Original Article

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Demographic and Biochemical Parameters of Community Survey Participants with Metabolic Syndrome from Terai Region of Nepal

Biochemistry Section

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ABSTRACT

Introduction: The Metabolic Syndrome (MS) is a multifactorial disease associated with central obesity, hypertension, atherogenic dyslipidemia and impaired glucose tolerance. Low grade inflammatory and a prothrombotic state are also involved in MS.

Aim: To explore the demographic and biochemical parameters of participants with MS in Terai region of Nepal using community based cross-sectional study.

Materials and Methods: A cross-sectional study was carried out during September 2019-December 2019 in adult participants with central obesity (n=378) selected from three districts of Terai region of Nepal. International Diabetes Federation (IDF) criteria were used to define MS. The C-reactive protein-ultra sensitive, fibrinogen, and apolipoprotein-B were estimated as inflammatory, prothrombotic, and atherogenic dyslipidemia markers, respectively.

Results: The MS was present in 283 participants with central obesity. The mean (±SD) age, height, weight, and BMI of the participants with MS were 46.36±12.52 years, 5.56±0.11 feet, 66.54±13.45 kg and 27.28±4.98 kg/m^2, respectively. The mean (±SD) of biochemical factors were significantly different than their respective normal ranges: decreased serum High Density Lipoprotein (HDL) cholesterol in mg/dL (male: 34.50±9.93, p<0.001, female: 36.77±7.28, p<0.001), raised serum triglycerides level- 184.96±85.72 mg/dL (p<0.001), and impaired fasting serum glucose level 108.14±48.27 mg/dL (p=0.002). Significant increase in inflammatory (CRP-US: 1.12±2.17 mg/L, p<0.001), prothrombotic (fibrinogen: 3.42±1.04 gm/L, p<0.001) and atherogenic dyslipidemia marker (Apo-B: 149.35±59.13 mg/dL, p=0.003) from normal values were observed in subjects with MS.

Conclusion: Lowered serum HDL cholesterol, increased triglycerides followed with impaired fasting glucose tolerance were observed as the major abnormal biochemical parameters and increased inflammatory and prothrombotic activities were present among participants with MS.

Keywords: Apolipoprotein-B, C-reactive protein-ultra sensitive, Fibrinogen, International diabetes federation

INTRODUCTION

The MS is characterised by synergistically interacting cardiovascular risk factors [1]. Central obesity with hypertension, dyslipidemia and impaired fasting blood glucose are the major components of MS [2]. Increased level of proinflammatory (CRP-US) and prothrombotic (fibrinogen) markers have also been reported in MS subjects [3].

The MS has become a major public health concern because of increase in its prevalence globally [4]. Increasing prevalence of MS in Nepal has been reported: 22.5% in general population of eastern Nepal and 82% prevalence in diabetes patients, using IDF criteria [5,6]. A recent study inTerai region of Nepal found MS in 74.9% participants with central obesity [7].

The identification of features at early stage of MS provides an opportunity to act proactively to prevent or postpone diabetes by lifestyle change, however, no such studies has been conducted in Terai region of Nepal. The objectives of the present study were to explore the demographic and biochemical parameters and their underlying association in subjects with MS in Terai region of Nepal.

MATERIALS AND METHODS

This was a community based cross-sectional study carried out during September to December 2019 in the three districts (Dhanusha, Mahottary and Sarlahi) of Janakpur Zone, Nepal. This research protocol was reviewed for Ethical compliance and approved by the Institutional Review Board of Tribhuwan University, Institute of Medicine, Maharajgunj, Kathmandu (reference number 110/071/071, date: November, 14, 2014). Four different camps were organised in each district for participants selection and sample collection. The target community people were informed about the research by establishing a joint approach between government health service network and research team using different tools (wall poster, volunteer mobilisation and radio).

Inclusion criteria: The participants were selected based on their central obesity having waist circumference ≥90 cm in males and ≥80 cm in females.

Exclusion criteria: Subjects below 18 years and having waist circumference <90 cm in males and <80 cm in females and having history of any abdominal surgery were excluded from the study.

Study Procedure

A structured questionnaire was used to collect the details information of participants. Physical examination, which included waist circumference, height, weight and Blood Pressure (BP) measurement were conducted by physician/trend paramedical staffs. After obtaining written consent, appropriate amount of fasting venous blood sample was collected maintaining aseptic condition from the participants meeting inclusion criteria. A 1.8 mL of blood sample were transferred to 3.2% sodium citrate vial (Liuyang SANLI Medical Technology Development Co. Ltd., No. 99, Jinsha North Road, Liuyang, Hunan, China) and remaining blood sample were transferred in the fluoride vial (Yash polymers, A/8/4, Sahajanand Tower, Jivraj park cross road, Jivrajpark, Ahmedabad-380051, Gujarat, India). Sample containing vials, sodium citrate and fluoride vials were centrifuged to obtained plasma and serum, respectively. Fibrinogen (citrated plasma sample), CRP-US and Apolipoprotein-B (Serum sample) concentration were estimated by immunoturbidimetry method (Quantia Fibrinogen: Tulip Diagnostic Pvt., Ltd., Unit II, 1st floor, Plot Nos. 92/96, Phase II C, Verna Industrial Estate, Verna, Goa-403722, India) using Gr8Lab 1.0 semi auto analyser (Gitanjali, Tulip block, Dr. Antonio Do RegoBagh, Alto Santacruz,

Bambolim complex post office, Goa-403722, India) [8-10]. Fasting blood glucose, cholesterol, Triacylglycerol (TAG), HDL and Low-Density Lipoprotein (LDL) cholesterol were estimated from serum sample by enzymatic method using Accent 200 fully automated biochemistry analyser (PZ Cormay S. A. Warsaw office, 303 Pulawska Str., 02-785 Marsaw) [11-15].

Waist circumference were measured obeying the instruction provided by IDF, regarding central obesity measurement [16]. A measuring tape in a horizontal plane around abdomen at midway between the inferior margin of the ribs and the superior border of the iliac crest was placed. Measurement was done at the end of normal expiration, without any compression on the skin. The BP measurement was carried out using standard mercury sphygmomanometer by physician/trend paramedical staffs. Participants were requested to do rest for at least 10 minutes, before BP measurement. The BP was measured in the appropriate sitting position. Initially, BP was measured on both arms, while arm that showed higher BP was used for BP measurement.

The IDF criteria (central obesity with any two of following four components: Triglycerides ≥150 mg/dL or specific medication for lipid abnormality, decreased HDL, raised BP and raised fasting blood glucose or previously diagnosed type 2 Diabetes Mellitus) were used to assess MS [17].

STATISTICAL ANALYSIS

All the data were entered in Excel spreadsheet and was analysed using Statistical Package for the Social Sciences (SPSS) 21.0. Authors used descriptive statistics mean (±SD) to summarise the demographic, biochemical and metabolic characteristics of the survey participants and the differences in these characteristics by gender was described. Authors further compared the mean differences in the observed values for the biochemical and metabolic characteristics with the normal values for each of the characteristics using student's t-test. The p-value was set at <0.05.

RESULTS

Out of 378 selected participants with central obesity, 283 participants found having MS. The mean (±SD) age, height, weight and BMI of the participants with MS is shown in [Table/Fig-1]. The mean (±SD) of biochemical factors: waist circumference, systolic BP, diastolic BP, triglycerides, fasting blood sugar, HDL cholesterol, total cholesterol and LDL cholesterol were 95.89±9.52 cm (male: 100.24±8.75, female: 91.35±8.09), 129.67±15.07 mm of Hg (male: 130.06±13.61, female: 129.27±16.49), 82.53±8.21 mm of Hg (male: 82.93±7.62, female: 82.11±8.80), 184.96±85.72 mg/dL (male: 197.15±93.67, female: 172.25±74.69), 108.14±48.27 mg/dL (male: 110.06±51.05, female: 106.14±45.29), 35.61±8.79 mg/dL (male: 34.50±9.93, female: 36.77±7.28), 189.01±55.38 mg/dL (male: 189.15±49.64, female: 188.87±60.98) and 116.99±31.71 mg/dL (male: 116.99±31.71, female: 119.12±33.22) found respectively. The mean (±SD) of biochemical factors known to be associated with MS were found to be significantly different than their respective normal range: decreased serum HDL cholesterol in mg/dL (male: 34.50±9.93, p<0.001, female: 36.77±7.28, p<0.001), increased serum triglycerides level 184.96±85.72 mg/dL (p<0.001), raised total cholesterol 189.01±55.38 mg/dL (p<0.001) and impaired fasting serum glucose level 108.14±48.27 mg/dL (p=0.002). Significant increase in inflammatory (CRP-US: 1.12±2.17 mg/L, p<0.001), prothrombotic (fibrinogen: 3.42±1.04 gm/L, p<0.001) and atherogenic dyslipidemia (apolipoprotein-B: 149.35±59.13 mg/dL, p=0.003) marker from normal values were also observed in subjects with MS.

General characteristics	Male (n=143)	Female (n=140)	Overall (n=283)
Age (years)	46.46±12.28	46.24±12.80	46.36±12.52
Height (feet)	5.37±0.25	4.87±0.33	5.56±0.11
Weight (kg)	74.45±10.88	58.29±10.63	66.54±13.45
BMI (kg/m^2)	27.81±4.12	26.72±5.71	27.28±4.98

[Table/Fig-1]: Distribution (mean±SD) of general characteristics of subjects (n=283) with Metabolic Syndrome (MS) from three Terai districts of Nepal by gender. Three Terai districts of Nepal (n=283).

DISCUSSION

Nepal is a small, land locked developing country of Himalaya region of South East Asia, situated between two big countries: India and China. Despite being small country, it has incredible geographical diversity, from southern plane area connecting northern part of India to the northern world's highest pick, the mount Everest. The southern plane part of Nepal adjoining India, is named as Terai region, sharing nearly same social, cultural and economic characteristics of northern India. Like other developing countries as well as other region of Nepal, Terai is also experiencing rapid urbanisation, industrialisation and increase in economic growth, resulting in increased trend of MS prevalence.

In this study, demographic and biochemical parameters of subjects presented MS and their underlying association was studied. The general characteristics of participants with MS stratified by gender is shown in [Table/Fig-1]. The findings of the present study showed that most of the subjects presented with MS were of middle aged (46.36±12.52 years) with higher Body Mass Index (BMI: 27.28±4.98), without any significant differences in age and BMI in male and female. The similar mean±SD (49.6±12.3) age group was reported in a study carried out in Iran, and Himalayan region of Sikkim, India, presented with MS [18]. A study conducted in Tunisa has reported that the prevalence of MS found increased with age, in both gender [19].

The mean±SD weight of the male subjects presented with MS was found higher (74.45±10.88) in comparison to female subjects (58.29±10.63), however overall mean (±SD) weight was found 66.54±13.45 kg. As expected, almost all biochemical parameters known to be related with MS were found abnormal [Table/Fig-2]. Overall mean (±SD) waist circumference of participants with MS were found 95.89±9.52 cm (male: 100.24±8.75, female: 91.35±8.09) and found significantly higher in both gender when compared with normal acceptable value (p<0.001). The overall increased waist circumference of participants may be partially related to the participants selection criteria, which were based on their central obesity. Mean (±SD) systolic and diastolic BP were found 129.67±15.07 and 82.53±8.21 mm of Hg, respectively, which showed significantly increased correlation when compared with normal acceptable value (systolic: p=0.453, diastolic: p=0.003). In addition, the results of other metabolic abnormalities such as triglycerides (mean±SD: 184.96±85.72 mg/dL), fasting blood sugar (mean±SD: 108.14±48.27 mg/dL), total cholesterol (mean±SD: 189.01±55.38 mg/dL) were also found significantly increased than their acceptable normal range with p-value <0.001, 0.002, <0.001, respectively [Table/Fig-3]. Significant decreased (p=<0.001) mean (±SD) HDL cholesterol was observed in both gender (male:34.50±9.93, female: 36.77±7.28). A similar cross-sectional study performed on 291 subjects with MS in Zahedan, Iran has shown nearly the same status of biochemical parameters (mean±SD age: 43.91±14.71 years, FBG: 109.30±44.97 mg/dL, waist circumference 99.50±11.61 cm, triglycerides: 183.72±77.15 mg/dL, total cholesterol: 210.48±45.10 mg/dL, HDL cholesterol: 41.76±6.97 mg/dL, LDL cholesterol: 124.57±40.72 mg/dL and BMI: 28.84±4.65 kg/m^2) [20]. Moreover, similar pattern of biochemical parameter was reported by various studies in subjects with MS [21-23].

Furthermore, in this study, authors had examined the proinflammatory (CRP-US), prothrombotic (fibrinogen) and atherogenic dyslipidemia (APO-B) markers in the subjects with MS to explore their inflammatory, prothrombotic and atherogenic dyslipidemia status respectively, convincingly known to be associated with MS, which

Metabolic abnormalities and related disorders	Male (n=143)	Female (n=140)	Overall (n=283)
Waist circumference (cm)	100.24±8.75	91.35±8.09	95.89±9.52
Systolic blood pressure (mmHg)	130.06±13.61	129.27±16.49	129.67±15.07
Diastolic blood pressure (mmHg)	82.93±7.62	82.11±8.80	82.53±8.21
Triglycerides (mg/dL)	197.15±93.67	172.25±74.69	184.96±85.72
Fasting blood sugar (mg/dL)	110.06±51.05	106.14±45.29	108.14±48.27
HDL cholesterol (mg/dL)	34.50±9.93	36.77±7.28	35.61±8.79
Total cholesterol (mg/dL)	189.15±49.64	188.87±60.98	189.01±55.38
LDL cholesterol (mg/dL)	116.99±31.71	119.12±33.22	118.03±32.42
Apolipoprotein (mg/dL)	152.38±62.90	146.18±54.99	149.35±59.13
CRP-US (mg/L)	1.10±2.10	1.13±2.24	1.12±2.17
Fibrinogen (gm/L)	3.36±1.04	3.48±1.03	3.42±1.04

[Table/Fig-2]: Distribution (mean±SD) of metabolic abnormalities and related disorders among subjects (n=283) with Metabolic Syndrome (MS) from three Terai districts of Nepal by gender.

Metabolic abnormalities and related disorders	Subjects with metabolic syndrome Mean±SD	Normal range	Test of signifi-cance	p-value
Waist circumference (cm): Male	100.24±8.75	<90	t=15.46	<0.001
Waist circumference (cm): Female	91.35±8.09	<80	t=17.98	<0.001
Systolic blood pressure (mmHg)	129.67±15.07	<130	t=0.75	0.453
Diastolic blood pressure (mmHg)	82.53±8.21	<85	t=3.01	0.003
Triglycerides (mg/dL)	184.96±85.72	<150	t=7.07	<0.001
Fasting blood sugar (mg/dL)	108.14±48.27	<100	t=3.19	0.002
HDL cholesterol (mg/dL): Male	34.50±9.93	≥40	t=5.44	<0.001
HDL cholesterol (mg/dL): Female	36.77±7.28	≥50	t=19.78	<0.001
Total cholesterol (mg/dL)	189.01±55.38	<150	t=12.17	<0.001
Apolipoprotein (mg/dL)	149.35±59.13	≤140	t=2.94	0.003
CRP-US (mg/L)	1.12±2.17	≤0.3	t=6.37	<0.001
Fibrinogen (gm/L)	3.42±1.04	≤4.0	t=9.37	<0.001

[Table/Fig-3]: Comparison of metabolic abnormalities and related disorders with normal acceptable values among subjects with Metabolic Syndrome (MS) from three Teraidistricts of Nepal (n=283), using student's t-test.

were found to be significantly increased. The CRP is considered as the best and well standardised biomarker of inflammation and various studies have confirmed that CRP levels are found increased in subjects with MS [24]. Recently, CRP-US has been added as a clinical criterion for MS. It has been reported that elevated CRP levels found involved in contributing cardiovascular risks. In this study, significant increase in CRP-US was observed (mean±SD: 1.12±2.17 mg/L, p=<0.001), in comparison with normal acceptable value. In addition to the CRP, fibrinogen which has categorised as an acute phase protein, synthesised by hepatocytes is also considered as an important inflammatory biomarker and widely being used as an important marker to monitor the atherosclerotic inflammatory process evaluation.

Fibrinogen has been found to be directly involved in atherothrombotic genesis process by regulating cell adhesion and proliferation, vasoconstriction at the site of endothelial injury, platelets aggregation stimulation and blood viscosity [25]. The result of this study has shown significantly increased fibrinogen concentration (mean±SD: 3.42±1.04 gm/L, p=<0.001) in the subjects diagnosed having MS. Statistically significant increased level of fibrinogen in subjects with MS was also reported in Pakistan [26], British [27], and Frinks cohort [28]. Few studies indicated that fibrinogen may play a major role in the pathway from overweight to MS [29].

Apolipoprotein B (Apo-B), recognised as the best marker of atherogenic dyslipidemia, observed significantly higher (mean±SD: 149.35±59.13 mg/dL) in both Gender's (male: 152.38±62.90 mg/dL, female: 146.18±54.99 mg/dL), in this study. Significantly higher Apo-B level has reported in a similar study conducted in Korea [30], Turkey [31] in Type 2 Diabetes Mellitus (T2DM) and in Venezuela [32] in the subjects with MS. The results of this study have shown that the demographic biochemical parameters and various markers of the subjects with MS found significantly abnormal, which have been recognised as the risk factors for increasing risk of cardiovascular diseases.

Limitation(s)

The study represents only three out of 22 districts of Terai region of Nepal, coverage of more districts would have provided more representative statistical correlation for the region.

CONCLUSION(S)

The present study explored the demographic, biochemical parameters as well as inflammatory, prothrombotic and atherogenic dyslipidemia markers of subjects with MS. Almost all variables found significantly abnormal, which may contribute to increased epidemic of cardiovascular diseases in the Terai region of Nepal. Further future studies covering the remaining districts can be conducted to better understand the distribution of biochecmical parameters in MS subjects in the entire Terai region.

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