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Pakistan National Diabetes Survey: prevalence of glucose intolerance and associated factors in Baluchistan province

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Abstract

The prevalence of diabetes mellitus (DM) and impaired glucose tolerance (IGT) and their relationship to age and obesity was estimated in a population-based survey in urban and rural areas in Baluchistan province, Pakistan. Cluster sampling of 834 adults (260 men, 574 women) in the urban and 570 adults (175 men, 395 women) in the rural areas was carried out. Oral glucose tolerance tests were performed in adults aged 25 years and above. Diagnosis of diabetes and IGT was according to the World Health Organization (WHO) criteria. The overall prevalence of diabetes and IGT in both sexes was 10.8 and 11.9% (urban) versus 6.5 and 11.2% (rural), respectively. The crude prevalence of diabetes in the urban versus rural area was 11.1% in men and 10.6% in women versus 10.3% in men and 4.8% in women. As against this IGT was found in 6.5% of men and 14.3% of women in the urban area and 7.4% of men and 13.0% of women in the rural setting. The major risk factors associated with diabetes were age, positive family history (F/H) of diabetes and obesity. Central obesity was more strongly associated with diabetes in women than men.

Keywords: Diabetes mellitus; Impaired glucose tolerance; Obesity; Prevalence; Asians

1. Introduction

The prevalence of non-insulin dependent diabetes (NIDDM) is increasing worldwide and the information on true frequency of the disease is considered essential for planning health care services in all countries. Studies carried out in migrant Asian Indian populations in a number of countries [1–7] have shown a high prevalence of NIDDM in these communities as compared to the indigenous population of their adopted countries. While a number of studies have been carried out

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on the indigenous population in the Indian subcontinent [8,9], they are not comparable as very few studies used the standardised WHO criteria for the diagnosis of diabetes mellitus (DM) [10]. A phased nationwide prevalence study of DM in Pakistan was started in 1994 and it was reported earlier, that the indigenous population of Pakistan appear to have high prevalence rate of diabetes which is comparable with the immigrant Asian population elsewhere [11]. This is the report of the second phase of the survey which was conducted in urban and rural areas of Baluchistan province.

2. Materials and methods

Baluchistan province is located in the southwest of Pakistan. It consists of dry mountainous regions that are thinly populated as compared to other provinces. Transportation is difficult, peripheral health services are limited and the inhabitants of this province are relatively poor. Quetta is the capital of Baluchistan. The urban city area has a population of 280 000 of mixed socio-economic status. Most of the inhabitants are permanent local residents (Baluchis) of that area with a small number (about 2%) of migrants (Hazara group of people who migrated to Pakistan from Afghanistan about 30 years ago) representing a relatively stable community. Most people have been resident in Quetta for more than 15 years. Ninety eight percent of the population is Muslim. There has also been a recent influx of refugees in the last 5 years from Afghanistan who have settled in Quetta after the Afghan war. Such subjects were not included in the survey. The rural population lives in scattered villages with limited facilities. Killimengal is a rural village situated near the Afghanistan border, having a population of 10 000 inhabitants who are permanent local residents.

The majority of people in Baluchistan lead a traditional life style living together as extended families within one compound. Most households eat together, men are traditionally fed first followed by women and children. The diet consists of approximately 36–41% fat, 50 55% carbohydrates and less than 10% proteins. Women's daily fat intake is more as compared to men (40 vs. 36%). Conventionally women observe 'purdah', seldom go out and hence outside routine household work their physical activity level is not much.

2.1. Study population selection criteria

The survey was carried out in two stages. In the first stage, 834 subjects were examined in March 1995 in urban Quetta. In the second stage, 570 subjects were examined in June 1995 in a village, Killimengal.

Three months before the survey, a team of survey officers and local volunteers marked households for inclusion in the survey. Cluster sampling was carried out in four geographically defined randomly selected areas in Quetta city. Similar cluster sampling was carried out in the Killimengal village. Names of those aged 25 years and above were noted for each household included in the study. The members of the household were provided with detailed information and printed leaflets emphasizing the significance of the survey and encouraged to take part in the survey.

2.2. Screening procedure and blood sampling

Screening and blood sampling procedures have been described previously (Diabetic Medicine 12 (1995) 1116–1121).

2.3. Diagnostic criteria

The diagnostic criteria for diagnosis of DM and impaired glucose tolerance (IGT) recommended by the WHO Study Group (1985) were used to classify glucose tolerance status. The diagnostic values used were:

1. For DM, fasting venous plasma glucose > 140 mg/dl or 2 h venous plasma glucose > 200 mg/dl.
2. For IGT 2 h 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.

Physical activity in this survey was defined as: (1) sedentary; (2) light; (3) moderate; and (4) heavy. Sedentary was applied to those men who had an office job or women who were not doing any housework. Heavy was applied to those who did manual labour. Light and moderate were in between categories.

2.4. Statistical Methods

Data analysis was conducted with statistical package 'Stat Graphic version 3'. Body mass index (BMI) was calculated as weight/height^2 (kg/m^2) and the waist–hip ratio (WHR) as the waist girth (cm)/hip girth (cm). The χ^2 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 (S.D.) and their 95% confidence intervals (CI). The significance between two group means was assessed by the Z-test. The relative risk was obtained by comparing BMI, WHR and positive family history (F/H) of diabetes, in both sexes separately.

3. Results

A total of 834 subjects were examined in Quetta (urban area), while 570 subjects were examined in Killimengal (rural area). The overall response rate for Quetta was 76% and for Killimengal 81%. Total response rates for men and women, was 63 and 84%, respectively, in Quetta, and 69 and 90% in Killimengal. A lower response rate seen in men in both areas was due to inability of men to attend the survey on working days.

In both urban and rural areas the average number of persons living in a single household was eight (range 1–35 persons). The mean (± S.D.) family income per month was Rs. 4520 ± 6273 (~US$ 98 ± 136) in Quetta and Rs. 3834 ± 4456 (~US$ 83 ± 97) in Killimengal. The age distribution of men and women in the urban and rural areas is shown in Figs. 1 and 2. In the younger age groups relatively more women were represented.

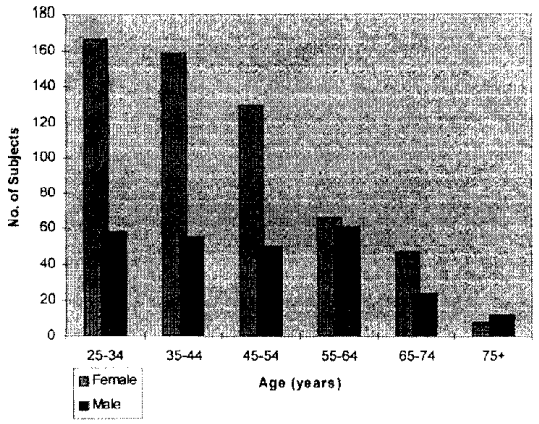

Fig. 1. Age structure of the urban survey population.

3.1. Prevalence of abnormal glucose tolerance

The prevalence of diabetes and IGT by age and gender in the urban and rural areas are shown in Table 1. Prevalence of previously diagnosed NIDDM was 11.1% in men and 10.6% in women in the urban and 10.2% in men and 4.8% in women in the rural areas. Newly diagnosed NIDDM was detected in 5.0% (men) and 5.7% (women) in Quetta and 2.3% (men) and 3.0% (women) in Killimengal. The mean age of the newly diagnosed diabetics for men was 45 ± 15 and for women 41 ± 12 years. IGT was detected in 6.5% of men and 14.3% of women in urban and

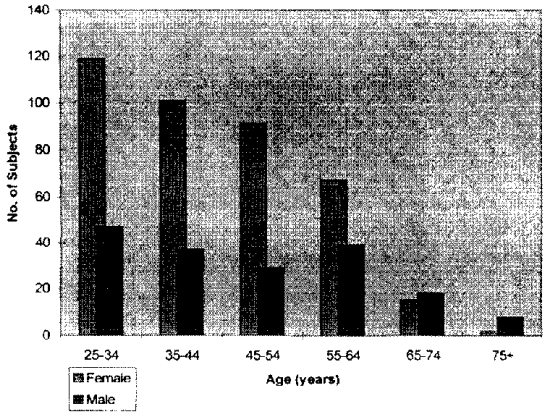

Fig. 2. Age structure of the rural survey population.

Table 1
Diabetes and impaired glucose tolerance (IGT) prevalence by age and sex in urban and rural Baluchistan

Age (years)	No. examined		Total no. with diabetes (%)		No. new cases of diabetes (%)		No. with IGT (%)	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Women:								
25–34	166	119	6 (3.6)	1 (0.8)	3 (1.8)	0	14 (8.4)	10 (8.5)
35–44	158	101	17 (10.8)	4 (4.0)	12 (7.6)	4 (4.0)	20 (12.6)	11 (11.0)
45–54	129	91	17 (13.2)	9 (10.0)	7 (5.4)	5 (5.5)	24 (18.6)	14 (15.4)
55–64	66	67	9 (13.6)	3 (4.5)	2 (3.0)	2 (3.0)	11 (16.6)	14 (21.0)
65–74	47	15	12 (25.5)	1 (6.6)	9 (19.1)	1 (6.6)	10 (21.3)	2 (13.3)
75+	8	2	0	0	0	0	3 (37.5)	0
All ages	574	395	61 (10.6)	19 (4.8)	33 (5.7)	12 (3.0)	82 (14.3)	51 (13.0)
Men:								
25–34	58	47	1 (1.7)	3 (6.3)	0	2 (4.2)	1 (1.7)	0
35–44	55	37	5 (9.1)	1 (2.7)	2 (3.6)	0	2 (3.6)	3 (8.1)
45–54	50	29	9 (18.0)	4 (13.8)	4 (8.0)	0	3 (6.0)	0
55–64	61	39	12 (19.6)	7 (19.4)	5 (8.2)	0	6 (10.0)	3 (8.3)
65 74	24	18	1 (4.2)	2 (11.1)	1 (4.1)	1 (5.5)	2 (8.3)	5 (27.7)
75+	12	8	1 (8.3)	1 (11.1)	1 (8.3)	1 (11.5)	3 (25.0)	2 (22.2)
All ages	260	175	29 (11.1)	18 (10.2)	13 (5.0)	4 (2.3)	17 (6.5)	13 (7.4)

in 7.4% of men and 13.0% of women in rural Baluchistan.

Overall glucose intolerance, including previously and newly diagnosed NIDDM and IGT was detected in 22.6% of men and women in urban and 15.9% of men and women in rural Baluchistan. Prevalence of glucose intolerance increased with advancing age in both sexes, reaching a peak in the 65–74 years age group in women and in the 54 64 years age group in men. The age specific rates for IGT prevalence were higher in women at almost all ages in both urban and rural areas of Baluchistan.

3.2. Distribution of 2-h blood glucose (BG)

The distribution of the 2-h BG values in the subjects with exclusion of known diabetics was unimodal and is shown in Fig. 3 (urban) and Fig. 4 (rural). The distributions are similar in the two regions and higher prevalence of diabetes in the urban sample is reflected by the larger proportion of subjects in the upper tail of the distribution.

3.3. Pattern of treatment

Eighty four percent of the previously known diabetes patients in the urban area were taking oral hypoglycaemic drugs, 11% were treated with diet alone, 2% were on insulin and 2% were taking no treatment. Against this 91% patients in the rural area were on oral hypoglycaemic drugs, and 9% were on insulin.

3.4. Factors associated with glucose tolerance

In both urban (Table 2) and rural (Table 3) areas of Baluchistan abnormal glucose tolerance (IGT and diabetes) was more prevalent in older subjects in both sexes. Obesity and high WHRs were also more prevalent in individuals with IGT and NIDDM than those with normal glucose tolerance (NGT). In both sexes WHR was more significantly associated with diabetes as compared to BMI.

The relative risk for development of diabetes in men in urban area with BMI > 27 was four times

whereas in men with WHR > 0.95 this increased to seven times compared to men with normal BMI and WHR. The relative risk of diabetes in women was increased to almost three times both with BMI > 25 and with WHR > 0.85 compared to women with normal BMI and WHR. Men with high WHR (> 0.95) were also four times more likely to have IGT.

In the rural area, the relative risk for development of diabetes in men with BMI > 27 was 0.6 times whereas in men with WHR > 0.95 this was twice that of men with normal BMI and WHR. The relative risk of diabetes in women was increased to 13.4 with BMI > 25 and 5.5 with WHR > 0.85 compared to women with normal BMI and WHR. Men with high WHR (> 0.95) were also twice more likely to have IGT.

Although a higher prevalence of positive F/H of diabetes was observed in subjects with NIDDM as compared to the subjects with NGT, in both urban and rural populations (Table 3), it was not significant statistically except in the case of rural women. In the urban area positive F/H was slightly higher in men and women with IGT than that seen in the subjects with NGT. However, an intermediate proportion of men with IGT (16.6%) in the rural area had a positive F/H whereas there was not much difference in women with IGT as compared to the women with NGT. The relative risk of developing diabetes in subjects with a positive F/H of diabetes increased four times in men and three times in women in both urban and rural areas but no significant association occurred between a positive F/H of diabetes and increase in risk of IGT.

The majority of women included in the study of both urban and rural performed routine household work defined as light physical activity (urban 76%; rural 86%). None of the women in the rural areas was involved in moderate or heavy physical activity whereas only 0.7% of women in the urban areas were performing moderate physical activity. In the urban areas only 38% of men and in the rural areas 28% of men were involved in moderate to heavy physical activity. Sedentary women in the urban area had four times the risk of development of diabetes. Sedentary women (both in the urban and rural areas) and men in the rural area performing only light physical activity had twice and thrice the risk of development of IGT, respec-

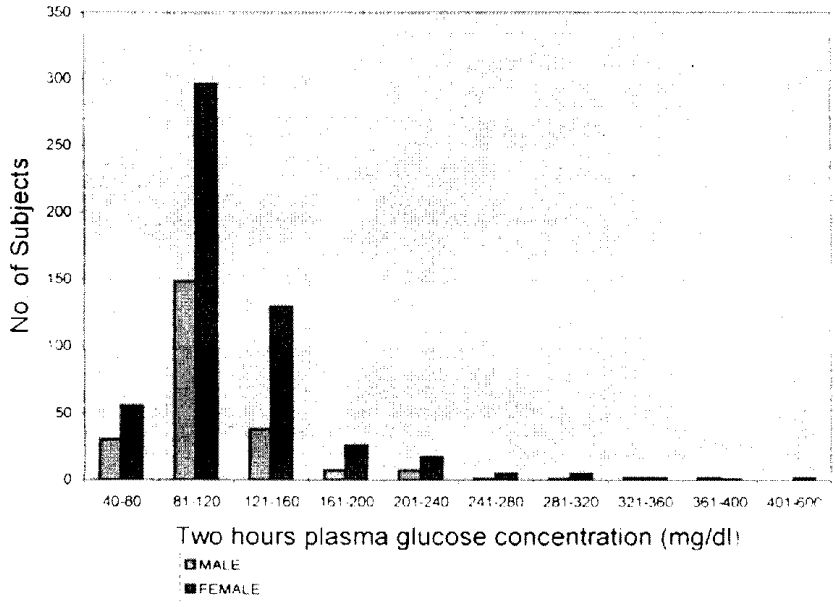

Fig. 3. Distribution of 2 h plasma glucose concentration (mg/dl) in Quetta. Subjects with previously known diabetes were excluded.

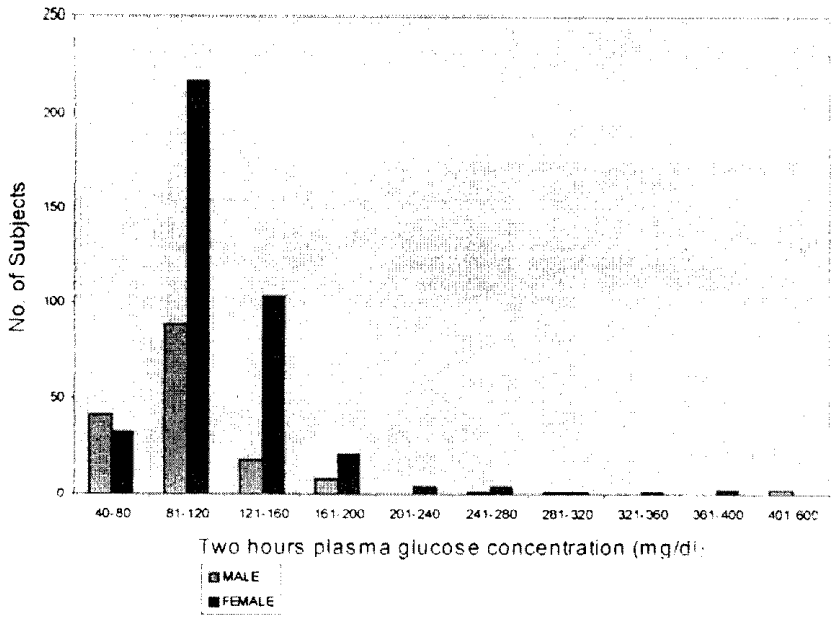

Fig. 4. Distribution of 2 h plasma glucose concentration (mg/dl) in Killimengal. Subjects with previously known diabetes were excluded.

tively. However, the association was significant in rural women only.

The prevalence of hypertension was associated with the glucose tolerance status. About one-third of women and one-fourth of men with diabetes and one-fourth of both with IGT in the urban area also had hypertension as compared to less than 15% of women and less than 10% of men with NGT. In the rural area hypertension was less prevalent both in diabetics and persons with NGT than seen in the urban population (women 15.8 vs. 8.3%; men 22.2 vs. 9.0%). However, both men and women with IGT in the rural area had higher prevalence of hypertension (19.6 and 30.7%, respectively).

Associations between glucose tolerance ($\log_{10}$ 2-h BG concentration) and the risk factors were also examined by means of multiple regression analysis. For men and women of both urban and rural areas, age, central obesity and diastolic blood pressure were significantly and independently associated with glucose tolerance.

4. Discussion

This is the report of the second phase of Pakistan National Diabetes Survey. Considering the geography and the life style of the inhabitants of Baluchistan it was expected that diabetes prevalence would be lower in this province. However, the overall prevalence rates of glucose intolerance (IGT and NIDDM) in this study was found to be 22.6% in urban and 14% in the rural Baluchistan, in both sexes. The prevalence of diabetes in the rural women was notably low in this study. The total glucose intolerance was higher (25%) in urban women as compared to urban men (18%) and in both sexes (17.6%) in the rural area. The studies carried out on prevalence of diabetes in the migrant South Asian populations elsewhere have consistently shown a much higher prevalence than the indigenous population of the Indian subcontinent and the native population of the host country. In Fiji [2], the prevalence of diabetes in rural and urban Indian population were similar (12.1

vs. 12.9% for men and 11.3 vs. 11.0% for women) but these were much higher as compared to the Malenesian population (1.1 vs. 3.5% for men and 1.2 vs. 7.1% for women). However, rates for IGT were not statistically different in the two populations (Indians 10.2 vs. 8.3% in men; 9.6 vs. 11.8% in women and Malenesians 5.7 vs. 7.3% in men; 8.5 vs. 13.2% in women). 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.

The prevalence of IGT in this study was noted to be approximately 2–3-fold higher than the prevalence of newly diagnosed NIDDM, which is also observed in other studies [19]. The finding of a higher prevalence of IGT in women than men at almost all ages, together with a higher prevalence of IGT than of diabetes in women, is similar to that found in our earlier survey in Skikarpur [11], Sindh province.

NIDDM, in this study, presented at a relatively young age, a finding also recognised in an earlier study [11] as well as in previous studies on Asian migrants [6,7,12]. Also in consistence with other studies in migrant South Asian communities [5–7] and the recently conducted studies in India [13,14] the prevalence rates of NIDDM and IGT increased with age in both men and women. Prevalence of NIDDM in both urban and rural areas was maximum in the age group 55–64 years. In women of urban area diabetes prevalence reached a peak in the age group 65–74 years whereas in the rural women the peak occurred at a younger age group (45–54 years). Even in an earlier study from India [8], giving a crude overall rate of 3% diabetes, rates of 10.3% in the age group 51–60 years and 16.4% for over 60 years was reported. In Leicester, UK [15] the prevalence rate of NIDDM rose sharply above

Table 2
Means and proportions for selected variables in women and men with normal glucose tolerance (NGT), impaired glucose tolerance (IGT) and diabetes mellitus (DM) in Quetta (Urban area), Baluchistan[a]

Variable	NGT	IGT	DM	Total population
Women:				
No. examined	431	82	61	574
Age	41 ± 1.2	47 ± 2.8	49 ± 3.2	43 ± 1.0
BMI (kg/m^2)	22.5 ± 0.7	24.7 ± 1.3*	25.7 ± 2.1**	24.6 ± 0.4
WHR	0.85 ± 0.01	0.93 ± 0.03**	1.00 ± 0.05**	0.93 ± 0.01
BMI > 25.0 (%)	38.0	47.5**	64.0**	41.6
WHR > 0.85 (%)	65.4	87.3**	90.0**	70.2
F/H of DM (%)	8.1	12.2	23.0	10.3
Hypertensive (%)	14.6	26.8	34.4	18.4
Men:				
No. examined	214	17	29	260
Age	46 ± 2.0	57 ± 7.6	54 ± 3.6	47 ± 1.7
BMI (kg/m^2)	22.0 ± 0.05	23.0 ± 2.0*	24.8 ± 1.6**	22.5 ± 0.4
WHR	0.90 ± 0.01	0.95 ± 0.05**	0.98 + 0.04**	0.91 ± 0.01
BMI > 27.0 (%)	8.0	23.5	32.2	11.9
WHR > 0.95 (%)	27.5	53.0**	67.7**	33.8
F/H of DM (%)	7.5	11.8	29.0	10.4
Hypertensive (%)	9.3	23.5	24.1	11.9

[a] Values shown are means or proportions ± 95% confidence interval (CI). BMI, body mass index; WHR, waist–hip ratio; F/H, family history; DM, diabetes mellitus.

* $P < 0.05$.

** $P < 0.01$.

Table 3
Means and proportions for selected variables in women and men with normal glucose tolerance (NGT), impaired glucose tolerance (IGT) and diabetes mellitus (DM) in Killimengal (rural area), Baluchistan[a]

Variable	NGT	IGT	DM	Total population
Women:				
No. examined	325	51	19	395
Age	41 ± 1.3	46 ± 3.3	50 ± 5.4	42 ± 1.2
BMI (kg/m^2)	21.0 ± 0.8	24.0 ± 1.8*	28.5 ± 5.6*	23.1 ± 0.5
WHR	0.84 ± 0.03	0.92 ± 0.04**	0.97 ± 0.10**	0.92 ± 0.01
BMI > 25.0 (%)	23.0	37.2**	69.5**	27.5
WHR > 0.85 (%)	66.6	78.4**	87.0**	69.3
F/H of DM (%)	4.3	6.0	21.7**	5.5
Hypenensive (%)	8.3	19.6	15.8	10
Men:				
No. examined	144	13	18	175
Age	45 ± 2.4	63 ± 9.8	53 ± 7.8	47 ± 2.3
BMI (kg/m^2)	21.4 ± 0.6	22.0 ± 3.0*	22.6 ± 2.5**	21.6 ± 0.6
WHR	0.86 ± 0.02	0.89 ± 0.06**	0.92 ± 0.04**	0.87 ± 0.01
BMI > 27.0 (%)	9.0	16.6	5.0	9.1
WHR > 0.95 (%)	19.4	25.0**	40.0**	22.2
F/H of DM (%)	6.2	16.6	25.0	9.1
Hypertensive (%)	9.0	30.7	22.2	12

[a] Values shown are means or proportions ± 95% confidence interval (CI). BMI, body mass index; WHR, waist-hip ratio; F/H, family history; DM, diabetes mellitus.
* $P < 0.05$.
** $P < 0.01$.

the age of 45 years to 10.6% and to 20.3% in those over 65 years of age.

A F/H of diabetes, obesity and abdominal fat distribution have been described as major risk factors in India [16–18]. A positive F/H as well as obesity were strongly related to diabetes and IGT. In subjects with NIDDM 26% (urban) and 23% (rural) had a positive F/H of diabetes as compared to 11.5% (urban) and 5% (rural) in normoglycaemic subjects. Positive F/H was also noted in 45% of migrant Indians in South Africa [3] and was more frequent (55%) in the Muslims. In Tanzania [4], a F/H of diabetes was present in 17.4% of Indian Muslims above the age of 34 years, and those with positive F/H had twice the prevalence of diabetes compared with those with a negative history. A positive correlation (47%) was also shown in the South Indian study [14].

Physical inactivity is considered to be a risk factor for both IGT and NIDDM [20–22]. Men in the rural area were less physically active as compared to the men in the urban area. This may be due to the fact that approximately half of the men examined in Killimengal were over 50 years of age leading a retired life whereas the younger men work in cities. However, in this study physical inactivity was not a risk factor for diabetes prevalence in men and only weakly associated in women in the urban area. In contrast, the sedentary women in the rural area were at twice the risk of development of IGT.

The findings of a stronger association of glucose intolerance with WHR than with BMI in both sexes is consistent with earlier studies reporting that individuals with central obesity have a greater risk of developing diabetes as compared to those with peripheral obesity, irrespective of the BMI [16–18]. It was also noted that central obesity is more strongly associated with glucose intolerance in women than men [16–18].

In this study the overall prevalence of high WHR observed in women from both the urban and rural areas was approximately 70%. This may be related to higher fat intake and less physically

active life style of women in Baluchistan. It has also been shown that physical activity may be a promising approach to the primary prevention of NIDDM in women [22]. Considering the high prevalence of IGT in women, there is a need to explore the potential role of increased physical activity in the primary prevention of NIDDM.

In conclusion, abnormalities in glucose tolerance are frequent in this community. Obesity is extraordinarily prevalent in both urban and rural populations, particularly among women. Age, a higher WHR and a positive F/H of diabetes are important determinants of diabetes in this study. Central obesity–diabetes association is notably greater in women.

As is evident from this and the earlier study conducted in Shikarpur [11], adult diabetes has emerged as a major problem in the indigenous population in Pakistan. This indicates the public health impact and the high cost diabetes will incur on the health care services in the country in the future. Increased knowledge of risk factors for diabetes may help to plan prevention programmes for diabetes and prevent a further rapid increase in the prevalence of diabetes in Pakistan.

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