The Prevalence of Diabetes in Rio de Janeiro, Brazil

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OBJECTIVE — To assess the prevalence of diabetes and impaired glucose tolerance (IGT) in the adult population of Rio de Janeiro, a two-stage cross-sectional survey was carried out in a random sample of 2,051 individuals aged 30–69 years from Rio de Janeiro city in Brazil.

RESEARCH DESIGN AND METHODS — Subjects were first screened by fasting capillary glycemia (FCG). All individuals who screened positive (FCG >5.6 mmol/l) and every sixth consecutive person who screened negative (FCG <5.6 mmol/l) were subjected to a 75-g glucose load. Diagnoses of diabetes and IGT were based on World Health Organization criteria.

RESULTS — Results from every sixth individual who screened negative were extrapolated to all individuals who screened negative after adjustment for some potential bias in the subsample. Age-adjusted prevalence rates for diabetes and IGT were 7.1 and 9.0%, respectively. The rates were higher ($P < 0.01$) among women than among men (8.7 vs. 5.2% for diabetes and 11.7 vs. 5.8% for IGT), among obese individuals than among nonobese individuals (7.9 vs. 6.2% for diabetes and 11.4 vs. 7.3% for IGT), and among those with family history of diabetes than among those without family history of diabetes (12.4 vs. 4.8% for diabetes and 13.8 vs. 6.7% for IGT). The rates for diabetes and IGT increased with age, being 1.7 and 4.5%, respectively, for the age-group of 30–39 years, 3.9 and 8.5% for the age-group of 40–49 years, 13.6 and 13% for the age-group of 50–59 years, and 17.3 and 15.3% for the age-group of 60–69 years ($P < 0.01$). The prevalence of diabetes was higher among individuals with low educational levels than among those with high educational levels (7.3 vs 4.2%). For IGT, the rates increased from the group with intermediate level of education (8.3%) to the low- (11.3%) and high-education group (12.6%). Differences in the rates for whites and non-whites (6.9 vs. 7.1% for diabetes and 8.8 vs. 9.6% for IGT) were not statistically significant. Among those with confirmed diabetes in the survey, 27.6% did not know of their diabetic condition. Among previously diagnosed diabetes (self-reported diabetes), 19.5% were not being treated, 31.8% were on diet only, 40.7% were on oral hypoglycemic drugs, and 8.0% were on insulin. Self-reported prevalence of diabetes was 0.1% for the population <30 years of age, 4.3% for the 30–69 year old age-group, and 16.6% for those >70 years of age.

CONCLUSIONS — The numbers found for Rio de Janeiro are similar to those for more developed countries and lead us to conclude that the impact of diabetes on public health is the same as in those countries where this disease is considered an important health problem.

The prevalence of diabetes in developing countries is increasing because of changes in lifestyles, with migration of rural populations to the cities (1). The health care costs associated with this disease are high, and there is evidence to support that adequate treatment may reduce morbidity and mortality (2,3). However, this decision is dependent on epidemiological data for planning, and there is a scarcity of data on distribution and risk factors for the frequency of diabetes among Brazilians.

In this study, we describe the prevalence of diabetes and impaired glucose tolerance (IGT) and the risk factors in the adult population of Rio de Janeiro city, located in Brazil's southwestern region.

RESEARCH DESIGN AND METHODS

— This was a cross-sectional home survey performed between 1988 and 1989 in the city of Rio de Janeiro, Brazil. A random sample composed of 2,051 people aged between 30 and 69 years, excluding pregnant women, was studied using the methodology described in the National Multicenter Study (4).

The 1980 Brazilian census was used as a reference for sample selection, using groups based on their representativeness of the population of Rio de Janeiro regarding sex, age, and socioeconomic status (5). The minimum sample size of 1,600 people was calculated estimating a possible prevalence of diabetes of 3.5%, with acceptable 95% CI and 1% maximum error (6,7). The final sample size was overestimated to 2,000 participants to take into account the losses and refusals of the chosen subjects, as reported in other similar studies (6,7).

The dwellings were randomly selected for each group. To reach the required sample size, 1,500 residential addresses were drawn because the 1980 census reported that on average there would be four inhabitants per home, 38% of who are within the eligible age bracket (4).

Known diabetic subjects and other suitable candidates were identified in the first visit. Participants were instructed to fast the night before the next visit when the fasting capillary glucose (FCG) was measured using a glucose-oxidase reagent strip and a portable reflectance meter (Dextrostix/Glucometer System, Miles, Elkhart, IN). The individuals with previously diagnosed diabetes and those with FCG >11.1 mmol/l were considered diabetic and were entered into phase 2. The subjects with FCG >5.6

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Received for publication 5 July 1995 and accepted in revised form 11 January 1996.

FCG, fasting capillary glycemia; IGT, impaired glucose tolerance; OGTT, oral glucose tolerance test; WHO, World Health Organization.

Table 1—*A selected sample of the population of the city of Rio de Janeiro participating in the screening phase (Phase 1) and subsample (Phase 2) by age-group, sex, skin color, level of education, and family history of diabetes*

				Phase 2 subsample			
	City of Rio	Selected sample (2,400)	Phase 1 sample (2,051)	Test+ (263)	Test− (1,788)	Test+ (263)	Test− (235)
Age-group (years)						254 (96.6)	216 (91.9)
30–39	35.5	888 (37.0)	755 (36.8)	38 (14.4)	717 (40.1)	35 (13.8)	90 (41.7)
40–49	28.9	581 (24.2)	491 (23.9)	50 (19.1)	445 (24.9)	48 (18.9)	51 (23.6)
50–59	22.5	554 (23.0)	466 (22.7)	94 (35.7)	369 (20.6)	92 (36.2)	46 (21.3)
60–69	13.1	377 (15.8)	339 (16.6)	81 (30.8)	257 (14.4)	79 (31.1)	29 (13.4)
Sex							
Male	46.4	1,072 (44.7)	878 (42.8)	89 (33.8)	789 (44.1)	87 (34.2)	73 (33.8)
Female	53.6	1,328 (55.3)	1,173 (57.2)	174 (66.2)	999 (55.9)b*	167 (65.8)	143 (66.2)a*
Skin color							
White	—	—	—	214 (81.4)	1,443 (80.7)	208 (82.0)	165 (76.4)
Nonwhite	—	—	—	49 (18.6)	345 (19.3)	46 (18.0)	51 (23.6)
Education							
Low	—	—	—	73 (27.8)	390 (21.8)	74 (29.1)	54 (25.0)
Average	—	—	—	151 (57.4)	1,095 (61.3)	148 (58.3)	123 (56.9)
High	—	—	—	39 (14.8)	303 (16.9)	32 (12.6)	39 (18.1)
Diabetes in family							
Yes	—	—	—	120 (45.6)	522 (29.2)b*	115 (45.3)	80 (30.0)a*
No	—	—	—	143 (54.4)	1,266 (70.8)	139 (54.7)	139 (63.0)

Data are *n* (%). *$P < 0.05$ (a > b). Population of the city 30–69 years old, 2,038,334.

mmol/l and every sixth subject with FCG <5.6 mmol/l (sixth negative) were also included in phase 2 and submitted to the oral glucose tolerance test (OGTT). The selection of the cutoff point was based on the results published by Haffner et al. (8). In phase 2, there was a more detailed questionnaire on the issues addressed in phase 1 concerning education, occupation, family income, type of dwelling, and health status. Other questions related to physical activity, obstetric profile, use of medication, and alcohol and dietary habits were added. Height and weight were recorded for all subjects.

After a night of fasting, all subjects with FCG >5.6 mmol/l and the "sixth negatives" received 75 g of glucose (Dexpak, Miles). Capillary blood glucose levels were measured 2 h after the 75 g of glucose, following World Health Organization (WHO) recommendations. Individuals with 2-h FCG >11.1 mmol/l were considered diabetic, those with FCG of 7.8–11 mmol/l were considered to have IGT, and those with values <7.8 mmol/l were considered nondiabetic. The population sample screened in phase 1 was compared with that of eligible residents in the dwellings drawn for the study, and these were compared with all the inhabitants of the city of Rio to assess the representativeness by age and sex. The individuals with positive and negative test results from phase 2 (OGTT) were compared, respectively, with the subjects with positive and negative test results from phase 1 to evaluate representativeness for age, sex, skin color, education, and presence of diabetes in the family. The prevalence found in phase 2 was extrapolated for phase 1, and the potential trends found by the variables studied were corrected using the technique of cross-stratification (9). The prevalences were adjusted for age, by the direct method, using as standard the population of Rio de Janeiro from the 1980 census (9). The χ^2 test was used to analyze representativeness between the samples and in comparing the prevalence rates. When it was necessary to characterize significant differences between comparisons, partition of χ^2 to $2 \times N$ tables was used (10). The limits for rejecting the null hypothesis for all the statistical tests used was 0.05. The database was organized with the help of the software dBase III+ (Ashton-Tate). The statistical analysis was conducted using the software Epi-info 5 (WHO).

RESULTS — There were 4,790 people living in the 1,500 selected residential addresses, 2,400 being eligible for the study and 2,051 (85.4%) participating in phase 1, with 226 (94%) refusals and 123 (5.1%) not found (Table 1). This group was the basis for the computing prevalence estimates. There were no differences between participants of phase 1 and the city population composition as far as age and sex were concerned.

Using phase 1 FCG results, 113 diabetic subjects previously aware of their condition were identified. According to type of treatment, 31.8% were on diet only, 40.7% were on diet plus hypoglycemic agents, 8% on were diet plus insulin, and 19.5% were untreated. These patients were included in phase 2 of the study but were not subjected to a 75-g oral glucose load.

Applying the WHO criteria to the 254 positive tests of phase 2, 145 (57.1%) individuals were diabetic and 30 (11.9%) had IGT. Among 216 individuals with negative tests, 1 had diabetes (0.5%) and 21 had IGT (9.7%). If we extrapolate the prevalence of positive tests in phase 2 to phase 1, this will result in 150 patients with diabetes and 31 with IGT. A cross-stratification technique was used to cor-

Table 2—*Prevalence of diabetes and IGT in the city of Rio de Janeiro distinguished by skin color, level of education, presence of obesity, and diabetes in the family*

	Diabetes		IGT	
	Crude	Age-adjusted	Crude	Age-adjusted
Diagnosis				
Previously known	5.5	5.1	—	—
Newly diagnosed	2.1	2.0	9.3	9.0
Skin color				
White	7.6	6.9	9.3	8.8
Nonwhite	7.3	7.1	9.5	9.6
Level of education				
Low	11.9a*	7.3a*	9.7	11.3
Average	7.2b*	7.2a*	8.4	8.3
High	3.2c*	4.2b*	11.3	12.6
Diabetes in family				
Yes	13.0	12.4a*	14.0	13.8a*
No	5.2	4.8b*	7.1	6.7b*
Obesity				
Yes	10.2a*	7.9a*	13.4a*	11.4a*
No	5.7b*	6.2b*	6.8b*	7.3b*

Data are %. For age-adjusted data, standard equals population of the city of Rio de Janeiro, Instituto Brasileiro de Geografia e Estatística, 1980. Men, BMI > 27 kg/m^2; women, BMI > 25 kg/m^2. *$P < 0.01$ (a > b > c).

rect for sex and family history of diabetes in those with negative tests, resulting in 0.3% of diabetes and 9.0% of IGT. By extrapolating these results to phase 1, we identified 6 people with diabetes and 161 with IGT. The final results demonstrated 156 people with diabetes and 192 with IGT. Crude and age-adjusted prevalences, according to age, sex, skin color, level of education, positive family history, and obesity, and percentage of newly diagnosed cases during the survey are shown in Tables 2 and 3.

The data obtained during the selection phase allowed estimates of self-reported diabetic prevalence for all ages. In those individuals aged <30 years of age, prevalence was 0.1%; among the age-group of 30–69 years, it was 4.3% (56.5% of the 7.6% rate in the survey); and among people >69 years of age, it was 16.6%.

CONCLUSIONS — The 7.1% prevalence of diabetes in the age-group of 30–69 years in Rio de Janeiro was slightly lower than the national prevalence (7.6%), while the IGT prevalence of 9.0% was higher (7.8%). The frequence of diabetes and IGT among women was also higher in Rio de Janeiro, while no difference was found in the national survey. Although prevalence of diabetes and IGT increased with age, it was not influenced by skin color. This result differs from the one found in the U.S., and it can be explained by the high rate of mixed marriages that occurred in Rio de Janeiro (9,11). A higher prevalence of diabetes was also found among obese individuals, individuals with lower levels of education, and individuals with a positive family history of diabetes. Differing from the national average (46.5%), only 27.6% of patients in Rio de Janeiro were unaware of their diabetic condition. The self-reported prevalence in individuals >69 years old was probably underestimated. This is suggested by findings among those eligible for the study in the 60- to 69-year-old age-group. Our results are similar to those reported from developed countries, and we concluded that diabetes is already a major public health problem among us.

Table 3—*Prevalence of diabetes and IGT by age-group and sex in Rio de Janeiro*

	Women		Men		Total	
	Diabetes	IGT	Diabetes	IGT	Diabetes	IGT
Age-group (years)						
30–39	1.6	4.3	1.8	4.6	1.7a*	4.5a*
40–49	4.9	14.3	2.9	1.9	4.0b*	9.1b*
50–59	15.8	16.2	11.1	9.1	13.7c*	13.1c*
60–69	22.4	17.3	10.4	12.5	17.4d	15.3d
Total	9.0	11.6	5.7	6.4	7.6	9.3
Age-adjusted	8.7a*	11.7a*	5.2b*	5.8b*	7.1	9.0

For age-adjusted data, standard equals population of the city of Rio de Janeiro, Instituto Brasileiro de Geografia e Estatística, 1980. $P < 0.01$ (a > b > c > d).

APPENDIX — STEERING COMMITTEE OF THE COOPERATIVE GROUP FOR THE STUDY OF DIABETES PREVALENCE IN RIO DE JANEIRO

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