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Original Research Article

An associative study determines the role of Physiological parameters with gender difference on the development of metabolic syndrome and severe metabolic syndrome

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Abstract

Objective & Background: High incidence of diabetes and cardiovascular risk was due to urbanization in India. In South Asia, Indians were at high risk for T2 DM, CVD, and MS. So compared certain physiological parameters in metabolic syndrome and severe metabolic syndrome of male and female.

Materials and methods: A total 211 men and 239 women participants aged ≥35 years were included in this study. The comparative study of mean and SE done by ANOVA and with the Student-Newman-Keul's multiple comparison methods.

Results: The parameters like BMI, WC, SBP, DBP found significantly high in MS, and SMS in males and females compared with controls. The PR was found high significant between groups control vs. MS and SMS groups in male, and control vs. MS in females, but insignificant in Control vs. SMS in females. Further, the physiological factors WC, SBP, DBP was high significance in group MS vs SMS in male and female, also the BMI, and PR in males, but these two variables were insignificant in females.

Conclusion & Interpretation: It was observed that the physiological variables showed a significant difference with MS, and SMS in the male and female, except PR in SMS female. And all these parameters showed significance in intergroup analysis of MS and SMS in male and female groups, except BMI and PR in females.

Keywords: Gender, Waist circumference, Body mass Index, Hypertension, Metabolic Syndrome.

Introduction

Metabolic syndrome (MS) is a collection of risk factors, including high blood glucose, low HDL cholesterol, elevated triglycerides, obesity, and hypertension, that increases the likelihood of developing cardiovascular diseases (CVD), diabetes, and related complications. [1, 2, 3] The global prevalence of MS affects roughly 25% of people, with higher rates in adults. Men and women aged 40–59 years are three times more likely to have MS than those aged 20–39 years, with individuals over 60 showing an even greater risk.

India has a high prevalence of MS and type 2 diabetes, with urbanization further driving these conditions. Studies show hypertension, abdominal obesity, and insulin resistance (IR) are pivotal in MS development. [1] Gender differences significantly impact the distribution of these risk factors, with men more likely to have elevated blood pressure and abdominal obesity, while women frequently exhibit low HDL and increased risk post-menopause. [2]

Effective management of MS involves lifestyle interventions, including dietary changes, physical activity, and stress reduction practices like yoga, which have shown benefits in blood pressure and obesity control. [4, 5] The study's objective is to investigate how physiological parameters, specifically waist circumference, body mass index (BMI), hypertension, and pulse rate, vary by gender and contribute to the development of MS and its severe forms. This research hypothesizes significant differences between males and females in MS and severe MS presentations across these selected physiological factors, potentially supporting gender-specific prevention and intervention strategies.

Materials and Methods

It was an observational and analytical study, conducted in Katuri Medical College, Guntur. The

Institutional Ethics Committee approved the study protocol. All the participating individuals in the study submitted written informed consent.

The data collected from the participants after giving a detailed explanation about the procedure of the study and their cooperation and willingness were obtained with written informed consent. Weight was measured in kilograms and height in meters of the participant to estimate body mass index (BMI; kg/m^2). BMI was calculated by dividing the weight in kilograms and height in meter square. BMI $\geq$ 23 kg/m^2 were obese and between $\geq$21-23 kg/m^2 were overweight according to the revised guidelines of WHO. [6] Waist circumference (WC) was measured by using a measuring tape with measurements made halfway between the lower border of the ribs and the iliac crest in a horizontal plane. [7] Instructed the individual to be in standing posture and asked to take a deep breath, then exhale and noted WC. Blood pressure has been measured by using a mercury sphygmomanometer (Diamond, Mumbai, India) with the participants in a sitting position. After 5 minutes of rest in sitting posture, systolic and diastolic blood pressure was measured on arms. On that visit, blood was collected from the individuals who were under fasting.

Statistical Analysis

The comparative study of mean and standard error done by one-way analysis of variance (ANOVA) and with the Student-Newman-Keul's multiple comparisons methods. Statistical analysis and graph plotting carried out, using Sigma Plot 13.0 (Systat Software, USA). Statistical significance was considered if the p-value less than 0.05.

Results

In this study, physiological parameters such as BMI, waist circumference (WC), systolic blood pressure (SBP), diastolic blood pressure (DBP), and pulse rate (PR) were compared among control, MS, and severe metabolic syndrome (SMS) groups by gender. BMI was significantly higher in MS and SMS groups compared to controls for both males and females, with a more pronounced increase in females. WC was also significantly elevated across groups in both genders ($P<0.001$). Among hemodynamic variables, SBP and DBP were significantly higher in MS and SMS groups than controls, especially between groups I and III in both genders. PR was higher in MS and SMS groups compared to controls in both males and females, though some comparisons (e.g., group II vs. III in females) were not significant. These findings underscore gender differences in the association between these parameters and MS severity.

Table 1: Comparison of body mass index (BMI), waist circumference (WC), systolic blood pressure (SBP), diastolic blood pressure (DBP) and pulse rate (PR) of males and females in Control, MS and SMS.

Variable	Gender	Control Group I	MS Group II	SMS Group III	Statistical information
BMI (Kg/m^2)	Male	24.4 ± 0.3	27.3 ± 0.4	28.5 ± 0.3	p = <0.001
	Female	24.3 ± 0.2	30.1 ± 0.5	30.6 ± 0.6	p = <0.001
WC (cm)	Male	85.9 ± 0.7	93.5 ± 0.5	99.6 ± 0.7	p = <0.001
	Female	81.4 ± 0.7	87.1 ± 1.0	96.4 ± 0.5	p = <0.001
SBP (mmHg)	Male	125.0 ± 1.6	133.1 ± 1.4	147.0 ± 1.5	p = <0.001
	Female	120.3 ± 1.3	142.8 ± 2.1	146.4 ± 2.0	p = <0.001
DBP (mmHg)	Male	79.6 ± 0.8	83.0 ± 0.9	85.4 ± 0.7	p = <0.001
	Female	76.8 ± 0.8	82.8 ± 1.0	87.4 ± 1.2	p = <0.001
PR (beats/min)	Male	72.4 ± 1.0	76.4 ± 0.9	80.4 ± 1.8	p = <0.001
	Female	76.3 ± 0.9	80.1 ± 1.1	78.2 ± 0.7	p = 0.012

Values expressed as mean ± SE. (Male control n= 72, MS n= 75 and SMS n= 64;
Female control n= 78, MS= 75 and SMS = 86 respectively)

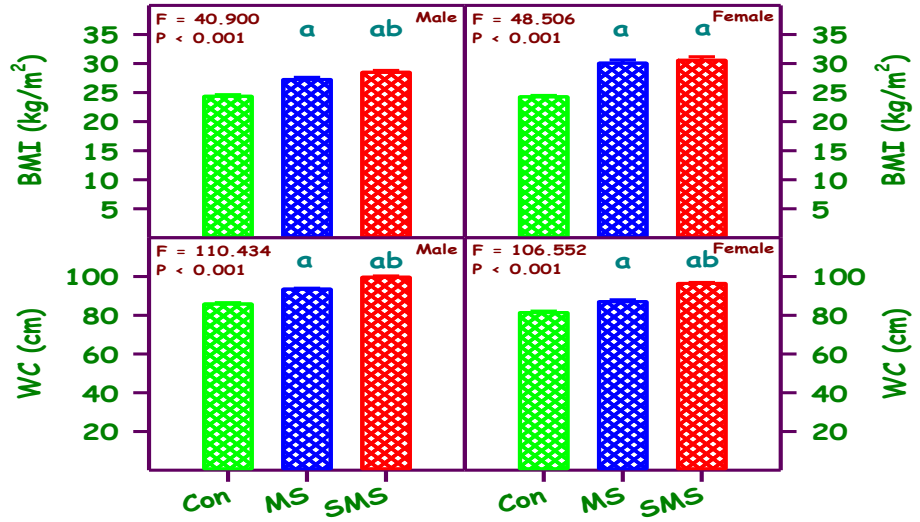

Figure 1: The levels of body mass index (BMI) and waist circumference (WC) in control (Con), metabolic syndrome (MS) and severe metabolic syndrome (SMS) of males and females.
Values are mean ± SE
n – male – Con = 72; MS = 75; SMS = 64
n – female – Con = 78; MS = 75; SMS = 86
The 'F' and 'P' values are by one-way ANOVA with Student Newman Keul's multiple comparison test.
[a] Significantly different from control group
[b] Significantly different from MS group

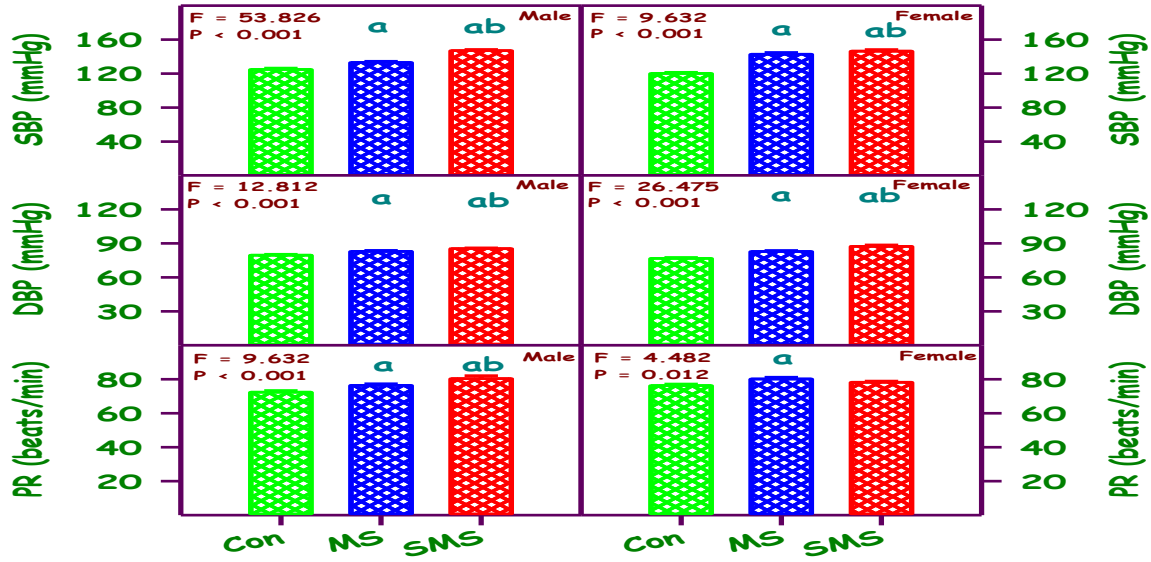

Figure 2: The levels of systolic blood pressure (SBP), diastolic blood pressure (DBP) and pulse rate (PR) in control (Con), metabolic syndrome (MS) and severe metabolic syndrome (SMS) of males and females.
Values are mean ± SE
n – male – Con = 72; MS = 75; SMS = 64
n – female – Con = 78; MS = 75; SMS = 86
The 'F' and 'P' values are by one-way ANOVA with Student Newman Keul's multiple comparison test.
[a] Significantly different from control group
[b] Significantly different from MS group

Discussion

In the present study, the mean BMI showed significant difference between MS and SMS in both genders. The same result assessed on MS components including BMI, WC, SBP, and DBP, and the progression of coronary calcium and CAD studied by Kim et al. [8, **25**] When the number of MS components included a raise in the consequences of CAD and the progression of coronary artery calcium score (CACS). The MS individuals with the evolution of CACS increased gradually, from 31% to 66% respectively in participants without and with all five MS components. [8] The BMI of adolescents with MS was 30.1%, on average for BMI by age and sex. The Adolescents who had MS were 25.2% at risk by overweight, and 73.9% by obese. [9] The present study found the high significance of BMI in the severity of MS in males and females.

In the present study, the results of the WC showed a significant difference in both gender with MS and severe MS (Table1 and Figure 1) which supported by the following: Mexican Americans had a higher rate 13% of visceral obesity and high share in raised BP was 6.2% than black adolescents. [9] Intraabdominal fat as an independent risk factor for MI. [10] And increased WC was high mortality in MS people. [11] The association of MS with thyroid dysfunction denoted the increased WC caused the high incidence of thyroid disease when compared to other components in women. [12] This study also found a significant difference in thyroid disorder with MS only in women, also observed WC with MS and SMS in men and women.

The studies reported that both anthropometric parameters like BMI and WC increased significantly in MS and it was the result of the present study. [13] BMI and WC are the most common methods to measure obesity. Abdominal obesity was considered a health disaster in developed and developing countries. [14] Thus, this study indicates that obesity may be one of the high incidences of MS. Similar study reported in urban north India that BMI and WC had a high significance in both genders. [15]

In the present study SBP, DBP and PR showed significant difference in MS and severe MS in gender (Table: 1 and Figure: 2). So systolic BP and diastolic BP showed a significant difference in all three groups of males and females. The high blood pressure was due to obesity, IR, and stress. Similar studies showed that both SBP and DBP significantly differed with MS. [12] Increased systolic BP, when associated with MS, leads to CVD. [16] Similar this study hypertension was a significant difference with MS and SMS in men and women. By early detection of this fact, CVD was prevented by various studies. [17] An Asian study on MS was very similar which supports this study that the severity of MS increases in proportion to SBP, DBP, and PR with gender difference.

Conclusion

It was observed that the physiological variables BMI, WC, SBP, DBP, and PR showed a significant difference with the controls vs MS, SMS in the male and female, except PR in SMS female. Further, this study found that between MS and SMS with BMI, WC, SBP, DBP, and PR had a significant difference in the male, and female except insignificant with the BMI, and PR. Future studies would include the association study of age & physiological parameters such as BMI, WC, SBP, DBP, & PR in Mets and severe Mets.

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References

1. Tehrani FR, Tohidi M, Dovom MR, Azizi F. A population-based study on the association of thyroid status with components of the metabolic syndrome. J Diabetes Metab. 2011; 2:156-62.
2. IDF, 2017, J of Diabetes 2018 10: 353–56 doi: 10.1111/1753-0407.12644
3. Devaraj S, Singh U and Jialal I. Human C-reactive protein and the metabolic syndrome. Curr Opin Lipidol. 2009 Jun; 20(3): 182–89.
4. Pitsavos C, Panagiotakos D, Weinem M, Stefanadis C. Diet, exercise and the metabolic syndrome. Rev Diabet Stud. 2006;3: 118-26.
5. Fappa E, Yannakoulia M, Pitsavos C, Skoumas I, Valourdou S and Stefanadis C. Lifestyle intervention in the management of metabolic syndrome: could we improve adherence issues? Nutrition. 2008;24: 286-91.
6. Onis M, Garza C, Victora CG, Onyango A, Frongillo EA, and Martines J. The WHO Multi-center Growth Reference Study: Planning, Study Design, and Methodology. Food and Nutrition Bulletin, 2004 vol. 25, no. 1 (supplement 1). Western Pacific region and WHO Expert Consultation, 2004.
7. World Health Organization. Waist Circumference and Waist-Hip Ratio Report of a WHO Expert Consultation. WHO-2008: p1-39.
8. Kim LK, Yoon JW, Lee DH, Kim KM, Choi SH, Park KS, et al. Impact of metabolic syndrome on the progression of coronary calcium

and of coronary artery disease assessed by repeated cardiac computed tomography scan. Cardiovasc Diabetol 2016;15: 92.
9. Cook S, Weitzman M, Auinger P, Nguyen M, Dietz WH. Prevalence of a MS Phenotype in adolescents: findings from the third National Health and Nutrition Examination Survey, 1988–1994. Arch Pediatr Adolesc Med. 2003; 157: 821–27.
10. Nicklas BJ, Ambrosius W, Messier SP, Miller GD, Penninx BWJH, Loeser RF et al. Diet-induced weight loss, exercise, and chronic inflammation in older, obese adults. Am J Clin Nutr 2016;79: 544–51.
11. Visscher TLS, Seidell JC, Molarius A, Kuip DV, Hofman A and Witteman JCM. A comparison of body mass index, waist – hip ratio and waist circumference as predictors of all-cause mortality among the elderly: the Rotterdam study. Int J of Obesity. 2001;25: 1730–35.
12. Sudhakar MK, Agarwal G, Mohini singh, Senthil N, Rajendran A. The prevalence of thyroid dysfunction among South Indian women with Metabolic Syndrome. Journal of Clinical and Diagnostic Research. 2011 Apr;5(2): 213-16.
13. Ying X, Jiang Y, Qin G, Qian Y, Shen X, Jiang Z, et al. Association of body mass index, waist circumference, and metabolic syndrome with serum cystatin C in a Chinese population. Medicine. 2017;96(10): e6289.
14. Goblan AS, Alfi MA, and Khan MZ. Mechanism linking diabetes mellitus and obesity. Diabetes Metab Syndr Obes. 2014;7: 587–91
15. Mahajan A, Tabassum R, Chavali S, Dwivedi OP, Bharadwaj M, Tandon N, et al. High-Sensitivity C-Reactive protein Levels and Type 2 Diabetes in Urban North Indians. J Clin Endocrinol Metab. 2009;94: 2123-27.
16. Kannel WB. Elevated systolic blood pressure as a cardiovascular risk factor. Am Cardiol 2000: 251-55.
17. Thaman RG, and Arora GP. Metabolic Syndrome: Definition and Pathophysiology – the discussion goes on! J Phys Pharm Adv. 2013;3(3): 48-56