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Original article

Effect of obesity on cardiometabolic risk factors in Asian Indians

D.S. Prasad [a,*], Zubair Kabir [b], A.K. Dash [c], B.C. Das [d]

[a] Consultant Cardiologist, Sudhir Heart Centre, Berhampur 760 002, Orissa, India
[b] Department of Epidemiology & Public Health, University College Cork, Cork, Ireland
[c] Department of Pathology, M. K. C. G. Medical College, Berhampur 760004, Orissa, India
[d] Department of Community Medicine, Kalinga Institute of Medical Sciences, Bhubaneshwar 751024, Orissa, India

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ABSTRACT

Objectives: To determine the prevalence of overweight and obesity and their effects on cardiometabolic risk factors in a representative sample of urban population in Eastern India.
Materials and methods: A population-based survey was conducted among a randomly selected study population aged 20–80 years in an urban population of Berhampur city of Eastern India. Both anthropometric and biochemical information were collected, in addition to detailed information on classical cardiometabolic risk factors. Both descriptive and inferential statistical analyses were performed. Obesity and overweight were defined based on the revised Asian–Pacific population criteria (Body mass index [BMI] $\geq$25 kg/m^2 and $\geq$23 kg/m^2, respectively).
Results: The age-standardized rates of obesity and overweight are 36.8% (Males: 33.2%; Females: 40.8%) and 17.6%, (Males: 20.4%; Females: 15.1%) respectively, i.e., over half are either obese or overweight in this study population. Compared to the World Health Organization (WHO) standard cutoff criteria of overweight [BMI $\geq$25 kg/m^2] and obesity [BMI >30 kg/m^2], the cardiometabolic risk factors studied showed a significant incremental rise even with the lower cutoffs of the revised Asia–Pacific criteria. Older age, female gender, family history of diabetes, being hypertensive, hypertriglyceridemia, hypercholesterolemia, physical inactivity and middle to higher socioeconomic status significantly contributed to increased obesity risk among this urban population.
Conclusion: One-third of the urban populations are obese in Eastern India – an underestimate compared to the standard BMI cutoff criteria. Nevertheless, significant associations of the classical cardiometabolic risk factors with obesity were observed using the revised Asia–Pacific criteria clearly indicating a more aggressive cardiovascular prevention strategy for Asian Indians.

1. Introduction

Obesity is a well-recognized cardiovascular risk factor that exerts effects on the heart and circulation both directly and indirectly through its influence on known risk factors such as hyperlipidemia, hypertension, hyperglycemia, prothrombotic state and proinflammatory mediators.[1] There are also some unrecognized mechanisms of obesity-related cardiovascular risk. Overweight and obesity together predispose to long-term cardiovascular disorders (CVD) such as coronary heart disease, heart failure, and sudden death.[1] Distinct regional and ethnic patterns in obesity associated cardiometabolic disorders are also reported.[2]

Impaired cardiovascular fitness is commonly associated with obesity in physically inactive individuals contributing to additional cardiovascular risk independent of the degree of obesity. Thus both "fatness" and "fitness" are important independent and modifiable risk factors for heart disease.[3] Obesity – as an independent cardiometabolic risk factor is unclear. Methodological issues, such as variations both in the measurement and definition of obesity add further challenges in proving the validity of this apparent relationship. Obesity often occurs in a cluster with established cardiometabolic risk factors and, thereby making it more difficult to establish whether the presence and pattern of obesity is an independent cardiometabolic risk factor or not.

Relationship of cardiometabolic risk factors with Body mass index (BMI) has been studied in multiple populations across European, North American and Asian–Pacific countries.[4–7] These studies have shown that the risk of cardiovascular disease increases continuously with increasing BMI. But few comparable prospective

* Corresponding author. Sudhir Heart Centre, Main Road, Dharmanagar, Berhampur 760 002, Orissa, India. Tel.: +91 0680 2224278; fax: +91 0680 2225080.
E-mail address: sudhir_heartcare@hotmail.com (D.S. Prasad).

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data are currently available for South Asian region, even though South Asians are at a higher risk than White Caucasians for the development of obesity and obesity-related cardiometabolic disorders for the same level of increase in BMI levels.[8,9] They also seem to have a peculiar body phenotype known as South Asian Phenotype, predisposing them to increased cardiometabolic risk. There could also be unique genetic markers which make South Asians more susceptible to diabetes.[8–10]

Data from various mortality statistics and morbidity surveys indicate significant regional variations in cardiovascular risk factors prevalence across Indian subcontinent.[11] Furthermore, data from the Registrar General of India reported greater age-adjusted cardiovascular mortality in southern and eastern states of the country.[11] But regrettably, accurate recent data on a national scale are not available in India.[12,13] 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.[14–16] Such a distinctive geographic location opens up to cultural and socioeconomic interactions. Obesity is a lifestyle disease and factors contributing to changing patterns in obesity prevalence in this geographic region may provide significant insights into tackling the ever-rising burden of obesity and its effect on cardiovascular risk factors in South Asians. The present study aims at updating on changing patterns of obesity in this urban Eastern Indian population and quantifying factors significantly contributing to any observed underlying pattern. Increased BMI has been shown to be associated with increased cardiometabolic risk in urban Indian populations from North and South India.[17–20] Likewise to correlate BMI with multiple cardiometabolic risk factors in Eastern India we analyzed data using regression-based statistical techniques.

2. Materials and methods

2.1. Study design and setting

The present 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 residents here are diverse mix of socioeconomic class, language, faith and customs.

2.2. Sampling design and sample size

The urban population of Berhampur city of Eastern India spread across 37 electoral wards constituted the sampling frame. Thirty wards were selected randomly to identify the sampling unit, a household. Each ward of the city is divided into 12–14 streets and each street is spread in two rows of households. Two rows of households were randomly selected and the sampling unit household was selected by simple random sampling to enroll approximately 40 subjects who are ≥20 years of age from each ward. A total of 1178 subjects who are ≥20 years of age out of 1200 eligible subjects finally participated in the study. These details of sampling design have been published earlier.[14]

2.3. Survey methods

Demographic, socioeconomic status as per modified Kuppuswamy scale,[21] 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, High density lipoprotein cholesterol [HDL-c] 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 (WHO).[22] 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. Ethical approval

Institutional ethical committee approval was obtained prior to the start of study and informed consent was taken from all the study subjects.[23]

2.5. Definitions of cardiovascular risk factors

Definition and diagnosis of diabetes mellitus and intermediate hyperglycemia was based on a Report of a World Health Organization (WHO)/International diabetes Federation (IDF) Consultation, Geneva: World Health Organization; 2006.[24]

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 126 mg/dl (≥7.0 mmol/l) or 2 h plasma glucose ≥200 mg/dl (11.1 mmol/l).[24]

Impaired fasting glucose (IFG) as fasting plasma glucose level of 100–125 mg/dl (5.6–6.9 mmol/l). **Impaired glucose tolerance (IGT)** as fasting plasma glucose level of 110–125 mg/dl (5.6–6.9 mmol/l) or 2 h post-glucose load plasma glucose level of 140–199 mg/dl (7.8–11.1 mmol/l).[24]

Obesity and overweight was based on the revised criteria specific for Asian–Pacific populations.[25] Value of BMI ≥23 kg/m^2 was used to define overweight and ≥25 kg/m^2 were used to define obese.

Hypertension definition was based on the seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure.[26]

Dyslipidemia was based on the third report of the National Cholesterol Education Program (NCEP).[27]

2.6. Metabolic syndrome

We followed a unified definition of the metabolic syndrome by joint interim statement of five major scientific organizations – the International Diabetes Federation, the National Heart, Lung, and Blood Institute, the American Heart Association, the World Heart Federation, the International Atherosclerosis Society, and the International Association of the Study of Obesity.[28]

2.7. Anthropometric profile

Body weight and height were measured with the subject barefoot and wearing light clothing. 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.

2.8. Biochemical analysis

A fasting blood sample was collected after an overnight fast of at least 10 h for biochemical investigations. In addition, venous