

## DIET AND DIABETES MELLITUS: POSSIBLE RELATIONSHIPS\*

## A COMPARATIVE STUDY IN A RURAL AND URBAN COMMUNITY

W. M. POLITZER, M.D. (PRAGUE), *South African Institute for Medical Research, Johannesburg*, and T. SCHNEIDER, M.D. (RAND), F.R.C.P. (EDIN.), *Diabetic Clinic, General Hospital, Johannesburg*

In previous papers<sup>1,2</sup> attention was drawn to the low prevalence of diabetes mellitus among outpatients at a hospital in the Butha-Buthe district of Basutoland. The prevalence encountered in this rural Bantu population was 0.23% among 3,000 individuals. This compared strikingly with the prevalence of 1.7% in a White community of the United States<sup>3</sup> and 1.2% in Great Britain.<sup>4</sup>

It was therefore decided to carry this investigation further by comparing the prevalence found in the outpatient group of rural Bantu with a similar group in an urban area.

As a result, 3,121 new outpatients attending the Non-European Hospital, Johannesburg, were screened for the incidence of glycosuria.

The average age of the rural group was 36.8 years while that of the urban group was 31.1 years. The males in the rural group totalled 673 and the females 2,327 while the corresponding figures in the urban group were 2,006 and 1,115 respectively. Table I gives an analysis of the age groups encountered in both series. In the case of the rural group 63.8% of the population examined was under the age of 40 years compared with 84.8% in the urban group.

'Tes-Tape' was used as the screening agent and where glycosuria was found — all urine being examined post-prandially — blood was taken for blood-sugar determination by King and Garner's method.<sup>5</sup> As in the previous series blood-sugar levels above 140 mg. per 100 ml. were regarded as abnormal.

On this basis 7 diabetics were found in the rural group. All except one were over the age of 40 years.

The urban group presented 20 patients with glycosuria, but of these 2 absconded before blood for sugar estimation could be obtained; they were therefore not included in the final result. The remaining 18 had blood-sugar levels above 140 mg./100 ml. Thus 18 diabetics were found in a series of 3,121 persons examined, i.e. 0.58%.

Detailed results are recorded in Tables I and II.

Certain interesting points arise from these findings:

(a) There is a noticeable difference in the constitution of the rural and urban groups, the urban groups showing a marked preponderance of males (1.8 males to 1 female) compared with 1:3½ male to female ratio in the rural groups. This may be explained by the fact that many able-bodied rural males are away from home working on the mines or in other occupations.

(b) The average age group in the urban series is lower than that of the rural. In spite of this the incidence of diabetes is 3 times greater than in the rural areas.

TABLE I. AGE AND SEX OF 3,000 RURAL AND 3,121 URBAN BANTU INVESTIGATED, WITH DIABETIC DISTRIBUTION

Group	Age in years							Total
	10-19	20-29	30-39	40-49	50-59	60-69	70+	
Rural Bantu males	0	139	148	141	139	72	34	673
Diabetes	0	0	0	1	0	0	1	2
Urban Bantu males	40	887	565	388	92	29	5	2,006
Diabetes	0	1	2	3	1	1	1	9
Rural Bantu females	0	929	572	293	279	148	106	2,327
Diabetes	0	0	1	3	0	1	0	5
Urban Bantu females	35	649	299	84	32	13	3	1,115
Diabetes	0	0	2	3	4	0	0	9

TABLE II. ANALYSIS OF DIABETICS FOUND

Rural group	Sex	Age in years	Blood glucose (mg./100 ml.)
1	F	65	368
2	F	42	254
3	F	30	200
4	M	42	177
5	M	80	165
6	F	45	163
7	F	50	144
Urban group			
1	F	45	720
2	M	60	700
3	M	40	432
4	M	50	396
5	M	46	296
6	M	76	289
7	M	24	283
8	M	40	274
9	F	53	274
10	F	49	270
11	F	30	264
12	F	30	230
13	F	50	200
14	M	46	194
15	F	40	172
16	M	33	152
17	F	33	147
18	F	56	143
19	M	67	Red subst. present in urine ++++
20	M	22	Red subst. present in urine ++++

\* Based on a paper read at the Plenary Session of the 43rd South African Medical Congress (M.A.S.A.), Cape Town, on 27 September 1961.

(c) While only 1 patient of the age of 40 years or below was encountered in the rural group, there were 8 such patients in the urban series (Table II).

(d) Only 1 of 7 rural patients was obese as against 7 of the urban patients.

(e) In spite of the smaller number of urban females examined (1,115 urban as against 2,327 rural), there were more patients with diabetes in the urban (9 = 0.81%) than in the rural group (5 = 0.22%). The prevalence of diabetes was thus much higher among urban females.

Similarly, the prevalence among the males was also higher in the urban group — 9 diabetes among 2,006 urban Bantu males examined (=0.45%) as against 2 diabetes among 673 rural Bantu males (=0.29%).

(f) Reference to Table I further illustrates the higher prevalence of diabetes among the urban Bantu when the series is broken down into the various age groups. In each 10-year series, where the number of patients examined is sufficient to make comparison possible, the urban prevalence is significantly higher than the rural.

(g) The prevalence of diabetes in the urban group seems to fall somewhere between that of the rural Bantu and the White overseas populations.

(h) There was a surprising lack of symptoms referable to diabetes in the patients encountered. Actually, only one urban patient in the whole series presented with overt signs of diabetes. His blood sugar was 432 mg. per 100 ml. The remaining glycosurics presented with bronchitis, dyspepsia, giddiness, abdominal pain, gastro-enteritis, urticaria, cystitis, urethral discharge, constipation, pyoderma, congestive cardiac failure, for tooth extraction, and one was accompanying a patient.

(i) So far as is known the rural patients had lived in the same environment since infancy. The urban patients, however, had resided in or around Johannesburg for periods varying between 3 and 50 years, with an average of 23 years.

Various possible factors relating to the prevalence of diabetes were discussed in a previous paper.<sup>2</sup> These included heredity, age, obesity, dietary factors and endocrine imbalance, but particular stress was laid on the possibility of change in dietary habits leading to the higher incidence of the disease. The present investigation strongly supports this possibility. In Table III is shown the difference in the average diet consumed by Bantu living in the area of Seboche<sup>6</sup> where our first investigation was carried out, compared with that in an urban township of the Witwatersrand.<sup>7</sup> The caloric intake varies markedly in the 2

groups, being much higher in the urban area. Similarly, the quantities of protein, calcium and thiamin are greater in the urban diet.

This would point to an increase in the caloric intake being associated with an increase in diabetic prevalence. In addition, more patients with obesity appear in the urban group. Dublin<sup>8</sup> has shown (Table IV) that the greater the overweight the higher the prevalence of diabetes, and other authors such as Joslin<sup>9</sup> and Long<sup>10</sup> have found between 70 and 80% of their diabetics to be overweight at the onset of the disease.

TABLE IV. OVERWEIGHT AND DIABETES MORTALITY

Above average weight	Diabetes mortality above normal	
	Under 45 years	Over 45 years
5 - 14%	1.5 times	2 times
15 - 24%	3.2 times	4 times
25% or more	8.5 times	10 times

Reference to Table III shows that excessive amounts of iron (recommended allowance: 10 mg. per day) are present in the diets of both rural and urban Bantu, and the possibility therefore exists that the incidence of diabetes in some patients may be related to this high intake.<sup>11-15</sup>

The low intake of riboflavin (recommended allowance: 1.6 mg. per day) in both groups may be related to the comparatively low incidence of diabetes even in the urban group, if the work of Ershoff<sup>16</sup> can be applied to the human being. This author showed that riboflavin deficiency markedly increases the insulin sensitivity of the rat, so that a pronounced and frequently fatal hypoglycaemia could be induced by this deficiency.

An important consideration would appear to be the length of time that the patient has spent in the urban area under new dietary conditions before the disease is discovered. Our present patients had all lived in an urban environment for 3-50 years (average 23 years). And if we could be sure that diabetes had not been latent before they had taken up residence in an urban area, it would be possible to postulate that a period of several years must elapse in the new environment before diabetes will manifest itself. Cohen,<sup>17</sup> in fact, has shown that among the Yemenite and Kurd newcomers to Israel an extremely low prevalence of diabetes (0.06%) was found. Among the old settlers (i.e. 25 or more years residence in Israel), this had risen to 2.9% in the case of the Yemenites, and 2.0% in the Kurds.

This suggests, therefore, that a similar trend is to be found in our own Bantu population.

This further study underlines the fact that diabetic prevalence is related to our way of life. In the same way as, during the war years, it was found that decrease of calories in the diet in certain European countries was associated with a decrease in diabetic prevalence, so we find that, with the increase in calories associated with the urbanization of the Bantu, the prevalence of diabetes is rising. We can therefore expect that with the adoption of European standards of living and food intake, diabetic prevalence in the Bantu will match that found in the European.

We would be failing in our duty if we did not stress

TABLE III. COMPARISON OF DIET CONSUMED BY THE BANTU IN A RURAL AREA AND AN URBAN AREA

	Seboche	Johannesburg
Calories	1,905	2,935
Protein (G.)	38.5	78.3
Calcium (mg.)	0.14	0.33
Iron (mg.)	14.5	19.9
Vitamin A (i.u.)	7,558	2,010
Thiamin (mg.)	0.89	1.034
Riboflavin (mg.)	0.42	0.504
Vitamin C (mg.)	101	43.2

the amazing opportunity that exists in Africa today of carrying out population surveys in diabetes mellitus and other diseases at a time when changes are occurring in the mode of living of primitive African communities. With the change towards European ways of life and the alteration in diet it can be expected that the prevalence of disease will be altered radically.

Further surveys into the prevalence of diabetes mellitus among rural and urban communities may throw considerable light on the aetiology of a condition which, in spite of a vast amount of research, has continued to baffle us.

We wish to thank Dr. J. H. S. Gear, the Director of the South African Institute for Medical Research, and Dr. P. Keen, Superintendent of the Non-European Hospital, Johannesburg, for facilities provided. We also wish to thank Mr. I Spitz,

Mrs. J. E. Kemp and Miss B. Josselsohn for their technical assistance.

#### REFERENCES

1. Politzer, W. M., Hardegger, B. and Schneider, T. (1960): *Brit. Med. J.*, **1**, 615.
2. Politzer, W. M. and Schneider, T. (1960): *S.Afr. Med. J.*, **34**, 1037.
3. Wilkerson, H. L. C. and Kraal, L. P. (1947): *J. Amer. Med. Assoc.*, **135**, 209.
4. Walker, J. D. (1959): *J. Endocr.*, **18**, 18.
5. King, E. J. and Garner, R. J. (1947): *J. Clin. Path.*, **1**, 30.
6. Communication by World Health Organization.
7. du Toit, D. (1953): *J. Soc. Res.*, **4**, 63.
8. Dublin, L. I. (1930): *Hum. Biol.*, **2**, 159.
9. Joslin, E. P., Root, H. F., White, P. and Marble, A. (1959): *Treatment of Diabetes Mellitus*, 10th ed. London: Henry Kimpton.
10. Long, C. N. H. (1947): *J. Endocr.*, **15**, 6.
11. Gillman, J. and Gillman, T. (1945): *Arch. Path.*, **40**, 239.
12. Edington, G. M. (1954): *W. Afr. Med. J.*, **3**, 66.
13. *Idem* (1956): *Méd. Afr. noire*, **4**, 5.
14. Dodu, S. R. A. (1958): *Trans. Roy. Soc. Trop. Med. Hyg.*, **52**, 425.
15. Seftel, H. C., Isaacson, C. and Bothwell, T. H. (1960): *S. Afr. J. Med. Sci.*, **25**, 89.
16. Ershoff, B. H. (1954): *Metabolism*, **3**, 357.
17. Cohen, A. M. (1961): *Ibid.*, **10**, 50.