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Original Article

Metabolic syndrome in north Indian type 2 diabetes mellitus patients: A comparison of four different diagnostic criteria of metabolic syndrome

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1. Introduction

Metabolic syndrome is a complex disorder with a collection of metabolic risk factors like central obesity, glucose intolerance, hyperinsulinemia, low HDL cholesterol, high triglycerides and hypertension [1], which doubles the risk of cardiovascular disease [2] and further raises the risk for type 2 diabetes mellitus by about 5-fold [3]. Moreover, collection of metabolic abnormalities in diabetes patient is associated with development of additional cardiovascular disease risk factors [4,5]. Metabolic Syndrome is also linked with other chronic disorders like fatty liver [6], cholesterol gallstones [7], polycystic ovary syndrome [8], and sleep apnea [9]. It is estimated that metabolic syndrome is prevalent in about a quarter of the world's adult population [10] and about one third of urban South Asians population [11]. Furthermore, insulin resistance is also observed in approximately 30% of Asian Indian children and adolescents and many of them suffer from metabolic syndrome [12]. Data also indicate that Asian Indian have an increased prevalence of premature coronary artery disease [13] and type 2 diabetes mellitus [14] amongst all ethnic groups. The global prevalence of type 2 diabetes mellitus is increasing very swiftly, particularly in developing countries of the world [15]. India has leading number of diabetes population in the world [14] and it is expected that there will be 79.4 million diabetes patients in India by 2030 [14]. Diabetes patients also have an increased prevalence of metabolic syndrome

and are predisposed to higher risk of cardiovascular disease, strokes and premature death compared to diabetes patients without metabolic syndrome and non-diabetes patients [16–18]. Moreover, life expectancy among diabetes patients with metabolic syndrome has found to be decreased at least by 10 years [19].

Presently different diagnostic criteria are used for the diagnosis of metabolic syndrome including WHO (World Health Organization, 1999) [20], NCEP-ATPIII (National Cholesterol Education Program: Adult Treatment Plan III, 2001) [21], IDF (International Diabetes Federation, 2005) [22], modified NCEP-ATPIII (2006) [23], Harmonized (JIS- joint interim statement of five major scientific organizations – the International Diabetes Federation, the National Heart, Lung, and Blood Institute, the American Heart Association, the World Heart Federation, the International Atherosclerosis Society, and the International Association of the Study of Obesity, 2009) [24] etc. Each criteria make use of different parameters with different cut offs. This leads to diverse prevalence rate of metabolic syndrome in the same population. Therefore, the prevalence of metabolic syndrome in diabetes patients seems to differ in various studies across India. The prevalence rate of metabolic syndrome is ranging from 23.0% to 84.0% by using WHO criteria [25,26], 18.0%–78.0% by using NCEP-ATPIII criteria [25–29], from 20.0% to 79.0% by using IDF criteria [25,26,30,31] and from 11.7% to 75.1% by using modified NCEP-ATPIII criteria [30–32]. While study from urban Orissa reported 35.5% of prevalence rate of metabolic syndrome by using Harmonized (JIS) criteria [33].

While numerous studies on the prevalence of metabolic syndrome have been carried out worldwide, there are limited studies from India which use four diagnostic criteria viz. WHO, NCEP-ATPIII, IDF and Harmonized (JIS). Therefore, the aim of present study was to determine the prevalence rate and distribution of risk factors of metabolic syndrome in type 2 diabetes patients using above mentioned four diagnostic criteria and also to determine their level of agreement and disparity in the diagnosis of metabolic

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syndrome at a tertiary health care center in northern India.

2. Materials and methods

The present study was conducted over a period of one year among 410 diabetes patients who attended the Endocrine OPD of Pt. B.D. Sharma PGIMS, Rohtak, Haryana, India. The study protocol was approved by the Ethics Committee of the Institute. Written informed consent was taken from all the participants at the time of enrollment.

2.1. Inclusion criteria

1. Patients above 18 years of age,
2. Patients of either sex,
3. Patients having type 2 diabetes mellitus irrespective of their duration of illness or treatment.

2.2. Exclusion criteria

1. Patients with chronic medical or surgical illness other than diabetes mellitus,
2. Patients on long-term treatment for other medical illness,
3. Patients who were terminally ill,
4. Patients having renal, neurological or cardiovascular dysfunction who require immediate hospitalization for serious illness,
5. Patients who were on corticosteroids or any psychotropic drug.

2.3. Measures

A semi-structured performa was used to obtain socio-demographic variables of patients and relevant past medical history and duration of illness, treatment taken for diabetes. Anthropometric measurements including weight, waist circumference, body mass index (BMI) were recorded. Blood pressure was measured using a sphygmomanometer. Blood pressure was recorded in the sitting position in the right arm. Two readings were taken 5 min apart and the mean of the two was taken as blood pressure. Fasting and 2-h post glucose load plasma glucose level, glycated hemoglobin (HbA1c), urinary albumin and creatinine level and lipid profile were done.

2.3.1. Diabetes mellitus definition

Diagnosis of diabetes was based on WHO criteria [20], which is.

1. Fasting plasma glucose- ≥ 126 mg/dl (≥ 7.0 mmol/L) and/or
2. 2-h post glucose load- ≥ 200 mg/dl (≥ 11.1 mmol/L)
3. Impaired glucose tolerance (IGT) - if 2-h post glucose load ≥ 140 mg/dl (≥ 7.8 mmol/L) and < 200 mg/dl (< 11.1 mmol/L).

2.3.2. Metabolic syndrome definition

Metabolic syndrome was defined in these patients by using four different diagnostic criteria given by:

2.3.2.1. WHO (World Health Organization, 1999) [20]. Diagnostic criteria- Diabetes, impaired glucose tolerance or insulin resistance plus any two or more of the following risk factors:

1. Central Obesity- Body mass index (BMI) ≥ 30 kg/m² and/or waist-to-hip ratio > 0.90 (Men), > 0.85 (Women)
2. Blood pressure- $\geq 140/\geq 90$ mmHg
3. Serum triglyceride- ≥ 150 mg/dl (≥ 1.7 mmol/L)

4. Serum HDL- < 35 mg/dl (< 0.9 mmol/L) in men and < 39 mg/dl (1.0 mmol/L) in women
5. Micro-albuminuria- Urinary albumin excretion rate ≥ 20 mg/min or albumin/creatinine ratio ≥ 30 mg/g

2.3.2.2. NCEP-ATPIII (National Cholesterol Education Program: Adult Treatment Plan III, 2001) [21]. Diagnostic criteria- At least three of the following risk factors:

1. Central Obesity/Waist circumference- ≥ 102 cm (Men), ≥ 88 cm (Women)
2. Blood pressure- $\geq 130/\geq 85$ mmHg or on specific medication
3. Fasting plasma glucose- ≥ 110 mg/dl (≥ 6.1 mmol/L) or on specific medication
4. Serum triglyceride- ≥ 150 mg/dl (≥ 1.7 mmol/L) or on specific medication
5. Serum HDL- < 40 mg/dL (1.03 mmol/L) in men and < 50 mg/dl (1.29 mmol/L) in women or on Specific medication

2.3.2.3. IDF (International Diabetes Federation, 2005) [22]. Diagnostic criteria- Central/Abdominal obesity plus two or more of the following risk factors:

1. Central Obesity/Waist circumference- ≥ 90 cm (Men), ≥ 80 cm (Women) for South Asians
2. Blood pressure- $\geq 130/\geq 85$ mmHg or on specific medication
3. Fasting plasma glucose- ≥ 100 mg/dl (≥ 5.6 mmol/L) or on specific medication
4. Serum triglyceride- ≥ 150 mg/dl (≥ 1.7 mmol/L) or on specific medication
5. Serum HDL- < 40 mg/dL (1.03 mmol/L) in men and < 50 mg/dl (1.29 mmol/L) in women or on Specific medication

2.3.2.4. Harmonized/JIS (Joint Interim Statement) (2009) [24]. Diagnostic criteria- At least three of the following risk factors:

1. Central Obesity/Waist circumference- ≥ 90 cm (Men), ≥ 80 cm (Women)
2. Blood pressure- $\geq 130/\geq 85$ mmHg or on specific medication
3. Fasting plasma glucose- ≥ 100 mg/dl (≥ 5.6 mmol/L) or on specific medication
4. Serum triglyceride- ≥ 150 mg/dl (≥ 1.7 mmol/L) or on specific medication
5. Serum HDL- < 40 mg/dL (1.03 mmol/L) in men and < 50 mg/dl (1.29 mmol/L) in women or on Specific medication

2.4. Statistical analysis

The data collected during the study was entered in the Microsoft Excel format and was analyzed using SPSS 20 version. A descriptive statistical analysis was done for continuous and categorical variables. Differences in characteristics between participants were tested with unpaired *t*-test for normally distributed variables and with the Chi-square test for categorical variables. Binary logistic regression model was used to examine the association between predictor variables and risk of depression. Results were expressed as odds ratio (OR) and 95% confidence intervals. The agreements among the definitions of WHO, NCEP-ATPIII, IDF and harmonized (JIS) criteria were assessed with kappa statistics. The level of agreement was categorized as poor with $\kappa \leq 0.20$, fair with $\kappa = 0.21$ to 0.40, moderate with $\kappa = 0.41$ to 0.60, substantial with $\kappa = 0.61$ to 0.80, and very good with $\kappa > 0.80$ [34]. The *P* values were two-

tailed, and probability level of significant difference was set at <0.05.

3. Results

A total of 410 diabetes patients were enrolled in the present study, out of which 213 females (52.0%) and 197 males (48.0%) were there. The socio-demographic and clinical characteristics of these patients are shown in Table 1. The overall mean age of the population was 54.73 ± 9.99 years, whereas the ages of the males and females were 56.19 ± 9.37 and 53.38 ± 10.36 , respectively. The duration of type 2 diabetes was 6.78 ± 5.52 years. The prevalence of individual components of metabolic syndrome according to WHO, NCEP-ATPIII, IDF and Harmonized (JIS) criteria are shown in Table 2. The degree of agreement (kappa statistic) between WHO, NCEP-ATPIII, IDF and Harmonized (JIS) definition are shown in Table 3. The degree of agreement was found to be highest between IDF and Harmonized (JIS) definitions [$\kappa = 0.72$ (0.55–0.71), substantial] and the lowest between WHO and IDF definitions [$\kappa = 0.24$ (0.19–0.28), fair]. The independent risk factors for metabolic syndrome among the diabetes patients is calculated by applying binary logistic regression analysis are shown in Table 4. For metabolic syndrome, Odd Ratio was significantly higher for female sex with the value of 3.54, followed by 2.81 for age group (41–60 years), 1.98 for BMI

$\geq 30 \text{ kg/m}^2$, 1.52 for systolic hypertension and 0.77 for low serum HDL level, while it was lowest (0.53) for low education level (illiteracy).

4. Discussions

The diversity in definitions of metabolic syndrome and the influence of ethnic variation amongst the different populations has led to different prevalence rates of metabolic syndrome. Therefore, in this study, the prevalence rate of metabolic syndrome in diabetes patients was found to be 76.1% by IDF criteria, 68.7% by Harmonized (JIS) criteria, 51.4% by NCEP-ATPIII criteria and 26.3% by WHO criteria. While in a large epidemiological study from Chennai, metabolic syndrome was identified 25.8% by IDF criteria, 23.2% by WHO criteria and 18.3% by NCEP-ATPIII criteria in diabetes patients [25]. In a recent study including 1000 diabetes Kashmiri population, the prevalence of metabolic syndrome was found to be 84.5% by WHO criteria, 79.5% by IDF criteria and 78.0% by NCEP-ATPIII criteria [26]. A study from urban Delhi showed the prevalence of metabolic syndrome as 75.3% and 75.1% by using IDF and modified NCEP-ATPIII criteria, respectively [31]. Another study from urban Orissa including 1178 adults reported 35.5% of prevalence rate of metabolic syndrome by using Harmonized (JIS) criteria [33]. Whereas study from rural population of South India reported the

Table 1
Socio-demographic and clinical profile of the participants.

Variables	Total n (%) 410 (100.0)	Male n (%) 197 (48.0)	Female n (%) 213 (52.0)	p value
Age (in years)	54.73 ± 9.99	56.19 ± 9.37	53.38 ± 10.36	0.004*
Marital status				
Married	391 (95.4)	194 (98.5)	197 (92.5)	<0.001*
Unmarried	5 (1.2)	3 (1.5)	2 (0.9)	
Widow	14 (3.4)	0	14 (6.6)	
Residential area				
Rural	131 (32.0)	72 (36.5)	59 (27.7)	0.045*
Urban	279 (68.0)	125 (63.5)	154 (72.3)	
Education level				
Illiterate	69 (16.8)	14 (7.1)	55 (25.8)	<0.001*
Literate	341 (83.2)	183 (92.9)	158 (74.2)	
Type of family				
Nuclear	176 (42.9)	76 (38.6)	100 (46.9)	0.184
Joint	234 (57.1)	121 (61.4)	113 (53.1)	
Life style				
Sedentary	231 (56.3)	110 (55.8)	121 (56.8)	0.843
Physically active	179 (43.7)	87 (44.2)	92 (43.2)	
Smoking				
Yes	124 (30.2)	124 (61.9)	0	<0.001*
No	286 (69.8)	73 (38.1)	213 (100.0)	
Alcohol				
Yes	66 (16.1)	66 (33.0)	0	<0.001*
No	344 (69.8)	131 (67.0)	213 (100.0)	
Waist (cm)	95.76 ± 10.69	94.81 ± 10.63	96.64 ± 10.70	0.083
Height (cm)	161.32 ± 9.93	166.80 ± 9.28	156.26 ± 7.53	<0.001*
Weight (kg)	67.35 ± 10.07	69.32 ± 10.17	65.53 ± 9.63	<0.001*
BMI (kg/m ²)	25.96 ± 3.79	24.95 ± 3.36	26.89 ± 3.93	<0.001*
Systolic BP (mmHg)	134.95 ± 19.75	133.31 ± 18.73	136.46 ± 20.58	0.107
Diastolic BP (mmHg)	85.96 ± 14.13	84.95 ± 12.42	86.89 ± 15.52	0.166
Fasting plasma glucose (mg/dl)	157.43 ± 52.47	153.36 ± 53.24	161.19 ± 51.59	0.132
2-h post glucose load plasma glucose level (mg/dl)	230.40 ± 62.80	225.18 ± 65.28	235.23 ± 60.17	0.106
Serum triglyceride (mg/dl)	201.00 ± 62.01	199.02 ± 63.69	202.83 ± 60.51	0.535
Serum HDL (mg/dl)	43.21 ± 8.63	41.92 ± 8.00	44.40 ± 9.04	0.004*
HbA1c (%)	9.6 ± 2.0	9.4 ± 2.1	9.8 ± 1.9	0.129
Micro-albuminuria	36.79 ± 64.38	28.01 ± 50.56	44.91 ± 74.15	0.016*
Duration of diabetes (years)	6.78 ± 5.52	7.09 ± 6.11	6.50 ± 4.91	0.282
Type of therapy for diabetes				
Oral therapy	281 (68.5)	139 (70.6)	142 (66.7)	0.427
Insulin therapy	129 (31.5)	58 (29.4)	71 (33.3)	
History of anti-hypertensive drugs				
Yes	139 (33.9)	60 (30.5)	79 (37.1)	0.156
No	271 (66.1)	137 (69.5)	134 (62.9)	

*p < 0.05 significant.

Table 2
Prevalence of individual component of metabolic syndrome by using different criteria.

Criteria	Sex n(%)	Central Obesity n(%)	Plasma glucose (Fasting) n(%)	Serum triglyceride n(%)	Serum HDL n(%)	Blood pressure		Micro-albuminuria n(%)	Metabolic syndrome n(%)
						Systolic n(%)	Diastolic n(%)		
WHO	Male	19 (4.6)	164 (83.2)	154 (78.1)	31 (15.7)	81 (41.1)	78 (39.5)	23 (11.6)	44 (22.3)
	Female	40 (18.7)	188 (88.2)	174 (81.6)	46 (21.5)	97 (45.5)	87 (40.8)	70 (32.8)	64 (30.0)
	Total	59 (14.3)*	352 (85.8)	328 (80.0)	77 (18.7)*	178 (43.4)	177 (43.1)	93 (22.6)*	108 (26.3)
NCEP-ATPIII	Male	47 (23.8)	154 (78.1)	154 (78.1)	88 (44.5)	111 (56.3)	84 (42.6)	-	77 (39.0)
	Female	176 (82.6)	178 (83.5)	174 (81.6)	172 (80.7)	137 (64.3)	93 (43.6)	-	134 (62.9)
	Total	223 (54.3)*	332 (80.9)	328 (80.0)	250 (60.9)*	248 (60.4)	177 (43.1)	-	211 (51.4)
IDF	Male	133 (67.5)	174 (88.3)	154 (78.1)	88 (44.5)	111 (56.3)	84 (42.6)	-	96 (48.7)
	Female	207 (97.1)	195 (91.5)	174 (81.6)	172 (80.7)	137 (64.3)	93 (43.6)	-	163 (78.7)
	Total	340 (82.9)*	369 (90.0)	328 (80.0)	250 (60.9)*	248 (60.4)	177 (43.1)	-	259 (76.1)
Harmonized (JIS)	Male	133 (67.5)	174 (88.3)	154 (78.1)	88 (44.5)	111 (56.3)	84 (42.6)	-	84 (42.6)
	Female	207 (97.1)	195 (91.5)	174 (81.6)	172 (80.7)	137 (64.3)	93 (43.6)	-	161 (76.5)
	Total	340 (82.9) *	369 (90.0)	328 (80.0)	250 (60.9) *	248 (60.4)	177 (43.1)	-	245 (68.7)

*p < 0.05 significant.

Table 3
Agreement between various definitions of metabolic syndrome.

Definitions	Concordance			Agreement
	κ	-value (95% CI)	p value	
WHO and NCEP-ATPIII	0.30	(0.27–0.43)	<0.001*	fair
WHO and IDF	0.24	(0.19–0.28)	<0.001*	fair
WHO and Harmonized (JIS)	0.29	(0.21–0.30)	<0.001*	fair
NCEP-ATPIII and IDF	0.46	(0.43–0.50)	<0.001*	moderate
NCEP-ATPIII and Harmonized (JIS)	0.64	(0.51–0.69)	<0.001*	substantial
IDF and Harmonized (JIS)	0.72	(0.55–0.71)	<0.001*	substantial

*p < 0.05 significant.

Table 4
Predictors of metabolic syndrome in type 2 diabetes mellitus patients (Results of logistic regression analysis).

Independent variables	OR	95% CI for OR		p value
		Lower	Upper	
Female sex	3.54	1.96	6.39	0.004*
Age group (41–60 years)	2.81	1.78	5.20	0.001*
BMI ≥ 30 kg/m ²	1.97	1.55	4.67	0.001*
Systolic hypertension	1.52	0.82	2.39	0.038*
Low serum HDL level	0.77	0.66	1.92	0.045*
Low education level (Illiteracy)	0.53	0.39	1.73	0.011*

*p < 0.05 significant.

prevalence as 20.5% and 17.8% by using IDF and modified NCEP-ATPIII criteria, respectively [30]. The total age adjusted prevalence rates of metabolic syndrome among 1061 Nepalese type 2 diabetes patients were 80.3%, 73.9%, 69.9% and 66.8% according to Harmonized (JIS), NCEP-ATPIII, WHO and IDF definitions, respectively [35]. In a nationwide, cross-sectional study including 4341 subjects across Malaysia by Wan Nazaimoon et al. [36], the prevalence of metabolic syndrome was found to be 32.1%, 37.1%, 34.3%, and 42.5% by using WHO, IDF, NCEP-ATPIII and Harmonized (JIS) definitions, respectively. A study from Pakistan found prevalence rate of metabolic syndrome as 34.8% and 49.0% by IDF and modified NCEP-

ATPIII criteria, respectively [37]. Various other studies from Asia found that prevalence of metabolic syndrome ranging from 14.5% to 24.3% by IDF criteria [38,39] and from 11.9% to 16.5% by NCEP-ATPIII criteria [38,40]. However, study from US reported the prevalence of metabolic syndrome 28.0% by WHO criteria and 23.0% by NCEP-ATPIII criteria [41]. Similarly, a study from south Australia showed prevalence of metabolic syndrome as 22.8% and 15.0% by using IDF and NCEP-ATPIII criteria, respectively [42].

In present study, metabolic syndrome was more prevalent in female patients with diabetes than males (78.7% vs. 48.7% by IDF criteria, 76.5% vs. 42.6% by Harmonized (JIS) criteria, 62.9% vs. 39.0% by NCEP-ATPIII criteria and 30.0% vs. 22.3% by WHO criteria). Diabetes female patients were almost 3 times [3.54 (1.96–6.39)] more likely to develop the metabolic syndrome, as compared with male patients (Table 4). In a previous study from Kashmir showed metabolic syndrome was highly prevalent in female patients with diabetes compared to male by using IDF criteria, NCEP-ATPIII criteria and WHO criteria [26]. However study by Deepa et al. [25] found that the prevalence of metabolic syndrome was higher in females by NCEP-ATPIII and IDF criteria but it was higher in males by WHO criteria. Female preponderance was also reported in various previous studies across India [28,31,32,33,43and44] as well as globally [35,36and37]. Female preponderance in prevalence of metabolic syndrome may be due to relatively sedentary lifestyle, low education level, high BMI and metabolic changes accompanied by menopause.

The prevalence rate of metabolic syndrome was significantly higher in age group between 41 and 60 years and it was decreasing after 61 years of age [Fig. 1]. Similar results had already been observed by Deepa et al. [25], Pokharel et al. [35] and Nsiah et al. [47] in their studies. This could be attributable to the fact that diabetes patients of age group 40–60 years are physically inactive, having long and stressful work environment, lack of adequate sleep and poor dietary compliance. Moreover, there is gradual decrease in the basal metabolic rate, stress induced hypercortisolism, abdominal fat deposition and concomitant insulin resistance, which favor increase predisposition of metabolic syndrome in these patients

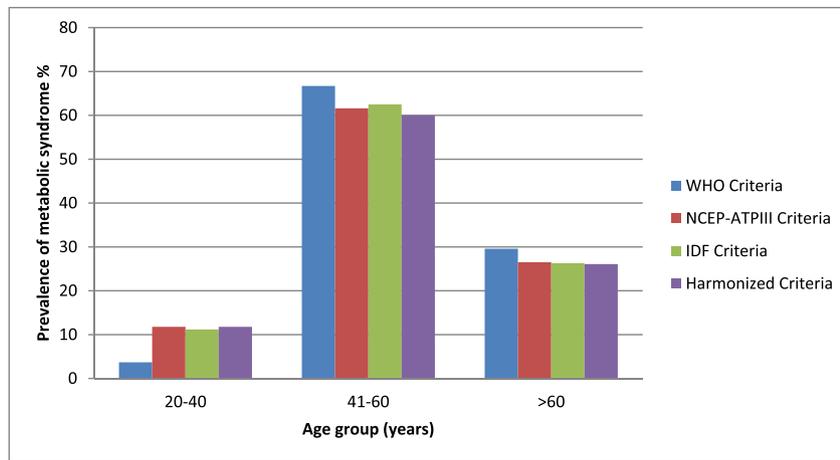


Fig. 1. Prevalence of metabolic syndrome according to age group.

[45]. On the other hand, the sharp decline of the prevalence in older age group might be due to increased frequency of mortality of diabetes patients who were most vulnerable to obesity related complications like coronary artery diseases and cerebro-vascular accidents [25,46]. But, study by Adediran et al. [48] showed that the metabolic syndrome was more common amongst the elderly patients, which was not similar to our findings.

In this study, metabolic syndrome was found to be significantly associated with BMI ≥ 30 kg/m², systolic hypertension and low serum HDL level in diabetes patients. Obesity increased the probability of one having the metabolic syndrome, as diabetes patients with obesity were almost 2 times [1.98 (1.55–4.67)] more likely to develop the metabolic syndrome, compared with normal weight patients (Table 4). This could be due to fact that South Asians (Indian) are having increase risk of obesity, dyslipidemia and insulin resistance at younger age, compared to Western world and hence have greater risk of metabolic syndrome, type 2 diabetes mellitus and cardiovascular diseases than any other population in the world [49]. Similar association of high BMI and risk of development of metabolic syndrome in the diabetes patients had already been observed in their studies by Lone et al. [26], Zafar et al. [32], Pokharel et al. [35] and Nsiah et al. [47]. Lone et al. [26] in their study also showed that hypertension, low serum HDL level and high serum triglycerides level were significantly associated with metabolic syndrome in diabetes patients. But in present study, high serum triglycerides level was not significantly linked with metabolic syndrome. In this study, low education level (illiteracy) was also significantly associated with metabolic syndrome in diabetes patients (Table 4). This could be due to poor dietary habits (carbohydrate rich foods, high saturated fatty foods and low fiber diet) as well as sedentary life style in diabetes patients with low education level. These findings were consistent with previous studies by Nsiah et al. [47] and Moebus et al. [50].

In this study, the most common components of the metabolic syndrome were raised fasting plasma glucose followed by central obesity by using IDF and Harmonized (JIS) criteria and raised fasting plasma glucose followed by high serum triglycerides by using NCEP-ATPIII and WHO criteria. In females, the most common components were central obesity followed by raised fasting plasma glucose according to IDF and Harmonized (JIS) criteria; raised fasting plasma glucose followed by central obesity according to NCEP-ATPIII criteria and raised fasting plasma glucose followed by high serum triglycerides according to WHO criteria. On the other hand, in males, raised fasting plasma glucose followed by high serum triglycerides were the most common components by

applying IDF, Harmonized (JIS), NCEP-ATPIII and WHO criteria. Diastolic hypertension was the least prevalent component of metabolic syndrome in overall as well as in both female and male groups by using above criteria of metabolic syndrome. These findings are not similar to previous Indian studies by Surana et al. [28], Yadav et al. [29] and Prasad et al. [33], which reported hypertension as the commonest component of metabolic syndrome. While in Nepalese study, central obesity was the most prevalent component according to WHO and IDF criteria and low HDL cholesterol according to NCEP ATPIII and Harmonized criteria and hypertension was the least common component according to all four criteria [35]. Despite of many controversies in diagnosis and definition of metabolic syndrome, it is still considered to be a valuable diagnostic tool in primary prevention of diabetes mellitus and cardiovascular diseases. Therefore, these patients should be managed by adequate behavioural education, lifestyle modification and use of medications to lessen the metabolic abnormalities associated with this syndrome, hence diminish the probability of diabetes mellitus and cardiovascular morbidity and mortality.

5. Conclusion

The study revealed that the prevalence of metabolic syndrome among patients of diabetes was highest (76.1%) according to IDF criteria and lowest (26.3%) according to WHO criteria. The degree of agreement was found to be highest between IDF and Harmonized (JIS) definitions and the lowest between WHO and IDF definitions. The presence of risk factors for metabolic syndrome among diabetes patients predicts a causal association and warrants attention from healthcare providers. The common predictors of metabolic syndrome in type 2 diabetes patients were female sex, age group 41–60 years, BMI ≥ 30 kg/m², systolic hypertension, low HDL cholesterol level and low education level (illiteracy). Therefore, screening of these risk factors of metabolic syndrome is required for every diabetes patient and efforts should be intensified in educating patients about lifestyle modifications and treatment to reduce insulin resistance, so that future cardiovascular morbidity and mortality could be prevented to an enormous extent.

6. Limitations

This study reveals prospective clinical conclusion but there are few limitations. The sample size of study was relatively small and therefore, these results may not be generalized to entire population. Moreover, it was a cross-sectional study and hence, cannot be

used to establish long-term conclusions. Therefore, multi-central and longitudinal studies are required from different geographical areas to establish causal association between metabolic syndrome and type 2 diabetes mellitus.

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Conflicts of interest

There are no conflicts of interest.

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