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ORIGINAL ARTICLE

Prevalence of Dyslipidemia and Hypertension in Indian Type 2 Diabetic Patients with Metabolic Syndrome and its Clinical Significance

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Abstract
Objectives: The present study was designed to estimate the prevalence of dyslipidemia and hypertension based on the National Cholesterol Educational Programme Adult Treatment Panel III definition of metabolic syndrome (MetS). The study also focuses on prevalence for MetS with respect to the duration of disease in Gwalior–Chambal region of Madhya Pradesh, India.
Methods: Type 2 diabetic patients ($n = 700$) were selected from a cross-sectional study that is regularly being conducted in the School of Studies in Biochemistry, Jiwaji University Gwalior, India. The period of our study was from January 2007 to October 2009. Dyslipidemia and hypertension were determined in type 2 diabetic patients with MetS as per National Cholesterol Educational Programme Adult Treatment Panel III criteria.
Results: The mean age of the study population was 54 ± 9.3 years with 504 (72%) males and 196 (28%) females. The prevalence of MetS increased with increased duration of diabetes in females; however, almost constant prevalence was seen in the males. Notable increase in the dyslipidemia (64.1%) and hypertension (49%) in type 2 diabetic patients were seen. The steep increase in dyslipidemia and hypertension could be the reason for the growing prevalence of diabetes worldwide. The study also noted a close association between age and occurrence of MetS.
Conclusion: Individual variable of MetS appears to be highly rampant in diabetic population. Despite treatment, almost half of patients still met the criteria for MetS. Effective treatment of MetS components is required to reduce cardiovascular risk in diabetes mellitus hence accurate and early diagnosis to induce effective treatment of MetS in Indian population will be pivotal in the prevention of cardiovascular disease and type 2 diabetes.

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1. Introduction

Metabolic syndrome (MetS) is a group of anthropological and biochemical abnormalities that confers a greater risk factor for type 2 diabetes mellitus (T2DM) and cardiovascular disease (CVD) [1]. Gerald Reaven [2] introduced the concept of the syndrome in 1988. Later, this constellation of CVD risk factors was given a number of names, such as Syndrome X, dysmetabolic syndrome, insulin resistance syndrome, and the deadly quartet [3,4]. Dyslipidemia and hypertension are classical constituents of MetS. The underlying mechanism for development of hypertension and hyperlipidemia in the MetS has been clearly established [5,6]. Insulin resistance and obesity play a central role in causing hypertension and dyslipidemia, and further predisposes to MetS [7,8]. Cuspidi et al [9] and Schillaci et al [10] observed the prevalence of MetS in almost one third of the hypertensive patients observed in their studies. In obese individuals, the prevalence of MetS is about 40% [11]. Therefore, high blood pressure and dyslipidemia were included for efficiently diagnosing MetS in the National Cholesterol Educational Programme Adult Treatment Panel III (NCEP-ATPIII). Currently, the rate of MetS is increasing globally, even in the general population [12]. The recent increase in cardiovascular mortality and morbidity in diabetic patients [13] offer the ample time to apply these criteria for predicting the risk of CVD in these populations [14]. Macrovascular complications are indeed the most common cause of morbidity and mortality in patients with T2DM [15].

The study follows ATP III criteria for predicting the occurrence of MetS. The definition is an effort to make the criteria more user-friendly for medical practitioners. Unlike the other definitions, no single risk factor is required. Any three of five factors [increased waist circumference, high triglyceride, low high-density lipoprotein-cholesterol (HDL-C), elevated blood pressure, and high fasting plasma glucose] are sufficient to establish the diagnosis. The primary goal of NCEP is to identify individuals at increased risk of CVD [16]. Recently, the NCEP-ATPIII definitions for MetS were renewed to include the new cut-off waist circumference and fasting glucose for the Asia-Pacific Region [17].

The present study was performed to determine the prevalence of dyslipidemia and hypertension in T2DM patients with MetS. Accurate information regarding the prevalence of dyslipidemia and hypertension in studied populations will predict the exact threat for a particular disorder and aid in the early diagnosis and possible prevention of CVD.

2. Materials and methods

2.1. Study participants

T2DM patients were selected from a weekly diabetes camp organized in the School of Biochemistry, Jiwaji University Gwalior, India. The period of study was between January 2007 and October 2009. The cross-sectional study included 504 males and 196 females, with a mean age of 55 ± 9.15 years and 53.1 ± 9.6 years, respectively. Information about participants' age, sex, monthly income, life style, family history of diabetes, and prior diseases/disorders history were recorded. Before registering for the study written consent was obtained from the participants, expressing their willingness to participate in the study. Ethical approval was obtained from the Jiwaji University Gwalior prior to commencement of the study. The study design and experimental protocols were approved by the Institutional Human Ethics Committee. Selected anthropometrical parameters such as height, weight, and waist circumferences were measured with the participant being barefooted and dressed lightly. The abdominal (waist) circumference was measured at the end of expiration, by wrapping a tape at the level of the umbilicus. Body mass index (BMI) was calculated as kg/m^2. Blood pressure (BP) was measured with a special precaution to reduce the variation of BP value with resting values; individuals were requested to take 10 minutes rest prior to measuring the BP with a standard electronic BP measuring instrument.

2.2. Blood sample collection

Fasting blood samples were collected in EDTA vial and plasma was separated by centrifuging the blood samples at 8000 rpm for 10−15 minutes following which the fasting blood glucose was measured by glucose oxidase−peroxidase method using a kit (Monozyme India Limited, Ahmadabad, India) [18]. Total cholesterol, triglyceride, and HDL-C levels were estimated by spectrophotometric assays employing commercially available kits [19−21]. Low- and very-low-density lipoproteins were calculated from Freidewald's formula.

2.3. Definitions for diagnosing dyslipidemia and hypertension

For diagnosing of dyslipidemia, triglyceride and HDL-C level were used as parameters. Plasma triglycerides (≥150 mg/dL); HDL-C (<40 mg/dL for males and <50 mg/dL for females); and hypertension (≥130/85 mmHg) as listed in NCEP guidelines [16].

2.4. Statistical analysis

Data are expressed as mean ± standard deviation. Student t test was used for deducting the mean of the two groups. A p value of <0.05 was considered as statistically significant. The age specific distribution of the prevalence of MetS were calculated separately for males and females described in percentages. Data were analyzed employing Sigma Stat, statistical software, version 1.0 (Jandel Corporation, San Rafael, CA, U.S.A) for descriptive statistics.

3. Results

The study shows that the prevalence of MetS was 41% in males and 58% in females. Table 1 represents the frequency of MetS, hypertension, and dyslipidemia in the selected population stratified by sex. Hypertension and dyslipidemia were frequently observed in T2DM populations involved in the study. Out of 504 males and 196 females, hypertension was observed as 55.2% and 42.9%, respectively, in the total population, which was found to be statistically significant ($p < 0.001$). The prevalence of dyslipidemia in T2DM population were 56.3% and 72% in males and females, respectively.

The mean age of the studied population was calculated to be 54 years. The duration of diabetes in the study participants was 1−20 years with a mean of 6 years. Table 2 depicts the clinical data representing the anthropometrical and biochemical parameters of the patients categorized by the duration of disease. The prevalence of MetS was evaluated in patients with a different duration of disease (0−5 years, 6−10 years, > 10 years), in relation to age, fasting, BMI, systolic BP, diastolic BP, pulse, cholesterol, triglyceride, and HDL-C. In males, the prevalence was 37% under 0−5 years. Prevalence of MetS in T2DM patients with a duration of disease 6−10 years and >10 years were 39.4% and 39%, respectively. In females, the prevalence was 53% with duration of the disease <5 years and increased to 56% and 68% in 6−10 years, and >10 years of disease duration, respectively. The overall prevalence of MetS in T2DM patients studied was significantly ($p < 0.001$) higher in females (58.2%) than in males (41%; Tables 1 and 2). The occurrence of MetS female patients with a lesser duration of disease exhibited lower prevalence when compared with those females with >10 years of disease duration but the same was not found to be consistent in males. The prevalence in females increased from 53% to 68% with an increase in the duration of disease from <5 years to >10 years.

The association between age group and occurrence of MetS in type 2 diabetic patients is represented in Table 3. The patients were grouped into five categories based on their age (25−34 years, 35−44 years, 45−54 years, 55−64 years, and <65 years). Coded values in the dataset were given with respect to each age group. The patients with MetS were coded as "yes" and those without MetS were coded "no". The odd ratio for the MetS was seen to increase with age in all populations except the elderly. It was noted that in the age group of 55−64 years, the odds are almost five times higher for the MetS compared with the baseline.

Table 4 shows the percentage of individual variables in the MetS patients categorized by NCEP-ATP III in males and females. The total number of MetS patients in the studied population was 321, of which 207 were males and 114 were females. The elevated waist circumference (>102 cm (M) >88 cm (F)) among MetS was found to be 38%, of which 22%, were males and 68.4% females. Out of all MetS patients 77% were hypertensive, of which 85% were males and 64% were females. The percentage of high triglyceride and low HDL-C levels in the total MetS population was 49% and 62% respectively; in males this was 49% and 58%, and 50% and 67.5% in females, respectively.

Prevalence rate of the individual components of MetS at baseline variables are shown in Table 5. Out of 700 patients 504 were males. The occurrence of MetS was higher in females with 58% frequency. The crude relative prevalence of MetS in the female patients was found to be statistically significant ($p < 0.05$) when compared with the male population. The influence of the potential factors of dyslipidemia and hypertension in the MetS definition was determined by univariate analysis. The fasting blood glucose was classified according to the level as 111−150 mg/dL, 151−190 mg/dL, and ≥191 mg/dL, with crude relative prevalence of 2.5, 2.29, and 2.22 respectively with an observed ($p \leq 0.001$) significance. The systolic blood pressure level was 130−149 mmHg and 150−169 mmHg with significant

Table 1. Frequency of metabolic syndrome, hypertension, and dyslipidemia in the studied population with respect to gender.

	Male ($n = 504$), n (%)	Female ($n = 196$), n (%)	Difference (95% CI)[a]
Metabolic syndrome			
Absent	297 (59)	82 (41.8)	
Present	207 (41)	114 (58.2)	$p < 0.05$
Hypertension[b]			
Absent	226 (44.8)	112 (57.1)	
Present	278 (55.2)	84 (42.9)	7.8 (3.739, 11.861)**
Dyslipidemia[c]			
Absent	220 (43.6)	55 (28)	
Present	284 (56.3)	141 (72)	9 (−5.34, 23.34)

[a]Difference is the difference in the mean or percentage of the variable between males and females; [b]Hypertension: systolic blood pressure ≥130 mmHg or diastolic blood pressure ≥85 mmHg or use of oral antihypertensive medication; [c]Dyslipidemia: triglyceride ≥150 mg/dL or HDL cholesterol <40 mg/dL (0.9 mmol/L) in men or < 50 mg/dL (1.0 mmol/L) in women. *p < 0.05. **p < 0.001.

Table 2. Clinical data of type 2 diabetic patients in respect to the duration of disease classified by using NCEP-ATPIII criteria.

Males	*N*	Age (y)	Fasting (mg/dL)	BMI (kg/m^2)	SBP (mmHg)	DBP (mmHg)	Pulse	Cholesterol (mg/dL)	Triglyceride (mg/dL)	HDL-C (mg/dL)	Prevalence, %
All males	504	55 ± 9.15	140 ± 63.27	24.7 ± 3.23	132.7 ± 19.2	76.7 ± 10.3	87 ± 10.8	155 ± 54	137 ± 64.2	50 ± 18.6	41
Duration (0−5 y)	339	53.5 ± 8.9	136.8 ± 54.9	24.9 ± 3.8	132.4 ± 20	77.9 ± 11.7	88 ± 11.4	155.7 ± 55.3	132.3 ± 60.4	51.4 ± 23.6	37
Duration (6−10 y)	104	56.2 ± 9.7	149.2 ± 59.9	24.8 ± 4.8	130.9 ± 20.8	74.9 ± 9.8	86.6 ± 11	155.9 ± 47.6	144.6 ± 90.8	48.2 ± 23.1	39.4
Duration (> 10 y)	61	60.25 ± 9.1	139.9 ± 54.8	23.5 ± 2.5	137.3 ± 22.8	72.8 ± 10.4	86.6 ± 10.1	152 ± 65.9	135.2 ± 66.1	45.7 ± 19.5	39
Females											
All females	196	53.1 ± 9.6	157.8 ± 70	25.9 ± 4.3	127 ± 16.1	74.2 ± 9.6	92 ± 12.9	169.3 ± 49	138.8 ± 67.8	49.8 ± 22.9	58.20
Duration (0−5 y)	130	51.7 ± 8.84	154.4 ± 64.6	26.1 ± 4.3	126.3 ± 15.9	74.6 ± 9.7	91.8 ± 10	170.8 ± 43.8	138.1 ± 64.9	49.3 ± 24.5	53
Duration (6−10 y)	50	54.62 ± 11.08	149.7 ± 52.3	26 ± 4.28	131 ± 19.7	73.8 ± 10.8	90.5 ± 10.3	166.8 ± 50.1	132.9 ± 59.5	49.4 ± 19.8	56
Duration (> 10 y)	16	59.31 ± 10.4	210 ± 78.2	23.1 ± 3.45	123.7 ± 17.8	71 ± 9.94	98.8 ± 21	165.1 ± 54.5	163.1 ± 65.9	55.2 ± 15	68

Data are presented as mean ± SD. BMI = body mass index; DBP = diastolic blood pressure; HDL-C = high density lipoprotein cholesterol; SBP = systolic blood pressure.

($p \leq 0.001$) crude relative prevalence of 2.85 and 2.91. The systolic BP $\geq$ 170 mmHg had crude relative prevalence of 2.49 with $p \leq 0.01$, which indicates strong association of systolic BP with MetS. Similar results were observed in diastolic BP. The triglyceride levels 150−299 mg/dL and ≥300 mg/dL illustrated a crude relative prevalence of 2.10 and 1.84 with a significance of $p \leq 0.001$ and $p \leq 0.05$, respectively. Significance of $p \leq 0.01$ and $p \leq 0.05$ was also observed in HDL-C level in the range 40−49 mg/dL and >50 mg/dL, respectively.

4. Discussion

The aim of the present study was to focus on the prevalence of dyslipidemia and hypertension in studied population as per the definition of NCEP-ATPIII criteria in an urban setting. The study included T2DM patients who attended the diabetes camp in 2007−2009 (every weekend) organized by Jiwaji University Gwalior. This study elucidates the individual and clustering of cardiovascular risk factors, like hypertension, obesity, including the MetS in T2DM. Cardiovascular risk factors in T2DM are the common causes of morbidity and mortality in patients with diabetes. In a developing nation such as India, limited information is available about the prevalence of dyslipidemia and hypertension in T2DM patients.

From this study we have found that the prevalence of MetS in the studied population was 45.8% based on NCEP-ATPIII criteria [22]. We reported hypertension were significantly prevalent ($p < 0.001$) in 55.2% of males and in 42.9% of females. The high prevalence of MetS was dependent on the duration of disease in both the sexes. The prevalence was increased from 58.2% to 68% with an increase in the duration of disease in females from <5 years to >10 years (Table 2). The present study also observed that the odds ratio for MetS increased with an increase in age in the diabetic population (Table 3). The association of age and the development of MetS in the normal and diabetic population has already been observed in several of studies [23−25].

In this study, 50% of the participants had high systolic and diastolic BP, and low HDL-C (Table 4). Prevalence rates of individual components of MetS by baseline variables are shown in Table 5. The table shows, that on moving from baseline to higher levels in systolic as well as diastolic BP, triglyceride, and HDL-C, the crude relative prevalence in each parameter has increased significantly. The present study corroborates with the observations of previous studies [26−29]. Over half of the participants had hypertension and dyslipidemia, which is in accordance with the previously reported studies [23,30]. We found an overall prevalence of dyslipidemia and hypertension in the

Table 3. The association between age group and occurrence of metabolic syndrome in type 2 diabetic patients.

Age group (y)	Coded value in dataset[a]	Metabolic syndrome		Odds of syndrome	Odds ratio compared to baseline group
		Yes	No		
25–34	0	2	9	0.22	1
35–44	1	35	49	0.71	3.27
45–54	2	121	148	0.81	3.68
55–64	3	106	100	1.06	4.81
>65	4	57	73	0.78	3.5

[a]*Coded values in dataset were given with respect to each age group.*

studied population as 64.1% and 49%, respectively (Table 1). Hypertension and dyslipidemia were found to be significantly more common among females with MetS (Table 4).

Our study also provides the first estimate of the prevalence of dyslipidemia and hypertension in an urban population of T2DM patients attributed to the lower cut-off for waist circumference and higher cut-off for HDL-C in females as compared to males. Therefore, more females were classified as having high waist circumference or low HDL-C. Males, by contrast, were likely to have hypertension. The overall prevalence of hypertension among the studied population was 49% and was different between males and females (Table 1). This was not consistent with the study reported by Kengne et al [31], who observed an equal prevalence among males

Table 4. Frequency of high waist circumference, high blood pressure, elevated triglyceride, and low high density lipoprotein cholesterol (HDL-C) in metabolic syndrome patients diagnosed by National Cholesterol Educational Programme Adult Treatment Panel III criteria.

Characteristics		Males	Females
Metabolic syndrome	321	207	114
High waist circumference	123 (38)	45 (22)	78 (68.4)
High blood pressure	248 (77)	175 (85)	73(64)
Elevated triglyceride	158 (49)	101 (49)	57(50)
Low HDL-C	98 (62)	121 (58)	77 (67.5)

Data are presented as *n* (%).

Table 5. Prevalence rates of systolic and diastolic blood pressure (BP) and dyslipidemic parameters by baseline variables.[a]

Variables	Numbers	Metabolic syndrome	Prevalence (%)	Crude relative prevalence (95% CI)
Systolic BP				
<130	359	87	24.2	1
130–149	221	153	69	2.85 (2.06, 3.95)***
150–169	82	58	70.7	2.91 (1.89, 4.47)***
≥170	38	23	60.5	2.49 (1.34, 4.54)**
Diastolic BP				
<80	459	154	34	1
80–90	162	104	64	1.91 (1.38, 2.62)***
≥90	79	63	80	2.37 (1.59, 3.52)***
Triglyceride				
<150	473	161	34	1
150–299	192	138	72	2.10 (1.57, 2.82)***
≥300	35	22	63	1.84 (0.99, 3.34)*
HDL-C				
>40	254	150	59	1
40–49	171	60	35	0.59 (0.40, 0.86)**
≥50	275	111	40.3	0.68 (0.501, 0.931)*

[a]*Relative prevalence (with 95% confidence interval). Hypertension: systolic blood pressure ≥130 mmHg or diastolic blood pressure ≥85 mmHg or use of oral antihypertensive medication. Dyslipidemia: triglyceride ≥150 mg/dL or high density lipoprotein-cholesterol (HDL-C)< 0.9 mM in men or < 1.0 mM in women.* *p < 0.05. **p < 0.01. ***p < 0.001.

and females. Moreover, in our study, hypertension observed in males was higher than that in females, which is in accordance with Marjani and Shirafkan's [32] observations in Gorgan T2DM patients. The overall prevalence of dyslipidemia in our recruited population was 64.1%, which was higher than that reported in the study by Janghorbani and Amini [33] in a follow-up T2DM population.

The study concludes that hypertension in males was higher than in females of T2DM populations whereas dyslipidemia was more predominant in females. The cross-sectional study by Janghorbani and Amini [34] in T2DM report significantly higher prevalence of both hypertension and dyslipidemia in females. The prevalence of high waist circumference, high BP, and low HDL-C in MetS group of diabetic patients was 38%, 77%, and 62%, respectively (Table 4), indicating high risk factors for cardiovascular morbidity and mortality in the future. Our study on the prevalence of dyslipidemia and hypertension in MetS correlates with the study on the Nigerian population conducted by Osuji et al [35]. In the MetS population, the current study found 55.5% of patients to be dyslipidemic (Table 4) whereas Janghorbani and Amini [33] reported only 36.6% of dyslipidemic patients in one of the prospective follow-up study.

The prevalence of hypertension in MetS patients in our study population was 77%, which is higher than in those studies reported earlier on MetS patients [34]. In adults with T2DM, the presence of MetS was associated with a fivefold increase in CV risk independent of age, sex, smoking status, and glycated hemoglobin (HbA1c) [36]. Therefore, it is necessary that assertive therapy be aimed at controlling hyperglycemia, dyslipidemia, and hypertension. Accurate information regarding the prevalence of dyslipidemia and hypertension associated risk factors in people with T2DM plays a significant role for the prevention or delaying of fulminant complications in the near future.

The limitations of our study include our experimental design, which is cross-sectional; therefore, our findings may not clearly show the involvement of dyslipidemia and hypertension. The time taken for selecting the patients was about 3 years and the test population was restricted to a lower number of people. In spite of this our results suggest that the severity of diabetes relates with the duration of disease, age, and the entire MetS variables are important in defining the risk of macrovascular diseases in diabetic patients. Periodic assessment of patients with diabetes should include the calculation of the MetS score so that those who have particularly high cardiovascular risk can be targeted for dyslipidemia and hypertension in forceful risk management. Overall, dyslipidemia and hypertension diagnosed with NCEP-ATPIII criteria can serve as a simple clinical approach to identify persons at risk for the timely intervention directed to reduce both CVD and T2DM. Treatment for each variable is needed to reduce the risk factor for CVD. Knowledge of the variables influencing the development of the syndrome can be utilized in interventions that could favorably alter its prevalence and therefore reduce the aggressiveness of the disease.

Conflicts of interest

All contributing authors declare no conflicts of interest.

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References

1. Zimmet P, McCarty D, de Courten M. The global epidemiology of non-insulin-dependent diabetes mellitus and the metabolic syndrome. J Diabetes Complications 1997 Mar–Apr;11(2):60–8.
2. Reaven G. Banting lecture role of insulin resistance in human disease. Diabetes 1988 Dec;37(12):1595–607.
3. Zimmet PZ, Alberti G. The metabolic syndrome: perhaps an etiologic mystery but far from myth–where does the International Diabetes Federation Stand? Medscape Diabet Endocr 2005;7(2).
4. Wilson P, D'Agostino R, Levy D, et al. Prediction of coronary disease using risk factor categories. Circulation 1998 May 12;97(18):1837–47.
5. Carr MC, Brunzell JD. Abdominal obesity and dyslipidemia in the metabolic syndrome: importance of type 2 diabetes and familial combined hyperlipidemia in coronary artery disease risk. J Clin Endocrinol Metab 2004 Jun;89(6):2601–7.
6. H1 Yanai, Tomono Y, Ito K, et al. The underlying mechanisms for development of hypertension in the metabolic syndrome. Nutr J 2008 Apr 17;7:10.
7. Fujioka S, Matsuzawa Y, Tokunaga K, et al. Contribution of intra-abdominal fat accumulation to the impairment of glucose and lipid metabolism in human obesity. Metabolism 1987 Jan;36(1):54–5.
8. Marsh JB. Lipoprotein metabolism in obesity and diabetes: insights from stable isotope kinetic studies in humans. Nutr Rev 2003 Nov;61(11):363–75.
9. Cuspidi C, Meani S, Fusi V, et al. Metabolic syndrome and target organ damage in untreated essential hypertensives. J Hypertens 2004 Oct;22(10):1991–8.
10. Schillaci G, Pirro M, Vaudo G, et al. Prognostic value of the metabolic syndrome in essential hypertension. J Am Coll Cardiol 2004 May 19;43(10):1817–22.
11. Termizy HM, Mafauzy M. Metabolic syndrome and its characteristics among obese patients attending an obesity clinic. Singapore Med J 2009 Apr;50(4):390–4.
12. Ford ES, Giles WH, Mokdad AH. Increasing prevalence of the metabolic syndrome among U.S. adults. Diabetes Care 2004 Oct;27(10):2444–9.
13. International Diabetes Federation. In: Diabetes atlas. 5th ed. Brussels: International Diabetes Federation; 2011.

14. Nesto R. Correlation between cardiovascular disease and diabetes mellitus: current concepts. Am J Med 2004 Mar 8;116(Suppl. 5A): 11–22.
15. Ridker P, Buring J, Cook N, et al. C-reactive protein, the metabolic syndrome, and risk of incident cardiovascular events: an 8-year follow-up of 14719 initially healthy American women. Circulation 2003 Jan 28;107(3):391–7.
16. National Cholesterol Education Program (NCEP) Expert Panel on Detection. Evaluation and treatment of high blood cholesterol in adults (Adult Treatment Panel III) executive summary of the third report. JAMA 2001 May 16;285(19):2486–97.
17. Grundy S, Cleeman J, Daniels S, et al. Diagnosis and management of the metabolic syndrome: an American Heart Association/National Heart, Lung and Blood Institute Scientific Statement. Circulation 2005 Oct 25;112(17):2735–52.
18. Trinder P. Determination of glucose in blood using glucose oxidase with an alternative oxygen acceptor. Ann Clin Biochem 1969 Jan;6(1):24–7.
19. Stockbridge H, Hardy R, Glueck C. Public cholesterol screening: motivation for participation, follow-up outcome, self-knowledge and coronary heart disease risk factor intervention. J Lab Clin Med 1989 Aug;114(2):142–51.
20. Fossati P, Prencipe L. Serum triglycerides determined colorimetrically with an enzyme that produces hydrogen peroxide. Clin Chem 1982 Oct;28(10):2077–80.
21. Lopes-Virella M, Stone P, Ellis S, et al. Cholesterol determination in high-density lipoproteins separated by three different methods. Clin Chem 1977 May;23(5):882–4.
22. Yadav D, Mahajan S, Subramanian SK, et al. Prevalence of metabolic syndrome in type 2 diabetes mellitus using NCEP-ATPIII, IDF and WHO definition and its agreement in Gwalior Chambal region of Central India. Glob J Health Sci 2013 Sep 17; 5(6):142–55.
23. Ilanne-Parikka P, Eriksson JG, Lindström J, et al. Prevalence of the metabolic syndrome and its components: findings from a Finnish general population sample and the Diabetes Prevention Study cohort. Diabetes Care 2004 Sep;27(9):2135–40.
24. Simões PP, Chagas CB, Dias VM, et al. Metabolic syndrome and diabetes type 2 in patients cared for at a nutrition out-patient facility in the city of Rio de Janeiro, RJ. J Diabetes Metab; 2013 Jun 25. S13–005.
25. Mohebbi I, Saadat S, Aghassi M, et al. Prevalence of metabolic syndrome in Iranian professional drivers: results from a population based study of 12,138 men. PLoS One 2012;7(2):e31790.
26. Ashraf S, Ziauddin F, Jahangeer U. Metabolic syndrome in type 2 diabetes mellitus. Pak J Med Sci 2006 Sep;22(3):295–9.
27. AlSaraj F, McDermott J, Cawood T, et al. Prevalence of the metabolic syndrome in patients diabetes mellitus. Ir J Med Sci 2009 Sep;178(3):309–13.
28. Titty FVK, Owiredu WKBA, Agyei Frempong MT. Prevalence of metabolic syndrome and its individual components among Diabetic patients in Ghana. J Biol Sci 2008 Jun;8(6):1057–61.
29. Isezuo S, Ezunu E. Demographic and clinical correlates of metabolic syndrome in Native African type 2 diabetic patients. J Natl Med Assoc 2005 Apr;97(4):557–63.
30. Reaven G, Lithell H, Landsberg L. Hypertension and associated metabolic abnormalities—the role of insulin resistance and the sympathoadrenal system. N Engl J Med 1996 Feb 8;334(6): 374–81.
31. Kengne AP, Limen SN, Sobngwi E, et al. Metabolic syndrome in type 2 diabetes: comparative prevalence according to two sets of diagnostic criteria in sub-Saharan Africans. Diabetol Metab Syndr 2012 May 31;4(1):22.
32. Marjani A, Shirafkan A. The metabolic syndrome in type 2 diabetic patients in Gorgan: according to NCEP ATPIII and IDF definitions. Diabetes Metabol Syndr: Clin Res Rev 2011 Apr;5(4): 207–10.
33. Janghorbani M, Amini M. Incidence of metabolic syndrome and its risk factors among type 2 diabetes clinic attenders in Isfahan, Iran. ISRN Endocrinol 2012;2012:167318.
34. Janghorbani M, Amini M. Metabolic syndrome in type 2 diabetes mellitus in Isfahan, Iran: prevalence and risk factors. Metab Syndr Relat Disord 2007 Sep;5(3):243–54.
35. Osuji CU, Nzerem BA, Dioka CE, et al. Metabolic syndrome in newly diagnosed type 2 diabetes mellitus using NCEP-ATPIII, the Nnewi experience. Niger J Clin Pract 2012 Oct–Dec;15(4): 475–80.
36. Bonora E, Targher G, Formentini G, et al. The metabolic syndrome is an independent predictor of cardiovascular disease in type 2 diabetic subjects. Prospective data from the Verona diabetes complications study. Diabet Med 2004 Jan;21(1):52–8.