METABOLIC SYNDROME: COMPARING PERFORMANCE OF THREE DIFFERENT DIAGNOSTIC CRITERIA IN PAKISTAN

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ABSTRACT

Background: Metabolic syndrome has reported prevalence of 33.4% with the WHO, 22.6% with the NCEP-R, and 30.9% with the IDF criteria in urban population. As per the literature, in non-insulin dependent diabetic patients, the consistency of IDF and NCEP-R in picking up Metabolic Syndrome was greater than the WHO criteria.

Aim: This study aimed at evaluating three different diagnostic criteria of Metabolic Syndrome according to their sensitivity and specificity, then in order to suggest the most suitable criteria we compared the relation of WHO with IDF and NCEP-R.

Material and Method: The type of this study was descriptive case-control study and it was carried out in the Diabetes, Endocrine and Metabolic Center of Lahore General Hospital, Lahore. We gathered data of 3300 patients from November 2011 to November 2013 and interviewed them for demographics like diet, activity status, smoking habit and history of alcohol intake, biochemical parameters were identified by laboratory analysis and anthropometric measurements were carried out manually. The data analysis was done using SPSS version 23 using Chi-square test and Kappa statistics.

Results: The incidence of Metabolic syndrome in non-insulin dependent diabetic patients according to WHO criteria was highest, followed by IDF and NCEP-R. IDF and NCEP-R had better specificity as compared to WHO criteria. Positive Predictive Value (PPV) was high for NCEP-R and Negative Predictive Value (NPV) for IDF. Kappa showed both were in agreement, with IDF criteria better.

Conclusion: WHO criteria was most sensitive in picking diagnosis of MetS. IDF was second in sensitivity and NCEP-R was most specific. There is need to improve awareness, in view of the alarming number of patients.

Key Words: Metabolic Syndrome, Diagnosis, Criteria, Agreement, Sensitive, Specific

INTRODUCTION

The combination of various cardio-metabolic risk factors like insulin resistance, deranged lipid profile, central obesity and hypertension is termed as Metabolic syndrome[1, 2, 3]. It is estimated that approximately 25% of the people living on this planet are suffering from this disease and it has led to an increased incidence of stroke and cardiac diseases[2].Prevelance of insulin resistance is pretty high in patients suffering from Metabolic syndrome and might reach up to five times than normal population[1]. The pivotal pathogenesis underlying metabolic syndrome is insulin resistance and it is exacerbated by increased body fat[4].The accumulation of excess fat around viscera is one of the key causes of metabolic syndrome[6].

Patient gender, age, cultural background, country of origin and ethnicity all influence the prevalence of metabolic syndrome[5]. Different diagnostic criteria have been used to conduct various studies on metabolic syndrome, which had led to a great variation in the results of these studies, so it was need of the hour to compare the different diagnostic criteria for diagnosing metabolic syndrome, as it has effected a large population of our society. Majority of studies have focused on relationship between metabolic syndrome and heart attack, and considered it as a robust indicator of non-insulin dependent diabetes mellitus[7, 8]. It has been found that higher waist circumference has a stronger association with metabolic syndrome than higher BMI[9, 10, 11]. As is evident by the fact that those patients having higher waist circumference with BMI between 25 to 34.5 kg/m^2 are more prone to getting diabetes, deranged LFTs, hypertension, stroke and myocardial infarction[9]. It has been seen that Asians living in America have higher waist circumference and BMI, so they are more likely to suffer from the metabolic syndrome[10, 11]. IDF and NCEP-R have defined metabolic syndrome in a very similar manner in

contrast to the definition of WHO. However there are slight differences on comparing IDF and NCEP-R, the important one being that IDF does not include measurement of waist circumference. According to IDF central obesity is defined as BMI > 30kg/m^2, thus excluding all patients with central obesity. According to IDF criteria, people from different geographic locations have different waist cut off points, however NCEP-R focuses on only one waist criteria for people of all geographic locations on earth, irrespective of their cultural backgrounds.

Prevalence rates are different for different populations, as shown in the literature that it is between 13-30% for Caucasian non-diabetic[12, 13] and 70-80% for Caucasian diabetic populations[14,15]. According to Eregie and Edo et al in Benin City, WHO showed rate of 33.4%, NCEP-R showed 22.6% and IDF had 30.9%[16].According to Ahmed A et al, NCEP-R was more sensitive than IDF. [1]

Considering the above discussion, it was need of the hour to make a comparison of different diagnostic criteria and to establish the sensitivity and specificity of one diagnostic criteria over the other. We will also try to find out the best diagnostic criteria among our population and to establish a correlation between them.

MATERIALS AND METHODOLOGY

The type of this study was a descriptive cross-sectional, case-control study and it was carried out in the Diabetes, Endocrine and Metabolic Centre (DEMC), Department of Medicine of Lahore General Hospital, Lahore. Data was collected from November 2011 to November 2013, from 3300 patients who were already diagnosed with type2 diabetes mellitus including both males and females in equal proportions. The study was approved by the Ethical Review Committee of, Ameer-ud-Din-Medical College/Post Graduate Medical Institute/Lahore General Hospital. The data was collected for parameters of age, sex, diet, exercise, smoking, alcohol consumption, lipid profile, BMI and waist circumference. A standard method for measuring waist was applied that is with a measuring tape horizontally, between the lower margin of ribs and the upper border of the iliac crest, most likely at the level of umbilicus.[12].

According to WHO criteria, metabolic syndrome was defined as presence of diabetes in any form, along with any two of either hypertension, disturbed lipid profile, low high density lipoproteins, increased waist hip ratio, presence of micro-albuminuria or increased albumin – creatinine ratio, with varying values in both genders[9].

According to Revised NCEP-R criteria (2001), presence of any three of the following defined metabolic syndrome: higher waist, raised triglycerides, decreased high density lipoproteins, elevated blood pressure and high fasting blood sugar[18, 20].

According to IDF, obesity was defined according to their geographical location and ethnicity along with presence of any two of the following i.e raised triglycerides, decreased high density lipoproteins, hypertension, raised fasting blood sugar levels or non-insulin dependent diabetes mellitus and if BMI was above 30 kg/m2, then it was not necessary to measure waist circumference[19].

The data was then analysed using SPSS version 16 and chi-square test was used for making a comparison of proportions taking P value of less than 0.05 as statistically significant. Kappa statistical analysis was used to analyse degree of agreement to compare performance of IDF and NCEP-R with WHO criteria.

RESULTS

Our results showed that, the incidence of metabolic syndrome was found to be highest according to WHO criteria (92.7%) followed by IDF and NCEP-R **(Figure 1)**. The chi square value for prevalence of metabolic syndrome according to WHO criteria was 2236.285, for IDF was 1658.845 and for NCEP-R was 1529.277 **(Table 1)**. The WHO criteria was used as standard and then compared with the other

two. The results showed that the sensitivity of IDF (88.4%) was higher than the NCEP-R criteria (84.6%), however NCEP-R criteria (98.8461%) had better specificity as compared to IDF (98.5384).The positive predictive value of the NCEP-R was greater (99.121%) than that of IDF (98.93%). The IDF criteria had a negative predictive value of 84.66% higher than the NPV of NCEP-R criteria i-e 80.66%. The kappa value for IDF criteria was 0.845 as compared to the NCEP-R criteria which had kappa value of 0.803**(Table 2)**.

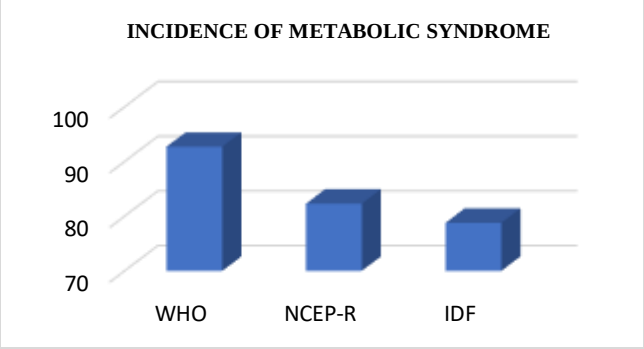

Figure 1: Illustrating the incidence of Metabolic Syndrome in type2 diabetic patients

Table 1: Comparison of the prevalence of metabolic syndrome using three different criteria in T2DM patients

Parameters	T2DM		X^2	Df	P value
	Yes	No			
WHO criteria					
MetS	1870 (92.7%)	130 (10.1%)	2236.285	1	.000
No MetS	148 (7.3%)	1152 (89.9%)			
IDF criteria					
MetS	1661 (82.3%)	126 (9.8%)	1658.845	1	.000
No MetS	357 (17.7%)	1156 (90.2%)			
NCEP-R criteria					
MetS	1591 (78.8%)	116 (9.0%)	1529.277	1	.000
No MetS	427 (21.2%)	1166 (91.0%)			

X^2= chi square, df= degree of freedom, p value= probability value.

Table 2: Comparison of performance and level of agreement of IDF and NCEP-R with WHO criteria

Criteria	WHO		Sensitivity	Specificity	PPV	NPV	Kappa	Agreement
	MetS	No MetS	%	%	%	%		
IDF								
MetS	1768 (88.4%)	19 (1.5%)	88.4	98.5384	98.93	84.66	.845	Almost perfect
No MetS	232 (12.6%)	1281 (98.5%)						
NCEP-R								
MetS	1692 (84.6%)	15 (1.2%)	84.6	98.8461	99.121	80.66	.803	Almost perfect
No MetS	308 (15.4%)	1285 (98.8%)						

X^2= chi square, df= degree of freedom, p value= probability value, PPV= positive predictive value, NPV= negative predictive value

DISCUSSION

The prevalence of obesity in 2001 was 20.9%, as compared to 19.8% in 2000. Similarly, incidence of diabetes increased from 7.9% vs 7.3% from 2000 to 2001 and BMI > 40 by 2.3%[8]. There was a strong relationship between overweight and obesity. According to Movakovic et al, the incidence of metabolic syndrome in type2 diabetics was 87.1%[13] and our results reported a prevalence of 92.7%, thus indicating that WHO criteria was not sufficient to differentiate between populations of different cultural and ethnic backgrounds. Similarly, according to Ergie et al prevalence of metabolic syndrome was 87.1%[16] and Ahmed et al, reported a prevalence of 81.4% in type2 diabetics[17]. The results reported a high prevalence of metabolic syndrome in type2 diabetics. The difference from our study with same geographical background and culture values may be due to eating habits, physical activity status or level of education, which require further exploration.

Chan JM et al stated that it was better to use waist circumference as an indicator of metabolic syndrome relationship between abdominal adiposity and diabetes[9]. As, IDF criteria uses ethnic specific values for waist circumference and in our region, central obesity was assumed as waist above 90 cm in males and above 80 cm in females. However if BMI was above 30 kg/m^2 then obesity was presumed[2]. According to our study the prevalence of metabolic syndrome according to IDF criteria was 82.3%, Movakovic et al reported a

prevalence of 64.5%[13], Ergie et al reported 61.3%[16] and Ahmed A et al reported 86.7%[17]. Our findings were similar to those of Ahmed A et al thus supporting the notion that prevalence of metabolic syndrome varies with cultural and ethnic backgrounds.

NCEP-R criteria used waist circumference for central obesity but without following ethnic specific values and also not considering increased waist circumference for diagnosing metabolic syndrome. Our resukts showed that the prevalence of metabolic syndrome according to NCEP-R was 78.8%. Movakovic et al reported a prevalence of 61.3%[13], Ergie et al reported 61.3%[16] and Ahmed A et al reported 91.9%[17]. Thus again strongly suggesting that we need ethnic specific values for diagnosing metabolic syndrome.

Our results showed that IDF criteria was more sensitive in identifying the disease as compared to NCEP-R criteria but the specificity of NCEP-R was more than IDF. Alberti KG et al reported in AusDiab study that the proportion of populations identified by WHO and NCEP-R was same[3]. Similarly, according to Movakovic et al the sensitivity of IDF criteria was more than the NCEP-R criteria but he stated that there specificity was same[13]. Contrary to that Eregie A et al reported almost same specificity of IDF and NCEP-R criteria[16]. The probable reason for this difference being the variation in the population being studied. Our results showed that PPV of NCEP-R was superior to the IDF, but the NPV of IDF was greater than NCEP-R criteria. Contrary to our results Ghanassia et al [21] reported the PPV and NPV of IDF and NCEP-R opposite to our results. This variation might be explained by the size of sample taken, the ethnic and cultural background and trends of eating and drinking habits. Kappa statistic was used to calculate the level of agreement between WHO criteria with IDF and NCEP-R respectively. Although, both had almost perfect level of agreement but the kappa value of IDF was higher (0.845) as than that of NCEP-R (0.803). To sum up, we can conclude that IDF criteria was superior to NCEP-R criteria in diagnosing metabolic syndrome. The reason being it fits more with our patients due to variation in waist circumference.

CONCLUSION

Our study advocated that for diagnosing metabolic syndrome in diabetics all the three diagnosing criteria showed consistent results. However, if we just want to assess the prevalence in our population then we can use WHO criteria, as it captures the most number of patients along with identifying the population at risk. Meanwhile, IDF criteria had better sensitivity and NCEP-R criteria had better specificity. NCEP-R had higher PPV and IDF criteria had higher NPV.

The degree of agreement through kappa statistics also suggested that both can be used for calculating metabolic syndrome, with IDF criteria having significance over NCEP-R.

The proportion of patients suffering from metabolic syndrome is alarmingly high, we need to formulate strategies to control this number from increasing. Although, our resources are scanty but we can devise strategies and increase awareness in public to focus on primary prevention by sensitizing public and private organizations.

REFERENCES

1. Alberti KG, Zimmet P, Shaw J IDF Epidemiology Task Force Consensus Group. The Metabolic Syndrome-a new worldwide definition. Lancet. 2005;366:1059–62.[PubMed]
2. The IDF consensus worldwide definition of the metabolic syndrome. [Last accessed on the 2008 Nov 6]. Available from: http://www.idf.org/webdata/docs/idf_meta_def_final.pdf .
3. Alberti KG, Zimmet P, Shaw J. Metabolic syndrome--a new world wide definition. A Consensus Statement from the International Diabetes Federation. Diabet Med. 2006; 23:460–9. [PubMed]
4. Reaven GM. Role of insulin resistance in human disease. Diabetes. 1989;37:1595–607.[PubMed]
5. Eckel RH. The metabolic syndrome. In: Fauci AS, Braunwald E, Kasper DL, et al., editors. Harrison's Principles of Internal Medicine. 17th ed. Vol. 236. United States of America: The McGraw-Hill; 2008. pp. 1509–13.
6. Sironi AM, Gastaldelli A, Mari A, Ciociaro D, Postano V, Buzzigoli E, et al. Visceral fat in hypertension. Influence on insulin resistance and beta cell function. 2004;44(2):127-133.[pubmed]
7. Eckel RH, Grundy SM, Zimmet PZ. The metabolic syndrome. Lancet 2005; 365: 1415-28.
8. Mokdad AH, Ford ES, Bowman BA, Dietz WH, Vinicor F, Bales VS, et al. Prevalence of obesity, diabetes, and obesity-related health risk factors, 2001. JAMA 2003; 289: 76-9.
9. Chan JM, Rimm EB, Colditz GA,Stampfer MJ, Willett WC. Obesity, fat distribution, and weight gain as risk factors for clinical diabetes in men. Diabetes Care. 1994;17:961-969.
10. Potts J, Simmons D. Sex and ethnic group differences in fat distribution in young United

Kingdom South Asians and Europids. J Clin Epidemiol. 1994;47:837-841.
11. Klatsky AL, Armstrong MA. Cardiovascular risk factors among Asian Americans living in northern California. Am J Public Health. 1991;81:1423-1428.
12. Ford ES, Giles WH, Dietz WH. Prevalence of the metabolic syndrome among U.S. adults: Finding from the 3rd national health nutrition examination survey. JAMA. 2002;287:356–9. [PubMed]
13. 6. Movakovic B, Popovic M. Occurrence of the metabolic syndrome in the population of the town of Novi Sed. Med Pregl. 2001;54:17–20.[PubMed]
14. Abdu-Rahim HF, Husseini A, Bjerfness F, Giacaman R, Gordon NH, Jervell J. The metabolic syndrome in the West Bank population: An urban-rural comparison. Diabetes Care. 2001;24:275–9. [PubMed]
15. 8. Balkau B, Charles MA, Drivsholm T, Borch-Johnsen K, Wareham N, Yudkin JS, et al. European Group For The Study Of Insulin Resistance (EGIR). Frequency of WHO-defined metabolic syndrome in European cohort and an alternative definition of an insulin resistance syndrome. Diabetes Metab. 2002;28:364–76. [PubMed]
16. Eregie A, Edo A. Diagnosing the metabolic syndrome: A comparative evaluation of three Diagnostic tools. Poster presentation. 19thWorld Diabetes Congress, International Diabetes Federation. December 3rd-7th 2006 Cape Town, South Africa. Diabetic Med. 2006;23
17. Ahmed A et al. "Metabolic syndrome in type2 diabetes: comparison of WHO, modified ATPlll and IDF criteria. "JPMA, vol.6 no. 62, 2012.
18. Alberti, KGMM; Zimmet (1999). "Definition, Diagnosis, and Classification of Diabetes Mellitus and its Complications" (PDF). World Health Organization. pp. 32–33. Retrieved 25 March 2013
19. (IDF) consensus PDF
20. Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (May 2001). "Executive Summary of the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III)". JAMA: The Journal of the American Medical Association. **285** (19): 2486–97. PMID 11368702. doi:10.1001/jama.285.19.2486
21. Ghanassia E, Raynaud de Mauverger E, Brun J-F, Fedou C, Mercier J. Limited predictive value of the IDF definition of metabolic syndrome for the diagnosis of insulin resistance measured with the oral minimal model. Ann Biol Clin (Paris). 2009 Oct;67(5):535–42.