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Prevalence and risk factors for diabetes and impaired glucose tolerance in Asian Indians: A community survey from urban Eastern India

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ABSTRACT

Objectives: To determine the prevalence of diabetes and impaired glucose tolerance (IGT) and to identify risk factors for the same specific to an underdeveloped urban locale of Eastern India.

Methods: Study design. Population based cross-sectional study, with multistage random sampling technique.

Setting. Urban city-dwellers in Orissa one of the poorest states of Eastern India bordering a prosperous state of Andhra Pradesh of Southern India.

Participants. 1178 adults of 20–80 years age randomly selected from 37 electoral wards of urban populace.

Definition and diagnosis of diabetes mellitus and IGT. These were based on a Report of a World Health Organiztion/International Diabetes Federation Consultation of 2006.

Main outcome measure. Prevalence and significant risk factors for Diabetes and IGT.

Statistical analysis. Both descriptive and multivariable logistic regression analyses.

Results: The crude rates of diabetes and IGT in the study population were 15.7% and 8.8%, respectively. Similarly age-standardized rates of diabetes and IGT were 11.1% and 6.7%, respectively. Both diabetes and IGT had shown a male preponderance.

Conclusion: Diabetes and IGT were very highly prevalent in this urban populace. Cardiometabolic risk factors like older age, central obesity, inadequate fruit intake, hypertension, hypertriglyceridemia and socio economic status were found to be significant predictors of diabetes in this study.

1. Introduction

The Diabetes Atlas of the International Diabetes Federation shows that India has the dubious distinction of leading the world in diabetes prevalence and is home to over 51 million diabetics [1]. Recent surveys indicate that the prevalence of Diabetes in urban Indian adults has increased from 1.2% in 1971 [2] to about 20% at present [3,4]. With its chronic course; we can expect diabetes to have a serious adverse impact on the life expectancy as well as the quality of life [5]. South Asians have an increased prevalence of coronary heart disease (CHD) and diabetes mellitus amongst all the ethnic groups irrespective of their religious affiliations, life style, diet or the country of residence [6–8]. This South Asian Paradox refers to the fact that high prevalence rates of diabetes are seen in people originating from South Asian nations of Bangladesh, India, Nepal, Pakistan and Sri Lanka despite low rates of obesity as defined by conventional body mass index criteria [9,10]. South Asians also seem to have a peculiar body phenotype known as South Asian phenotype, characterized by increased waist circumference, waist hip ratio, excessive body fat, increased plasma insulin levels, insulin resistance and an atherogenic dyslipidemias with low levels of HDL cholesterol and increased triglyceride levels [9,10]. All these predispose them not only to diabetes but also to premature CHD. There could also be unique genetic markers which make South Asians more susceptible to diabetes [9–11].

Unfortunately, accurate recent nationwide data are lacking in India [12,13], let alone data from specific states within India. Earlier we reported that the state of Orissa, one of the poorest states of Eastern India bordering a prosperous state of Andhra Pradesh of Southern India, showed interesting variations in classical coronary risk factors among an urban population [14]. Such a unique geographic location opens up to cultural and socio-economic interactions. Diabetes is a lifestyle disease and factors

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contributing to changing patterns in Diabetes prevalence in recent years in this geographic region may provide interesting insights into tackling the ever-rising burden of Diabetes in South Asians in general. Interesting to note, one of the earliest studies for prevalence of diabetes in India was conducted from Orissa state [2,15]. The present study aims at updating on changing patterns of Diabetes in a unique urban Eastern Indian population and quantifying factors significantly contributing to any observed underlying pattern.

2. Methods

2.1. Study design and setting

The current study was a population-based survey of cohort under Berhampur Municipal Corporation with an estimated population of 307,724 in 2001, in Orissa one of the poorest states of Eastern India bordering a prosperous state of Andhra Pradesh of Southern India. So the inhabitants here are heterogeneous mix of language, religion, varied socioeconomic statuses and culture.

2.2. Sampling design and sample size

The study population of 1178 adults of 20–80 years of age was selected using a multi-stage random sampling technique. The sampling frame constituted 37 electoral wards spread across the urban population of Berhampur city of Orissa state in Eastern India.

2.3. Survey methods

Demographic, socio-economic status as per modified Kuppuswamy scale [16], and self-reported behavioral information (smoking, alcohol, physical activity, fruit intake and diet), objective measures of anthropometry (height, weight, waist and hip circumferences), biochemical (plasma glucose, total cholesterol, triglycerides, HDL cholesterol levels), and Electrocardiographic data were collected from all study participants. Detailed interviews were performed through a previously validated questionnaire based on the guidelines of World Health Organization [17]. History of any chronic illness, in the participant as well as in the family, including diabetes mellitus, hypertension, cerebrovascular accident and coronary heart disease were recorded. Details of study methodology have been published elsewhere [14].

2.4. Definitions of cardiovascular risk factors

Definition and diagnosis of diabetes mellitus and intermediate hyperglycemia was based on a Report of a WHO/IDF Consultation, Geneva [18].

Diabetes was defined as individuals diagnosed by a physician and on glucose-lowering medications (self reported) and/or those who had a fasting plasma glucose level of $\geq$126 mg/dl ($\geq$7.0 mmol/l) or 2-h plasma glucose $\geq$200 mg/dl (11.1 mmol/l) [18].

Impaired glucose tolerance (IGT) was defined as fasting plasma glucose of $<$7.0 mmol/l (126 mg/dl) and 2–h plasma glucose of $\geq$7.8 and $<$11.1 mmol/l (140 mg/dl and 200 mg/dl) [18].

Obesity and overweight was based on the revised criteria specific for Asian Pacific populations [19].

Hypertension definition was based on the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure [20].

Definition of *Dyslipidemia* was based on the Third Report of the National Cholesterol Education Program (NCEP) [21].

2.5. Anthropometric profile

Body weight and height were measured with the subject barefoot and wearing light clothing and were used to calculate the body mass index (BMI). BMI was calculated as weight in kilograms over height in meters squared. Waist circumference was measured at the mid point between the lower limit of the rib cage and upper border of iliac crest.

Blood pressure was recorded in a sitting position of the right arm to the nearest 2 mmHg using mercury sphygmomanometer. Two readings were taken 5 min apart and the mean was taken as the blood pressure.

2.6. Biochemical analysis

A fasting blood sample was collected after an overnight fast of at least 10 h for biochemical investigations. In addition, venous plasma glucose 2 h after ingestion of oral glucose load in all subjects except in known diabetics, who underwent 2 h postprandial plasma glucose estimation. All biochemical parameters were performed using enzymatic kits [22–26].

2.7. Ethical approval

Institutional ethical committee approval was obtained prior to the start of study and informed consent was taken from all the study subjects [27].

2.8. Statistical analysis

Significant differences in proportions of potential lifestyle factors by diabetes status were estimated using Pearsons' Chi-square. Univariate logistic regression and multivariable logistic regression analyses were performed using SAS software (9.1.2, Cary, NC, United States) to predict potential significant predictors of diabetes employing backward elimination modeling technique.

Direct age-standardization was performed to calculate rates. Adjustments were done using a standard population from urban National health and family welfare survey 2005 of urban population of Orissa, based on the standard formula given below.

2.9. Direct method

$$\mathrm{SR} = \frac{\mathrm{SUM}(r_i^o P_i)}{\mathrm{SUM}\, P_i}$$

where SR is the age-standardized rate for the population being studied, r_i^o is the age-group specific rate for age group i in the population being studied, P_i is the population of age group i in the standard population

3. Results

This was one of the large community based surveys done from Eastern India for ascertaining the prevalence of cardiovascular risk factors with the aim of providing the baseline information on prevalence rates for intervention programmes to the policy planners. A total of eleven hundred seventy eight subjects participated in the study (185 had diabetes; 104 were having IGT and the remaining 889 individuals were considered normal).

3.1. Demographic and clinical profile of subjects

The sex distribution in this study was equal. The age of the subjects ranged from 20–80 years, with a mean age of 47 years in