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ABSTRACT

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ANTHROPOLOGICAL AND BIOCHEMICAL METABOLIC FACTORS IN THE NORMOGLYCEMIC, PRE-DIABETIC, AND DIABETIC METABOLIC POPULATION

Background: The term "metabolic syndrome" (MetS) describes a collection of risk factors with metabolic origins that increase the chance of developing type 2 diabetes and cardiovascular disease (CVD). Diabetes is becoming more prevalent in underdeveloped countries, which challenges already limited health expenditures.

Aim and Objective: To determine the burden of anthropometric and biochemical metabolic risk factors in normoglycemic, pre diabetics and diabetics metabolic population.

Material and Methods: Study conducted in Physiology Department at RUHS College of Medical Sciences and associated hospital, Jaipur, after receiving the Ethical Clearance. The study's sample size was 300. Parameters recorded for data collection: anthropometric (Body Mass Index, Waist Hip Ratio), Blood pressure, biochemical (Fasting blood glucose, HbA1C, Lipid profile parameters).

Result: 300 metabolic syndrome subjects were divided into three groups based on their Fasting Blood Glucose level and HbA1C level according to the American Diabetes Association for Diabetes Classification as normal [79 (26.33%)], pre-diabetic [85 (28.33%)], and diabetic [136 (45.33%)].There was significant difference of mean values of age, Waist Hip Ratio, Systolic Blood Pressure, Diastolic Blood Pressure, Fasting Blood Glucose, HbA1C, total cholesterol, High Density Lipoprotein, Low Density Lipoprotein and Triglyceride in three groups.

Conclusion: According to the findings of the current study, the metabolic population of pre-diabetics and diabetics has a greater prevalence of metabolic risk factors. The metabolic risk factors grows when fasting blood glucose and HbA1C levels rise. It can also

be said that these risk factors contribute to the onset of diabetes, which leads to metabolic syndrome.

Keywords: Diabetic, Fasting Blood Glucose, Metabolic syndrome, Pre-diabetic.

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INTRODUCTION / ВСТУП

The term "metabolic syndrome" (MetS) describes a collection of risk factors with metabolic origins that increase the chance of developing type 2 diabetes and cardiovascular disease (CVD). Diabetes is becoming more prevalent in underdeveloped countries, which challenges already limited health expenditures. About a billion individuals worldwide, or one-fourth of the adult population, are estimated to be affected by MetS [1]. Insulin resistance and MetS are quite common in India. According to studies, the age-adjusted prevalence of metabolic syndrome in urban Indian populations was estimated to be almost 25% [2]. In India and other South Asian nations, the incidence of obesity and metabolic syndrome is rapidly growing, which is increasing mortality and morbidity from cardiovascular disease and type 2 diabetes (T2DM) [3]. According to the Joint Interim Statement from 2009, a person was diagnosed with metabolic syndrome if they had 3 or more of the following cardiometabolic risk factors [4]:

I. Waist greater than 40 inches for men and 35 inches for women.
II. 150 mg/dl or more of elevated triglycerides are found in the blood.
III. Less than 40 mg/dl for males or less than 50 mg/dl for women indicates low levels of high-density lipoprotein cholesterol (HDL).
IV. Elevated fasting blood sugar of 100 mg/dl or more.
V. Blood pressure readings of 130 mmHg or more in the systolic and/or 85 mmHg or more in the diastolic.

Increased waist circumference, high triglycerides, low high-density lipoprotein, high blood pressure and high fasting blood glucose are risk factor of Met S and T2DM [5]. Since metabolic syndrome is a disease of lifestyle, understanding the variables that have recently changed trends in its incidence in this particular geographic area may be useful in understanding how to address the growing burden of T2DM and CVD in South Asians as a whole. An essential requirement is the early diagnosis of diabetes risk utilizing non-invasive measures. Thus, the current study's goal was to determine the burden of anthropometric and biochemical factors in normoglycemic, pre diabetics and diabetics in metabolic population.

Material and Methods

The current observational study was carried out at the RUHS College of Medical Sciences and affiliated hospital, Jaipur, at the Physiology Department. The study received ethical clearance from the RUHS College of Medical Sciences, Jaipur, institutional ethics committee. The study's estimated sample size was 282, with a margin of error of +/-10%, a sample percentage of 50%, and a confidence level of 95%. The study's sample size was 300, people owing to dropouts or non-responding participants [6]. After analysing the inclusion and exclusion criteria, all participants were recruited from the medicine OPD at the RDBP Jaipuria hospital, and a written informed consent taken from each participant.

According to the Joint Interim Statement from 2009, if an individual had three or more of the cardiometabolic risk factors listed below, they were considered to have metabolic syndrome [4]:

I. Waist greater than 40 inches for men and 35 inches for women.
II. 150 mg/dl or more of elevated triglycerides are found in the blood.
III. Less than 40 mg/dl for males or less than 50 mg/dl for women indicates low levels of high-density lipoprotein cholesterol (HDL).
IV. Elevated fasting blood sugar of 100 mg/dl or more.
V. Blood pressure readings of 130 mmHg or more in the systolic and/or 85 mmHg or more in the diastolic.

The weight (kg) and height (cm) were determined using calibrated weighing scales and stadiometers, respectively, in line with NHANES criteria [7]. BMI was calculated using the formula weight (kg)/height (m2).The respondents were asked to stand with their heels together and measure their

waist and hip circumferences using a linen measuring tape at the umbilicus and the maximum protrusion of the hip, respectively [7]. The Sphygmomanometer will be used to measure both SBP and DBP after 15 to 30 minutes of immobile sitting [8]. The biochemical data of all research participants were collected, including fasting blood glucose, total cholesterol, LDL, VLDL, triglyceride, and HDL cholesterol levels [9–11]. They were instructed to report for the biochemical tests after an overnight fast of 8 to 10 hours. According to the American Diabetes Association's Diabetes Classification for Asians [12], which defined normal blood sugar levels as falling between 70 and 100 mg/dl, pre-diabetes as falling between 100 and 125 mg/dl, and diabetes as exceeding 126 mg/dl, study participants were categorized into three categories.

Statistical analysis: The collected information was organised using Microsoft Excel. The mean ± SD were calculated using data that was normally distributed. ANOVA was performed to assess the level of statistical significance as a test of significance using the SPSS programme.

Results: 300 metabolic syndrome subjects were divided into three groups based on their Fasting Blood Glucose level and HbA1C level according to the American Diabetes Association for Diabetes Classification as normal [79 (26.33%)], pre-diabetic [85 (28.33%)], and diabetic [136 (45.33%)].

Table 1 – Distribution of Anthropometric and Biochemical Parameters in different groups

	Normal (N = 79)	**Pre-diabetic (N = 85)**	**Diabetic (N = 136)**	**F- value**	**P- value**
	Mean ± SD	**Mean ± SD**	**Mean ± SD**		
Age	37.16 ± 11.43	42.55 ± 10.98	46.51 ± 10.49	18.515	.000
Weight	75.01 ± 10.22	71.89 ± 11.13	74.04 ± 13.36	1.496	.226
Height	1.64 ± 0.08	1.61 ± 0.1	1.62 ± 0.09	2.339	.165
BMI	28.13 ± 4.06	27.84 ± 4.12	28.44 ± 5.03	0.465	.626
Waist	39.73 ± 3.75	41.34 ± 10.09	44.34 ± 17.36	0.465	.033
Hip	40.41 ± 3.87	41.38 ± 11.04	44.49 ± 17.98	2.670	.071
WHR	0.98 ± 0.06	1 ± 0.06	1 ± 0.06	3.233	.041
SBP	137.47 ± 17.57	139.58 ± 18.59	145 ± 20.78	4.349	.014
DBP	88.23 ± 9.89	87.98 ± 9.87	92.24 ± 10.87	5.968	.003
FBG	87.4 ± 8.04	111.48 ± 7.06	172.92 ± 10.82	2,493.604	.000
HbA1C	5.03 ± 0.34	6.23 ± 0.11	9.46 ± 0.97	1,232.036	.000
Total Cholesterol	192.76 ± 38.48	196.42 ± 36.54	211.93 ± 42.06	7.236	.001
HDL	41.92 ± 12.75	39.97 ± 13.11	36.84 ± 10.36	4.950	.008
LDL	116.82 ± 32.25	123.83 ± 33.74	135.47 ± 32.24	8.794	.000
VLDL	34.73 ± 16.29	37.39 ± 14.95	40.46 ± 16.4	3.326	.037
TG	170.11 ± 62.91	163.11 ± 34.51	198.08 ± 49.93	15.190	.000

BMI: Body Mass Index; WHR: Waist Hip Ratio; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; FBG: Fasting Blood Glucose; HbA1C: Glycated Haemoglobin; HDL: High Density Lipoprotein; LDL: Low Density Lipoprotein; VLDL: Very Low-Density Lipoprotein; TG: Triglyceride. (Significant, $p < 0.05$)

Table 1 depicts distribution of anthropometric and biochemical parameters in different groups divided based on glycaemic index.

There was significant difference of mean values of age, WHR, SBP, DBP, FBG, HbA1C, total cholesterol, HDL, LDL and TG in three groups. But there was no significant difference seen in BMI of three groups. There was hypertriglyceridemia and low HDL level in pre-diabetic and diabetic subjects.

Discussion

We grouped the metabolic population into three groups according to their fasting blood glucose level and HbA1C level given by American Diabetes Association for Diabetes Classification [12]: as normal [79 (26.33%)], pre-diabetic [85 (28.33%)], and diabetic [136 (45.33%)]. Our study shows high prevalence of Pre-diabetic and diabetic in metabolic syndrome population. Studies from India have reported a prevalence of diabetes to be 13% to 16% and prevalence of pre-diabetes to be between 2–29%, in general population [13, 14]. As far as we are aware, there is no study that compares our population with metabolic syndrome from this perspective. According to the acceptable body mass index given by the WHO for Asian populations, the mean BMI of our study participants revealed that each of them fall into the obese category. When compared to the WHO's recommended body mass index for Asian people, all of the participants were obese. A WHO consultation also showed that a significant portion of Asian individuals had BMIs below the current WHO criteria for overweight (≥ 25 kg/m2) and were at a high risk of type 2 diabetes and cardiovascular disease [15]. According to a study, obesity and being overweight have had a significant role in the rise in diabetes prevalence in India [16]. In our study, prediabetic and diabetic participants had higher waist-hip ratios than normoglycemic subjects. This was more than the standards recommended for Asians (0.95 in men and 0.80 in women) [17]. T2DM and intra-abdominal fat have been linked [18]. Insulin resistance is associated to both type 2 diabetes and obesity. The most significant contributor to the development of metabolic disorders is thought to be obesity. Leptin, cytokines, adiponectin, proinflammatory chemicals, and glycerol are among the additional compounds secreted by adipose tissue that have an impact on metabolism. It also releases NEFAs. These chemicals will secrete more readily in obese people [19]. All study participants had hypertension, and we identified differences that were statistically significant. Pre-diabetic and diabetic patients had higher blood pressure than normal. This suggests that blood pressure increases are a result of hyperglycemia. Both macrovascular (large arteries, such as conduit vessels) and microvascular (small arteries and capillaries) disorders are associated with hyperglycemia. Chronic hyperglycemia and insulin resistance contribute to the development of vascular complications of diabetes through a number of mechanisms, including (1) increased formation of advanced glycation end products (AGEs) and activation of the receptor for advanced glycation end products (RAGE) AGE-RAGE axis, (2) oxidative stress, and (3) inflammation [20]. Contrarily, mounting data show that abnormalities in glucose metabolism are more prominent in hypertensive people, showing that the pathogenic relation between diabetes mellitus and hypertension is truly mutual [21,22]. In our study, we observed low HDL and elevated TG, LDL, VLDL, total cholesterol levels. The population in the current study who were pre-diabetic and diabetic had higher levels of dyslipidemia than normal [23]. Although lipid abnormalities are prevalent in those with T2DM and prediabetes, ethnic groups may differ in the distribution of the various lipids [24]. Atherosclerosis-related inflammation is exacerbated and made more widespread when dyslipidemia and elevated blood glucose levels are present [25]. As fasting blood glucose levels increased, more participants had undesirable lipid profiles.

CONCLUSIONS / ВИСНОВКИ

According to the findings of the current study, the metabolic population of pre-diabetics and diabetics has a greater prevalence of metabolic risk factors. As fasting blood glucose and HbA1C levels rise, so does the cluster of risk factors for metabolic syndrome. If we change our lifestyle to reduce or remove these risk factors, we may be able to avoid or reduce the probability of having metabolic syndrome.

PROSPECTS FOR FUTURE RESEARCH / ПЕРСПЕКТИВИ ПОДАЛЬШИХ ДОСЛІДЖЕНЬ

Further research may be conducted by assessing the relationship between various parameters and the metabolic population in a large population. We may also assess the impact of lifestyle modification intervention on individuals with metabolic syndrome.

Strength: According to our knowledge, this is the first research to assess metabolic risk variables between pre-diabetics and diabetics with metabolic syndrome.

Limitation: The present study's cross-sectional design makes it impossible to establish causality, which is one of its limitations. However, this kind of research may very well reveal significant associations that may be further explored in subsequent studies. Therefore, the results of this study will benefit in establishing a baseline for further research in Asian Indian communities to investigate connections between lipid abnormalities and the risk of DM or CVD.

CONFLICT OF INTEREST / КОНФЛІКТ ІНТЕРЕСІВ

The authors declare no conflict of interest.

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AUTHOR CONTRIBUTIONS / ВКЛАД АВТОРІВ

JS - concept, design and data collection of the study along with interpretation of results, review of manuscript.

SK - review of literature and manuscript preparation, interpretation of results.

NS - statistical analysis and interpretation of results, review of manuscript, manuscript preparation, correspondence with journal.

MK - review of literature, data collection and review manuscript.

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