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Original article

Metabolic syndrome among rural Indian adults

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SUMMARY

Background & aims: To prevent an increasing level of mortality due to type 2 diabetes mellitus and cardiovascular disease among the rural Indian population, a management strategy of the metabolic syndrome (MetS) should be devised. This study aims to estimate the burden of MetS and its associated risk factors.

Methods: Data from the Birbhum Population Project covering 9886 individuals (4810 male and 5076 female population) aged ≥18 years were used. The burden of metabolic syndrome, as defined by the Third Report of the National Cholesterol Education Program Adult Treatment Panel, was determined. Bivariate and multivariate (logistic regression) analyses were used to attain the study objective.

Results: Over 10.7% of the males and 20.3% of the females were diagnosed with MetS. Irrespective of sex, older individuals, being overweight/obese (body mass index of ≥23 kg/m^2) had higher probability of developing MetS, whereas being underweight is deemed a protective factor against MetS. Low physical activity among women appeared to be a risk factor for MetS.

Conclusion: The prevalence of MetS is concerning even in rural India. Any intervention designed to address the issue could emphasize on weight loss, and physical activity, focusing on women and people at an advanced stage of life.

1. Introduction

Metabolic Syndrome (MetS) is a constellation of at least three of five risk factors common to type 2 diabetes mellitus (T2DM) and cardiometabolic disease: abdominal obesity, hypertriglyceridemia, low high-density lipoprotein (HDL), high blood pressure and hyperglycemia [1]. Globally, the prevalence of MetS ranges from 10% to 50% [2]. Individuals with MetS have an estimated 30%–40% probability of developing T2DM and/or cardiovascular disease (CVD) within 20 years depending on the number of components present [3], and 20%–25% of South Asians have developed MetS [4]. Individuals with MetS are also susceptible to developing polycystic ovary syndrome, fatty liver, cholesterol gallstones, asthma, sleep disturbances, and some forms of cancer [5].

India is no exception. All classical risk factors of MetS are prevalent among Indians, and often discussion of this issue focuses on people living in urban settings. The rural–urban difference in MetS indicates the major role of environmental and behavioral factors. Tremendous mechanized socioeconomic growth in urban India has slowly spread out to rural India, seeing an increased consumption of high-fat diets and low fruit and vegetable intake that have accelerated the level of obesity, with low physical activity exacerbating the situation [6,7]. Nearly 70% of the total population live in rural India, and the dynamics of MetS among rural Indians is poorly investigated.

Women have a unique physiology and their experience of illness, and health-care outcomes are often remarkably different from those of men [8,9]. If results for male and female participants are not studied separately, aggregate results may mask important clinical differences in the MetS mechanism [9]. Recognizing this importance, the National Institutes of Health (NIH), the European Commission, the Irish Research Council, and the Canadian Institutes of Health Research, all call for the inclusion of both men and women participants in scientific research [8]. The

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pathophysiological differences between males and females play a critical role in the development of MetS, which is often confounded by the socio-economic and demographic gradient of the population [10,11].

The defining guideline of MetS has advised that behavioral and lifestyle modification intervention could be an effective method to reduce the level of MetS, but an inadequate number of studies hinders the development of a MetS management strategy, especially in rural India where the identification of MetS is quite delayed [12]. Many of the subclinical conditions remain undiagnosed until the onset of complications resulting from MetS, such as myocardial infarction or stroke [13]. Against this shortcoming, this study undertakes an empirical analysis to examine sex differences in MetS among a select rural Indian population, focusing on factors associated with it.

2. Materials and methods

2.1. Study setting, survey, and sample derivation

Data from the Birbhum Population Project (BIRPOP) [14] was used to perform this study. BIRPOP is a Health and Demographic Surveillance Site (HDSS), functioning under the ambit of the Society for Health and Demographic Surveillance, located in the eastern state of West Bengal, India. Located in Birbhum district of West Bengal, HDSS-BIRPOP is predominantly rural and covers four administrative blocks, namely Mohammad Bazar, Rajnagar, Sainthia, and Suri I [14].

HDSS-BIRPOP gathers information on demographic processes, population health and epidemiology, and healthcare utilization, in its well-defined cohort population. At its inception in 2008, the 2001 Census was used as the sampling frame to select the study population. By adopting a multi-stage sampling design, 12,557 households were sampled taking into account a 10% drop out and non-participation rate. More about the sampling procedure and the profile of HDSS-BIRPOP is available in the published HDSS profile [14].

The data used in the study was collected between July 2012 and March 2013, and are representative of the four administrative blocks selected. It covers 12,557 households comprising a total of 54,585 rural Indians. The dataset consists of information on socioeconomic characteristics, anthropometric measurements, blood pressure measurement, and blood biochemistry to compute a composite measure of MetS. Blood samples were collected from a sub-sample drawn from 36,176 adults (over ≥18 years), the final sample being 9886 (4810 male and 5076 female population). The primary reason for sub-sampling was a lack of resources needed to cover whole sample. The total sample had enough power to execute the analysis. The sample selection flow is shown in Fig. 1.

2.2. Defining metabolic syndrome (MetS)

The Metabolic Syndrome (MetS) definition used in this study follows the National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP III) criterion (for South Asians) [1,15] as it is probably more appropriate to the study population than the definition devised by the World Health Organization and others [16,17]. Table 1 presents the defining level of MetS, at least three of the following five – 1) person having high blood pressure (≥130/≥85 mmHg),or taking antihypertensive drugs; 2) individual diagnosed with elevated fasting blood glucose level (≥100 mg/dl) or on hypoglycaemic drug/insulin; 3) individual diagnosed with hypertriglyceridaemia (≥150 mg/dl) or under medication; 4) individual with low high density lipoprotein (HDL) – cholesterol (male, <40 mg/dl; female, <50 mg/dl) or undergoing drug therapy; and 5) if a person has abdominal obesity as measured by a waist circumference of ≥90 cm for male and ≥80 cm for female. Antihypertensives, hypolipidaemic drugs, and oral hypoglycaemic agents or insulin taken by study participants were confirmed by a qualified physician.

Blood pressure of each participant was measured using a digital sphygmomanometer (OMRON, Model – HEM-7111) after participants had been sitting quietly for at least 10 min. Three consecutive measurements were taken five minutes apart on the right arm, with the person in a sitting position, and the average of each measurement was used for data analysis. During the 30 min preceding the measurement, participants were required to refrain from smoking or consuming stimulants such as caffeine. Venous plasma glucose is the standard method for measuring and reporting glucose concentrations in blood. Study participants were asked to fast for at least 12 h before blood collection. Fasting blood samples were obtained by trained phlebotomists in K2-EDTA tubes (3.0 ml), fluoride tubes (2.0 ml) and serum tubes (7.0 ml). Within two hours of blood collection, serum was prepared, and plasma glucose was estimated by using the hexokinase/glucose-6-phosphate dehydrogenase method. Cholesterol, triglyceride, high-density lipoprotein (HDL), and low-density lipoprotein (LDL) levels were analyzed by commercial laboratory kits (Randox Laboratories Ltd., UK) using a standardized semi-auto analyzer (Robonik Prietest Touch AT 1190512, Robonik India Pvt Ltd, India). Abdominal obesity/waist circumference was measured over light clothing at a level midway between the lower rib margin and the iliac crest in centimeters rounded up to the nearest 0.5 cm.

The inclusion criterion included study participants (aged ≥18 years) who had no clinical evidence of major cardiovascular disorders, which was defined as having a history of myocardial infarction, angina pectoris, prior revascularization, heart failure, atrial fibrillation, stroke, or peripheral arterial disease and end organ damage at enrollment. Participants with Type I diabetes mellitus (T1DM) were meant to be excluded from the study, but no sign of T1DM among the participants was observed.

2.3. Covariates

Guided by existing literature on determinants of MetS, potential covariates were computed. Self-reported information on age in completed years (18–24, 25–34, 35–44, 45–59, and ≥60), religion (Hindu and Non-Hindu), social group (scheduled caste, scheduled tribe, other backward class, and others), marital status (currently married, unmarried, and deserted/separated/widow/widower), educational level (non-illiterate, primary, secondary, and higher secondary or higher), occupation (unemployed, agriculture related, non-agriculture related, unpaid household work, in-service/retired, and no fixed employment), wealth index (poorest, poorer, middle, richer, and richest), alcohol use (none, and current/former use), current tobacco use (none, smokers only, chewer only, and both smokers and chewer), and physical activity level (high, medium, and low)were used in the analysis. The information on body mass index (underweight: <18.5 kg/m^2, optimum weight: 18.5–22.9 kg/m^2, and overweight/obese: ≥23 kg/m^2) were computed using standard measurement and diagnosis procedures. A guided protocol for computation and definition of wealth index [18], body mass index (BMI) [19], and physical activity [20]were followed. Studies have highlighted that MetS varies with age, religion [10,11] social group [21], marital status [11,22] and employment type [23,24]. The propensity of MetS is reported to be high among rich people with high BMI, and who undertake low physical activity [3,10,25]. Some behavioral risk factors include alcohol and tobacco use [3,25]. Scheduled Castes and Scheduled Tribes are identified by the government of India as

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