Effect of Socioeconomic Risk Factors on the Difference in Prevalence of Diabetes Between Rural and Urban Populations in Bangladesh

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OBJECTIVE — To compare the prevalence of diabetes between the poor and rich of rural and urban populations in Bangladesh.

RESEARCH DESIGN AND METHODS — A total of 1,052 subjects from urban and 1,319 from rural communities (age ≥20 years) of different socioeconomic classes were investigated. Capillary blood glucose levels, fasting and 2 h after a 75-g glucose drink (2-h blood glucose [BG]), were measured. Height, weight, waist, hips, and blood pressure were also measured.

RESULTS — Age-adjusted (30–64 years) prevalence of NIDDM was higher in urban (7.97% with 95% CI 6.17–9.77) than in rural subjects (3.84%, CI 2.61–5.07), whereas impaired glucose tolerance (IGT) prevalence was higher in rural subjects. In either urban or rural areas, the highest prevalence of NIDDM was observed among the rich, and the lowest prevalence was observed among the poor socioeconomic classes. The rural rich had much higher prevalence of IGT than their urban counterpart (16.5 vs. 4.4%, CI 6.8–17.4). Increased age was an important risk factor for IGT and NIDDM in both rural and urban subjects, whereas the risk related to higher BMI and waist-to-hip ratio (WHR) was less significant in rural than urban subjects. Using logistic regression and adjusting for age, sex, and social class, the urban subjects had no excess risk for NIDDM. In contrast, an excess risk for glucose intolerance (2-h BG ≥7.8 mmol/l) was observed in the rural subjects.

CONCLUSIONS — Adjusting for age, sex, and social class, the prevalence of NIDDM among urban subjects did not differ significantly from that among rural subjects. Increased age, higher socioeconomic class, and higher WHR were proven to be independent risk factors for glucose intolerance in either area.

Studies comparing rural and urban diabetes prevalence among Asians have shown that urban populations have a higher prevalence of diabetes than their rural counterparts (1–6). Urbanization with its changed lifestyle in the developing communities has been attributed as a risk factor for an increasing trend of diabetes prevalence (1). This trend in the developing countries has been substantiated by the World Health Organization (WHO) Diabetes Reporting Group (2). Several small surveys in Bangladesh have also shown an increasing trend (7–10).

Although the rural population constitutes >85% of the country's total population, almost 65% of the registered diabetic subjects of the Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM) were from urban areas (11,12). This study was undertaken to estimate the prevalence of impaired glucose tolerance (IGT) and NIDDM simultaneously in the rural and urban populations living at different socioeconomic levels and to determine the excess risk for diabetes, if any, in an urban population.

RESEARCH DESIGN AND METHODS

All men and women ≥20 years of age were considered eligible for the study, except pregnant women and subjects on medication. For rural subjects, 600 village households out of 3,620 were randomly selected in Kharua union, which has a total population of 19,910. The rural poor were classified as landless farmers subsisting on active agrarian labor and the rural rich as landholders, usually maintaining a sedentary habit. The rural middle class was a heterogeneous population other than the two classified groups (rural poor, rural rich).

In the city of Dhaka, 4 out of 12 slums were selected randomly for the urban poor (n = 315) and 5 out of 15 housing estates for government employees were chosen for the urban rich (n = 985).

Each eligible subject was examined for height, weight, and girth of waist and hip. The measurements were taken while the subject was barefoot and wearing light clothing. Fasting capillary blood glucose (BG) was estimated using Hemoglucotest strip and Reflolux (Boehringer, Mannheim), and a drink of 75 g glucose was given (13). Each subject was allowed a 15-min rest before taking blood pressure. Finally, blood glucose estimation was repeated 2 h after the drink.

Statistical analysis

Age-adjusted prevalence was given for the truncated age range of 30–64 years, based on the population census of 1991 (2,14). The groups based on geographical location, socioeconomic class, and glycemic status

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BG, blood glucose; dBP, diastolic blood pressure; IGT, impaired glucose tolerance; NGT, normal glucose tolerance; OR, odds ratio; sBP, systolic blood pressure; SD, standard deviation; WHO, World Health Organization; WHR, waist-to-hip ratio.

Table 1—*Age-specific and age-adjusted prevalence of IGT and NIDDM*

	Age-specific prevalence (years)										Age-adjusted prevalence (years)	
	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	>65	30–64	95% CI
Urban												
IGT												
Men	—	0.29	0.29	0.29	0.88	0.88	0.44	0.44	0.59	0.15	4.92	3.04–6.80
Women	0.27	0.54	0.27	1.08	1.36	0.27	—	0.27	—	0.27	3.73	1.59–5.87
Total	0.10	0.38	0.29	0.57	1.05	0.67	0.29	0.38	0.38	0.19	4.76	3.27–6.25
NIDDM												
Men	—	0.29	0.15	0.44	1.76	0.29	1.90	1.17	0.73	0.15	7.24	5.14–9.34
Women	—	0.27	—	1.08	2.17	1.63	0.27	0.81	0.54	—	8.89	5.42–12.36
Total	—	0.29	0.10	0.67	1.90	0.76	1.33	1.05	0.67	0.10	7.97	6.17–9.77
Rural												
IGT												
Men	0.25	0.50	0.50	0.63	0.75	0.88	0.88	0.63	1.51	1.76	8.07	5.80–10.34
Women	0.38	1.53	2.30	2.68	2.49	0.96	1.72	0.57	1.15	0.96	16.61	12.85–20.37
Total	0.30	0.91	1.21	1.44	1.44	0.91	1.21	0.61	1.36	1.44	11.78	9.68–13.88
NIDDM												
Men	—	0.50	0.13	0.25	0.50	0.38	0.50	0.38	0.63	1.00	3.76	2.19–5.33
Women	0.38	—	0.77	—	0.19	0.57	0.57	0.19	0.38	0.38	3.80	1.86–5.74
Total	0.15	0.30	0.38	0.15	0.38	0.45	0.53	0.30	0.53	0.76	3.84	2.61–5.07

Data are %. For the age-adjusted prevalence of IGT and NIDDM, the truncated age range (30–64 years) of screened subjects in the rural and in the urban population was adjusted to that of 1991 national population census (2).

were compared using Student's t test. The differences among socioeconomic groups and the associations between hyperglycemia and other variables were tested using the χ^2 test. Odds ratio (OR) with 95% CI for relative risks with increasing age, BMI, and WHR was calculated, taking the population of least prevalence as a reference (15). Stepwise logistic regression analysis estimated the risk related to area, age, sex, BMI, WHR, and social class, taking NIDDM as a dependent variable. SPSS/PC+ software package was used for all these analyses.

RESULTS — Of the 2,371 subjects investigated, 62.4% were men and 37.6% women. The rural participants were 1,319 (797 men, 522 women) and the urban participants were 1,052 (683 men, 369 women). The ratio of the newly detected subjects to the known NIDDM subjects in rural and urban populations was 3.7 and 1.9, respectively. The crude prevalence of IGT in all age-groups of the study population (n = 2,371) was 8.0% (6.4% men, 10.5% women) and the crude prevalence of NIDDM was 5.2% (5.5% men, 4.8% women). No cases of IDDM were found.

Age-standardized (30–64 years) prevalence of IGT was significantly higher in rural than in urban subjects (11.8 vs. 4.8%), and NIDDM prevalence was higher in urban than in rural subjects (8.0 vs. 3.9%; Table 1). This age-specific NIDDM and IGT prevalence did not differ significantly between men and women, except in the higher frequency of IGT observed in rural women than in rural men (16.6 vs. 8.1%).

When adjusted for sex and socioeconomic class, NIDDM prevalence showed no significant difference between rural and urban subjects (Table 2). The NIDDM

Table 2—*IGT and NIDDM by sex and social class*

	n	IGT (%)	χ^2	P	Diabetes (%)	χ^2	P
Men							
Poor							
Rural	285	6.32			2.81		
Urban	112	2.68	1.550	= 0.213	0.89	0.680	= 0.410
Rich							
Rural	130	13.08			9.23		
Urban	571	4.55	12.327	<0.001	8.06	0.315	= 0.575
Middle							
Rural	382	8.12			3.66		
Women							
Poor							
Rural	239	11.72			2.09		
Urban	129	4.65	4.415	= 0.036	0		
Rich							
Rural	64	23.44			6.25		
Urban	240	4.17	21.105	<0.001	10.42	0.094	= 0.760
Middle							
Rural	219	15.53			4.11		

The differences among socioeconomic groups and the associations between hyperglycemia and other variables were determined by χ^2 test: rural middle class vs. urban rich; NIDDM, men = 6.08, $P < 0.02$, women = 4.15, $P < 0.05$; IGT, men = 3.80, $P > 0.05$, women = 14.02, $P < 0.001$; rural middle class vs. rural rich; NIDDM, men = 5.13, $P < 0.05$, women = 0.15, $P > 0.2$; IGT, men = 2.93, $P > 0.05$, women = 1.88, $P > 0.1$.

Table 3—*The characteristics of euglycemic (2-h BG <7.8 mmol/l) subjects by sex, area, and social class*

	Men			Women		
	Rich	Poor	*P*	Rich	Poor	*P*
Urban						
n	499	108		205	123	
Age (year)	38.5 ± 11.6	38.4 ± 13.5	= 0.959	36.8 ± 9.3	35.5 ± 10.5	= 0.262
2-h BG (mmol)	4.9 ± 1.5	5.9 ± 1.3	< 0.001	5.0 ± 1.4	6.2 ± 1.0	<0.001
Height (cm)	163.5 ± 7.0	160.9 ± 7.6	= 0.002	152.5 ± 6.7	149.5 ± 5.8	<0.001
Weight (kg)	58.4 ± 9.2	49.7 ± 7.9	< 0.001	55.0 ± 9.4	43.6 ± 6.9	<0.001
BMI	21.9 ± 3.4	19.2 ± 2.6	< 0.001	23.7 ± 3.8	19.5 ± 2.8	<0.001
WHR	0.90 ± 0.08	0.87 ± 0.11	= 0.02	0.85 ± 0.09	0.83 ± 0.12	= 0.24
sBP (mmHg)	114.2 ± 17.8	102.6 ± 13.4	<0.001	113.3 ± 19.0	102.0 ± 16.9	<0.001
dBP (mmHg)	73.1 ± 10.9	66.9 ± 10.6	<0.001	72.1 ± 11.0	69.2 ± 15.6	= 0.065
Rural						
n	101	259		45	206	
Age (year)	42.2 ± 16.7	45.4 ± 15.2	= 0.093	38.5 ± 11.8	38.3 ± 13.0	= 0.930
2-h BG (mmol)	6.5 ± 0.9	6.1 ± 1.0	<0.001	6.7 ± 1.1	6.5 ± 0.9	= 0.186
Height (cm)	163.4 ± 5.6	159.7 ± 7.5	<0.001	150.7 ± 7.7	149.6 ± 6.4	= 0.378
Weight (kg)	55.2 ± 9.4	45.8 ± 6.2	<0.001	44.7 ± 7.6	39.4 ± 4.9	<0.001
BMI	20.6 ± 3.3	18.0 ± 2.7	<0.001	19.8 ± 3.5	17.6 ± 1.9	= 0.001
WHR	0.90 ± 0.07	0.87 ± 0.06	<0.001	0.88 ± 0.07	0.84 ± 0.07	<0.001
sBP (mmHg)	124.9 ± 19.6	120.7 ± 21.8	= 0.097	120.8 ± 22.8	115.1 ± 22.8	= 0.131
dBP (mmHg)	74.7 ± 11.2	72.3 ± 11.0	= 0.072	74.0 ± 8.6	71.9 ± 11.4	= 0.249

Table 4—*Relation of NIDDM (2-h BG >11.1 mmol/l) with other risk factors in logistic regression analysis*

	Model 1		Model 2		Model 3		Model 4	
Factors	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Area (urban 0, rural 1)	0.4	0.32–0.69	1.0	0.59–1.68	1.1	0.64–1.89	1.0	0.60–1.77
Age								
20–29	1.0	—	1.0	—	1.0	—	1.0	—
30–39	1.3	0.55–2.92	1.6	0.60–4.24	1.4	0.53–3.79	1.3	0.50–3.62
40–49	4.6	2.19–9.56	5.1	2.12–12.49	4.5	1.82–10.92	3.6	1.45–8.93
50–59	7.0	3.31–14.76	9.1	3.73–22.36	8.1	3.28–19.98	6.4	2.54–15.97
>60	6.9	3.14–15.19	7.8	2.95–20.65	7.1	2.69–18.96	5.6	2.09–15.15
Sex (F 0, M 1)	0.9	0.60–1.32	0.8	0.48–1.19	0.8	0.51–1.27	0.7	0.42–1.09
Social class (poor 0, rich 1)	—	—	5.6	2.96–10.66	4.4	2.17–8.80	4.1	2.02–8.23
BMI								
<16.0	—	—	—	—	1.0	—	1.0	—
16.1–19.0	—	—	—	—	0.6	0.22–1.63	0.5	0.19–1.48
19.1–22.0	—	—	—	—	1.0	0.38–2.67	0.8	0.28–2.06
22.1–25.0	—	—	—	—	1.2	0.42–3.15	0.8	0.27–2.17
>25.1	—	—	—	—	1.4	0.50–3.92	0.9	0.32–2.72
WHR								
<0.84	—	—	—	—	—	—	1.0	—
0.85–0.89	—	—	—	—	—	—	2.4	1.16–5.13
0.90–0.94	—	—	—	—	—	—	3.2	1.55–6.61
0.95–0.99	—	—	—	—	—	—	2.5	1.10–5.72
>1.00	—	—	—	—	—	—	3.9	1.52–9.95

Model 1, 899.1 and 2532.0; model 2, 677.9 and 2024.0; model 3, 672.7 and 1980.9; model 4, 659.8 and 1957.7.

prevalence among the rural rich (8.2%) did not differ significantly from the urban rich (8.7%). Similarly, the prevalence among the rural poor did not differ from the urban poor. However, IGT prevalence was much higher in rural subjects than in urban, irrespective of sex and social class.

We addressed the question of whether there was any difference in physiological characteristics between the rich and poor. We selected normoglycemic subjects (2-h BG <7.8 mmol/l) in each area for comparison (mean ± SD) of height, weight, BMI, WHR, systolic (sBP) and diastolic blood pressure (dBP) (Table 3). Adjusted for area and sex and compared with the poor, the rich had significantly higher height ($P < 0.01$), weight ($P < 0.001$), and BMI ($P < 0.001$). Although the values of WHR, sBP, and dBP were also higher in the rich, they were not significant in all cases.

To quantify the impact of an individual variable for its specific effect among the other independent variables, we used stepwise logistic regression analysis (21). Here, we took blood glucose (2-h BG ≥11.1 mmol/l) as a dependent variable. The risk variables (area, age, sex, social class, BMI, WHR) were quantified individually one after another as independent variables (Table 4). At first, the area was estimated as a risk variable when adjusted for age and sex (model 1). No individual area was found to have significant risk. When adjusting for area and sex in the same model, advancing age showed increasing risk. In model 2, social class was included. The risk for NIDDM among the rich was very high (OR 5.6, CI 2.96–10.66), which was retained even after the inclusion of BMI and WHR (models 3 and 4). Finally, in model 4, all independent variables were quantified. A high risk of NIDDM was observed in the rich and with increasing age; a moderate risk was observed with increasing WHR; and no risk was observed with area, sex, and BMI.

CONCLUSIONS — This study showed the prevalence of IGT and NIDDM was comparable to the prevalence observed in other Asian populations (3–5). The urban population had significantly higher prevalence of NIDDM than the rural population, which is consistent with other studies (2,4,5,16). Compared with the urban, the rural population had a significantly higher prevalence of IGT. This was also observed by Ali et al. (4). However, Ramachandran et al. (3) found no significant difference for IGT between rural and urban subjects. In this study, however, the higher frequency of IGT in rural people was limited among the rich and middle class, who can maintain a modern lifestyle of avoiding physical activities. In contrast, the rural poor maintain the traditional rural life, which necessitates physical activities, thus protecting them from developing glucose intolerance (18). In fact, on the basis of different physiological characteristics, we found two distinct populations, the rich and poor in either rural or urban areas (Table 3). Use of different heterogeneous rural middle class (the study's largest class showed higher prevalence of IGT) might have influenced rural preponderance of IGT (Table 2). However, the exact cause of increased prevalence of IGT in rural areas is not known. More studies are needed in this regard.

The overall estimation of risk suggests that advancing age, high WHR, and high social class (rich) were independent risk factors for IGT and NIDDM. These findings are consistent with other studies (18–21). With regard to geographical location, an urban area was thought to have an excess risk, but the excess risk was absent for NIDDM; however, a rural area had an excess risk for IGT. This latter observation sharply contrasts with other studies (2,4,5,17). However, none of these studies addressed socioeconomic risk in comparing rural and urban diabetes prevalence. A prospective study considering socioeconomic factors and genetic predisposition as the risk variables, especially in developing communities with rapidly changing lifestyles, may explain why there was no regional difference in NIDDM prevalence and why there was a rural preponderance of glucose intolerance.

This study reveals that the prevalence of IGT and NIDDM in Bangladesh is not negligible, whether the population be rural or urban. However, the detection rate is low in the rural area. Increased age and high socioeconomic group, irrespective of rural or urban areas, showed an independent risk for IGT and NIDDM, since the obesity-related risk, high WHR was shown to be more important than BMI. Although excess risk of glucose intolerance was observed in the rural subjects, both rural and urban subjects had similar risk for NIDDM.

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