and no shoes. Height was taken to the nearest cm and weight to the nearest 0.1 kg. Waist circumference was measured to the nearest cm at the mid-point between the iliac crest and the lower margin of the ribs, with the subjects standing and breathing normally. Hip circumference was measured to the nearest cm at the level of the maximum circumference around the buttocks posteriorly, and at the symphysis pubis anteriorly.

Basic demographic information from the subjects was collected by a physician using a standard questionnaire. Family history of diabetes was regarded as positive if NIDDM was present in a first degree relative. Subjects not known to be diabetic remained at the examination centre until the second sample of blood glucose was taken, exactly 2 hours after commencing the glucose drink. Blood pressure was recorded by a physician with the bell of the stethoscope and the subject seated for atleast 10 min, in the right arm using an adult size cuff and standard mercury column sphygmomanometer. Two readings were taken in every subject. If the two readings differed by 10 mmHg or more, a third reading was recorded by another doctor and the mean of the two closest ones was taken as the final result. The subjects were lastly interviewed by a dietitian who filled up a proforma using 24 hours recall method.

Every day the non-responders for that particular day were contacted by the survey team and given a new appointment.

All blood samples were collected in fluoride tubes, centrifuged immediately and refrigerated. After the sample collection was completed for the day, the plasma was transferred to separate tubes and refrigerated at -20 degrees centigrade for analysis later on the same day. Plasma glucose was determined by the glucose oxidase method using a Hitachi 705 analyzer in a laboratory which takes its quality assurance through CAP (College of American Pathologists) survey programme.

Diagnostic criteria

The 1985 WHO diagnostic criteria for diagnosis of diabetes mellitus and IGT were used to classify glucose tolerance status[10].

The diagnostic values used were:

1. For diabetes mellitus, fasting venous plasma glucose >140 mg/dl or 2 hour venous plasma glucose >200 mg/dl.

2. For IGT, 2 hour venous plasma glucose 140-199 mg/dl.

3. Diabetes was considered to be already present if the diagnosis of diabetes had been made previously by a physician.

Statistical Methods

Data analysis was conducted with statistical package Epinfo 6.0. BMI was calculated as weight/height^2 (kg/m^2) and the WHR as the waist girth in cm/hip girth in cm. Levels for BMI and WHR were defined separately for both sexes as follows: BMI for women: normal 20-25, high >25; BMI for men: normal 20-27, high >27; WHR for women: normal 0.75-0.85; high >0.85; WHR for men: normal 0.85-0.95, high >0.95. The Chi-square test was used to measure the association among the different variables. The results for continuous variables are given in the form of averages, standard deviations and their 95% confidence intervals. The significance between two group means was assessed by Z test. The relative risk was obtained by comparing BMI, WHR and positive family history of diabetes, in both sexes separately.

Results

A total of 1035 subjects were examined in the three villages. The age distribution of men and women is shown in Figure 1. In the younger age groups (25-44 years) relatively more women attended (42%). A lower response rate seen in men in all three areas was due to inability to attend on working days.

Table 1. Diabetes and IGT prevalence by age and sex in rural NWFP.

Age (years	Number examined	Total number with diabetes No. (%)	Number of new cases of diabetes	Number with IGT No. %
Women:				
25-34	236	7 3.0	4	18 7.6
35-44	203	19 9.4	13	6 7.9
45-54	156	23 14.8	14	14 9.0
55-64	126	25 19.8	15	14 11.1
65-74	75	14 18.7	9	11 14.7
75+	32	8 25.1	6	4 12.5
All ages	828	96 11.6	61 7.4	77 9.3
Men:				
25-34	63	0	0	2 3.2
35-44	25	2 8.0	2	1 4.0
45-54	32	5 15.6	4	4 12.5
55-64	39	6 15.4	3	4 10.3
65-74	30	3 10.0	2	7 23.7
75+	18	3 16.7	1	2 11.1
All ages	207	19 9.2	12 5.8	20 9.7

Prevalence of abnormal glucose tolerance

The prevalence of previously diagnosed NIDDM was 3.4% in men and 4.2% in women. Newly diagnosed NIDDM was detected in 5.8% (men) and 7.4% (women). The mean age ±SD of the newly diagnosed diabetics for men was 55±12 and women 53±15 years. IGT was encountered in 9.7% men and 9.3% women.

Overall glucose intolerance, including previously and newly diagnosed NIDDM and IGT was detected in 20.4% of men and women in rural NWFP. Prevalence of glucose intolerance increased with advancing age in both sexes, reaching a peak in the 75+ years age group in both men and women. The age specific rates for IGT prevalence were higher in women at younger ages (25-44 years) and peaked in men at 65-74 years (Table 1).

Distribution of 2-hour blood glucose

The distribution of the 2-hour BG values in the subjects with exclusion of previously known diabetics is shown in Figure 2. The mean±SD was 122±68.5 mg/dl for women and 114±72.4 mg/dl for men. The distribution, in both sexes was skewed to the right.

Factors associated with glucose tolerance

In all three villages abnormal glucose tolerance (IGT and diabetes) was more prevalent in older subjects in both sexes. Obesity and high waist-hip ratios were present in higher frequency in individuals with IGT and NIDDM than those with normal glucose tolerance. In both men and women high WHR was more closely associated with diabetes than high BMI.

The relative risk for development of diabetes in men with BMI >27 was 1.9 times whereas in men with WHR >0.95 this increased to 2.4 times compared to men with normal BMI and WHR. The relative risk of diabetes in women was twice with BMI >25 ($p<0.001$) and increased to four times with WHR >0.85 ($p<0.001$) compared to women with normal BMI and WHR. Men with high WHR were also 1.2 times ($p<0.01$) more likely to develop IGT. Although the difference in risk of developing IGT in women with high WHR was 1.3 times more, but this was not significant statistically.

A positive family history of diabetes (Table 2), was found more in subjects with NIDDM than in subjects with normal glucose tolerance both in men (27.5% vs 12.5%) and women (29.6% vs 15.3%). The relative risk of developing

Table 2. Means and proportions for selected variables in women and men with NGT, IGT and DM in NWFP.

Variable	Normal Glucose Tolerance	Impaired Glucose Tolerance	Diabetes Mellitus	Total Population
Women:				
No. examined	665	77	96	828
Age	42.7±1.1	47.7±3.6	53.2±2.8	44.4±1.0
BMI (kg/m^2)	23.6±0.38	24.6±1.36	25.8±1.19	24.0±0.36
WHR	0.93±0.02	0.93±0.04	0.98±0.02	0.94±0.02
BMI >25.0 (%)	35.4	44.2	56.2*	38.6%
WHR >0.85 (%)	78.2	83.1	94.8*	80.6%
F/H of DM (%)	15.3	20.8	26.0**	17.0%
Hypertensive (%)	19.8	33.7	44.8	24.0%
Men:				
No. examined	168	20	19	207
Age	45.6±2.6	57.5±6.1	58.2±5.2	47.9±2.3
BMI (kg/m^2)	21.2±0.69	22.7±1.72	25.3±1.39	21.4±0.64
WHR	0.87±0.02	0.91±0.04	0.96±0.03	0.88±0.02
BMI >27.0 (%)	8.3	10.0	15.8	9.2%
WHR >0.95 (%)	17.3	45.0	36.8	21.7%
F/H of DM (%)	12.5	20.0	42.1	15.9%
Hypertensive (%)	9.5	10.0	21.0	10.1%

Values shown are means or proportions ±95% confidence interval.
BMI: Body mass index; WHR: Waist hip ratio; F/H: Family history;
DM: Diabetes mellitus.
* = p<0.01 ** = p=0.01

diabetes in subjects with a positive family history of diabetes increased four times in men (p<0.01) and 1.76 times (p=0.01) in women. The relative risk of developing IGT in men and women with positive family history was 1.63 and 1.39 times more, respectively.

The prevalence of hypertension was associated with the glucose tolerance status (Table 2). About 45% of women and 21% of men with diabetes and one-third of women and one-tenth of men with IGT also had hypertension as compared to less than 20% of women and less than 10% of men with normal glucose tolerance. In the study population hypertension was less prevalent in men as compared to women.

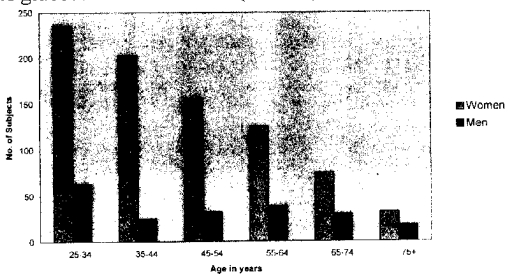

Figure 1. Age structure of the survey population.

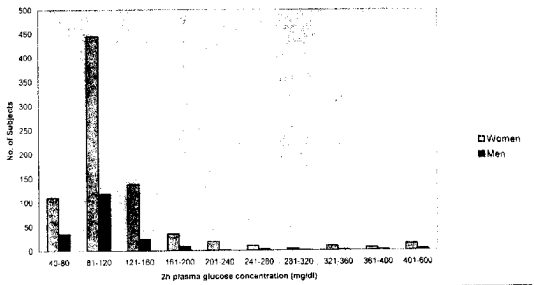

Figure 2. Two hour plasma glucose concentration (previously known diabetics excluded).

Discussion

This is the report of the third phase of Pakistan National Diabetes survey. The studies done on prevalence of diabetes in the migrant South Asian populations elsewhere have consistently shown a much higher prevalence of diabetes than the indigenous population of the Indian subcontinent and the native population of the host country[2-7]. In South Africa[3], the overall prevalence of diabetes and IGT was 11.1% and 6% respectively in Indians as compared to diabetes in Whites (3.6%) and Africans (4.1%). In Tanzania[4], the overall prevalence of diabetes was 7.1% (4.4% known and 2.7% new) and IGT was 21.5% in the Muslim Indians. In Mauritius[5], Indian Muslims had a prevalence rate of 13.3% for diabetes and 15.3% for IGT. Mather and Keen have documented a 3.8 times higher prevalence of known diabetes as compared to Europeans in Southall[6]. In the Coventry diabetes study, Simmons et al. noted diabetes in 11% of Asian men and 8% of Asian women as compared to 3% in white men and 4% in white women[7]. The overall prevalence rates of glucose intolerance (IGT and NIDDM) in this study was found to be 20.4% in both sexes which is comparable to our earlier studies done in the provinces of Sindh[11] (25%) and Baluchistan[12] (22%). However, as against our earlier surveys the prevalence of IGT are similar in both men and women. The finding of a higher prevalence of IGT in men as compared to women in the older age group is also in variation with our previous studies where women at almost all ages have a higher prevalence of IGT[11]. The high rates of IGT in this population suggest the need of introducing health intervention measures that may be effective in primary prevention of diabetes in this area.

NIDDM in this study presented at a younger age, a finding also recognised in our earlier surveys[11,12] as well as in previous studies on Asian migrants[6,7,14]. In consistence with other studies in migrant South Asian communities[5-7] and the recently conducted studies in India[22,23] the prevalence rates of NIDDM and IGT increased with age in both men and women. Prevalence of NIDDM in both men and women was highest in the age group 55-64 years. In women of urban area diabetes prevalence reached a peak (25.5%) in the age group 65-74 years.

A positive family history of diabetes, obesity and abdominal fat distribution have been described as related risk factors in a number of studies[11,16-19]. In our study a positive family history was strongly related to NIDDM. Earlier studies have shown that BMI and WHR are independent risk factors for NIDDM and IGT and also demonstrated that WHR conveys a relatively stronger risk for NIDDM[15,17,24]. In our study the finding of a stronger association of WHR as compared to BMI with glucose intolerance is consistent with above studies reporting that central obesity is a greater risk for developing diabetes as compared to peripheral obesity.

The relationship between hypertension and glucose intolerance is well documented[20,21]. In this study, as well as in our previous two surveys[11,12] a marked association between glucose intolerance and hypertension was observed with indication of a gradient from normoglycaemia, through IGT, to diabetes.

As is evident from this and the earlier studies conducted in Shikarpur[11] and Baluchistan[12], adult diabetes has emerged as a major problem in Pakistan indicating the urgent need for planning preventive programmes for diabetes.

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