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Prevalence of diabetes in rural and urban populations in southern Sierra Leone: a preliminary survey

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Summary We conducted a preliminary community survey for diabetes in the Bo district of southern Sierra Leone. Five hundred and one subjects comprising 256 rural adults in two villages and 245 urban adults in Bo town were randomly selected and screened for diabetes using random capillary blood glucose according to WHO criteria. There were 6 diabetics, all in the urban area, giving a prevalence of 2.4% in the urban population, and 0% in the rural villages. The mean (s.d.) capillary random blood glucose (RBG) concentration was 5.7 ± 1.7 mmol/l for the entire study population, while concentrations for the urban and rural populations were 5.8 ± 2 and 5.5 ± 1.4 mmol/l respectively ($P>0.05$). RBG increased significantly with age. The mean (s.d.) body mass index (BMI) was 22.3 ± 4.9 kg/m^2 for the total population while those for the urban and rural populations were 23.0 ± 5.8 and 21.6 ± 3.6 respectively ($P<0.01$). Only 5% of the population were obese, i.e. BMI $\geqslant 30$ kg/m^2. Dietary habits were similar in both town and country. According to this survey, the prevalence of diabetes is very low in rural Sierra Leone, but urban areas may be experiencing increasing prevalence. Mechanisms for effective screening and promotion of proper diet and exercise must be incorporated into existing health services to prevent an escalation of diabetes in urban Sierra Leone.

keywords diabetes, prevalence, Sierra Leone, rural, urban

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Introduction

Diabetes mellitus is a common clinical problem in hospital practice in Sierra Leone, yet there is no information on the prevalence of the disease in the community. The prevalence of diabetes in sub-Saharan Africa has been estimated by the World Health Organization (1985) to be in the range of 1–2%. Reported rates have varied from 0.0% in a rural community in Togo (Teuscher *et al.* 1987) to 5.7% in a rural population in Ivory Coast (Zmiron 1979); most studies suggest a prevalence of 0.0–1.0% in the indigenous African population. Rates are higher in males in urban populations (McLarty *et al.* 1991).

Diabetes prevalence in Africans is still much lower than recorded values in developed countries. In industrialized countries however, diabetes seems to be much more prevalent among blacks than whites living in the same environment. In the USA for instance, prevalence rates of 2–13% among blacks aged 25–64 years have been reported, compared with 1–6% among white Americans (Rosman 1985). In England, diabetes prevalence is 16% in Afro-Caribbeans and 5% in Europeans (Chaturvedi *et al.* 1993). This high prevalence of diabetes may reflect the adverse effects of a Western diet and life-style on blacks, an example of the thrifty genotype.

Since no information exists on the prevalence rates of diabetes in the community in Sierra Leone,

this preliminary study was undertaken to determine approximate rates in a rural and urban area in Bo District, southern Sierra Leone, and to determine the mean blood glucose concentration of the populations and possible risk factors influencing it.

Methods

Bo district has a population of 319 110 inhabitants and the predominant ethnic group is Mende. Bo town was used for the urban survey while two villages, Yamandu and Ngalu in the Bo district, were studied for rural sampling. Bo town is the district and provincial capital and the second largest city in Sierra Leone, situated 240 km from Freetown, with a population of 71 663. Yamandu is 27 km from Bo town and has a population of 4264 and Ngalu village is 45 km north-east of Bo town and has 785 inhabitants.

Bo town was divided into 3 fairly equal geographical areas using a map of the town. Each area was divided into a number of zones, from each of which 2 streets were selected at random. From each selected street, 3 households were chosen randomly from which 3–5 subjects per household were selected. Sampling was done in the mornings and early afternoons. In Yamandu village, the sampling method was similar. The village was divided into 2 fairly equal areas and households and subjects were randomly selected. In Ngalu village, because of its small size, the inhabitants were informed about the survey and asked to assemble at the local court, where subjects were randomly selected.

After obtaining informed consent, subjects were taken through a questionnaire which recorded their name, age, sex, locality, occupation, educational status, ethnic group, family history of diabetes, contents of last meal, time since last meal and diabetic status if known. All subjects were weighed using a mechanical scale; height was measured with a measuring tape. Capillary whole blood was obtained from a finger puncture and was immediately analysed using an electronic blood glucose monitor, the Pen 2 Companion 2 blood glucose system (Medisense Inc., Cambridge, MA, USA). This monitor uses the glucose oxidase method and analyses blood samples in 20 seconds.

Table 1 Age distribution in rural and urban populations

Age (years)	Rural (n=256)	Urban (n=245)	Total
16–25	62	106 (0)	168
26–35	73	54 (0)	127
36–45	58	28 (0)	86
46–55	31	26 (7.6)	57
56–65	18	17 (11.7)	35
Over 65	14	14 (14.2)	28
Total	256	245 (2.4)	501

Numbers in brackets signify the percentage of diabetics in the urban population according to age groups.

Occupation was divided into 3 groups: Group A, the unemployed, comprising students, unemployed, and home managers; Group B, artisans such as farmers, miners, welders, carpenters, drivers; and Group C, professionals, e.g. teachers, dispensers, businessmen, clerks. Five hundred and one subjects $\geqslant$16 years were investigated: 245 from Bo town, 170 from Yamandu and 86 from Ngalu Village.

Diabetes was defined according to WHO (1985) as a random capillary whole blood glucose level $\geqslant$11.1 mmol/l (200 mg/dl). Body mass index (BMI) was expressed as the Quetelet index, i.e. weight (kg) divided by the square of the height (m^2). Those with a BMI under 20 were regarded as underweight, 20–25 normal weight, 25–30 overweight, and above 30 as obese.

Two-tailed Student's t-test was used for comparison of group means, χ^2 for differences between groups, and linear regression to examine the relations between variables.

Results

General characteristics

Of the 501 subjects who participated in this study, 247 were male and 254 female. There were 256 rural inhabitants from Yamandu and Ngalu villages, and 245 urban dwellers from Bo town (Table 1). The study population was predominantly Mende (67%) followed by Mandingo (11%). The rest comprised several other ethnic groups.

Seventy-six per cent of subjects were between 16 and 45 years old and only 18% were over 50 years.

Table 2 Occupational groups and blood glucose in rural and urban populations in Bo Distict, Sierra Leone

	Urban *n* (%)	Rural *n* (%)	RBG (mmol/l) (s.d.)
Group A (non-employed)	165 (67)	35 (14)	5.7 (1.8)
Group B (artisans)	20 (8)	191 (74)	5.4 (1.7)
Group C (professionals)	60 (25)	30 (12)	5.8 (1.6)

RBG difference between A and B, P=0.08; B and C, P=0.058; A and C, P=0.65.

The mean age (s.d.) of the total population was 35.7 ± 15.7 years. The mean age (s.d.) of the rural population was 37.5 ± 14.6 years compared with 33.9 ± 16.5 years for the urban population. This difference was significant (P<0.01). There was no significant age difference between the sexes in either the rural or urban population.

The mean (s.d.) duration of stay of the population in their present locality was 18.4 ± 15.4 years; 22.4 ± 15 years for the rural population and 14.8 ± 15 years for the urban population. The difference was significant (P<0.001). Forty-six per cent of the subjects had no formal education; 37% had primary, 12% secondary and 5% tertiary education. Occupational Groups A and B constituted about 40% each of the study population, while group C formed less than 20%. The largest occupational group in the urban population was Group A, the non-employed, forming two-thirds of the population, while in the rural population, artisans (particularly farmers and miners, Group B) predominated (Table 2).

The mean (s.d.) BMI was 22.3 ± 4.9 kg/m² in the entire study population; 21.4 ± 5 for males and 23.2 ± 4.5 kg/m² for females (P<0.001). The mean (s.d.) BMI of the rural population was 21.6 ± 3.6 kg/m² and that of the urban population was 23.0 ± 5.8 kg/m². The difference was significant (P<0.001). Within the rural population, females had a significantly higher BMI than their male counterparts: 22.7 ± 4.3 against 20.6 ± 2.4 kg/m² (P<0.001). This sex difference was not observed in the urban population (Table 3).

Seventy-two subjects (14%) were underweight, 329 (66%) were of normal weight, 75 (15%) were overweight and 25 (5%) were obese. Seventy-five per cent of obese subjects were females. There was no significant increase in BMI with age (Table 4).

Blood glucose

The mean random blood glucose was 5.7 ± 1.7 mmol/l in the total study population. The rural and urban RBG levels were 5.5 ± 1.4 and 5.8 ± 2 mmol/l respectively (Table 3). The difference was not significant (P=0.162). There was also no significant difference in blood glucose levels between males and females (Table 5). But blood glucose rose significantly with age from a mean of 5.5 mmol/l in the age group 16–25 to 7.2 mmol/l in those over 65 years (Table 4). No significant correlation was found between blood glucose and BMI.

The mean blood glucose in artisans was 5.4 ± 1.7 mmol/l lower than that of the professionals, which was 5.8 mmol/l (P=0.058). The difference between the other groups, i.e. A (unemployed) and B, and A and C, were not significant (P=0.08 and 0.65 respectively, Table 2).

Prevalence of diabetes

There were 6 diabetics in the study population. All were urban dwellers, giving an urban prevalence of 2.4%. Two of the diabetics were lifelong residents of Bo town, while the others previously lived in other urban localities before settling in Bo town. There was a male predominance of 5:1. Five of the 6 diabetics were diagnosed on the basis of WHO criteria with RBS ranging from 11.6 to 22.1 mmol/l, and one was a known diabetic on oral treatment (glibenclamide). Only one of the subjects had a family history of diabetes. Their mean age and BMI were 61 (range 47–75 years) and 25.4 (range 21–30) kg/m² respectively. Only one was obese and similarly only one was illiterate. Their characteristics are shown in Table 6.

Discussion

In an attempt to determine the prevalence of diabetes mellitus in Sierra Leone, Bo District was

Table 3 Rural/urban and gender differences in age, body mass index and random blood glucose

	Rural			Urban		
	Males	Females	Total	Males	Females	Total
Age (years)	36.9 (14.7)	38.1 (14.4)	37.5 (14.6)[1]	33.8 (15.5)	33.9 (17.2)	33.9 (16.5)[1]
RBG (mmol/l)	5.5 (1.4)	5.6 (1.4)	5.5 (1.4)	5.6 (2.4)	5.9 (1.7)	5.8 (2.0)
BMI (kg/m^2)	20.6 (2.4)[2]	22.7 (4.3)[2]	21.6 (3.6)	22.3 (7.0)	23.6 (4.7)	23.0 (5.8)[3]

[1] Significant mean age differences between rural and urban population, $P<0.01$.
[2] Significant male/female differences in BMI in the rural population, $P<0.001$.
[3] Significant rural/urban differences in the mean BMI, $P<0.001$.
Numbers in parentheses are one standard deviation from the mean.

Table 4 Mean random blood glucose and body mass index according to age

Age (years)	*n*	RBG (mmol/l) (s.d.)	BMI (kg/m^2) (s.d.)
16–25	168	5.5 (1.3)	21.4 (4.0)
26–35	127	5.4 (1.3)	22.8 (6.3)
36–45	86	5.6 (1.3)	22.4 (3.7)
46–55	57	5.7 (2.2)	23.2 (4.9)
56–65	35	6.2 (2.0)	22.5 (3.8)
>65	28	7.2 (3.7)	23.5 (6.0)

Linear regression: RBG and AGE, *r* value 0.864 ($P=0.026$); BMI and AGE, *r* value 0.757 ($P=0.081$); BMI and RBG, *r* value 0.58 ($P=0.225$).

Table 5 Mean age, random blood glucose, and body mass index according to sex

	Males mean (s.d.)	Females mean (s.d.)	Total mean (s.d.)
Age (years)	35.6 (15.2)	35.9 (16.1)	35.7 (15.7)
RBG (mmol/l)	5.6 (1.9)	5.7 (1.5)	5.7 (1.7)
BMI (kg/m^2)	21.4 (5.0)[1]	23.2 (4.5)[1]	22.3 (4.7)

[1] Significant differences in BMI between males and females ($P<0.001$).

selected as a preliminary survey area. The urban and rural populations were similar in many respects but differed significantly in age, BMI, duration of stay and economic activity. Dietary habits were similar, the major component being carbohydrates in the form of rice, cassava, and yams. The ethnic composition was also similar. There were no significant differences in random blood glucose (RBG) concentrations in the rural and urban populations.

The major difference was the BMI, with the urban population having a significantly higher value. This may be due to less physical activity considering the difference in occupational activities. The difference in age could be explained by rural to urban migration accentuated by the ongoing rebel war, so that the young men and women moved to the relative security of Bo town, leaving the older population in the villages. This was supported by the shorter duration of stay in Bo town as well as the high level of unemployment in the town. The rural population tended to be more stable, older and agrarian.

Diabetes mellitus was detected in 5 subjects in addition to a known diabetic on treatment. This gave an urban prevalence rate of 2.4% and a rural prevalence rate of 0% which is consistent with values obtained in other studies in the indigenous African population (McLarty 1991), as opposed to higher rates in most developed countries (Rosman 1985; Chaturvedi *et al.* 1993). All 6 diabetics were from Bo town despite their younger age. The absence of any diabetic in the rural population is consistent with findings in Togo (Teuscher *et al.* 1987), but at variance with a rural Ivorian study reporting a prevalence of 5.7% (Zmiron 1979).

The different prevalence rates between urban and rural populations may be explained by different levels of activity and BMI, since the dietary habits were similar. The rural community engaged in more physical occupations such as farming and mining and is likely to be more active than the unemployed

Table 6 Characteristics of the diabetic subjects

Duration of stay in present area (years)	Age	Sex	Educational status	Occupation	RBG (mmol/l)	BMI (kg/m²)
2	60	M	None	Farmer	13.5	21.0
47	47	F	Secondary	Seamstress	17.5	30.2
25	75	M	Primary	Ret. soldier	14.0	20.8
50	71	M	Secondary	Unemployed	22.1	24.0
50	50	M	Primary	Retired	5.7[1]	27.3
2	64	M	Tertiary	Lecturer	11.6	29.0

[1] Known diabetic on treatment.

and professional urban population. Decreased physical activity is considered to be an important risk factor for diabetes (McLarty 1991; West 1978) and it is not surprising that the professionals had higher blood sugar levels than the artisans.

The prevalence rate in this study population is certainly lower than rates obtained in immigrant communities in Africa (McLarty 1991), African-Americans (Rosman 1985), Afro-Caribbeans in England (Chaturvedi *et al.* 1993) and Caucasians. A number of factors may explain this. Firstly, high intake of unrefined carbohydrates improves carbohydrate tolerance (Perisse 1958; King *et al.* 1984; Medalie *et al.* 1974) and therefore protects against diabetes. Secondly, the high level of physical activity in the study population probably protects against non-insulin dependent diabetes mellitus (West 1978). Only 5% of all subjects were obese, in contrast to European populations, where 20% of men and 24% of women were obese (Anon. 1986), and in Americans, with 20–30% obese adult men and 30–40% obese adult women, particularly among the poor and minority groups (National Institutes of Health 1985).

Another factor may be the rather low life expectancy in Sierra Leone of 45 years (Department of Health and Social Services 1993). Non-insulin dependent diabetes is a disease of middle and old age. The mean age of the urban population was only 33.9 years, while the mean age of the diabetics was 61 years. There were no diabetics under 47 years; thereafter, the rate of diabetes increased progressively with age (Table 1). The situation is similar to a study population in rural Tanzania with a low overall prevalence of diabetes of 0.87%, but a higher prevalence in the older subjects (McLarty 1989). It would be expected therefore that as the populations in these areas age, the rate of diabetes will increase.

The lack of correlation between RGB and BMI could be explained by the relatively low BMI in the population. It is consistent with results obtained in Togo (Teuscher 1987) where, as in this study, there were very few overweight or obese subjects. There was no significant difference in age or RBG between the sexes in the study; however, the male predominance among the diabetic subjects was consistent with most reports in Africa (McLarty 1989, 1991; Swai *et al.* 1990).

In conclusion, diabetes mellitus appears to be rare among rural Sierra Leoneans, though prevalence rates may be higher in towns. Further studies in other rural and urban areas and among other ethnic groups are required to get an overall picture of the prevalence in Sierra Leone.

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