ORIGINAL RESEARCH

Prevalence of Metabolic Syndrome in Urban and Rural areas of Jalandhar City

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ABSTRACT

Background: Metabolic Syndrome is one of the most important risk factor that is increasing the chances of developing chronic diseases in both developed and developing countries. The specific risk factors include central obesity, high blood pressure, impaired fasting glucose, high triglycerides and low leveled HDL. The main components of insulin resistance are sedentary lifestyle or physical inactivity and increased body fat and other causes includes genetic factors, unhealthy diet, tobacco and alcohol use. **Objective:** The main objective of the study conducted is estimate the prevalence of MS in the population of rural and urban people of Jalandhar city, Punjab and to find out which MS component in rural and urban people affected the most and to find out of male and female which population is more affected. **Materials and Methods:** A cross sectional study was conducted on 120 (N) OPD patients in Tagore Hospital and Heart Care Center from January 2023 – April 2023 on the parameters of hypertension, CVDs, diabetes, lipid profile and BMI against male and female sexes. After that the patients were randomly selected, the prevalence of MS components was studied. **Result:** The prevalence of diabetes seen more prominently with 68 patients out of 77 female patients that results out with 88.3% of total prevalence. BMI, HDL followed by TG came out with next common prevalence in involved female patients while hypertension seems with the lowest incidence as a metabolic component in same patients whereas in case of male population prevalence of diabetes seen more prominently with 39 patients out of 43 patients that result out with 90.69% of total prevalence. TG, HDL followed by hypertension came out with next common prevalence in involved male patients while BMI seems with the lowest incidence as a metabolic component in same patients. **Conclusion:** Here, from our present study we concluded that the prevalence of MS seen more common in female patient than male patients visiting Tagore Hospital and Heart Care Centre, Jalandhar, Punjab. The rate of prevalence of diabetes as a component of MS was seen much common in both sex while BMI as secondary most common prevalent in female sex contrast to that, male having TG as second most characterization. We also conclude that obesity is seen more common in female patients than male patient which signifies women in Jalandhar city having more prevalent to metabolic complication than men.

Key words: Metabolic Syndrome, Type 2 DM, hypertension, central obesity, dyslipidemia, fasting blood glucose

INTRODUCTION

Background

Metabolic Syndrome (MS) also known as 'Syndrome X' which was first given by Reaven (1) in 1988 and later it was renewed as MS. Each component has been associated with an increased risk of cardiovascular disease. MS is a group of hyperglycemia, obesity and dyslipidemia. This is important for many reasons:

1. It helps to identify patients who are at high risk of developing CVD and type-2 diabetes.
2. It helps to understand the pathophysiology that links the relationship between components of MS.
3. It supports clinical and epidemiological research of lifestyle, pharmacological and preventive treatment approaches.(1)

Metabolic Syndrome (MS) can be defined as a group of risk factors that can increase the risk of cardiovascular disease and type 2 diabetes mellitus. The risk factors include central obesity, hypertension, dyslipidemia and dysglycemia. The definition of MS is differently given by WHO, NCER ATP-III, and IDF with little variation.

According to the WHO 1999 criteria, the presence of any three from the following five metabolic abnormalities in a combination will lead to MS. The metabolic abnormalities are as follow:

- Rise in blood pressure: ≥140/90 mm Hg

- Central obesity: waist: hip ratio >0.90 (male); >0.85 (female), or body mass index (BMI >30 kg/m2
- Rise in triglycerides level
- Lowering of HDL (high density lipoprotein)
- Rise in fasting glucose level (1)

Factors that lead to development of MS

- Inherent genetic factors
- Increase in age
- Physical inactivity or sedentary lifestyle
- Habitual consumption of atherogenic diet
- Obesity
- Tobacco use
- Alcohol abuse (2)

When the above mentioned factors become operative, alone or in combination, the onset of insulin resistance and its resultant hyper insulinemia will lead to the clustering of specific risk factors that are responsible for the development of MS.

Metabolic Syndrome and its associated complications

Metabolic Syndrome (MS) is a most common, widely prevalent health challenge in both developed and developing countries. There are many criteria that have been proposed for quantifying MS, but the most commonly is from the International Diabetic Federation (IDF) and the National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) (3). It is an important risk factor that is increasing the chances of developing chronic diseases like Cardiovascular Diseases (CVDs), risk of heart attack and risk of developing Type 2 Diabetes Mellitus (T2DM). It is most common among the women all over the world and CVD is the main cause of mortality because the metabolic changes take place during menopausal transition which increases the risk of occurrence of obesity, T2DM, hypertension and dyslipidemia which are the main components that lead to metabolic syndrome. The various studies found that there is significant association of MS with colorectal, pancreatic, prosthetic and breast cancer (4). In the present study an attempt has been made to generate baseline data about the prevalence of metabolic syndrome among the adult rural and urban people of Jalandhar (Punjab).

Prevalence of Metabolic Syndrome, Globally

Globally it has been found that there is large variation in the prevalence of MS ranging from 7.1% to 41.6% and the prevalence of MS is quite high worldwide i.e 35% in USA, 24.9% in Latin America and 20.7% - 37.2% in gulf countries as per the criteria of ATP III. According to WHO or NCEP criteria and data of meta-analysis based on 21 cohort studies from Europe and United States, the prevalence of MS ranges from 23% to 46%. As per ATP III and IDF criteria the prevalence of MS in South Asia was 26.1% and 29.8% (3).

Prevalence of MS in population of Punjab

The various studies resulted that the prevalence of MS is significantly more in females (43.5%) as compare to males (34.1%). The maximum prevalence of MS in female was seen in the age group of 31-40 years and 41-50 years i.e. 29.1% and in case of males the prevalence of MS was more in the age group of 41-50 years and 51-60 years i.e. (44.8%). Various MS driving factors that were observed in females are central obesity (81.7%), hypertension (64.7%), hyper triglyceridemia (68.1%) and in case of males are hypertriglyceridemia (68.1%), central obesity (67.3%), hypertension (59.4%). In case of BMI, 15.6% females were overweight; 75.9% were obese and only 8.5% were having normal BMI range and in case of males 27.4% were overweight; 55% were obese and only 17.6% had normal BMI (7).

Diabetic Mellitus, as a component of MS

Insulin resistance occurs when the action of insulin to the cells starts declining and the cells become resistant to action of insulin and it affects the peripheral utilization of glucose and the large amount of glucose remains in the blood. This large amount of glucose in the blood triggers the need of more insulin to be produced by beta cells of pancreas so that the level of glucose become normal but the body cells are not responding against insulin, this will lead to hyper- insulinemia. This increase in production of insulin leads to beta cells failure and once the beta cells become non-functional the insulin will not be produced and the person become hyperglycemic and it will lead to T2DM. Before reaching to the state of T2DM much damage to the body have already occurred including increase in triglyceride level that will further impair insulin sensitivity (6).

Prevalence of T2DM in MS

Recent paper published in June 2020 in Journal of Diabetic and Metabolic disorder, elaborate the frequency of association between MS and DM cases. Such cross-sectional study revealed that the occurrence of MS in the diabetic population account 42.28% and 28.85% throughby International Diabetic Federation (IDF) and National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP III) criteria respectively.

Central Obesity, as a component of MS

Central obesity is measured by an increase in waist circumference (WC) or Waist Hip Ratio (WHR). Central obesity is a documented risk factor for T2DM and Ischemic Heart Disease (IDH). Also it is the "central obesity" that occurs due to excessive deposition of fat in our intra- abdominal tissue that is much stronger factor for the development of MS (6).

Central obesity as well as obesity is associated with physiological changes that may cause the

development of diseases like high blood pressure, heart disease, high blood cholesterol and type- 2 diabetes(8).

Obesity can be defined as a Body mass index (BMI) exceeding 30 kg/m^2. It is a new epidemic that is affecting millions of people worldwide. In England, obesity rise to 13.2% to 23.6% in men and 16.4% to 23.8% in women within 1993-2004. In the United States it rise from 23% in 1990to 31% in 2000 (8).

Hypertension, as a component of MS

Hypertension is one of the major risk factor leading to increase in global mortality in both developed and developing countries. The studies published in the year from 2000-2013 had observed the prevalence of hypertension as follows: Bhutan 23.95%; Bangladesh 17.9%; India 31.4%; Maldives 31.5%; Nepal 33.8%; Pakistan 25%; Sri Lanka 20.9% (9). Another study in Sri Lankan population in 2009 by Katulanda et al, states that prevalence of hypertension in males is 23.4% and females is 23.8% and in total is 23.7% (9).

Hypertension is considered as a key factor which leads to MS and it is also major factor that leads to CVD which attributes to about one-third of deaths worldwide (9).

Low HDL, as a component of MS

Low HDL-cholesterol level is associated with increased risk of coronary artery disease (CAD). This was observed with irrespective of age, blood pressure level, obesity, total cholesterol or LDL-cholesterol levels. The term "isolated low HDL" was used to describe the situation in which total cholesterol or LDL-cholesterol was considered normal but HDL-cholesterol is low. Low level of HDL-C from prolonged time has been demonstrated that the risk of developing CAD and it increase the risk for increasing the total cholesterol or LDL-cholesterol (bad cholesterol. According to latest guidelines, if the HDL-cholesterol is low, it should be considered a major CV risk factor. The major reasons for decrease in HDL levels- may be some of which are associated with insulin resistance, i.e. elevated triglycerides, overweight and obesity, physical inactivity, and type 2 diabetes. A combination of a low HDL-C with elevated plasma triglyceride level has been considered an insulin-resistant state. Some drugs can also reduce the level of HDL-C (for e.g. beta-blockers, anabolic steroids, progestational agents). Low HDL-cholesterol is an important component which leads to metabolic syndrome and deserves close clinical attention and management since these patients are at high risk of CVD (12).

Prevalence of HDL

As per recent conducted study in 2016, it was found that a good lifestyle via performing sustained exercise improves the serum level of HDL. The functional property of such high HDL's where found a great impact in reversing metabolic dysfunction as well as regressing atherosclerotic cardiovascular disease (10). An article in 2009, it was observed that low HDL level was the most common MS associated risk factor in heart failure. As of same studies, low HDL accounts 69% of MS cases in heart failure patients. It was also observed same patients also associated with hypertension, so to show synergetic effect to cause MS in heart failure patients (10).

High TG, as a component of MS

High level of triglyceride is associated with several atherogenic factors which includes increased concentrations of triglyceride-rich lipoproteins and the atherogenic lipoprotein phenotype that consists of small dense LDL particles, and low high- density lipoprotein (HDL) cholesterol. Factors that contribute to hyper-triglyceridaemia in population includes obesity, overweight, sedentary lifestyle, excess alcohol intake, high-carbohydrate rich diet, type 2 diabetes, and other diseases for e.g. chronic renal failure, nephrotic syndrome, certain drugs for e.g. corticosteroids, estrogens, retinoids, higher doses of adrenergic blocking agents, and genetic disorders like familial combined hyperlipidaemia, familial hypertriglyceridaemia, and familial dys-betalipoproteinemia. Increased serum triglyceride level is predominantly observed in persons with MS. Recent studies indicate that hyper-triglyceridaemia is strongly associated with all components of MS (12).

OBJECTIVE

The main objective of the study conducted is estimate the prevalence of MS in the population of rural and urban people of Jalandhar city, Punjab.

To find out which MS component in rural and urban people affected the most. To compare the above parameters based on gender.

METHODOLOGY

Study Design

It is a cross sectional and quantitative study data.

Participants

The total participants taken for the study is 120 (N)

Selection Criteria

Inclusion

1. Rural and urban population in Jalandhar city will be involved.
2. Participants of age > 18 years.
3. Participants under OPD department visiting Tagore Hospital and Heart CareCenter, Jalandhar.
4. Participants should be suffering from at least three of the following conditions Hypertension, Diabetes, High BMI ratio, high TG and low HDL.

Exclusion

1. Diseased patients with non-metabolic syndrome's

components.
2. Participants who are under medication under any diagnosed diseases.

Study site and JustificationStudy site
This study is carried out in Tagore Hospital and Heart Care Center, Jalandhar, Punjab,India.

Justification
Since the patients suffering with Diabetes and high Triglyceride level and low HDL level was readily available at the hospital so the data with history of hypertension was taken and BMI was also calculated by asking them their height and weight.

Sampling Method/ Technique
Stratified random sampling: First we divided strata i.e. selecting patients of only Jalandhar. The second strata was designed for those patients who are diagnosed with at least three symptoms of MS.
After selecting the desired population, 120 samples were selected randomly regardless furthermore strata.
The OPD department patients were selected who meet the inclusion criteria.

Data Collection Tools/ Measures
1. Sample Collection and requirements

Figure 1 To conduct a successful phlebotomy we require gloves, syringe / vacutainer syringe, vacutainer holder, vacutainer tubes / vials, tourniquet, spirit/alcohol swab, drycotton, different color blood collection tubes.

2. Fully automatic Biochemistry analyzer

Figure 2 Fully Automatic Biochemistry Analyzer

Company: Siemens
Model: Dimension RL Max.
Working Principle: Spectrophotometry
Reagent required:
- Glucose reagent
- HDL reagent
- TG reagent

3. Centrifuge Machine

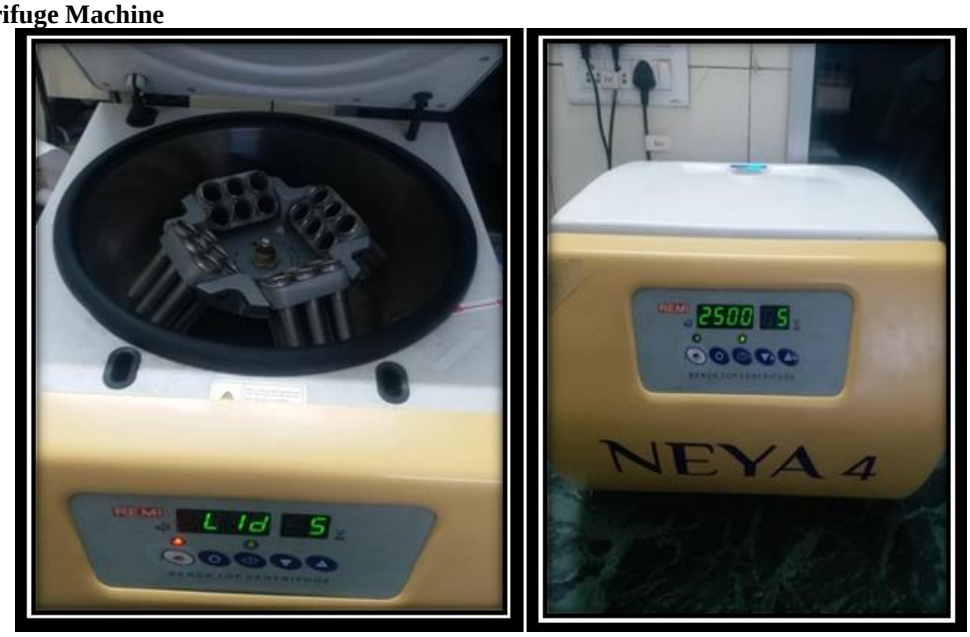

Figure 3 NEYA 4 Centrifuge

4. Max BP Machine

Figure 4 BP apparatus and Stethoscope

5. Height and weight measurement apparatus

Figure 5 Weighing machine

Figure 6 Height measuring scale

Procedure

1. OPD patients were allowed to participate and their history with hypertension, diabetes and previous or recent heart disease was taken.
2. Patient's name, age and gender were noted down who were advised with fasting blood sugar or lipid profile test or both.
3. Patient's weight, height and blood pressure was measured.
4. Patient was asked about the medication he / she was taking.
5. If the patient was suffering from hypertension, time duration was asked for how long he/she is taking medicine.
6. Patient was also asked if he/ she was suffering from heart disease, any pervious surgery related to heart.
7. Fasting blood sample was collected in a yellow vial (serum separator) for lipid profile test and a grey vial (sodium fluoride anticoagulant) for fasting glucose testing.
8. The results were noted down for the tests fasting blood glucose (FBS), Triglyceride level (TG) and High density lipoprotein (HDL).
9. After the results were obtained the patients were evaluated on the parameters of high FBS, high TG, low HDL, high BMI and high blood pressure. If any of the three or more conditions were positive the patient data was taken positive for MS.

Reference Range

1. Blood pressure: Systolic: less than 120 mm Hg
   Diastolic: less than 80 mm Hg
2. Fasting Blood Sugar: 70-100 mg/dl
3. Triglyceride: 30-150 mg/dl
4. H.D.L. Cholesterol: 40-60 mg/dl
5. Body mass index: 18.5 to 24.9

a) If BMI is less than 18.5, it falls within the underweight range
b) If BMI is 18.5 to 24.9, it falls within the Healthy Weight range
c) If BMI is 25.0 to 29.9, it falls within the overweight range.
d) If BMI is 30.0 or higher, it falls within the obese range

Further contact with participants
Not Required

Statistical analysis
Based on the nature of the data we are going to apply unpaired T-test (N=120)

RESULTS

Table 1 Prevalence of MS in the rural and urban population of Jalandhar city

Female Population (n_1 = 77)				Male Population (n_2 = 43)			
Rural		Urban		Rural		Urban	
Population size	Percentage	Population size	Percentage	Population size	Percentage	Population size	Percentage
37	46.75%	40	51.94%	17	39.53%	26	60.46%

In the above Table 1, the prevalence of urban female population came out with 51.94% while in the case of urban male population 60.46% were involved.

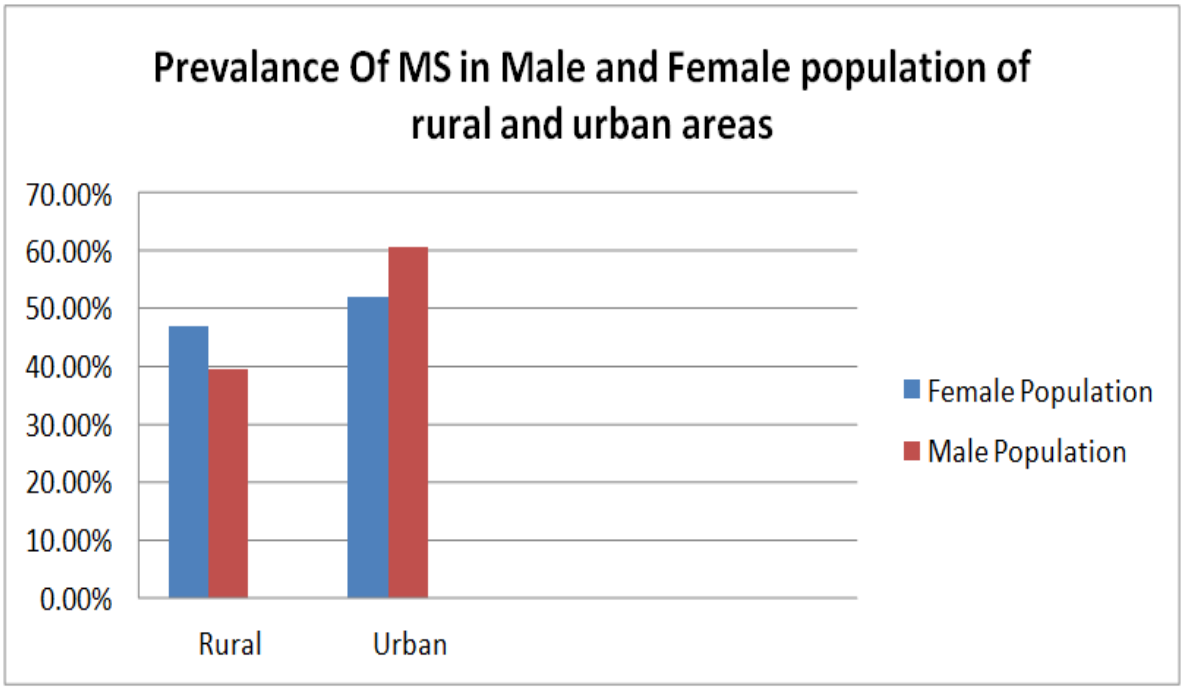

Figure 7 Bar graph showing prevalence of MS in the rural and urban population of Jalandhar city

Table 2 Prevalence of different components of MS in female patients

Components of MS in female (n_2 = 77)					
Name of Components	Low value	Normal	High value		Mean Value ± SD
BMI	-	20	Overweight	49	25.44± 3.16
			Obese	08	
Fasting blood glucose	-	9	Pre-diabetic	16	141.27± 26.51
			Diabetic	52	
Triglyceride	-	25	52		158.45±25.75
HDL	54	31	-		41.22±9.88
Hypertension	-	37	40		-

From table 2, prevalence of diabetes seen more prominently with 68 patients out of 77 female patients that results out with 88.3% of total prevalence.

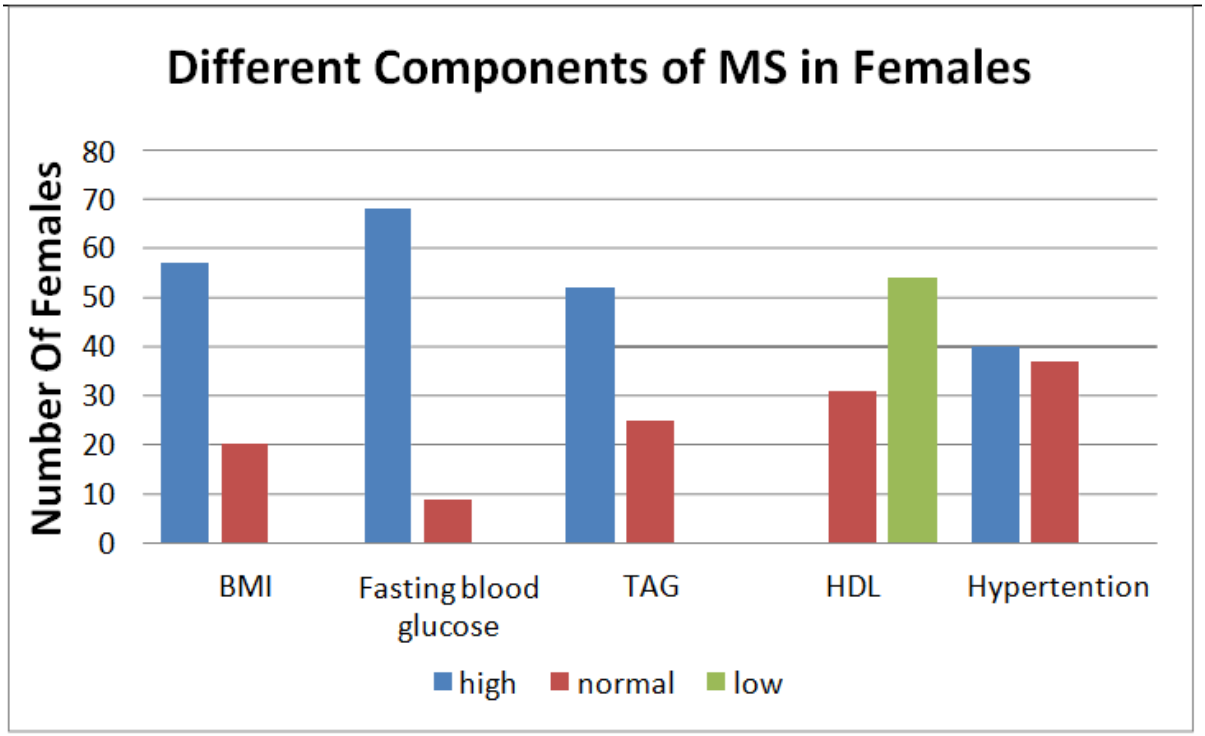

Figure 8 Bar graph showing prevalence of different components of MS in female patients

BMI, HDL followed by TG came out with next common prevalence in involved female patients while hypertension seems with the lowest incidence as a metabolic component in same patients.

Table 3 Prevalence of different components of MS in male patients

Components of MS in Male (n_2 = 43)					
Name of Components	**Low value**	**Normal**	**High value**		**Mean Value ± SD**
BMI	-	36	Overweight	04	23.46± 2.711
			Obese	03	
Fasting blood glucose	-	4	Pre-diabetic	15	136.46± 23.58
			Diabetic	24	
Triglyceride	-	8	38		177.76±29.25
HDL	29	14	-		38.58±7.36
Hypertension	-	15	28		-

From table 3, prevalence of diabetes seen more prominently with 39 patients out of 43 male patients that result out with 90.69% of total prevalence. TG, HDL followed by hypertension came out with next common prevalence in involved male patients while BMI seems with the lowest incidence as a metabolic component in same patients.

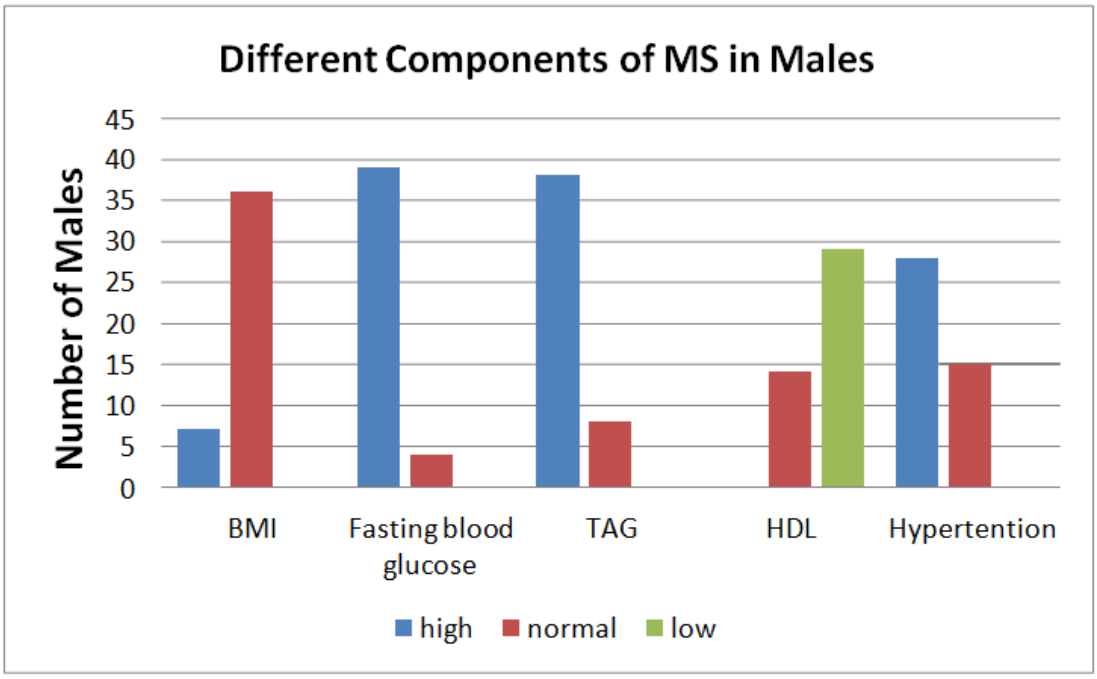

Figure 9 Bar graph showing prevalence of different components of MS in male patients

Table 4: Comparison of different components of MS in male and female population

Female Population n1=77			**Male Population n2=43**		
Name of Components	**Normal %**	**Positive %**	**Name of Components**	**Normal %**	**Positive %**
BMI	25.97%	74.02%	BMI	83.72%	16.27%
Fasting bloodglucose	11.68%	88.31%	Fasting bloodglucose	9.30%	90.69%
Triglyceride	32.46%	67.53%	Triglyceride	18.60%	88.37%
HDL	40.25%	70.12%	HDL	32.55%	67.44%
Hypertension	48.05%.	51.94%	Hypertension	34.88%	65.11%

From Table 4, the systemic comparison of different components of MS has been observed which significantly indicates the serum glucose level has been increased in both male and female patients while BMI observed with less prevalent in male population where hypertension observed as less prevalent in female population.

Table 5 Comparison of BMI component in male and female population of rural and urbanarea

Female Population n1=77			**Male Population n2=43**		
	Rural	**Urban**		**Rural**	**Urban**
Normal	27.02%	24.32%	Normal	55.55%	84.61%
Overweight	56.75%	67.5%	Overweight	38.88%	7.69%
Obese	16.23%	8.21%	Obese	5.55%	7.69%

From Table 5 it has been observed that the female obese cases were significantly higher in rural areas contrast to above urban male population has been observed with more obese cases.
When it comes to overweight, urban female population accounting higher incidence than rural female population contrast for same, rural male population seems with significant overweight as compared to urban male population.

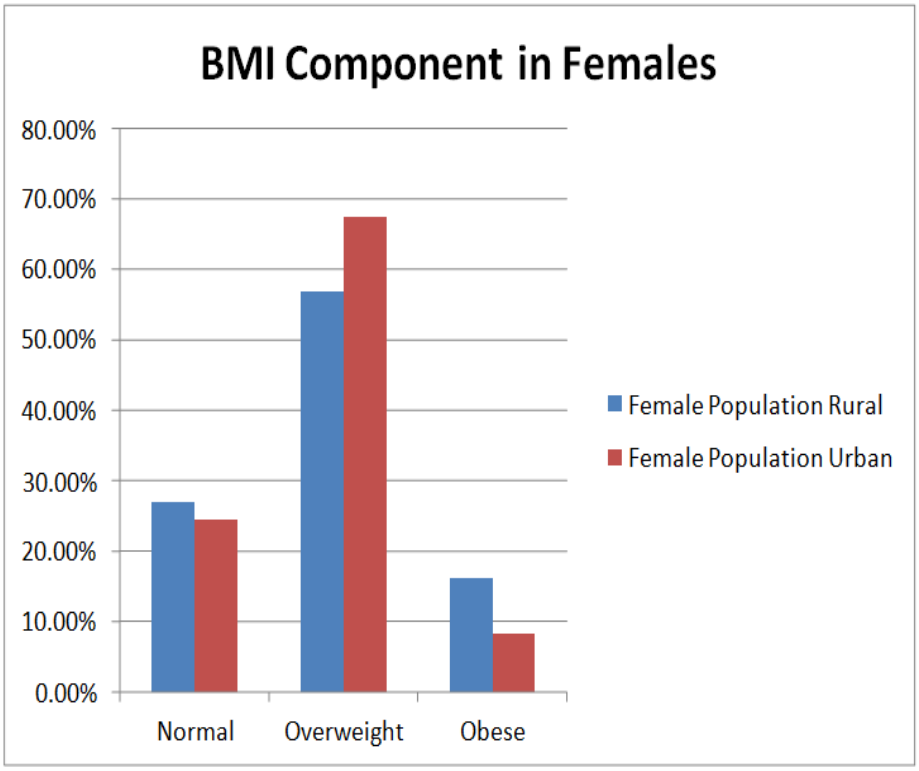

Figure 10 Bar graph showing comparison of BMI component of the rural and urbanfemale population.

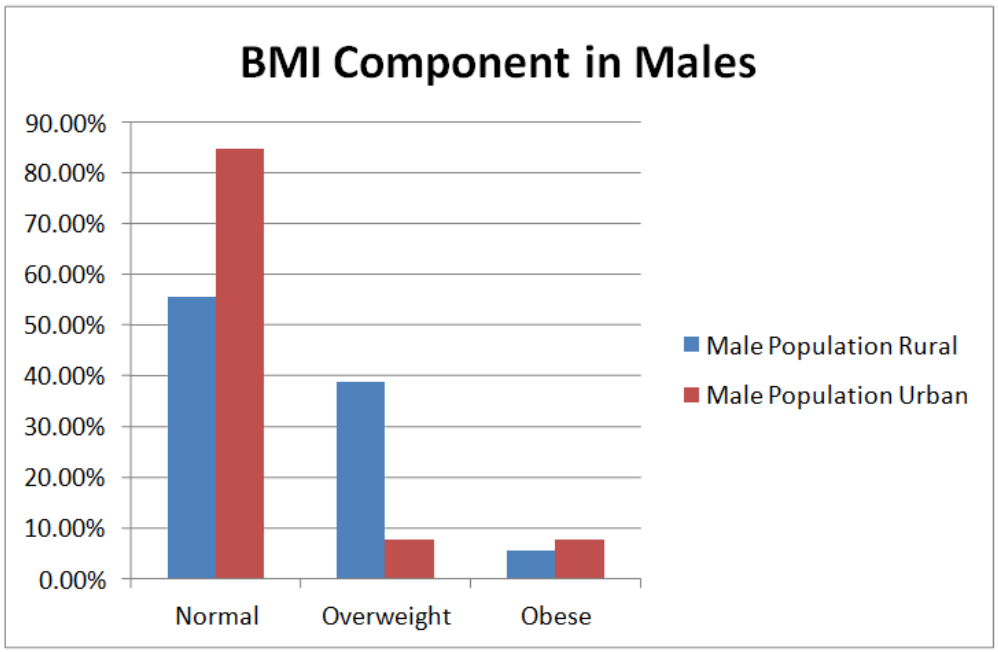

Figure 11 Bar graph showing comparison of BMI component of the rural and urban malepopulation

Table 6 Comparison of fasting blood sugar component in male and female population of rural and urban area

Female Population n1=77			**Male Population n2=43**		
	Rural	**Urban**		**Rural**	**Urban**
Normal	13.51%	12.5%	Normal	22.22%	3.57%
Pre-diabetic	18.91%	22.5%	Pre-diabetic	72.22%	14.28%
Diabetic	67.58%	65%	Diabetic	5.55%	82.14%

In Table 6 comparison of female and male population has been illustrated according to their serum glucose level. The diabetic cases observed with higher prevalence in rural female population contrast to that urban male population has been observed with more diabetic cases. In pre-diabetic, urban female population and rural male population had significantly higher prevalence.

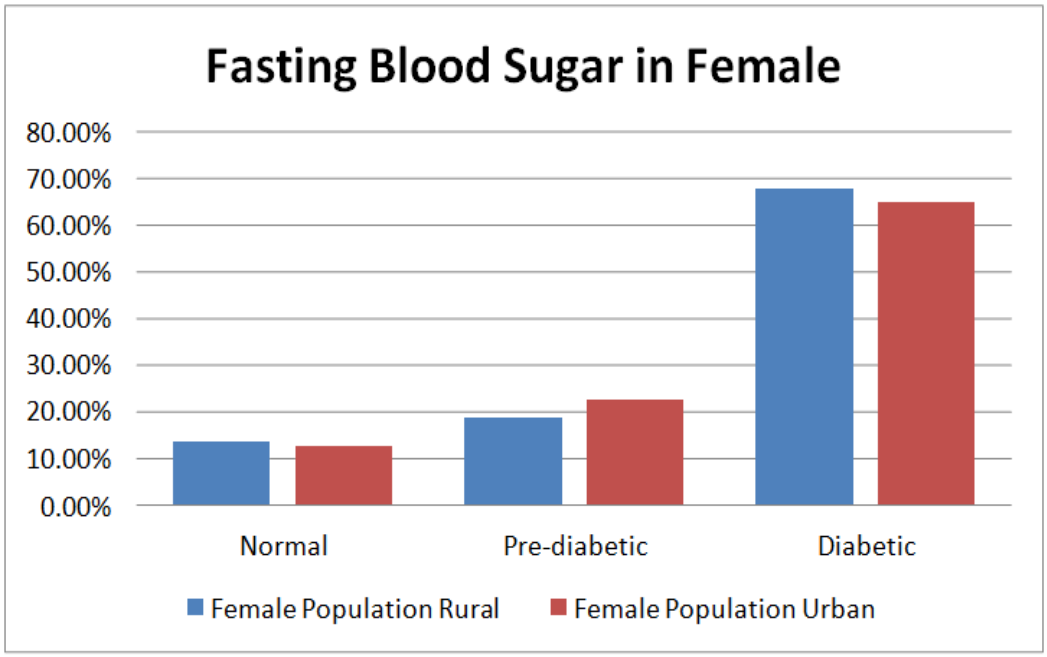

Figure 12 Bar graph showing comparison of fasting blood sugar of the rural and urban female population

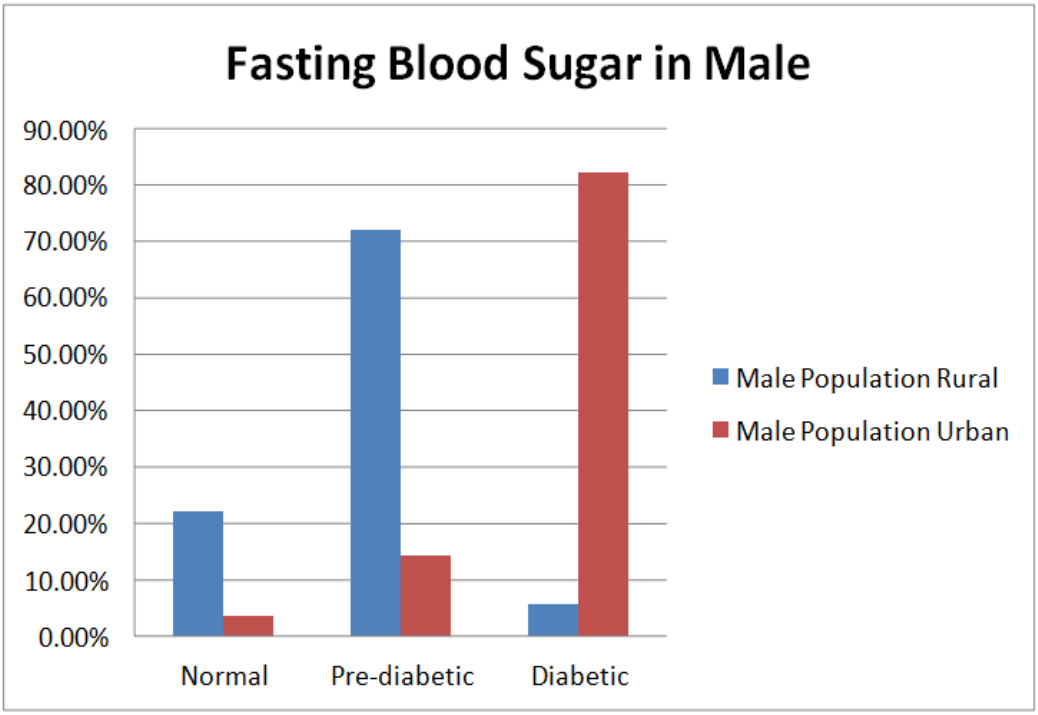

Figure 13: Bar graph showing comparison of fasting blood sugar of the rural and urbanmale population

Table 7 Comparison of Triglyceride in male and female population of rural and urban area

Female Population n1=77			Male Population n2=43		
	Rural	**Urban**		**Rural**	**Urban**
Normal	35.13%	42.37%	Normal	17.64%	23.07%
High	64.87%	57.63%	High	82.35%	76.92%

In Table 7 another component TG has been observed in both sexes where we find out both rural female population and rural male population has more prevalence than urban scenarios.

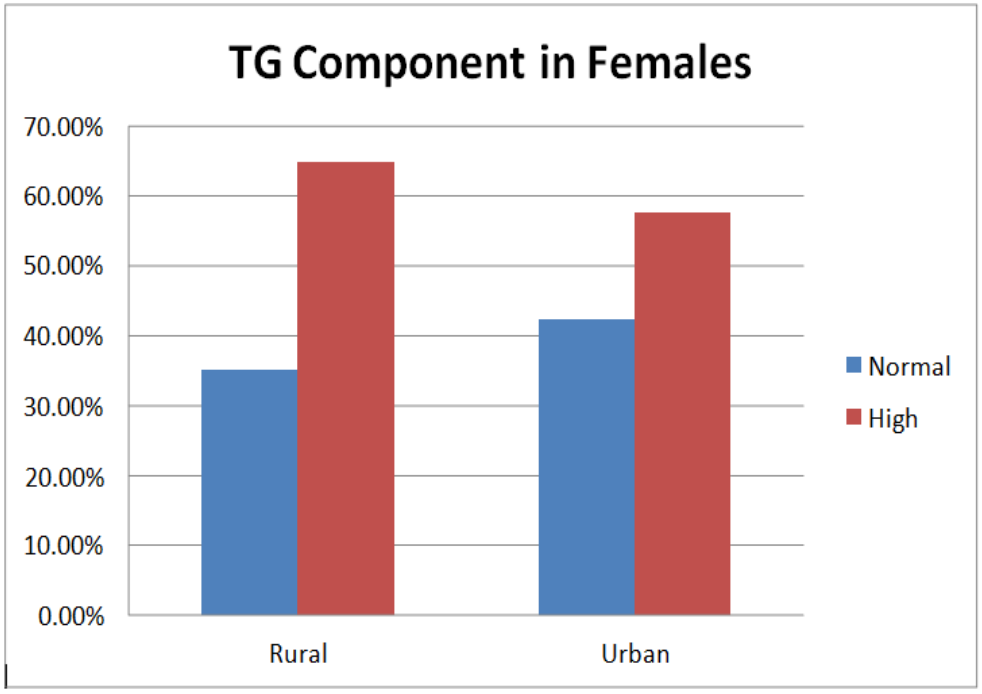

Figure 14 Bar graph showing comparison of TG component of the rural and urban femalepopulation

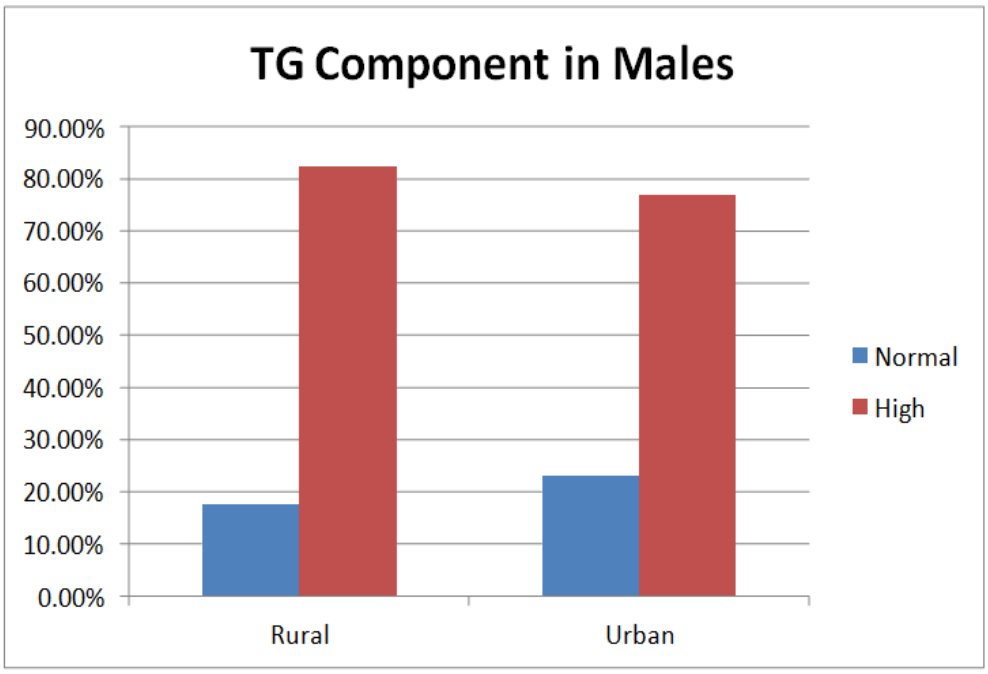

Figure 15 Bar graph showing comparison of TG component of the rural and urban malepopulation

Table 8 Comparison of HDL component in male and female population of rural and urban area

Female Population n1=77			Male Population n2=43		
	Rural	**Urban**		**Rural**	**Urban**
Normal	54.05%	47.50%	Normal	41.17%	28%
Low	45.95%	52.50%	Low	58.82%	72%

In Table 8 HDL was component according to opposite sexes where a significantly low HDL has been observed in urban male population. Nevertheless a low serum HDL also observed in urban female population but with low significant as compare to male.

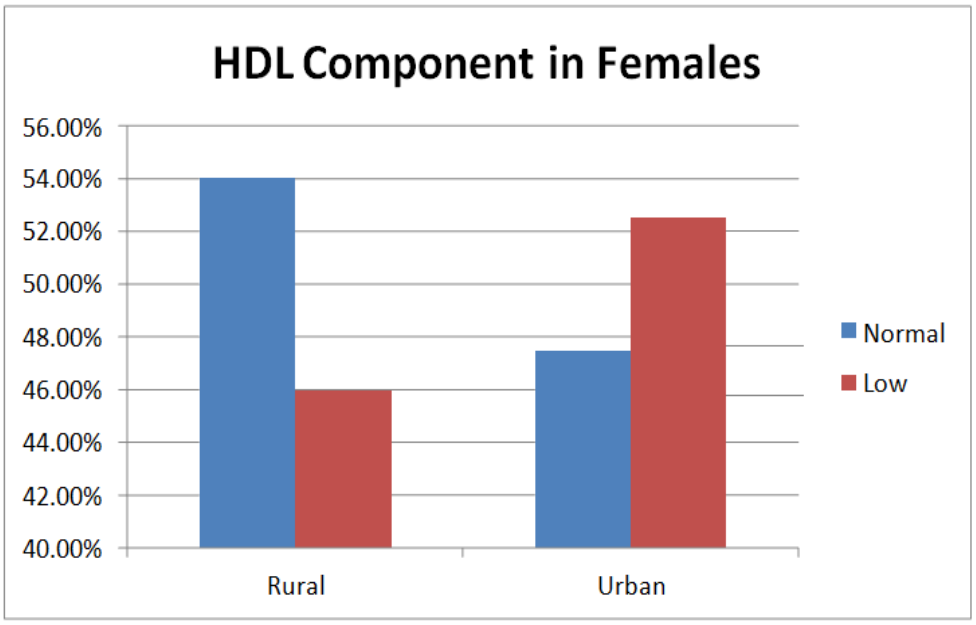

Figure 16 Bar graph showing comparison of HDL component of the rural and urbanfemale population

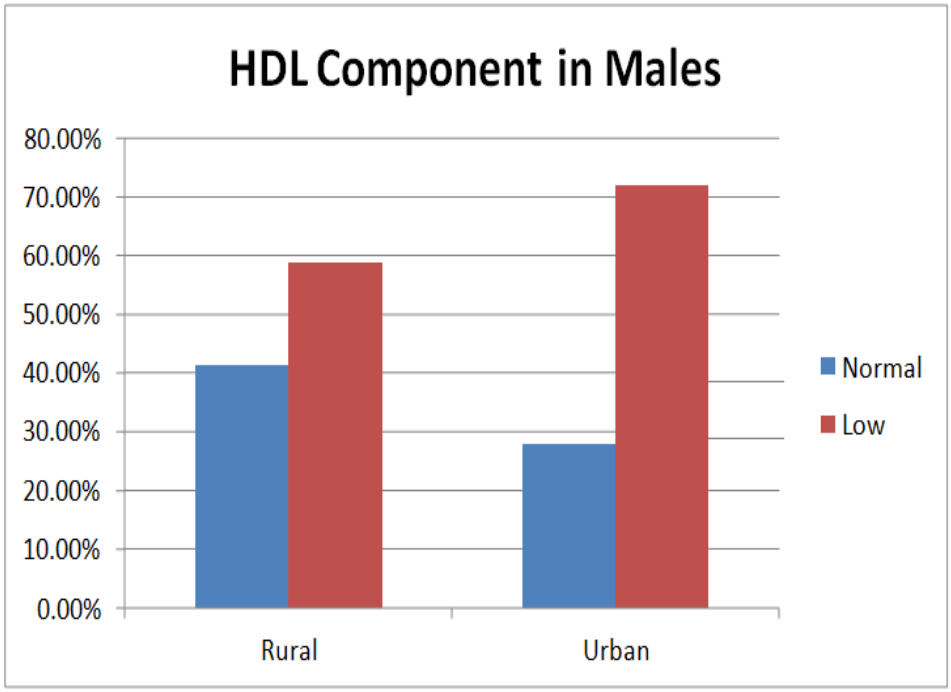

Figure 17: Bar graph showing comparison of HDL component of the rural and urban male population

Table 9 Comparison of Hypertension in male and female population of rural and urban area

Female Population n1=77			Male Population n2=43		
	Rural	**Urban**		**Rural**	**Urban**
Normal	51.35%	62.5%	Normal	29.41%	36%
High	48.65%	37.5%	High	70.58%	64%

In Table 9 Hypertension has been observed in male and female population where high blood pressure was observed in rural male population than urban population. Same perspective has been observed in female sex but with lower prevalence.

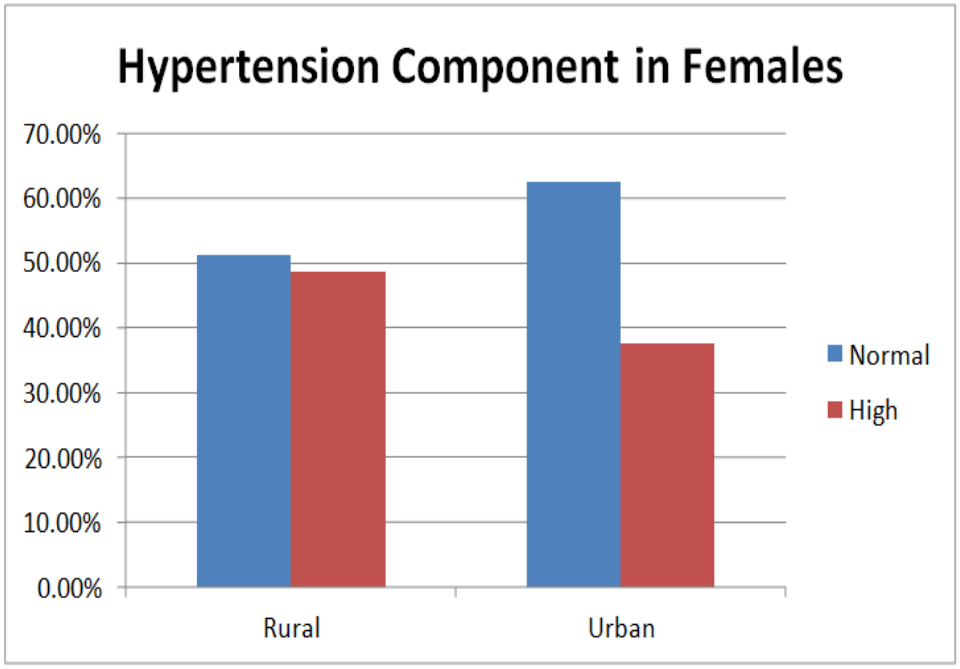

Figure 18 Bar graph showing comparison of hypertension component of the rural andurban female population

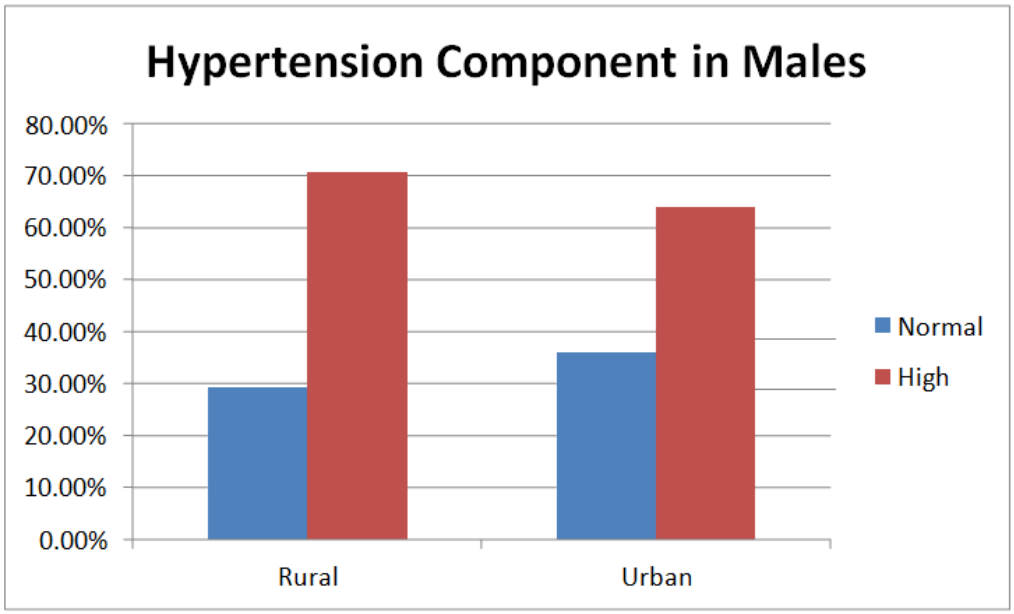

Figure 19 Bar graph showing comparison of hypertension component of the rural andurban male population

DISCUSSION

In this present study we want to explore the prevalence of various factors involved as a characterization of a metabolic syndrome. We know the components of MS had been significantly varied according to the local groups, their ethnics, division and the way of life/habits they used to follow. The clinical importance of these components not just signifies epidemiological values but related future complications as well. The benefit of these related components helps to interpret clinical expertise about different chances of upcoming another associated characterization if not created on time. When it comes with the prevalence of MS components, Western countries observed with higher incidence in which 35.5% of prevalence observed in USA while 24.9% observed in Latin America (3). When it comes to India and their sub-continent, the prevalence of 355 has been observed in which 40% of the population is of adult category. When we consider specifically about Punjab 38.8% of prevalence has been observed as per study conducted in 2018. In same study female observed with high prevalence of obesity while male with hypertriglyceridemia (7).

CONCLUSION

Here, from our present study we concluded that the prevalence of MS seen more common in female patient than male patients visiting Tagore Hospital and Heart Care Centre, Jalandhar, Punjab. The rate of prevalence of diabetes as a component of MS was seen much common in both sex while BMI as secondary most common prevalent in female sex contrast to that, male having TG as second most characterization. We also conclude that obesity is seen more common in female patients than male patient which signifies women in Jalandhar city are more prevalent to metabolic complications than men. We also concluded that the rural population was with high prevalence of TG in both the genders while normal HDL found to be more in rural as compared to urban. In case of hypertension we came out with higher prevalence in the urban female population while non- significant in rural population. In case of BMI, females came out with high BMI index as compare to males.

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