IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 14, Issue 10 Ver. IV (Oct. 2015), PP 100-106
www.iosrjournals.org

Prevalence of Metabolic Syndrome in newly diagnosed Type II Diabetes Mellitus

[1]Sudhagar Mookkappan, [2] Saranya Velusamy Chidambaram, [3]Nayyar Iqbal, [4]Aneesh Basheer, [5]Satyamanasa Gayatri Vinay.S

[1]Assistant Professor, Pondicherry Institute of Medical Sciences, Puducherry
[2]Senior Resident, Pondicherry Institute of Medical Sciences, Puducherry
[3]Assistant Professor, Pondicherry Institute of Medical Sciences, Puducherry
[4]Associate Professor, Pondicherry Institute of Medical Sciences, Puducherry
[5]Assistant Professor, Aarupadai Veedu Medical College and Hospital, Puducherry.

Abstract:
Background: *The metabolic syndrome includes a constellation of metabolic abnormalities that confers increased risk of cardiovascular disease and diabetes mellitus. A quarter of the world's adults have metabolic syndrome. People with metabolic syndrome are twice as likely to die from, and three times as likely to have a heart attack or stroke compared with people without the syndrome. People with metabolic syndrome have a five-fold greater risk of developing type 2 diabetes. This puts metabolic syndrome and diabetes way ahead of HIV/AIDS in morbidity and mortality terms yet the problem is not as well recognized.*
Aim and Objective: *The aim and objective of the present study is to assess the prevalence of metabolic syndrome in newly diagnosed type 2 diabetes mellitus aged 30 yrs and above and to determine the association of BMI, waist circumference, fasting blood sugars, blood pressure, fasting lipid profile with metabolic syndrome.*
Materials and Methods: *This is a cross-sectional study done among 150 OPD patients aged above 30 years of both the sexes who have been newly diagnosed as type II diabetes mellitus within the last 3 months. Detailed history and examination was done to record the blood pressure, waist circumference, height and weight. Fasting blood sugar, fasting lipid profile were performed. Diagnosis of Diabetes Mellitus was made based on ADA criteria and Metabolic syndrome was diagnosed based on modified NCEP: ATP III criteria and the data was analyzed using SPSS statistical software.*
Results and Discussion: *Out of 150 study group, 125 fulfilled the NCEP ATP III criteria for metabolic syndrome with 55 and 27 patients met 4 and 5 criteria respectively. The prevalence of metabolic syndrome in our study was 83.3% with male predominance though not statistically significant. Around 53% were among 40-60 years of age with 84.8% had high waist circumference, 73.6% had low levels of high density lipoprotein, 61.6% had high triglycerides, 67.2% had high blood pressure, 29.6% were obese and 41.6% were overweight. We found that with 1 cm increase in waist circumference there is 23% risk of developing metabolic syndrome. With 1 mm Hg increase in systolic blood pressure there is 14% risk of developing metabolic syndrome. With 1 mg/dl decrease in HDL there is 85% risk of getting metabolic syndrome. With 1 mg/dl increase in TGL there is 1% risk of getting metabolic syndrome.*
Conclusion: *The prevalence of metabolic syndrome in the present study is high. The most common risk factor was central obesity [which is measured by waist circumference] followed by low levels of High Density Lipoprotein followed by hypertension.*

I. Introduction

The metabolic syndrome or insulin resistance syndrome consists of constellation of metabolic abnormalities that confers increased risk of cardiovascular disease and diabetes mellitus. The major features of metabolic syndrome include central obesity, hypertriglyceridemia, low high density lipoprotein cholesterol, hyperglycemia and hypertension. A quarter of the world's adults have metabolic syndrome. People with metabolic syndrome are twice as likely to die from, and three times as likely to have a heart attack or stroke compared with people without the syndrome. People with metabolic syndrome have a five-fold greater risk of developing type 2 diabetes. Up to 80% of the 200 million people with diabetes globally will die of cardiovascular disease. This puts metabolic syndrome and diabetes way ahead of HIV/AIDS in morbidity and mortality terms yet the problem is not as well recognized.

With the formulation of the Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) (NCEP: ATP III) guidelines, some uniformity and standardization occurred in the definition of the metabolic syndrome and this has been very useful for

epidemiological purposes. Various criteria have been proposed by WHO[1], NCEP: ATP III[2], the European Group for the study of Insulin Resistance[3], and the International Diabetes Federation (IDF)[4]. There are essential components that are common to all definitions such as glucose intolerance, obesity, hypertension, and dyslipidemia though the exact criteria differ among definitions. Taken individually, each component of the metabolic syndrome is a well established risk factor for atherosclerotic cardiovascular disease (ASCVD). These factors act synergistically and increase the risk for ASCVD from two to three fold[5]. The NCEP: ATP III definition is better suited for clinical practice because it only requires measurement of fasting blood glucose[6].

We studied the prevalence of metabolic syndrome in newly diagnosed type 2 diabetes mellitus patients in the present study, so that we can create an awareness among the diabetic patients as well as concerned physicians about the importance of metabolic syndrome and thereby adequate measures may be taken to reduce the risk of cardiovascular disease.

II. Aims and Objectives

The aim and objective of the present study is to assess the prevalence of metabolic syndrome in newly diagnosed type 2 diabetes mellitus aged 30 yrs and above and to determine the association of BMI, waist circumference, fasting blood sugars, blood pressure, fasting lipid profile with metabolic syndrome.

III. Materials and Methods

This is a cross-sectional study done among 150 OPD patients aged above 30 years of both the sexes who have been diagnosed as type II diabetes mellitus within the last 3 months were included in the study. Patients on steroids, patients on anti psychotic medications were excluded from the study. Detailed history was taken and thorough examination was done to record the blood pressure, waist circumference, height and weight. Fasting blood sugar, fasting lipid profile were performed after taking informed consent. Diagnosis of Diabetes Mellitus was made based on ADA criteria and Metabolic syndrome was diagnosed based on modified NCEP: ATP III criteria. The data was analyzed using SPSS statistical software. Continuous variables were expressed using mean, standard deviation, range, and median. Categorical variables were expressed in terms of percentages. 95% confidence interval for the prevalence was estimated. Chi square test used to test for association between demographic and clinical variables of metabolic syndrome. To predict the variables associated with metabolic syndrome, odds ratios (unadjusted and adjusted) was estimated using binary logistic regression analysis. P value less than 0.05 was considered as statistically significant.

III.1. American Diabetes Association Criteria for diagnosis of Type 2 Diabetes Mellitus

a) Symptoms suggestive of type 2 diabetes plus random blood glucose level ≥ 200mg/dl or
b) Fasting plasma glucose level ≥126mg/dl or
c) HbA1C >6.5% or
d) 2 hrs plasma glucose ≥200mg/dl following an oral glucose tolerance test.

IV. Results and discussion

There were 150 patients who were newly diagnosed as having type 2 diabetes mellitus within past three months using the American Diabetes Association criteria (ADA) were included in our study. There are several criteria for metabolic syndrome like National Cholesterol Education Programme Adult Treatment Panel III (NCEP ATPIII), modified NCEP ATP III criteria, WHO criteria, International Diabetes Federation criteria (IDF), American Association of Clinical Endocrinologist criteria (AACE), European Group for the study of Insulin Resistance (EGIR) criteria. In our study we used modified NCEP ATP III criteria with South Asian cut off for waist circumference. In our study, as noted in table.no.1, male patients [n=84, 56%] are more compared to females [n=66, 44%] which is similar to a study done by Nahar et al[7] and Sawant et al[6]. In the present study, 114 were less than 60 years and 36 were more than 60 years. Among the 114, 37 subjects were within 30-39 years, 44 subjects were within 40-49 years, 33 were within 50 -59 years age group. A similar study done by Nahar et al also showed majority of the participants between 40-50 years[7].

Among 150 patients in our study, 97(64.7%) had BMI more than 25 kg/m^2, of which 56 being overweight and 41 being obese and 53(35.3%) had BMI less than 25 kg/m^2 of which 49 were of normal weight and 4 were underweight as listed in table. no.1. Nahar et al[7] shows that among their 200 participants, 42% were overweight and 7% were obese. Also in their study 49% had normal BMI and 2% had underweight BMI. It was noted as in table.no.1, that 113 (75.3%) patients had high waist circumference [which is ≥90cms in males and ≥80 cms in females as per modified NCEP ATP III criteria for metabolic syndrome], of which 47.8% were males and 52.2% were females [p value <0.001 which is statistically significant], when compared to 37 patients [24.7%] had normal waist circumference [which is <90cms in males and < 80 cms in females]. A study done by Katzmarzyk et al showed that there is a valuable role for waist circumference in metabolic syndrome[8]. A study

done by Bharadwaj et al in 459 subjects in India showed the prevalence of abdominal obesity assessed by waist circumference was 68.9% and was more common among women (74.8%) compared to men (62.2%)[9].

According to NCEP ATP III criteria, 71(47.3%) participants had triglycerides within normal limits and 79 (52.7%) participants had serum triglycerides above normal as listed in table.no.1. Of those [79 patients] with above normal triglycerides, 49 participants had borderline high serum triglycerides, 27 participants had high triglycerides and 3 participants had very high triglycerides and 44(55.7%) were males and 35 (44.3%) were females [the p value is 1.000 which is not statistically significant]. A study done by Mohan et al involving 1167 subjects in Chennai showed the prevalence of hypertriglyceridemia as 28.3%, dyslipidemia 40.2% and metabolic syndrome as 34.1%[10]. A study done in four selected regions of India showed that 29.5% had hypertriglyceridemia with the highest prevalence in Chandigarh and the common risk factors being obesity, diabetes[11].

In our study sample, 100(66.7%) patients had low levels of high density lipoproteins and 50 (33.3%) patients had high levels of high density lipoproteins according to modified NCEP ATP III criteria for metabolic syndrome as listed in table.no.1. Among those with low levels of high density lipoproteins, majority of them were females [58%] when compared to [42%]males, the p value is <0.001 which is statistically significant. A study done by Karadag et al in 109 heart failure patients showed that the prevalence of metabolic syndrome according to NCEP ATP III criteria was 51% and also it was significantly higher in females and the most prevalent parameters was found to be low HDL (69%) and hypertension(69%) [12] which shows that low HDL is one of the important risk factor for cardiovascular diseases.

As listed in table.no.1, among the total 150 participants, 45 (30%) had optimal levels of low density lipoproteins [LDL] according to ATP iii classification of low density lipoproteins. The remaining 105(70%) patients had high LDL [above 100 mg/dl]. A study shows that although LDL is not a component of metabolic syndrome, it was the commonly documented lipid abnormality in subjects with metabolic syndrome [13]. High LDL levels is one of the risk factors for developing cardiovascular complications. Among the 150 participants in our study, 107(71%) had desirable levels of total cholesterol which is < 200 mg/dl and remaining 43(29%) had above 200 mg/dl of total cholesterol as noted in table no.1. A study done by Joshi et al in India regarding prevalence of dyslipidemia has shown 13.9% of their study subjects had hypercholesterolemia and Tamil Nadu has the highest rates of hypercholesterolemia and high LDL levels [11]

Among the study population 87(58%) patients had high blood pressure [systolic blood pressure ≥ 130 mm Hg or diastolic blood pressure ≥ 85 mm Hg as per modified NCEP ATP III criteria for metabolic syndrome] and 63(42%) patients did not have high blood pressure as listed in table.no.1. Among those with high blood pressure, 54(62.1%) were males and 33(37.9%) were females with no statistical significance [P value is 0.096]. A study done by Alebiosu et al in Nigeria comprising of 218 type 2 diabetes patients, the prevalence of metabolic syndrome was 25.2% and systemic hypertension was the first most common component which was seen in 84(38.5%) patients[14]. Among the total 150 patients in our study, 135(90%) had high fasting blood sugars of which 17% had fasting blood sugar of > 250 mg/dl. 15 (10%) had impaired fasting glucose as listed in table.no.1.

Regarding the life style habits [as listed in table.no.1] of the 84 males in the study population, 51(60.7%) consume alcohol and 33(39.3%) do not consume alcohol. Among the 51 people who consume alcohol, 35 fulfilled the criteria for metabolic syndrome. Among the 33 participants who do not consume alcohol, 31 fulfilled the criteria for metabolic syndrome. When we compare the association of alcohol and metabolic syndrome the p value is 0.006 and is statistically significant. A study done has concluded that heavy alcohol drinking is associated with increased risk of getting metabolic syndrome [15]. But in our study though there is a positive correlation between alcohol and metabolic syndrome data regarding the amount of alcohol ingestion and the frequency of alcohol usage was not collected.

Regarding smoking, 39 (46.4%) had the habit of smoking and 45 (53.6%) do not smoke as listed in table no.1. None among the female study population had the habit of consuming alcohol and smoking. The association of smoking with metabolic syndrome is not significant [p value is 0.432]. A study shows positive correlation between smoking and metabolic syndrome and its individual components[16]. In our study we do not have the data regarding the number of cigarettes smoked per day and the frequency of smoking. Among the study population, 93 patients had a sedentary life style and 57 did not have a sedentary life style as listed in table no.1. Of those with a sedentary life style, 82 (88.2%) had metabolic syndrome and 11 (11.8%) had no metabolic syndrome. Among those who did not have a sedentary life style, 43 (75.4%) had metabolic syndrome and 14 (24.6%) did not had metabolic syndrome. A meta analysis has shown that people who spend more time in sedentary behaviour had a high possibility of having metabolic syndrome[17].

Table.no.1.Charateristics of patients in the study

Characteristics	Number [out of 150]	Percentage
Age groups		
30-39 years	37	24.70%
40-49 years	44	29.30%
50-59 years	33	22%
More than or equal to 60 years	36	24%
Gender		
Male	84	56%
Female	66	44%
Systolic blood pressure		
Normal	35	23.33%
Prehypertension	77	51.33%
stage I hypertension	29	19.33%
stage II hypertension	9	6%
Diastolic blood pressure		
Normal	45	30%
Prehypertension	50	33.33%
Stage I hypertension	39	26%
stage II hypertension	16	10.66%
Body mass index		
Underweight [<18.5]	4	2.66%
Normal [18.5-24.9]	49	32.66%
Overweight [25-29.9]	56	37.33%
Obesity [≥30]	41	27.33%
Waist circumference		
Normal	37	24.70%
High [≥90 cms in males and ≥80 cms in females]	113	75.30%
Serum triglycerides		
Normal [< 150 mg/dl]	71	47.33%
Boderline high [150-199 mg/dl]	49	32.66%
high [200-499mg/dl]	27	18%
Very high [≥500 mg/dl]	3	2%
High density lipoprotein		
Low [<40 in males and <50 in females]	100	66.70%
Normal [≥40 in males and ≥50 in females]	50	33.33%
Low density lipoprotein		
Optimal [<100mg/dl]	45	30%
Near optimal [100-129 mg/dl]	57	38%
Boderline high [130-159 mg/dl]	28	18.66%
High [160-189 mg/dl]	13	8.66%
Very high [≥190 mg/dl]	7	4.66%
Total cholesterol		
Desirable [<200mg/dl]	107	71.33%
Boderline high [200-239mg/dl]	27	18%
High [≥240mg/dl]	16	10.66%
Fasting blood sugar		
Impaired fasting glucose [100-125mg/dl]	15	10%
High fasting glucose[126-250mg/dl]	110	73.33%
Very high fasting glucose [>250mg/dl]	25	16.66%
Sedentary life style		
Yes	93	62.00%
No	57	38.00%
Family history of diabetes		
Yes	117	78.00%
No	33	22.00%
Smoking		
Men with habit of smoking	39	46.40%
Men with no habit of smoking	45	53.60%
Women with habit of smoking	0	0.00%
Women with no habit of smoking	66	100.00%
Alcohol consumption		
Men with habit of alcohol consumption	51	60.70%
Men with no habit of alcohol consumption	33	39.30%
Women with habit of alcohol consumption	0	0.00%
Women with no habit of alcohol consumption	66	100.00%

Regarding the family history of diabetes [as listed in table.no.1] among the study population, 117 had a positive family history of diabetes mellitus and 33 had no family history of diabetes mellitus. Among those [n=117] with a family history of diabetes mellitus, 106(90.6%) had metabolic syndrome and 11(9.4%) did not have metabolic syndrome. Among those [n=33] with no family history of diabetes mellitus, 19 (57.6%) had metabolic syndrome and 14(42.4%) did not have metabolic syndrome. A study done in India with 448 subjects showed that family history of diabetes mellitus had significant role in individuals with metabolic syndrome and they showed that individuals with history of both parents having diabetes had significantly higher waist circumference and BMI[18].

Among the 125 participants who fulfilled the criteria for metabolic syndrome in our study, 82 (67%) fulfilled four or more components for metabolic syndrome. Among them 55 had four components and 27 met all the five components as in table no.2. In our study majority had high waist circumference followed by low HDL followed by hypertension. A study done by Ogbera in Lagos involving 963 general population, 5.8% met four components, 41 % met three components and 53.2% met two components of NCEP ATP III criteria [13]. In their study they selected general population but our study was done in diabetic population in which all participants already fulfilled one component in NCEP ATP III criteria for metabolic syndrome [fasting blood sugars]. In our study the prevalence of metabolic syndrome in newly diagnosed type 2 diabetes was 83.3% with confidence interval of 76.4-88.9. A study done by Nahar et al in Sylhet also showed similar results of prevalence of metabolic syndrome in newly diagnosed type 2 diabetes mellitus which was 81% according to modified NCEP ATP III criteria, 73.5% according to NCEP ATP III criteria, 82.5% according to modified WHO criteria and 61% according to IDF criteria[7].

Of those with metabolic syndrome in our study as in table no.2, 66(52.8%) were male and 59 (47.2%) were females with no statistical significance [p value=0.121]. A study done by Osuji et al in Nigeria showed that metabolic syndrome in newly diagnosed diabetes mellitus according to NCEP ATP III criteria was 66.7%.

They concluded that the most common risk factor in their study was hypertension and the prevalence of metabolic syndrome was higher in females compared to male with statistically significant difference[19]. It was also noted as in table no.2, that 24% patients were between the age group of 30 – 39 years, 32% patients were between 40-49 years, 20.8% were between 50-59 years and 23.2% were 60 years and above. The association between age distribution and prevalence of metabolic syndrome was not found to be statistically significant [p value of 0.460]. Sawant et al has shown that the prevalence of metabolic syndrome in their study did not change much with respect to age difference, however they showed marginal decrease in metabolic syndrome in patients with age group more than 60 years [6]. It was also noted that among those with metabolic syndrome, 106 patients had high waist circumference, 92 patients had low levels of high density lipoprotein, 77 patients had high levels of serum triglycerides and 84 patients had high blood pressure as listed in table.no.2. With regard to BMI among those with metabolic syndrome, 37(29.6%) were obese, 52 (41.6%)were overweight, 35(28%) were normal and 1(0.8%) was underweight, with a highly significant statistical association [p value <0.001] as in table.no.3. Another study shows a similar significant association of BMI with metabolic syndrome [20].

Table.no.2. Characteristics of patients with metabolic syndrome in the study

Characteristics	Patients with Metabolic syndrome [number]	Percentage
Prevalence	125	83.33%
Gender		
Males	66	78.57%
Females	59	89.39%
Age group		
30-39 years	30	24%
40-49 years	40	32%
50-59 years	26	20.80%
≥60 years	29	23.20%
High Waist circumference	106	84.80%
Low HDL levels	92	73.60%
High triglycerides	77	61.60%
High blood pressure	84	67.20%
Body mass index		
Obese	37	29.60%
Overweight	52	41.60%
Normal	35	28%
Underweight	1	0.80%

In our study among the total male participants as noted in table no.3, we compared the mean BMI with waist circumference < 90cm and ≥90 cms and found to be statistically significant with a p value of <0.001. We

also compared total cholesterol , HDL levels, LDL levels , triglycerides, fasting blood sugars, systolic and diastolic blood pressure among males with waist circumference of <90 cms and ≥90 cms and did not show any statistical significance.

Table.no.3. Comparison of various components of metabolic syndrome among males with normal and high waist circumference

Components	Waist circumference [<90 cm]	Waist circumference [≥90cm]	p value
Body mass index	22.803	27.989	0.000 [significant
Total cholesterol	177.17	177.15	0.999
High density lipoprotein	37.23	37.59	0.888
Low density lipoprotein	119.37	115.06	0.636
Triglycerides	38.98	44.45	0.328
Fasting blood sugar	42.17	42.69	0.928
Systolic blood pressure	39.25	44.31	0.358
Diastolic blood pressure	40.07	43.85	0.484

In our study among the total female participants as noted in table no.3, we compared the mean BMI with waist circumference < 80cm and ≥80 cms and found to be statistically significant with a p value of 0.01. We also found statistically significant association between the mean TGL in females with WC <80 cm and WC ≥80 cm with a p value of 0.000. In addition to this, in our study the mean LDL in females with WC <80 cm and WC ≥80 cm were 76.29 and 120.31 mg/dl respectively with statistically significant p value of 0.002 as noted in table.no.4. A Study done by Weinbrenner et al has shown that high waist circumference was associated with increased concentration of oxidised LDL independent of BMI in men and women[21]. We also compared total cholesterol , HDL levels, fasting blood sugars, systolic and diastolic blood pressure among females with waist circumference of <80 cms and ≥80 cms which did not show any statistical significance.

Table.no.4. Comparison of various components of metabolic syndrome among females with normal and high waist circumference

Components	Waist circumference [<80cm]	Waist circumference [≥80 cm]	p value
Body mass index	22.757	28.207	0.01 [significant]
Total cholesterol	154.43	179.68	0.137
High density lipoprotein	43.14	40.66	0.468
Low density lipoprotein	76.29	120.31	0.002 [significant]
Triglycerides	9.29	36.37	0.000 [significant]
Fasting blood sugar	41.5	32.55	0.252
Systolic blood pressure	38.29	32.93	0.493
Diastolic blood pressure	22.64	34.79	0.092

In our study we also calculated the risk associated with metabolic syndrome with its various components using adjusted odds ratio. With 1 cm increase in waist circumference there is 23% risk of getting metabolic syndrome with p value of 0.001. With 1 mm Hg increase in systolic blood pressure there is 14% risk of getting metabolic syndrome with p value of 0.005. With 1 mg/dl increase in HDL there is 85% risk of getting metabolic syndrome with p value of 0.001. With 1 mg/dl increase in TGL there is 1% risk of getting metabolic syndrome with p value of 0.031. The other parameters like BMI and DBP did not show statistically significant risk.

V. Summary and Conclusion

There are 150 newly diagnosed type 2 diabetes mellitus patients in our study group with more Males (56%) when compared to females(44%) with maximum number of subjects between 40-49 years. Among the total participants, 37.3% patients were overweight, 27.3% were obese, 75.3% had high waist circumference and 66.7% had low HDL with statistically significant female predominance. About 58% patients had high blood pressure and 52.7% participants had high triglycerides with male predominance though not statistically significant.

Out of study group, 125 patients fulfilled the NCEP ATP III criteria for metabolic syndrome with a high prevalence of 83.3% and higher prevalence among males than females though not statistically significant. Among patients with metabolic syndrome, 52.8% were among 40-60 years of age, 84.8% had high waist

circumference, 73.6% had low levels of high density lipoprotein, 61.6% had high triglycerides and 67.2% had high blood pressure, 29.6% were obese and 41.6% were overweight. Our study showed a statistically significant association between waist circumference and triglycerides in females. Although LDL is not a component of metabolic syndrome, there was a significant association between waist circumference and LDL cholesterol. There was a significant association between alcohol intake and metabolic syndrome.

We also found that with 1 cm increase in waist circumference, there is 23% risk of developing metabolic syndrome; with 1 mm Hg increase in systolic blood pressure, there is 14% risk of developing metabolic syndrome; with 1 mg/dl decrease in HDL, there is 85% risk of getting metabolic syndrome and with 1 mg/dl increase in TGL, there is 1% risk of getting metabolic syndrome. It is also noted that the most common risk factor encountered was central obesity [which is measured by waist circumference] followed by low levels of HDL and followed by hypertension. Therefore it is important to create awareness among both the diabetic patients and the clinicians regarding the importance of identifying the components of metabolic syndrome and thereby to promote necessary interventions that help in reducing the risk of cardiovascular complications.

Bibliography

[1]. Fowler MJ. Microvascular and macrovascular complications of diabetes. Clinical Diabetes April. 2008 vol ; 26(2): 77-82.

[2]. Buse JB, Ginsberg HN, Bakris GL, Clark NG, Costa F, Eckel R, Fonseca V. Primary prevention of cardiovascular diseases in people with diabetes mellitus: a scientific statement from the American Heart Association and the American Diabetes Association. Diabetes Care.2007; 30: 162–172.

[3]. Eckel RH. The Metabolic Syndrome. In : Longo DL, Fauci AS, Kasper DL, Hauser SL, Jameson JL, Loscalzo J, editors. Harrison's principles of internal medicine.18th edition. New York: McGraw Hill; 2012.p.1992-1997.

[4]. Misra A, Khurana L. The metabolic syndrome in South Asians: epidemiology, determinants, and prevention. Metab Syndr Relat Disord. 2009 Dec; 7(6):497-514.

[5]. Lisak M, Demarin V, Trkanjec Z, Basic-kes V. Hypertriglyceridemia as a possible independent risk factor for stroke. Acta Clin Croat.2013 Dec; 52(4):458-63.

[6]. Sawant A, Mankeshwar R, Shah S, Raghavan R, Dhongde G, Raje H. Prevalence of metabolic syndrome in urban India. Cholesterol.2011; Article ID 920983.

[7]. Nahar S, Rahman MZ, Ullah M, Debnath BC, Sultana N, Farhad CMRQ. Prevalence of Metabolic Syndrome in Newly Diagnosed Type 2 Diabetes mellitus. Cardiovasc.J.2011; 4(1):17-25.

[8]. Katzmarzyk P T, Janssen I, Ross R, Church TS, Blair SN. The importance of waist circumference in the definition of metabolic syndrome.Diabetes care.2006; 29(2):404-409.

[9]. Bharadwaj S, Misra A, Misra R, Goel K, Bhatt SP, Rastogi K. High prevalence of abdominal, intra-abdominal and subcutaneous adiposity and clustering of risk factors among urban asian Indians in north India. PLoS One. 2011; 6(9): e 24362.

[10]. Mohan V, Deepa M, Farooq S, Prabhakaran D, Reddy KS. Surveillance for risk factors of cardiovascular disease among an industrial population in southern India. Natl Med J India.2008 Jan – Feb; 21(1):8-13.

[11]. Joshi SR, Anjana RM, Deepa M, Pradeepa R, Bhansali A, Dhandania VK. Prevalence of Dyslipidemia in urban and Rural India: The ICMR-INDIAB Study. PLoS ONE.2014;9(5): e 96808.

[12]. Karadag MK, Akbulut M. Low HDL levels as the most common metabolic syndrome risk factor in heart failure. Int Heart J.2009 sep ; 50(5):571-80.

[13]. Ogbera A O. Prevalence and gender distribution of the metabolic syndrome. Diabetol Metab Syndr.2010; 2:1.

[14]. Alebiosu CO,Odusan BO. Metabolic syndrome in subjects with type 2 diabetes mellitus. J Natl Assoc. Jun 2004; 96(6):817-821.

[15]. Baik L,Shin C.Prospective study of alcohol consumption and metabolic syndrome. AMJ Clin Nutr.2008 May; 87(5):1455-63.

[16]. Chen CC, Li TC, Chang PC, Liu WY, Wu MT, Li CL. Association among cigarette smoking, metabolic syndrome, and its individual components: the metabolic syndrome study in Taiwan. Metabolism.2008 Apr;57(4):544-8.

[17]. Edwardson CL, Gorely T, Davies MJ, Gray LJ, Khunti K, Wilmot EG et al. Association of sedentary behaviour with metabolic syndrome: A Meta-Analysis. PLoS ONE.2012; 7(4): e34916.

[18]. Das M, Pal S, Ghosh A. Family history of type 2 diabetes and prevalence of metabolic syndrome in adult Asian Indians. J Cardiovasc Dis Res.2012 Apr-Jun; 3(2):104-108.

[19]. Osuji CU, Nzerem BA, Dioka CE, Onwubuya EI. Metabolic syndrome in newly diagnosed type 2 diabetes mellitus using NCEP-ATP III, the Nnewi experience. Niger J Clin Pract.2012 oct-dec;15(4):475-80.

[20]. Mangat C, Goel NK, Walia DK, Agarwal N, Sharma M K, Kaur J. Metabolic Syndrome: a challenging health Issue in highly urbanized Union Territory of north India. Diabetol Metab syndr.2010 Mar 23; 2:19.

[21]. Weinbrenner T, Schroder H, Escurriol V, Fito M, Elosua R, Vila J. Circulating oxidised LDL is associated with increased waist circumference independent of body mass index in men and women. AMJ Clin Nutr.2006 Jan;83(1):30-5.