The prevalence of diabetes mellitus and impaired glucose tolerance in a group of urban South African blacks

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Abstract **The prevalence of diabetes mellitus and impaired glucose tolerance (IGT) was determined in 479 urbanised South African blacks (141 men and 338 women) of Zulu descent selected by cluster sampling in a suburb of Durban.**

All subjects underwent a modified glucose tolerance test whereby fasting and 2-hour post-glucose (75 g) plasma glucose levels were measured. On the basis of the revised World Health Organisation criteria, the overall prevalence of diabetes was 4,2% and of IGT 6,9%; the age- and sex-adjusted prevalences were 5,3% and 7,7% respectively.

Diabetes mellitus was more common in women (5,2% v. 2,3%), while the reverse was true of IGT (5,5% v. 11,5%). The mean age-adjusted body mass indices (BMIs) of diabetic (31,3 ± 1,9) and IGT (29,7 ± 1,9) subjects were significantly higher than those of the group with normal glucose tolerance (28 ± 0,5). Female subjects with all types of glucose tolerance had significantly higher mean BMIs than men.

There was a significant correlation between BMI and both fasting glucose (r = 0,16; P = 0,0039) and 2-hour plasma levels (r = 0,15; P = 0,0065) in the women, while in men only the fasting levels showed such a relationship (r = 0,21; P = 0,01719).

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Epidemiological studies over the past few years have shown high prevalence rates of diabetes mellitus in certain population groups such as the Pima Indians, Nauruans and migrant Indians.[1-5] It has also been recognised that the disease has a wide global distribution. However, data on its prevalence in African blacks based on the revised World Health Organisation criteria are at best scanty, and studies in Tanzania have highlighted the rarity of diabetes mellitus in a large rural black population.[6] While earlier studies in South Africa have also focused attention on its relative rarity in blacks compared with other population groups,[7-9] these were done long before the revised WHO criteria[10] were promulagated and had diagnosed diabetes on the basis of glycosuria, random blood glucose samples or a 1-hour post-glucose sample.

The present study was undertaken to assess the prevalence of diabetes mellitus in a South African urban black population residing in Durban.

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Patients and methods

The study group comprised Zulus living in Umlazi, a township on the outskirts of Durban with a population of 500 000.

The survey was conducted by means of cluster sampling whereby every tenth household in each street was selected. A social worker then interviewed the head of the household in order to obtain consent for the study, which involved the recording of age, measurement of height and weight and an oral glucose tolerance test (OGTT) for all family members over the age of 15. Both negative and positive responses were recorded. Members of households where consent was given then underwent the test on a Sunday morning, since this was the most suitable time for all family members to be present together. Glucose tolerance tests were carried out with the use of a 75 g glucose load and involved taking blood samples: (*i*) in the fasting state (after an overnight fast); and (*ii*) 2 hours after the glucose load, which was taken as a solution in 250 ml water over a period of 5 - 10 minutes. All subjects including those with known diabetes underwent the OGTT.

Each blood sample was immediately centrifuged and the plasma stored at –30°C. Diagnosis of diabetes mellitus and impaired glucose tolerance (IGI) was based on the revised WHO criteria.[10] Body mass index (BMI) was calculated thus:

$$\frac{\text{weight in kg}}{(\text{height in m})^2}$$

Patients were considered obese if the BMI was 25 or more in women and 27 or more in men, and obesity was considered severe if the values were 30 or more and 32 or more respectively. Blood glucose concentration was estimated by means of a glucose oxidase method.

The variables considered (e.g. age, BMI) were expressed as means ± SE. Comparison of variables between groups was done by means of Student's t-test. Obesity ratios were compared between the sexes by approximation of the binomial distributions with the normal distributions. When groups were compared with regard to BMI an age adjustment was necessary, and therefore an analysis of covariance was employed. In addition, for the same reasons, partial correlation co-efficients were found (removing the linear effects of age) in order to measure the correlation between BMI and the respective glucose levels.

Results

Of the 238 households selected, consent for the study was obtained from 180. The overall response rate was thus 78%. A total of 479 subjects (141 men and 338 women) participated in the study. Diabetes mellitus was found in 4,2% of these, and was more common in women (5,2%) than in men (2,3%). The overall age and sex-adjusted prevalence was 5,3%.

Impaired glucose tolerance (IGT) was seen in 33 subjects (6,9%), but was more common in men (11,5%) than in women (5,5%). The overall age- and sex-adjusted prevalence of IGT was 7,7%.

Of the total number of diabetic subjects, 8 (40%) did not know that they had the disease.

TABLE I.
Distribution of the various categories of glucose intolerance in the different age groups

	Total No. studied			Percentage frequency of diabetes			Percentage frequency of IGT		
Age group (yrs)	All	M	F	All	M	F	All	M	F
15 - 24	188	51	134	–	–	–	4,8	3,9	3,0
25 - 34	107	32	76	2,8	–	4	1,9	3,1	1,3
35 - 44	76	26	51	5,2	3,8	6	132	11,5	1,4
45 - 54	62	19	44	16,1	5,2	20,9	4,8	10,5	2,3
55 - 64	33	11	22	6,1	9,1	4,5	12,1	9,1	13,6
65 - 74	12	2	10	8,3	–	10	33	100	20
75 +	1	–	1	–	–	–	–	–	–

Both the diabetic subjects and those with IGT had significantly higher age-adjusted mean BMIs (31,3 ± 1,9 and 29,7 ± 1,9 respectively) compared with the group with normal glucose tolerance (28,0 ± 0,5; $P < 0,0001$). Female subjects with all categories of glucose tolerance had significantly higher mean age-adjusted BMIs (32,7 ± 2,1 for diabetes, 33,6 ± 2,6 for IGT, 29,6 ± 0,6 for normal glucose tolerance) compared with men (25,6 ± 4,3; 25,3 ± 2,4; 24,3 ± 0,8 respectively).

Eleven (64,7%) female diabetic subjects and 2 (66,7%) male diabetic subjects were obese. Severe obesity as defined was noted in 52,9% of female diabetic subjects but in none of the men with diabetes. Of interest was that obesity, including severe obesity, was common even in women with normal glucose tolerance and was found in 31,8% and 17,2% of women in this group respectively. In contrast, the corresponding prevalence in men was only 10,4% and 4,7% respectively. IGT was also characterised by a higher prevalence of obesity among women (21,2%) compared with men (6,1%). In fact all obese women with IGT had a BMI > 30, whereas only one of the men fell into this category.

As seen in Table I the majority of diabetic subjects were between the ages of 45 and 54 while IGT was associated with a bimodal age distribution (peak prevalence rates in the 15 - 24-year and 35 - 44-year age groups).

There was a significant correlation between age and the fasting plasma glucose levels ($r = 0,26$; $P = 0,0002$) and the 120-minute plasma glucose levels ($r = 0,29$; $P = 0,0001$). This was true for men ($r = 0,27$, $P = 0,0025$ and $r = 0,31$; $P = 0,0006$) and women ($r = 0,21$; $P = 0,0002$ and $r = 0,25$; $P = 0,0001$ respectively).

Whereas there was a significant correlation between BMI and both the fasting ($r = 0,16$; $P = 0,0039$) and the 2-hour ($r = 0,15$; $P = 0,0065$) plasma glucose levels in women, in men this was true only for the fasting levels ($r = 0,21$; $P = 0,0171$). No correlation was seen between age and BMI in either group.

Discussion

Reports of studies on the prevalence of diabetes mellitus in indigenous black Africans based on the revised WHO criteria are few and far between.[6] In fact there are virtually no data on rates in urban blacks.

The 5% prevalence of diabetes in the urban black population reported in this study is not significantly different from rates found in most developed countries.[1,3] It is certainly much higher than that observed in a large number of rural Tanzanians.[6] Of particular relevance is that the authors of that study comment on the threefold increase in prevalence of the disease in a preliminary survey done in an urban Tanzanian population group.[6] Unfortunately no previous studies on the true prevalence of the disease in urban Zulus are available to test the hypothesis that the disease is on the increase. None the less, if diabetes is categorised as a disease of urbanisation and modernisation then such a trend would certainly be true of South African Zulus who have become urbanised over the past few decades.

Various studies have shown conflicting results on the degree of obesity as a risk factor for diabetes. Although there is general agreement that it is a contributing factor, its importance appears to differ in different population groups.[1,11,12] Based on the results of the present study, it would appear that a rising BMI and obesity constitute important risk factors in the emergence of diabetes among black women. In fact a significant proportion was classified as severely obese. The higher prevalence of obesity in women could account for the female preponderance seen among the diabetic subjects in this study; even in some rural black African population groups a higher female/male ratio has been seen in the prevalence of diabetes, but whether the difference was due to women being more obese was not clarified in those studies.[13-14] The fact that more women than men were tested by virtue of the fact that often the male head of the household was not at home at the time of the study is another possible reason for the difference. Of interest is that earlier epidemiological studies of diabetes in South African blacks have also highlighted a female preponderance.[8,9]

There is little doubt that all the diabetics had non-insulin-dependent diabetes mellitus, since they were relatively asymptomatic, not on insulin and had a high prevalence of obesity. Insulin-dependent diabetes certainly does exist in this population group and is by no means rare, although it is much less common than non-insulin-dependent diabetes.[15] In contrast, malnutrition-related diabetes is rare.[15]

A somewhat surprising finding was the high prevalence of IGT in young men (25 - 34-year age group), although its importance is not clear. Whether it is associated with an increased risk of diabetes or whether it would revert to normal in the majority of such subjects, deserves further study. In rural Tanzanians this entity certainly does not have a sinister connotation since 80% reverted to normal on a repeat OGTT done within 5 days of the initial investigation.[16]

In conclusion, this study has shown a high prevalence of diabetes among a group of urban South African blacks of Zulu descent; it is strongly associated with obesity.

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