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Original Article

Study of Metabolic Syndrome and Its Components Among Kurnool District Population of Andhra Pradesh with Different Ethnic Backgrounds

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ABSTRACT

Background: There is a constant increase in the preponderance of cardiovascular diseases in India. The recent scientific evidences have shown that if you do not detect and treat the metabolic syndrome patients at an early stage, it may proceed to cardiovascular disease. A scientific data on pattern of metabolic syndrome components of a population is very essential to formulate the preventive and treatment modalities among them. **Aim:** To explore the prevalence of metabolic syndrome and its components among Kurnool district population of Andhra Pradesh with different ethnic background. **Method:** A total of 1032 (344 subjects in each group) participants of 20-60 years of age group were analyzed for MetS. A modified NCEP ATP III criterion was applied for this. From each group 20 subjects were analyzed for fasting serum insulin and HOMA-IR randomly. **Results:** Overall prevalence of metabolic syndrome was found to 31.97%. It was almost equally prevalent among men (32.82%) and women (30.87%). Urban population (42.15%) were found to be highly inflicted by metabolic syndrome than rural (31.97%) and tribal (21.80%). Decreased HDL (78.87%) followed by increased waist circumference (57.84%) and hypertriglyceridemia (31.78%) were found to be the preceding risk factors of Mets in all the groups. The lipid estimates were not in correlation with insulin resistance (by HOMA IR) in rural population. Tribal women were found to be having a slightly higher mean waist circumference (86.45cm) compared to rural women (85.87cm). The behavioural cardiovascular risk factors like smoking alcohol consumption decreased circadian physical activity were high in rural and tribal population compared to urban population. Whereas other physiological cardiovascular risk factors like family history of hypertension and diabetes of rural population were in concordance to urban population. **Conclusion:** Metabolic syndrome prevalence is very high in Kurnool district population. Mets components are highly prevalent among the individuals with low WC (Waist Circumference) and BMI (Body Mass Index). This warrants the need to implement preventive strategies for Mets among the population of Kurnool district. The future projects has to be formulated with an aim to find out the genetic factors behind this scenario.

Key words: Adults, Insulin Resistance, Kurnool District, Prevalence of Metabolic Syndrome, Rural, Tribal, Urban, Population.

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INTRODUCTION

Metabolic syndrome (Mets) is a cluster of metabolic abnormalities that predispose an individual to develop cardiovascular disease (CVD).[1] The treatment modalities of CVD are very costly. It represents a major health care economic burden of poor people. However, early detection of Mets can help us to prevent or delay the CVD risk among them. Simple non-expensive diagnostic modalities are enough to identify the individuals with Mets. Moreover, the treatment for Mets is very cost effective.

According to the modified NCEP APT III (National Cholesterol Education Programme Adult Treatment Panel III) Mets is present if three or more of the following criteria are satisfied:[2] increased waist circumference, fasting blood glucose, serum triacylglycerol, blood pressure and decreased high density lipoprotein. Scientific studies have proved that insulin resistance is playing a crucial role in pathological transformation of metabolic syndrome to cardiovascular disease. Insulin resistance in lean persons can increase the risk of CVD two fold than in obese individual. Most of the lean persons with insulin resistance having metabolic syndrome are left undiagnosed. This causes increase in CVD related deaths in India.

The pattern of the metabolic syndrome components may vary with geographic elements, age, gender and type of population.[3] However, genetic susceptibility, behavioural and physiological factors also should be considered. This scenario implies that preventive strategies have to be formulated intended to that population. So, a scientific data representing the prevalence of metabolic syndrome risk factors of an area is very important to achieve the above.

Kurnool district is located in west-central part of Andhra Pradesh in India. It is having 28.40% of urban population and 71.60% rural population whereas schedule tribe are 2.00% of the total population in Kurnool district. Most of them are with poor and middle class economic background. Thereby this study is designed with an aim to determine the prevalence of metabolic syndrome in Kurnool district among urban, rural and tribal population.

MATERIALS AND METHOD

This is a cross sectional study done among the urban, rural and tribal population of Kurnool district in Andhra Pradesh, India. Assuming prevalence of Mets 41%, considering 95% confidence limit and ±5.2% margin of error the worked out sample size is 344 in each group together it is 1032.

From 54 mandal of Kurnool district, Nandyal was chosen by simple random sampling. In Nandyal 34 wards (in urban) 20 villages (rural) and 24 thandas areas are present. From 34 wards 6 wards were chosen by probability proportional to size sampling (PPS) method to collect 344 sampling units. Likewise 4 villages and 7 thandas were selected. 57 samples were collected from each ward by systemic random sampling technique, like wise 86 and 49 samples were collected from each village and thandas respectively. Pregnant women, lactating mothers and those who refused to participate were excluded from this study.

The subjects were analyzed by oral, anthropometric and biochemical parameters. WC (Waist Circumference) is measured at the level of uppermost lateral border of the iliac crest. Blood pressure was measured in supine position using sphygmomanometer; average of two brachial readings was taken. Cigarette smoking is defined by lifetime history of smoking at least 100 cigarettes, alcohol drinking is defined as at least once in a week alcohol consumption, physical activity is defined as participating in moderate activity for 30 min every day and family history is defined as at least one of the parent diagnosed as diabetic or hypertension in a life time by self-reporting.

5 ml of fasting (12 h overnight) venous blood was collected from the subjects and analyzed for FBS (Fasting Blood Glucose) by glucose oxidase and peroxidase method,[4] T.CHO (Total Cholesterol) by cholesterol oxidase-peroxidase method,[5] TGL (Triacylglycerol) by GPO peroxidase method,[6] HDL (High Density Lipoprotein) by Phosphotungstate method,[7] Fasting insulin levels by elecrochemiluminescence immunoassay "ECLIA" method.[8] The sensitivity of the assay was 0.2-1000 µU/ml. Insulin resistance (IR) was derived using the Homeostasis Model Assessment (HOMA) non-computerised calculation.[9]

The MetS defined by Asian specific modified NCEP ATP III criteria. Presence of any three following risk factors is considered as positive for risk of MetS. Central obesity - WC > 90 cm (men), > 80 cm (women); BP – SBP (Systolic Blood Pressure) ≥ 130 mmHg and / or DBP (Diastolic Blood Pressure) ≥ 85 mmHg or medical treatment for previously diagnosed hypertension; hypertriglyceridemia - TGL ≥ 150 mg/dl; low HDL-C < 40 mg/dl (men), < 50 mg/dl (women); impaired FBS ≥ 100 mg/dl. During the entire study the utmost care was taken according to Helsinki Declaration about patient confidentiality.[10] The study was approved by Institutional Ethical Committee (IEC). Written Informed consent of the participants was taken prior to study

Data analysis was done by graph pad instat 3 version. Mean and standard deviation (S.D.) of the numerical variables were calculated. Unpaired student's "t" test was used for statistical significance. A p value <0.05 was considered significant. Correlation was seen by applying correlation coefficient (r).

RESULTS

The clinical, behavioural and physiological characteristics of the participants are shown in Table 1. Compared to urban and tribal residents alcohol consumption, smoking, fasting serum insulin and insulin resistance were very high in rural. The MetS components have shown a statistically significant difference (p=<0.05) among the groups. Family history of DM and HTN of rural population both were in concordance with urban population.

N= number of participants; n=number of participant with that Mets component

Table 2 & 3 are showing that overall prevalence of Mets in Kurnool district is 31.97%. It is almost equally prevalent among men (32.82%) and women (30.87%). Urban (42.15%) population is highly effected than rural (31.97%) and tribal (21.80%) population. Mets risk factors are found to be increase with increasing age in all, male and female subgroups. Low HDL, high WC followed by raised TGL is found to be potent risk factors for Mets. Increased waist circumference is highly prevalent in tribal women compared to rural women. Blood pressure is highly prevalent in men than women. There is a sudden increase in Mets among the women at postmenopausal age group. *= p value is less than 0.05

Table 4 shows that fasting plasma insulin and HOMA IR are not correlated. HOMA IR in rural residents does not show correlation with any Mets risk factors except DBP. HOMA IR does not show any correlation with HDL in any of the three study groups.

DISCUSSION

The underlying systemic inflammation is the main cause of cardiovascular diseases among the patients with Mets. It increases the CVD risk by 2 fold and type 2 diabetes mellitus by 3 fold.[11] The importance of Mets lies in the cardiovascular risk factors of the Mets criteria applied. The current study has implemented a modified NCEP ATP III criterion that is specific for Asian population. Total 31.97 % participants are estimated to be afflicted by Mets. The previous studies have noted 19.80%[12] (WHO criteria); and 29.60%[13] (ATP III criteria) of MetS prevalence in this population. Mets is almost equally present in males (32.82%) and females (30.87%) of this population. The slight difference may be attribute to the low physical activity, high smoking and alcohol consumption among the male of this population (Table 1). Chow CK *et al*[14] MA Njelekela *et al*,[15] L Fezeu *et al*[16] have noted high prevalence of Mets in men compared to women. The reverse was reported by T Ahonen *et al*,[17] Y He *et al*.[18]

The current study has focused on distribution pattern of metabolic syndrome and its components among urban, rural and tribal population of Kurnool district. The results imply that urban population are highly afflicted by Mets than rural and tribal population. Like our findings, previous studies also reported a higher prevalence of MetS in urban when compared with semi-urban and rural population, Gu D *et al*[1] survey among Chinese adults aged 35-74 years showed 18.60% prevalence of MetS in urban population than in rural 12.70%. The reverse was noted by Shanoyong *et al*[20] among north-western population of china, age-standardized prevalence of MetS was significantly higher in rural (29.00%) residents than urban (25.90%) counterparts.

The contribution of Mets components may oscillate with ethnic population, gender and country.[21] We have identified that elevated WC followed by decreased HDL-C and increased triglycerides are common cluster components of MetS in this population (Table 2-3). The results were in accordance with Deedwaina *et al* [22] and Hussain *et al*.[23] The proportion of MetS risk factors was found to increase with increasing age in all, male and female subgroups. This may be attributed to the increased BMI (Body Mass Index) with increasing age in this population. The cardio metabolic abnormalities which may develop at lower BMI in Indians compared to other ethnic groups is also to be considered. The current study has identified total 95.16% of participants as having any one or two Mets with normal WC or BMI. This givens an impression that all the above participants are may proceed to Mets.

Obesity plays a role in the development of MetS and appears to precede the appearance of the other MetS components.[21] The other important outcome of the study is tribal women have high mean waist circumference (86.45 cm) compared to rural women (85.87 cm). It represents recent scientific data showing that increasing burden of central obesity all over the world irrespective of ethnicity. This scenario alarms the need to study the role of Mets component in development of CVD on ethnic bases. In supporting to this Bharathi *et al*[18] have recorded 95 cm of larger WC in Bhagatha tribal women of Eastern Ghats in Vijayanagaram district of Andhra Pradesh. The study has also identified preponderance of Mets among the females of Kurnool district at post-menopausal age. This can be explained by metabolic changes in menopause and the fac-

Table 1: Clinical characteristic of study participants in Kurnool district.

VARIABLE		URBAN	RURAL	TRIBAL	TOTAL
Number (n)		344	344	344	1032
Gender	Male n (%)	208 (60.46)	205 (59.59)	172 (50.00)	585(56.68)
	Female n (%)	136 (39.53)	139 (40.40)	172 (50.00)	447(43.31)
Literacy	Illiterate	115(33.43)	126 (36.62)	162(47.09)	403(39.05)
	up to secondary	127 (36.91)	158 (45.93)	131 (38.08)	416(40.31)
	Above secondary	102 (29.65)	60 (17.44)	51 (14.82)	213(20.63)
Cigarette Smoking n (%)		106 (30.81)	82 (23.83)	45 (13.08)	233(22.57)
Alcohol Consumption n (%)		87 (25.29)	93 (27.03)	45 (13.08)	225(21.80)
Chewing n (%)		6 (1.74)	44 (12.79)	26 (7.55)	76(7.36)
Family History (FH) of diabetes mellitus (DM) n (%)		28 (8.13)	41 (11.91)	28 (8.13)	97(9.39)
FH of hypertension n (%)		27 (7.84)	26 (7.55)	9 (2.61)	62(6.00)
Personnel history of DM n (%)		48 (13.95)	46 (13.37)	27 (7.84)	121(11.72)
Personnel history of HTN n (%)		82 (23.83)	41 (11.91)	11 (3.19)	134(12.98)
Waist circumference (cm)		91.04±5.39	85.87±11.96	86.45±7.78*	87.92±9.11
Systolic blood Pressure (mmHg)		122.31±9.21	122.97±6.97	121±5.25*	122.17±7.44
Diastolic blood pressure (mmHg)		81.58±4.30	82.22±4.46	80.64±3.63*	81.49±4.23
Fasting blood glucose (mg/dl)		93.06±16.86	90.65±27.76	85.20±13.88*	89.77±20.91
Serum triglycerides (mg/dl)		142.68±29.13	142.49±26.08	125.16±24.41*	89.77±20.91
Serum HDL-C (mg/dl)		34.37±4.34	38.56±6.64	39.87±6.08*	37.27±27.67
Fasting Insulin µU/ml		18.32±9.56	23.83±10.15	14.18±9.68*	18.77±10.61
HOMA-IR		4.14±3.06	5.62±3.38	2.90±2.08*	4.17±2.99

Table 2: Crude and age standardized prevalence of metabolic syndrome in the study groups by gender.

Age group (year)	URBAN n/N-%		RURAL n/N-%		TRIBAL n/N-%		Total n/N-%	
			All					
20-30	37/133	27.81	28/124	22.58	26/156	16.66	91/413	22.03
31-40	30/80	37.50	25/87	28.73	14/68	28.58	69/235	29.36
41-50	32/63	50.79	31/80	38.75	17/53	32.07	80/196	40.81
51-60	46/68	67.64	26/53	49.05	18/67	26.86	90/188	47.87
Crude Standardized	145/344	42.15	110/344	31.97	75/344	21.80	330/1032	31.97
			Male					
20-30	23/83	27.77	17/71	23.94	12/77	15.58	52/231	22.51
31-40	22/51	43.13	16/48	33.33	6/33	18.18	44/132	33.33
41-50	15/34	44.11	19/49	38.77	7/20	35.00	41/103	39.80
51-60	27/40	67.50	17/37	45.94	11/42	26.19	55/119	46.21
Crude Standardized	87/208	41.82	69/205	33.65	36/172	20.93	192/585	32.82
			Female					
20-30	14/50	28.00	11/53	20.75	14/79	17.72	39/182	21.42
31-40	8/29	27.58	9/39	23.07	8/35	22.85	25/103	24.27
41-50	17/29	58.62	12/31	38.70	10/33	30.30	39/93	41.93
51-60	19/28	67.85	9/16	56.25	7/25	28.00	35/69	50.72
Crude Standardized	58/136	42.64	41/139	29.49	39/172	22.67	138/447	30.87

Table 3: Crude prevalence of individual component of metabolic syndrome in the study groups by gender

Variable	URBAN n/N-%		RURAL n/N-%		TRIBAL n/N-%		TOTAL n/N-%	
Overall								
Raised fasting glucose	69/344	20.05	62/344	18.02	26/344	7.55	157/1032	15.21
Raised SBP	104/344	30.23	81/344	23.54	48/344	13.95	233/1032	22.57
Raised DBP	84/344	24.41	67/344	19.47	42/344	12.20	193/1032	18.70
Raised sr. TGL	142/344	41.27	129/344	37.50	57/344	16.56	328/1032	31.78
Lowered sr. HDL	327/344	95.34	254/344	73.83	233/344	67.73	814/1032	78.87
Larger waist circumference	255/344	74.12	179/344	52.03	163/344	47.38	597/1032	57.84
Male								
Raised fasting glucose	43/208	20.67	42/205	20.48	14/172	8.13	99/585	9.59
Raised SBP	66/208	31.73	56/205	27.31	30/172	17.44	152/585	14.72
Raised DBP	52/208	25.00	41/205	20.00	25/172	14.53	118/585	11.43
Raised sr. TGL	95/208	45.67	88/205	42.92	41/172	23.83	224/585	21.70
Lowered sr. HDL	196/208	94.23	131/205	63.90	92/172	53.48	419/585	40.60
Larger waist circumference	135/208	64.90	104/205	50.73	66/172	38.37	305/585	29.55
Female								
Raised fasting glucose	26/136	19.11	20/139	14.38	12/172	6.97	58/447	5.62
Raised SBP	38/136	27.94	25/139	17.98	18/172	10.46	81/447	7.84
Raised DBP	32/136	23.52	26/139	18.70	17/172	9.88	75/447	7.26
Raised sr. TGL	47/136	34.55	41/139	29.49	16/172	9.30	104/447	10.07
Lowered sr. HDL	131/136	96.32	123/139	88.48	141/172	81.97	395/447	38.27
Larger waist circumference	120/136	88.23	75/139	53.95	97/172	56.39	292/447	28.29

N= number of participants; n=number of participant with that Mets component

Table: 4 Correlation between components of Mets and insulin resistance.

Correlation between	Urban	Rural	Tribal	Overall	
FBS	r-value	0.3194	0.1302	0.4095	0.2909
s.	95% CI	-0.1578-0.6757	-0.5416-0.01696	-0.07109-0.7358	0.03275-0.054127
Fasting Insulin	P-value	0.1826	0.5842	0.0915	0.0281
WC	r-value	0.4586	0.1035	0.8333	0.5258
vs.	95% CI	0.005388-0.7555	-0.3554-0.5222	0.5996-0.9360	0.3072-0.2764
HOMA IR	P-value	0.0483*	0.6642	<0.0001*	<0.0001*
TGL	r-value	0.5848	0.002958	0.7381	0.5714
vs.	95% CI	0.1486-0.8110	-0.4402-0.4450	0.4137-0.8962	0.3652-0.7242
HOMA IR	P-value	0.0118*	0.9901	0.0005*	<0.0001*
SBP	r-value	0.4406	0.3030	0.5359	0.4241
vs.	95% CI	-0.01719–0.7456	-0.1612-0.6575	-0.09190-0.8021	0.1838-0.6166
HOMA IR	P-value	0.0590*	0.1941	0.0219*	0.0010*
DBP	r-value	0.8093	0.6372	0.5052	0.5906
vs.	95% CI	0.5613-0.9239	0.2710-0.8423	0.05007-0.7866	0.3901-0.7377
HOMA IR	P-value	<0.0001*	0.0025*	0.0325*	<0.0001*
HDL	r-value	-0.1570	-0.03458	0.2095	-0.1554
vs.	95% CI	-0.5706-0.3201	0.5209-0.4141	0.2853-0.6162	-0.3998-0.1097
HOMA IR	P-value	0.5209	0.8839	0.4040	0.2483

*= p value is less than 0.05

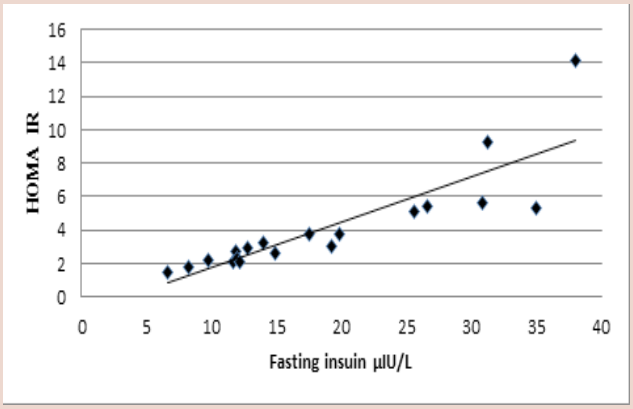

Figure1: Correltion of Fasting Insulin and HOMA IR in urban population.

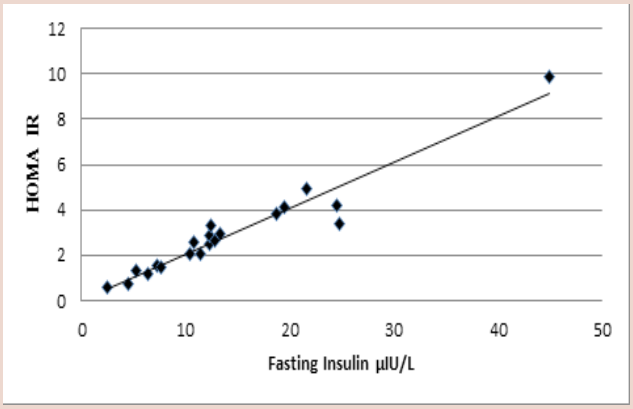

Figure 2: Correlation of fasting insulin and HOMA IR in rural population.

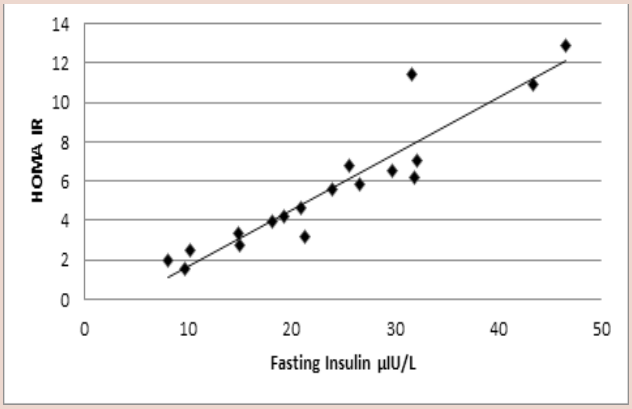

Figure:3 Correlation of Fasting Insulin and HOMA IR in tribal poplation.

tors protecting women like endogenous estrogens against atherosclerosis in premenopausal females. The results have shown postmenopausal female have higher BMI. Higher prevalence of blood pressure (BP) in males compared with females can be explained by gender and sex hormones effect on components of the rennin-angiotensin system.

Insulin resistance is the preceding cause for CVD in patients with Mets. We have correlated the Mets components with HOMA IR. The estimates have shown that fasting plasma insulin and HOMA-IR were not correlated (Table 4). It proves presence of insulin resistance in all the three groups (Figure 1-3).

HOMA IR in rural residents has not shown correlation with any MetS risk factors except DBP. The results are coincides with the findings of M.K. Garg *et al* and Snehalatha *et al.*[20, 21] On the contrary, others found significant positive correlation between HOMA-IR and lipid parameters, and fasting plasma glucose. HDL was not correlated with HOMA IR in all three groups. Inverse correlation between HOMA-IR and HDL cholesterol was noted by Kressel G *et al.*[22] The results are showing that lipids do not directly interfering with MetS in this population. May be genetic predisposition is playing the major role for insulin resistance and MetS among this population. This scenario needs an attention to study the role genetic factors in Kurnool district population for Mets.

The behavioural CVD risk factors like alcohol consumption is high in both the gender (men 34.52%; women 5.14%) compared to smoking (men 20.34; women 2.22 %). Overall 21.80% alcoholism; and 21.80% smoking was reported (Table-1). According to Global Adults Tobacco Survey (GATS) – 2010, smoking is about 15% in men and 1.90% in women.[24] Ganesh Kumar *et al.*[25] have reported 16.80% alcohol consumption in men and 1.30% in women among the rural population of Tamilnadu. The National health profile survey reported 11%-20% alcohol consumption.[26] In this current study alcohol and smoking is high in women compared to other studies. Our previous study[27] have shown that risk for MetS with alcohol consumption is low (r=1.517 CI 1.076 to 2.139) whereas along with smoking it is high (r=1.738 1.258 to 2.401). This gives an impression that clustering of modifiable risk factors may increase the cardio metabolic risk.

The outcome of the study includes

1. High prevalence of metabolic syndrome in Kurnool district
2. Higher levels of HOMA IR in rural population than urban residents
3. There is no correlation of insulin resistance (HOMA IR) with any Mets components in rural population

4. Higher prevalence of physiological and behavioural risk factors among rural and tribal population in concordance to urban population.
5. Higher prevalence of Mets components in low waist circumference and normal BMI.
6. High mean of BMI in tribal women compared to rual women.

CONCLUSION

Metabolic syndrome prevalence is very high in Kurnool district population. Almost all the lean participants showed the presence of 1 or 2 of the Mets components. This warrants a regular screening for Mets irrespective of obesity. It may help in preventing the consequent CVD related mortality and morbidity by taking preventive measures like simple life style modifications.

LIMITATIONS OF THE STUDY

The study is an observational study. Longitudinal studies are important to make causal inferences and to identify unmeasured or unknown risk factors for cardiometabolic risk in this population. The subjects are almost from middle class to poor socioeconomic background.

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CONFLICT OF INTEREST

None

ABBREVIATION USED

CVD: Cardiovascular disease; ECLIA: elecrochemiluminescence Immunoassay; FBS: Fasting blood glucose; HDL: High density lipoprotein; Mets: Metabolic syndrome; NCEP ATP III: National Cholesterol Education Programme Adult Treatment Panel III; T.CHO= total cholesterol; TGL=Triacylglycerol; WC: Waist circumference.

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