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High Prevalence of Metabolic Syndrome in Kashmiri (India) Adult Population: Time to Intervene

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ABSTRACT

Objectives: The prevalence of Metabolic Syndrome (Met S) is increasing swiftly among the developing nations. This observational study aims at evaluating prevalence of Met S and the relative contribution of its components in the Kashmiri adult population. **Method**s: In this study, 400 participants including 204 males and 196 females were taken. All the participants were estimated for various anthropometric and biochemical parameters. The prevalence of Met S was evaluated using the IDF criteria. SPSS software was used for statistical analysis. **Results:** Overall, 145/400 patients(36.3%) exhibited Met S, including 42/204 (20.6%) men and 103/196 (52.6%) women. The most prominent components of Met S in women were high blood pressure (43.4%) (85/196) and increased waist circumference (86.2%) (169/196), while among men the major components were increased triglycerides (51.0%) (104/204) and high blood pressure (52.9%) (108/204).Conclusion: Met S was more widespread in females than males. The high prevalence in women was mostly due to their increased WC whereas, determinants like high BP and high triglycerides levels were mostly seen to be present among men. Therefore, estimation of parameters like WC, triglycerides and BP levels can be applied preferentially for assessing the risk of CVD &type II diabetes mellitus among Kashmiri adult population.

Keywords

Cardiovascular disease; Dyslipidemia; Metabolic Syndrome; Obesity

Introduction

Metabolic Syndrome (Met S) also known as Syndrome X, The Deadly Quartet or Dysmetabolic Syndrome is a great public health concern worldwide [1,2]. Met S is defined as the clustering of various abnormalities like obesity, hypertension, insulin resistance, dyslipidemia which may generally result into various chronic disease developments, for example, type 2 diabetes as well as cardio vascular defects [3,4]. In addition, the Met S is strongly linked with a large number of clinical conditions like non- cholesterol gall stones, polycystic ovarian syndrome, obstructive sleep apnoea, alcoholic fatty liver disease, hyperuricemia and psoriasis. The exact association between Met S and most of these pathological conditions is still an area of ongoing research[5]. Principally Met S is a seed that can develop into numerous chronic diseases resulting in an enormous economic burden to society. The aetiology of Met S is complex and is determined by both genetic and environmental factors. Various reports suggest that the insulin resistance is the main link between the various derangements present in Met S and the abnormal abdominal obesity [6,7]. The insulin resistance linked abdominal obesity is mainly caused due to intake of poor diet and lack of physical activity. The Met S people generally hold the probability of developing CVD and diabetes within the short time of period which will be based on the number of elements of the syndrome present. Met S has been associated with 5-fold risks of developing diabetes and 2-fold risk of developing CVD over a period of 5-years to a decade [8]. Based on the region, age, and ethnicity, the prevalence of Met S in worldwide ranges from <10% to 84% [9]. Its prevalence is also hugely affected by the difference in gender [10,11]. It has been reported that the prevalence of Met S is almost 1.5 to 2 times more in females than in males

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[12,13]. Also, Met S is prevalent in 12-26% of the European population and 12-37% of Asian population [14]. The prevalence of Met S in India has been reported to be in the range of 11% to 41%, reflecting numerous socio-cultural varieties [15]. India is considered to be the major contributor to worldwide cardiovascular mortality [16,17]and there is increasing pattern in the prevalence of components of Met S[18,19,20]. It is really difficult to measure a similar worldwide data on Met S, but since it is believed that Met S is almost three-folds more common than the diabetes, so we can estimate the worldwide prevalence to be about one fourth of the world population [21].To be more specific, more than a billion people in the world are now affected with this syndrome [22].Currently the causes, prevention and management of metabolic syndrome are important aspects of many research activities. There are various definitions of metabolic syndrome given by different institutions and organizations, like WHO in 1999 [23], National Cholesterol Education Program Adult Treatment Panel (NCEP ATP III) in 2002 [24], but the one proposed by International Diabetes Federation (IDF) in 2005 is the most widely used [25]. The IDF criteria considers the central obesity as the major essential component for the presence of Met S. Met S is a considered as a lifestyle disease. In Kashmir, like other developing parts of the world the changing lifestyle (lack of exercise, poor diet) and work pressure has put tremendous amount of metabolic stress on population – be it men or women. Increasing incidences of CVD and Type II diabetes mellitus call for immediate need of strategizing the health and intervention programmes at large scale in order to curb these chronic diseases at the early stage. There is no clear therapy for metabolic syndrome. Patients are treated as per the risk factors they have. There is no therapeutic regimen that specifically targets the underlying insulin resistance in Met S. Measures like regular physical exercise; diet modification and weight reduction have been advocated to improve insulin resistance. Notwithstanding current disputes in diagnosis and definition, Met S is still known to be a valuable diagnostic technique in the prevention of primary care. Many physicians find the idea of Met S helpful because it fits the profile of many primary care practitioners in contemporary practise. It offers an incentive for early patient detection and education about the proper health lifestyle improvements inherent in the progression of cardiovascular disease. Patients should be informed early on about the relationship between their health hazards, lifestyle and medical consequences. Due to unavailability and dearth of data regarding various factors contributing to the metabolic syndrome and its associated diseases in Kashmir, there is an obstruction to the development of policies for preventing and treating the syndrome at the earliest. Keeping this in view, we have performed an observational study to find out the prevalence of Met S and the relative contribution of its components in our part of the world.

Materials and Methods

Study type, study setting and study duration

The observational study was approved by the Institutional Board of Research Studies (BORS). The participants were included randomly from various medical camps held in different parts of Kashmir including the university campus (from August 2014- 2019 March), wherein people were screened for various metabolic disorders. This study was carried out at the Department of Clinical Biochemistry, University of Kashmir, Srinagar, J&K, and India. The study consisted of a total of 400 participants, which included 196 Kashmiri women and 204 Kashmiri men. All the participants involved in this study signed the voluntary consent agreement.

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Anthropometric analysis

The baseline data and anthropometry was collected through a proper structured questionnaire. Weight has been measured in kilograms. The measurement of the waist circumference at the point was halfway between the iliac crest in a horizontal plane and lower ribs border which has been undertaken with the help of a measuring tape in minimal light clothing. Blood pressure was measured in sitting position after the subject was comfortable using properly sized cuff. When the peculiar systolic blood pressure was at a standing measurement rate of almost ≥135 mm Hg along with diastolic blood pressure was ≥ 85 mm Hg diagnosis has been made for Hypertension. Through mercury manometer, the diastolic & systolic blood pressures have been calculated. Information about the medication used by the participants was collected through the proper questionnaire. People reported of taking anti-diabetic, anti-hypertensive and anti-dyslipidemia were considered to have increased fasting glucose levels, elevated blood pressure, raised triglycerides or lower HDL levels respectively.

Biochemical analysis

From all the participants involved in the study, the fasting blood samples were collected and were further centrifugated at 3000 rpm for 10 minutes for the separation of the serum. The analysis was done within 24 hours. The various biochemical parameters like the serum levels of triglycerides, fasting blood glucose and concentrations of HDL- cholesterol have been estimated using an ERBA semi-automatic analyser with the commercially available enzymatic reagents (ERBA diagnostics Manheim Gmbh).

Criterion used for determining Met S

The Prevalence of Met S was determined according to the IDF criterion. Briefly, the women participants with the waist circumference of ≥80 cm and men catering waist circumference of ≥94 cm along with any two below mentioned risk factors were considered positive for Met S.

- Elevated triglyceride levels (>150mg/dl) or particular treatment for lipid abnormality;
- lowered HDL which in females is less than 50 mg/dl & in males is <40 mg/dl; or the specific treatment for the same;
- increased blood pressure (which includes diastolic Blood Pressure >85mmHg & systolic Blood Pressure > 130mmHg) or treatment for hypertension;
- Previously diagnosed Type 2 Diabetes or increased FBG (>100mg/dl).

Statistical analysis

The results or the outcome of this study have been calculated in terms of mean ±SD and percentages. In order to investigate and analyse the data, the statistical analysis has been conducted with the help of SPSS software. The independent t- tests were carried out and at a p-value of less than 0.05 were considered statistically significant. Also, a logistic regression analysis was carried out in order to determine association of various variables with Met S in terms of odds ratio. Two tailed p-values of <0.05 were considered significant, along with the 95% confidence intervals.

Results

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Prevalence of Met S

As per the analysis, 145 were reported to have Met S, total prevalence of the Met S in the above subject population is 36.3%. Out of which, males were 204 in number and females were 196 in number. In males 20.6% were identified to be having Mets S and in females 52.6% were identified as having Met S as is shown in Figure1 and Figure2. Thus, indicating the increased prevalence of Met S in Kashmiri adult women as compared to Kashmiri adult men.

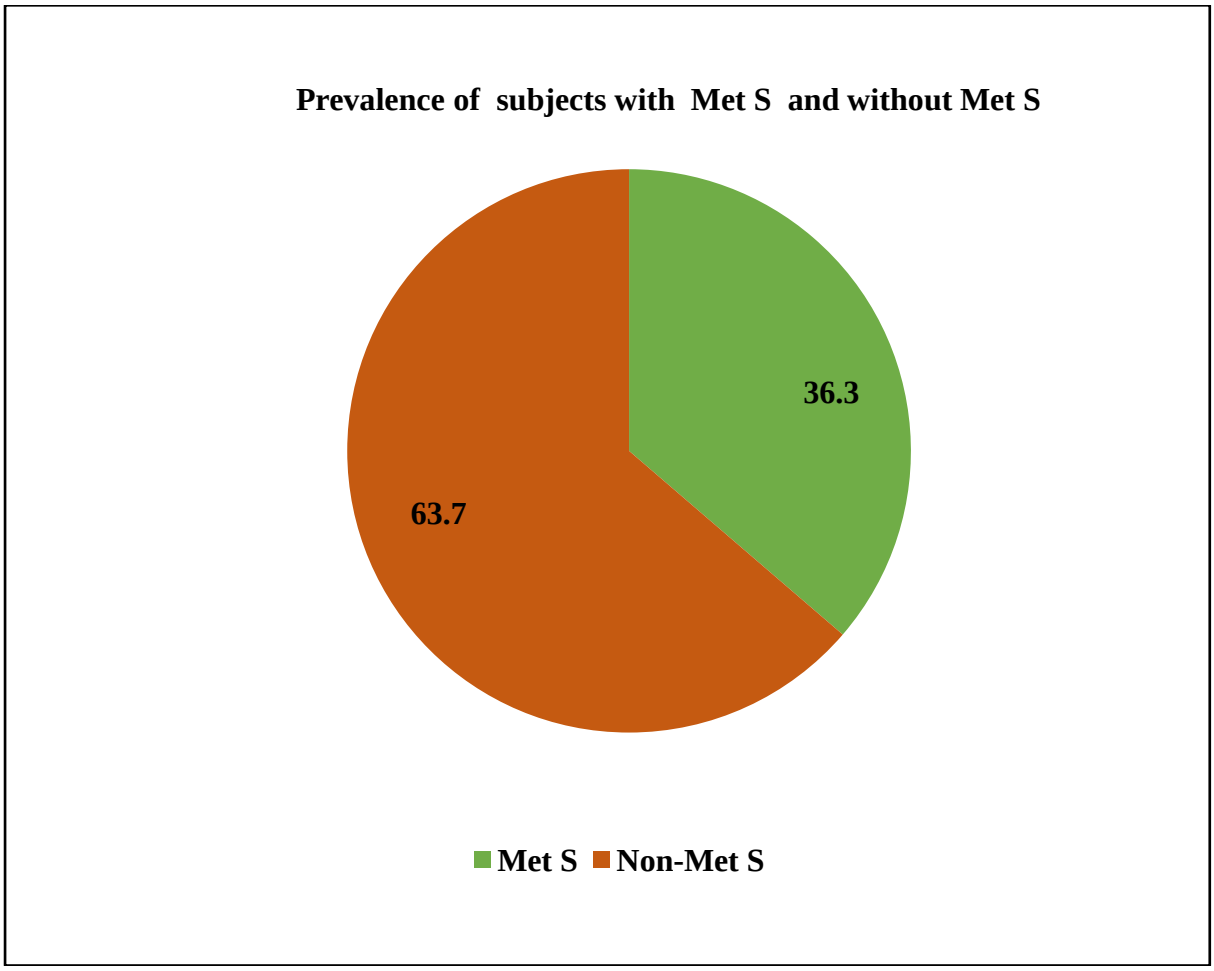

Figure 1. Showing prevalence of Metabolic Syndrome in overall samples/subjects

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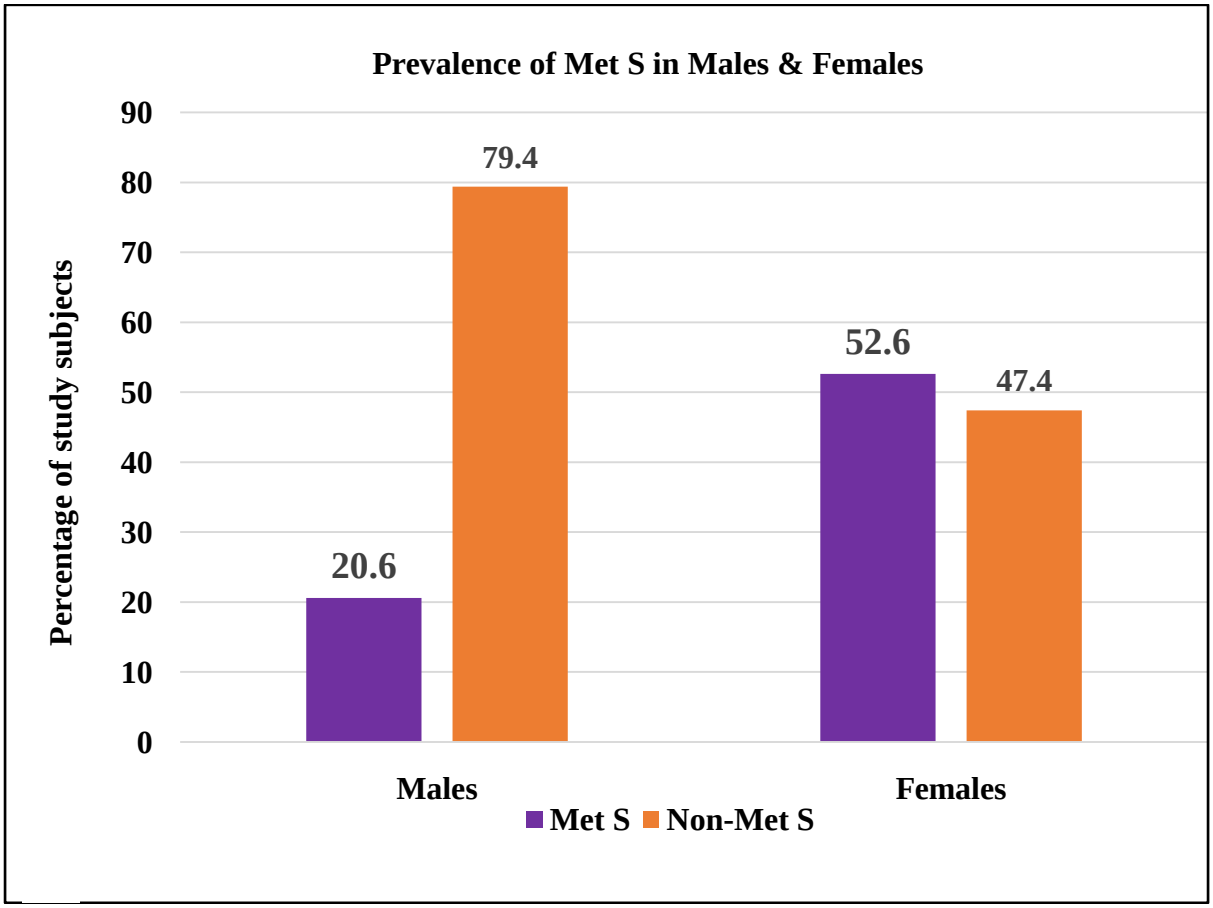

Figure 2. Prevalence of Metabolic Syndrome in Male and Female Participants (%)

Prevalence of various components of Met S in men and women

The entire participants were further analysed for presence of different components of Met S, and it was found that in men raised blood pressure was the most common component (52.9%) followed by high triglyceride levels (51.0%), abnormal waist circumference (31.9%), high fasting glucose levels (30.9%), and low HDL (8.3%). And among women, it was seen that the abnormal waist circumference (86.2%) was the most common component followed by high Blood pressure (43.4%), low HDL (40.3%), increased triglycerides (39.3%), and increased fasting glucose level (29.1%) as evident from the Table1. In relation with other Met S, high levels of triglyceride (51.0%) and high blood pressure (52.9%) were considered to be the most common characteristics in Kashmiri adult men. However, it can also be stated that an increased waist circumference (86.2%) and high Blood pressure level (43.4%), low HDL levels (40.3%) and were found to be the most common characteristics in relation with the different metabolic components among Kashmiri adult women.

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Table 1: Prevalence of Met S and its components in Kashmiri adult men (n=204)as well as women (n=196)

Parameters	N (men)	%	N (women)	%
Met S	42	20.6	103	52.6
FBG> 100 or RX	63	30.9	57	29.1
HDL< 40 mg/dl or Rx	17	8.3	79	40.3
TG> 150 mg/dl or Rx	104	51.0	77	39.3
WC ≥ 94 cm	65	31.9	169	86.2
SBP> 130 mmHg or DBP> 85 mmHg	108	52.9	85	43.4

Note: WC= Waist Circumference, SBP= Systolic Blood Pressure, DBP= Diastolic Blood Pressure, FBS=Fasting Blood Glucose, TG= Triglycerides, HDL= High Density Lipoprotein.

Baseline data of the subjects

Comparison of anthropometric and biochemical characteristics of both males and females are shown in Table2 and Table3 respectively. The men with Met S showed significant differences in all of the biochemical and anthropometric parameters compared to the men without Met S. Men with Met S had significantly higher anthropometric parameters like weight (73.9±8.97versus 67.8±11.07; p= <0.05), waist circumference (98.6± 5.88versus 83.6±9.49; p= <0.05) compared to men without Met S. Metabolic parameters were also significantly higher in men with Met S in comparison to men without Met S like triglycerides (203.0± 67.72versus 151.9±51.76; p= <0.05), FBG (102.9±19.94 versus 93.2±18.81; p= <0.05), HDL (50.9±5.87versus 51.3±5.80; p= <0.05), SBP (135.9±9.89 versus 130.9±14.93; p= <0.05), DBP (87.9±5.84versus 83.6±8.42; p= <0.05).

Table 2. Baseline data of Kashmiri adult men

Parameters	Total no. of men	No. of men with Met S	No. of men without Met S	p-value
Men n (%)	204 (100)	42 (20.6)	162 (79.4)	
Age (years)	45.23±12.64	45.2±10.50	45.2±13.16	0.97
Height (cm)	162.52±9.48	169.7± 6.26	167.3±7.43	0.036

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Received 05 March 2021; Accepted 01 April 2021.

Weight (kg)	63.7± 10.28	73.9±8.97	67.8±11.07	0.001
WC (cm)	90.7±10.59	98.6±5.88	83.6±9.49	0.001
SBP (mmHg)	127.9±13.94	135.9±9.89	130.9±14.93	0.01
DBP (mmHg)	81.7± 8.18	87.9±5.84	83.6±8.42	0.001
FBS (mg/dl)	96.57±21.17	102.9±19.94	93.2±18.81	0.01
TG (mg/dl)	158.9±61.54	203.0±67.72	151.9±51.76	0.001
HDL (mg/dl)	51.9±5.80	50.9±5.87	51.3±5.80	0.001

Note: Values are mean± SD, p <0.05 is considered significant. WC=Waist Circumference, SBP= Systolic Blood Pressure, DBP= Diastolic Blood Pressure, FBS= Fasting Blood Glucose, TG= Triglycerides, HDL= High Density Lipoprotein.

For women a similar trend was observed with anthropometric and metabolic parameters significantly differing in women with Met S and those without Met S, such as; weight (62.9±9.98 versus(67.4±12.02; p= <0.05), waist circumference (89.2±6.99versus 88.2±10.25; p= <0.05), triglycerides (154.2±50.53versus 150.6±53.66; p= <0.05), FBG (92.1±14.75versus 93.8±15.95; p= <0.05), HDL (47.9±7.35versus 48.5±6.27; p= <0.05), SBP (134.5±15.67versus 133.8±14.39; p= <0.05), DBP (84.3±9.31versus 85.3±7.32; p= <0.05).

Table 3. Baseline data of Kashmiri adult women

Parameters	Total no. of women	No. of women with Met S	No. of women without Met S	p- value
Women n (%)	196 (100)	103 (52.6)	93 (47.4)	
Age (years)	41.04±12.94	44.1±12.8	37.5±12.2	0.001
Height (cm)	162.6±8.78	157.2±8.16	156.9± 6.81	0.77
Weight (Kg)	66.4±12.27	62.9±9.98	67.4±12.02	0.002
WC (cm)	88.7±8.68	89.2±6.99	88.2±10.25	0.001
SBP (mmHg)	134.2±15.04	134.5±15.67	133.8±14.39	0.001
DBP (mmHg)	84.7±8.42	84.3±9.31	85.3±7.32	0.001
FBS (mg/dl)	92.93±15.3	92.1±14.75	93.8±15.95	0.001
TG (mg/dl)	152.5±51.94	154.2±50.53	150.6±53.66	0.001

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 14863 - 14877
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HDL (mg/dl)	48.1±6.84	47.9±7.35	48.5±6.27	0.001

Note: Values are mean± SD, p <0.05 is considered significant. WC=Waist Circumference, SBP= Systolic Blood Pressure, DBP= Diastolic Blood Pressure, FBS= Fasting Blood Glucose, TG= Triglycerides, HDL= High Density Lipoprotein.

A t-test was carried out to explore the data further, by comparing the waist circumference, blood pressure, triglycerides, HDL, FBG across the gender, as revealed from Table4. The information provided in this table reveals that excluding HDL and FBG, all the parameters of metabolism differ significantly across the gender as indicated by significant t-values. These findings have a lot of theoretical and clinical implications. E.g. earlier we noticed high prevalence of Met S in female, the t-test analysis made it clear that it is because of the reason that females have comparatively higher waist circumference than their counterparts. The male Met S on the contrary can be attributed to their high triglyceride and increased blood pressure levels.

Table 4. Showing comparison of parameters of metabolic syndrome across gender

Parameter	Gender	N	Mean	Std. Deviation	Std. Error Mean	t-value	p-value
Age (years)	Male	204	45.23	12.64	0.88	3.27	0.001
	Female	196	41.04	12.94	0.92		
Weight (kg)	Male	204	69.08	10.93	0.76	7.74	0.001
	Female	196	60.86	10.25	0.73		
Height (cm)	Male	204	167.86	7.26	0.50	14.51	0.001
	Female	196	157.12	7.53	0.53		
Waist (cm)	Male	204	88.62	10.21	0.71	2.465	0.014
	Female	196	91.01	9.096	0.64		
Systolic (mmHg)	Male	204	131.99	14.16	0.99	1.318	0.188
	Female	196	130.03	15.42	1.1		
Diastolic (mmHg)	Male	204	84.54	8.143	0.57	3.183	0.002
	Female	196	81.89	8.530	0.60		
TG (mg/dl)	Male	204	162.43	58.99	4.13	2.400	0.017
	Female	196	148.84	54.26	3.87		
HDL (mg/dl)	Male	204	49.299	7.142	0.50	1.475	0.141
	Female	196	50.255	5.772	0.41		
FBG (mg/dl)	Male	204	95.223	19.41	1.35	0.47	0.63

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 14863 - 14877
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Female	196	94.341	17.75	1.26

Note: N=Frequency, WC=Waist Circumference, SBP= Systolic Blood Pressure, DBP= Diastolic Blood Pressure, FBS= Fasting Blood Glucose, TG= Triglycerides, HDL= High Density Lipoprotein.

A logistic regression test was carried out to check the strength of association of various variables for predicting the risk of Met S in the study population as given in Table5. The chances of developing the Met S in participants with raised BMI was 5.38 times more as compared with the non-Met S population (CI:2.75-6.63; p<0.001). Absence of dyslipidemia (CI:0.212-1.03; p<0.06) and hypertension (CI: 0271-0.626; p<0.001) was found to reduce the risk of developing Met S in comparison against the non- Met S participants. Also, the risk for developing Met S in individuals with normal fasting blood glucose was found to be as low as compared with non-Met S subjects (CI 0.312-1.54: p<008).

Table 5. Association of various variables for predicting the risk of metabolic syndrome in the study population

Parameter	Ranges	OR	CI	p-value
BMI	**Normal High**	5.385	2.75-6.63	<0.001
Hypertension	**Absent Present**	0.412	0.271-0.626	<0.001
Dyslipidemia	**Absent Present**	0.386	0.212-1.03	0.06
FBG	**Normal High**	0.91	0.312-1.54	0.08

Note: P<0.001 is significant. BMI= Body Mass Index, FBG= Fasting Blood Glucose

Discussion

Metabolic Syndrome is considered to be the most important problem related to the healthcare and its prevalence is rising throughout the world. The prevalence of the Met S is in part affected by the choice of the criteria selected for defining this syndrome, the components included and the composition of the population under study viz; age, gender, ethnicity, race. Despite of these factors, its prevalence is quite high and is rising at an alarming rate in Asian and western societies greatly due to increasing obesity [26,27,28,29]. According to our study the overall prevalence of Met S was found to be 36.3% which is quite high. The presence of Met

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S also varies in several parts of the world which seems to be rising in various developing countries like ours. The Asian Indian populations are considered to be as the high risk zones with regard to CVD and diabetes. The study results showcase the prevalence of metabolic syndrome in India, Philippines, Turkey, Malaysia, Venezuela, Iran, and Brazil were 28.8%, 19%, 33.4%, 24.2%, 31.2%, 33.7%, and 25.4%, respectively [30].

As far as the gender dependency is considered, the data is conflicting with the most of the studies showing higher prevalence in women than men [31,32]. As per the demonstration of this pilot study, our results are in line with many other researches carried out by prominent researchers, showing increased prevalence of Metabolic syndrome in women than in men[33,34].The findings suggest that the metabolic ailments are found to be greater among women (52.6%) in comparison with rate of metabolic syndrome in men (20.6%) thereby, again illustrating heterogeneity according to gender. These variations with regard to the gender may partly be attributed to the choice of the definition of Metabolic Syndrome and different cut off points used for metabolic syndrome criteria like WC and HDL, and to other factors like genetic traits and lifestyle habits and hormonal issues[35,36]. Women had a higher prevalence of abnormal waist circumference, increased blood pressure and decreased HDL levels. Men were more likely to have hypertriglyceridemia and hypertension. There are other studies, which have shown similar trend in the prevalence of these risk factors among men and women [37,38]. Our study is the first of its sort to find out the prevalence of Met S in general adult Kashmiri population.

The process of Met S is complex and is subjected to variation according to the lifestyle modulations, region, socioeconomic factors, urbanization, and cultural factors in our community [39,40]. Metabolic Syndrome results as an interplay between genetic and environmental factors. It constitutes insulin resistance, dyslipidemia, increased blood pressure, visceral adiposity and genetic susceptibility etc, as several important factors [8]. Diabetes mellitus is a complex state involving Insulin resistance, hyperglycemia, dyslipidemia, increased adipogenesis, pancreatic beta cells stress, and altered fasting and postprandial glucose levels. Impaired fasting glucose levels have been shown as the strongest predictor for the development of type II Diabetes Mellitus [41,42]. In our study 30.9% of men had fasting blood glucose levels greater than 100mg/dl. Raised triglycerides, decreased levels of HDL cholesterol, increased LDL cholesterol levels all are features of dyslipidemia, which is an independent factor for CVD [43]. A strong relationship between coronary heart disease and presence of serum triglyceride levels have been shown by several studies which further generates CVD. Therefore, increased serum triglycerides help to investigate the risk of the person to CVD. Our study showed 51.0% of men had greater than 150 mg/dl triglycerides that's is quite high. Low HDL was also found to be associated with high LDL and elevated serum triglycerides[44].

High blood pressure is one of the most important component of metabolic syndrome. There is a strong connection between coronary heart ailments and high blood pressure levels. In our study, the existence of hypertension in Kashmiri men was 52.9% which is quite significant. According to the reports, upto one third of hypertensive patients have metabolic syndrome [45,46]. Insulin resistance and obesity have been strongly associated with increased blood pressure [47]. Moreover, study showcased 40.3% of women with the existence of low HDL cholesterol. Several studies recommend that increased risk for coronary heart disease is connected with the low HDL cholesterol [48]. For metabolic syndrome, dyslipidemia is considered to be an essential element and basically involves the definitions of low HDL and hypertriglyceridemia as important determinants. Increasing awareness and early

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identification of these risk factors should be taken into consideration while designing prevention strategies for Kashmiri population. According to the results of the study, it can be stated that abdominal obesity is the main reason for higher existence of metabolic syndrome [49]. The abdominal fat is also represented by the waist circumference. For men catering a waist circumference standing at ≥94 cm and for women catering the waist circumference to ≥80 cm is regarded as overweight. The existence of obesity is reaching epidemic levels worldwide. It is considered to be the examining tool for cardiovascular disease. According to the analysis of this study, 86.2% of women have been found in holding high waist circumference which is quite alarming. The overall trend for the prevalence of Met S and its components in our study is revealed in the Figure 3.

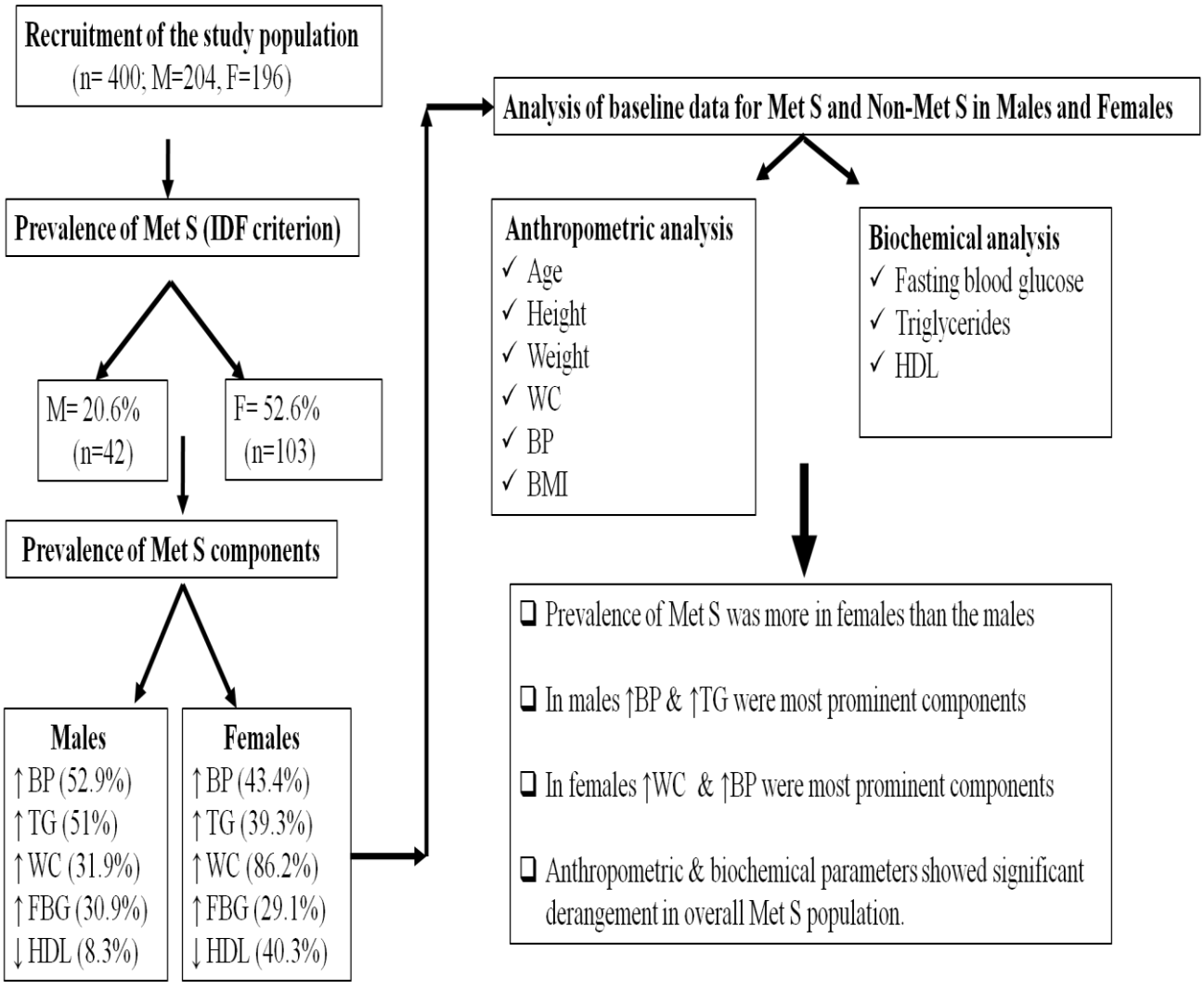

Figure 3. A flowchart depicting the overall scenario of the Met S prevalence in Kashmiri adult population

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 14863 - 14877
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Conclusion

It is appropriate to call Met S an energy imbalanced condition where calorie intake exceeds the calories burnt by an individual's body. Over eating contributes significantly to the development of Met S. Thus, increasing the physical activity in day-to-day life could help an individual burn the excess calories and reverse the effect to a greater extent. In adult Kashmiri population, the presence of metabolic syndrome indicates the need for an extended control program and prevention of non-communicable disease. This study has shown the unacceptably high prevalence rate of Met S in females (52.6%) compared to males (26.6%). Increasing awareness and early identification of these risk factors (increased fasting blood glucose, increased waist circumference, hypertriglyceridemia, hypertension, increased LDL, decreased HDL) should be taken into consideration while designing prevention strategies for Kashmiri population, in particular. Therefore, by implementing the suitable treatment and screening system for Met S, various chronic diseases that prove to be expensive for the society can be prevented.

Limitations and Future Studies

Although, we have taken a good number of subjects for this epidemiological study, but we believe that increasing sample size would provide a much clear picture about the prevalence of Metabolic Syndrome in the studied population. Therefore,future studies need to focus on performing large scale screening/sampling of subjects from both urban and rural population of studied region.In addition, incorporation of other lifestyle and dietary factors such as physical activity, eating habits and stress should also be taken into consideration in future.

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Declarations

All the contributing authors declare that there is no conflict of interest related to this manuscript.

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