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Comparison of ADA 1997 and WHO 1985 criteria for diabetes in south Indians – the Chennai Urban Population Study

R. Deepa, S. Shanthi Rani, G. Premalatha and V. Mohan

Madras Diabetes Research Foundation, Chennai, India

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Abstract

Aims To compare the American Diabetes Association (ADA) fasting criteria and World Health Organization (WHO) 2-h criteria for diabetes in an urban south Indian population.

Methods Subjects were drawn from the Chennai Urban Population Study. Of the 1001 subjects studied, 52 (5.2%) were diagnosed as having diabetes according to WHO 2-h criteria and 32 (3.2%) according to the ADA fasting criteria.

Results Twenty-five (48%) of the subjects diagnosed with diabetes by the WHO 2-h criteria were not classified as having diabetes by the ADA fasting criteria. Similarly, of the 78 subjects (7.8%) classified as having impaired glucose tolerance (IGT), only eight (10.3%) had impaired fasting glucose (IFG) according to the ADA fasting criteria. The overall agreement between the WHO 2-h criteria and ADA fasting criteria was poor ($\kappa = 0.40$).

Conclusions Use of the ADA fasting criteria results in a lower prevalence rates of diabetes in this lean urban south Indian population.

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Keywords ADA fasting criteria, WHO 2-h criteria, south Indians

Abbreviations ADA, American Diabetes Association; GGT, glucose tolerance test; IFG, impaired fasting glucose; IGT, impaired glucose tolerance; NFG, normal fasting glucose; WHO, World Health Organization; WHR, waist-to-hip ratio

Introduction

The new diagnostic criteria for diabetes proposed by the American Diabetes Association (ADA) Expert committee [1] is under consideration for acceptance in Europe [2]. It is therefore important to determine the clinical implications of this criteria in different ethnic groups.

Correspondence to: Professor Viswanathan Mohan, Madras Diabetes Research Foundation, 35 Conran Smith Road, Gopalapuram, Chennai 600 086, India. Email: mvdsc@vsnl.com

Subjects and methods

The Chennai Urban Population Study (CUPS) is an ongoing epidemiological study in Chennai (formerly Madras) in southern India, the details of which are published elsewhere [3]. Briefly, two residential colonies in Chennai at Tirumangalam and T. Nagar representing the middle income and lower income groups, respectively, were selected.

All individuals above the age of 20 years were invited to participate in a screening programme for diabetes. A total of 479 out of the 524 eligible subjects in the Tirumangalam colony (91.4% response rate) and 783 of the 875 eligible subjects in the T. Nagar colony (89.4% response rate) participated (overall response rate 1262/1399–90.2%). Ninety-one had 'known'

diabetes at the time of the survey and they were excluded. The remaining 1171 subjects were requested to undergo a glucose tolerance test (GTT). A fasting sample (at least 10 h fasting) was taken at 7.00 h for estimation of glucose and lipids. Seventy-five grams of glucose was given orally with 200 ml water and a 2-h post glucose sample was collected. In 170 individuals, the GTT could not be performed and they were excluded. This study deals with the 1001 individuals, in whom both FPG and 2-h PG values were available. There were no significant differences in the age, sex, body mass index (BMI) or fasting plasma glucose (FPG) between the individuals excluded and the individuals in whom the GTT was performed. Diabetes was diagnosed based on ADA fasting criteria [1] and WHO 2-h criteria [4].

Height and weight were measured and body mass index (BMI) calculated. Obesity was defined as BMI > 25 kg/m^2. Waist and hip measurements were carried out with the patient in the standing position and waist-to-hip ratio (WHR) was calculated. The blood pressure was recorded twice, 5 min apart in the right upper limb in the sitting position using a mercury sphygmomanometer and the mean of the two was taken.

Biochemical estimations were carried out within 3 h of blood collection using Boehringer Mannheim kits (Mannheim, Germany) on a Ciba Corning Express Plus Autoanalyser (Medfield, MA). Plasma glucose was estimated by the glucose oxidase method. Serum cholesterol, triglycerides and HDL cholesterol were measured and LDL cholesterol was calculated using the Friedewald formula [5].

A resting 12 lead ECG was performed and Minnesota coded coronary artery disease (CAD) was diagnosed if there was a history of myocardial infarction, or if Minnesota codes 1.1.1–1.1.7, 4.1–4.2 or 5.1–5.3 were present.

Hypertension was diagnosed based on history or drug treatment and/or if blood pressure was > 140/90 mmHg [6].

Statistics

Prevalence of glucose intolerance was calculated for both sets of diagnostic criteria. To examine the agreement between the two sets of criteria, a cross-table was made. The overall Kappa 'κ' which measures the agreement across all categories of glucose intolerance was calculated [7]. Values were expressed as mean ± SD. Differences among the groups were tested using the Student's *t*-test. The McNemer test was used to compare proportions among the different groups. Receiver–operating characteristic (ROC) curves were plotted to identify an optimal FPG concentration which maximized sensitivity and specificity with respect to the 2-h PG of 11.1 mmol/l. All statistical analysis were carried out using the SPSS+ package (Version 4.0.1, Chicago, IL).

Results

The study population consisted of 1001 individuals including 427 men and 574 women with a mean age of 42 ± 15 years and a mean BMI of 22.4 ± 4.4 kg/m^2. The overall prevalence of obesity was 26.5% which included 20.8% of males and 30.7% of females. The prevalence rate of diabetes based on WHO 2-h criteria was 5.2% (52/1001) while that based on the ADA fasting criteria was 3.2%. This difference reached statistical significance on McNemer analysis (P < 0.001). Of the 52 individuals diagnosed to have diabetes based on WHO 2-hour criteria, only 27 (52%) individuals were classified as diabetic by the ADA fasting criteria (Table 1). Thus 25 (48%) individuals would remain undiagnosed if ADA fasting criteria were

Table 1 Agreement between the WHO 1985 criteria and the ADA 1997 criteria for glucose intolerance in the study population

Diagnostic criteria ADA fasting criteria	WHO 2-h criteria			
	NGT	IGT	Diabetes	Total
NFG	861	66	19	946
IFG	9	8	6	23
Diabetes	1	4	27	32
WHO FPG ⩾7.8	0	1	21	22
FPG > 7.0 – < 7.8	0	3	6	9

NGT, normal glucose tolerance; IGT, impaired glucose tolerance; NFG, normal fasting glucose; IFG, impaired fasting glucose; FPG, fasting plasma glucose.

Table 2 Clinical features of the diabetic groups diagnosed by ADA fasting criteria and WHO 2-h criteria

Parameters	Diabetes mellitus (ADA fasting criteria) (n = 32)	Diabetes mellitus (WHO 2-h criteria) (n = 52)	P val
Age (years)	56 ± 12	53 ± 12	NS
Body mass index (kg/m^2)	24.0 ± 3.4	24.5 ± 3.6	NS
Waist-to-hip ratio	0.86 ± 0.07	0.88 ± 0.08	NS
Fasting plasma glucose (mmol/l)	10.5 ± 3.5	8.3 ± 3.8	0.009
2-h post plasma glucose (mmol./l)	18.0 ± 6.2	16.4 ± 5.3	NS
Serum cholesterol (mmol/l)	5.36 ± 1.3	5.27 ± 1.21	NS
Serum triglycerides (mmol/l)	1.94 ± 0.87	2.07 ± 1.23	NS
HDL cholesterol (mmol/l)	0.96 ± 0.19	0.93 ± 0.17	NS
LDL cholesterol (mmol/l)	3.51 ± 1.27	3.38 ± 1.12	NS
Hypertension n (%)	11 (34%)	20 (38%)	NS
Coronary artery disease n (%)	4 (13%)	7 (13%)	NS

Values are expressed as mean ± SD.

used for diagnosis. Of these 25, 19 subjects were classified to have NFG and six IFG. Conversely, four (12.5%) of the 32 subjects diagnosed as having diabetes according to ADA fasting criteria were classified as IGT by the WHO 2-h criteria and one (3.1%) as NGT (Table 1). The kappa value 'κ' for agreement of WHO 2-h criteria and ADA fasting criteria was 0.4 indicating poor agreement. The prevalence of diabetes based on WHO 2-h criteria and ADA fasting criteria in the Tirumangalam population (age 48.5 ± 14.0 years, BMI 24.3 ± 4.0 kg/m^2) was 7.7% and 3.4%, respectively. In the T. Nagar population (age 39 ± 15 years, BMI 21.5 ± 4.3 kg/m^2) the corresponding values were 3.8% and 3.1%, respectively. The difference reached statistical significance in the Tirumangalam population (McNemer test $P < 0.001$).

Table 2 compares the clinical and biochemical features of the subjects diagnosed with diabetes by the ADA fasting criteria and the WHO 2-h criteria. Individuals diagnosed by the ADA criteria had higher fasting plasma glucose values than those diagnosed by the WHO criteria ($P = 0.009$).

There was no significant difference with respect to the cardiovascular risk factors (BMI, waist-to-hip ratio (WHR), total cholesterol, LDL cholesterol, HDL cholesterol, triglycerides and hypertension) or the prevalence of coronary artery disease in either the subjects with diabetes or those with pre-diabetes (data not shown) diagnosed by the ADA fasting or the WHO 2-h criteria.

The ROC curve showed that a FPG of 5.1 mmol/l maximized the sensitivity and specificity of a 2-h PG value of 11.1 mmol/l in the present population.

Discussion

The impact of the ADA diagnostic criteria has been studied in various populations [8,9,10] and the results appear to differ in different ethnic groups. The DECODE study recently reported that the correlation of FPG with 2-h post plasma glucose depends on the body mass index and the age of the individuals [8]. Thus the WHO 2-h criteria is more likely to diagnose diabetes in lean individuals, while the ADA fasting criteria is more likely to identify middle aged obese individuals [8]. Further the FPG value corresponding to a 2-h PG value in lean people (BMI < 25 kg/m^2), was reported to be considerably lower than in obese people (BMI > 30 kg/m^2).

This study of a relatively lean south Indian population with a mean BMI of 22.4 kg/m^2 confirms these findings and indicates that FPG of 5.1 mmol/l corresponds to a 2-h PG of 11.1 mmol/l in this population. This study also shows that if the ADA fasting value alone is used, the prevalence rates for diabetes would be considerably lower than that using the WHO 2-h criteria [8–10]. These findings could have significant implications in populations like that in Chennai where the prevalence rates of diabetes are very high. It is of interest that there were no significant differences with respect to occurrence of the cardiovascular risk factors studied. These findings are similar to that reported in the Hoorn Study [10].

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