# TITLE: GENERATION-WISE DIFFERENCES IN METABOLIC SYNDROME AMONG THE ADULT TOTO OF WEST BENGAL, INDIA

**Subhrajyoti Das[1*] and Mithun Das[2]**

[1]ICSSR Doctoral Fellow, Department of Anthropology & Tribal Studies, Sidho-Kanho-Birsha University, Purulia, West Bengal

[2]Associate Professor, Department of Anthropology & Tribal Studies, Sidho-Kanho-Birsha University, Purulia, West Bengal

*Corresponding Author: subhrajyoti1996.das@gmail.com

## ABSTRACT

**Background:** Metabolic syndrome (MetS) or Syndrome X is a lifestyle-driven syndrome resulting in to constellation of several metabolic abnormalities. Over the last few decades, the change in lifestyle has severely affected the younger generation in respect to their parental generation. Toto is a homogeneous tribal population living in a small single village. Therefore, their genetic and environmental condition remains same generation after generation. So, whatever changes occur is due to change in lifestyle. **Objective:** This study was aimed to compare the prevalence of metabolic syndrome and its components between two generations of this population. **Materials and Methods:** The present population based cross-sectional study was comprised of adult (≥25 years) Toto men and women of Totopara, West Bengal, India. A total of 198 individuals aged between 25 and 70 years participated in the study. A simple random sampling procedure was conducted for the study. Age, sex, height, weight, minimum waist circumference, blood pressure, blood glucose, and lipids were measured in all study participants. All Subjects were screened for the components of MetS according to criteria given by NCEP-ATP III. Data were analysed using 'SPSS (IBM version 26)' and 'MS Excel'. Independent sample t-test was used to analyse continuous variables. The level of significance was considered as $P < 0.05$. **Results:** The prevalence of MetS in this population is 52.02%, among parental generation (G1) the prevalence is 26.77% (males 27.85%, females 39.24%), while among younger generation (G2) it is 25.25% (males 24.37%, females 17.65%). The prevalence of hypertension was 28.28% for G1 and 27.78% for G2. The prevalence of hyperglycaemia was 34.34% for G1 and 50.51% for G2. About 17.17% G1 and 26.77% G2 had low HDL-C. 25.25% G1 and 24.75% G2 had elevated triglyceride levels. The prevalence of high waist circumference in G1 was 15.15% and in G2 it was 13.64%. **Conclusion:** Hypertension and hyperglycaemia were the most common factor affecting the estimates of MetS in this particular population. Studies have shown high prevalence of hypertension and diabetes mellitus in this population.

**Keywords:** Metabolic syndrome, Toto, Lifestyle, Hypertension.

## INTRODUCTION

Metabolic syndrome (MetS) is characterized by a combination of metabolic abnormalities, including hypertension, abdominal obesity, elevated blood sugar, elevated triglycerides (TG), and reduced high-density lipoprotein cholesterol (HDLc). In a person, MetS is defined as the occurrence of three or more of the following five cardio metabolic abnormalities concurrently [1-2]. These abnormalities result in a two-fold increase in the risk of cardiovascular disease (CVD) and a five-fold increase in the risk of type 2 diabetes mellitus (T2DM), respectively [3-4]. The guidelines for the diagnosis of MetS have been put forward by the World Health Organization (WHO) [5], the National Cholesterol Education Program's Adult Treatment Panel III (NCEP ATP III) [6], the International Diabetes Federation (IDF) [7], and the American Heart Association and National Heart Lung and Blood Institute (AHA/NHLBI) [8] (Table 1). In this research, we followed the NCEP ATP III (2005) definition for the diagnosis of MetS which is similar to the 2005 IDF definition, and the 2009 AHA/NHLBI definition for MetS.

***Table 1. Diagnostic criteria for MetS for WHO, NCEP ATP III, IDF, and AHA/NHLBI definitions [cm (centimeter), mmHg (millimeter mercury), mg/dl (milligram/deciliter)].***

| ***Determinants*** | ***AHA/NHLBI definition (2009)*** | ***IDF definition (2005)*** | ***NCEP ATP III definition (2005)*** | ***WHO definition (1998)*** |
|---|---|---|---|---|
| ***High WC*** | | | | BMI >30 kg/m$^2$, or Waist–hip ratio >0.9 in men and >0.85 in women |
| ***Male*** | ≥ 90cm | ≥ 90cm | ≥ 90cm | |
| ***Female*** | ≥ 80cm | ≥ 80cm | ≥ 80cm | |
| ***High FBG*** | ≥ 100 mg/dl | ≥ 100 mg/dl | ≥ 100 mg/dl | ≥100 mg/dl |
| ***High BP*** | Systolic blood pressure ≥ 130 mmHg and/or Diastolic blood pressure ≥ 85 mmHg | Systolic blood pressure ≥ 130 mmHg and/or Diastolic blood pressure ≥ 85 mmHg | Systolic blood pressure ≥ 130 mmHg and/or Diastolic blood pressure ≥ 85 mmHg | Systolic blood pressure ≥ 140 mmHg and/or Diastolic blood pressure ≥ 90 mmHg |
| ***High TG*** | ≥ 150 mg/dl | ≥ 150 mg/dl | ≥ 150 mg/dl | >150 mg/dl |
| ***Low HDLc*** | | | | |
| ***Male*** | < 40 mg/dl | < 40 mg/dl | < 40 mg/dl | <35 mg/dl |
| ***Female*** | < 50 mg/dl | < 50 mg/dl | < 50 mg/dl | <39 mg/dl |

Obesity and insulin resistance are considered pivotal underlying factors in the development of this syndrome. Additionally, other contributing factors include a sedentary lifestyle, consumption of a high-calorie diet, alcohol consumption, smoking, psychosocial stress, and poor sleep duration [3, 8-9]. In the Korean population, Yi and An [10] observed a high risk of MetS among middle-aged individuals primarily attributable to alcohol consumption, household income, and education level.

According to previous studies, high prevalence rates of Metabolic Syndrome (MetS) have been reported in Europe (24.3%), the USA (22.9%), China (24.5%), and South Korea (16.3%) [11]. The prevalence of MetS has been rapidly increasing in developing countries like India due to changes in lifestyle. The prevalence rates of metabolic syndrome in different regions of India were as follows: 30% in North India, 30% in Western India, 33% in Eastern India, and 30% in South India [12]. The major contributing factors to the rise in MetS in India are rapid urbanization, unhealthy diets, sedentary lifestyle, illiteracy, unemployment, and increasing rates of obesity [13-18]. Das M. [19] conducted a study among the 'Toto' of West Bengal, India. The study observed the prevalence of overweight (BMI > 23 $kg/m^2$) among males and females. Among males, the prevalence of overweight was 8% in 2007-2008, which increased to 13% in 2011-2012 and further to 20% in 2015-2016. Among females, the prevalence of overweight was 5% in 2007-2008, which increased to 8% in 2011-2012 and 11.5% in 2015-2016. This study indicates the adoption of urbanized lifestyles not only affected the cardiovascular health of the older population it also affected the younger population as well.

The Toto is a genetically homogenous and demographically small population, who live in a single village (Totopara) of the Alipurduar district of West Bengal. Therefore, their genetic and environmental factors are the same generation after generation, so whatever changes across generations were due to their change in lifestyle. With the aforementioned perspective in consideration, the present study was conducted to compare the prevalence of metabolic syndrome and its components between two generations among the Toto community residing in West Bengal, India.

## MATERIALS AND METHODS

### Study Population:

The present population-based cross-sectional study was conducted on a Particularly Vulnerable Tribal Group (PVTG) namely 'Toto', living in a small single village 'Totopara' of the Alipurduar district of West Bengal. Toto is a small tribal community they have a specific language, culture, and simple economy. This study comprised 198 individuals (79 parental generation and 119 younger generation) aged between 25 and 70 years. A simple random sampling procedure was adopted for the research.

### Anthropometric Measurements:

Anthropometric measurements, including Height, Weight, and Waist Circumference (WC), were obtained using standardized techniques [20]. Height was measured with an accuracy of 0.1 cm, while Weight was measured with an accuracy of 0.5 kg. WC was measured with a non-elastic tape, with an accuracy of 0.1 cm. The Body mass index (BMI) was obtained by dividing weight (kg) by the square of the height (m).

### Blood pressures:

The systolic and diastolic blood pressure of each participant was measured by a Sphygmomanometer and a Stethoscope. A minimum of two readings were obtained with a five-minute interval between each reading, and the average of the two readings was determined as the final blood pressure [21].

**Biochemical profiles:**

Fasting blood glucose (FBG), high-density lipoprotein cholesterol (HDLc), and triglycerides (TG), were measured after 12 hours of fasting using the Standard SD Biosensor (Korea) analyser. Metabolic syndrome (MetS) was defined using the NCEP-ATP III guidelines [6].

**Physical activity level (PAL):**

PAL was categorized into high, moderate, and low as per physical activity level to determine the 'Indian Diabetes Risk Score' [22].

**Statistical analysis:**

Data were analysed using 'SPSS (IBM version 26)' and 'MS Excel'. Independent sample t-test was used to analyse continuous variables. The level of significance was considered as $P < 0.05$. A line graph was utilized to compare MetS and its components, while bar graphs were used to compare physical activity levels and fast-food intake between the two generations.

## RESULTS

In this research, a group of 198 individuals was examined, consisting of 79 individuals from the parental generation (42 males and 37 females) and 119 individuals from the younger generation (67 males and 52 females). The anthropometric and metabolic parameters of the study population are summarized in Table 2. The results showed that males in the younger generation had significantly higher triglyceride levels compared to their parental generation ($p=0.023$). Although males in the younger generation had slightly higher BMI, the difference was not statistically significant ($p=0.835$). Conversely, females in the younger generation had high triglyceride levels and low HDLc, but these differences did not reach statistical significance ($p=0.112$, $p=0.464$).

The prevalence of Metabolic Syndrome (MetS) in the study population is 52.02%. Among the parental generation (G1), the prevalence is 26.77% (males: 27.85%, females: 39.24%). Among the younger generation (G2), the prevalence is 25.25% (males: 24.37%, females: 17.65%). The prevalence of hyperglycaemia and low high-density lipoprotein cholesterol (HDL-C) is higher in the younger generation compared to their parental generation. Conversely, hypertension, triglyceride levels, and waist circumference are slightly lower in the younger generation compared to their parental generation (Figure 1).

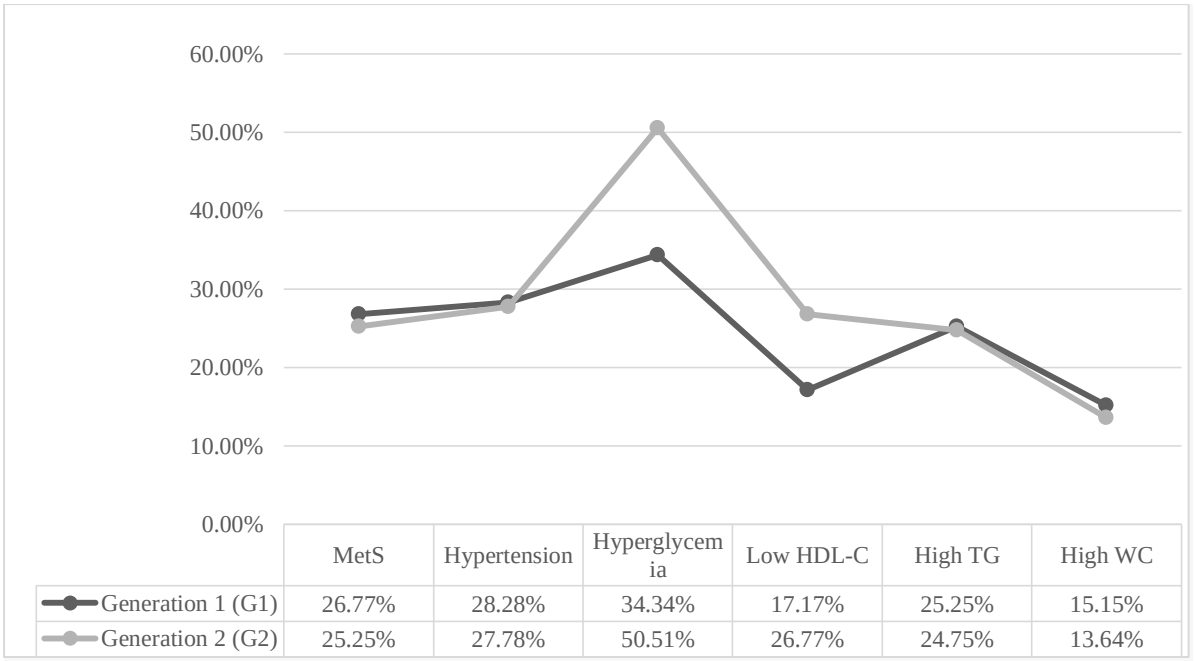
The physical activity level and frequency of fast-food intake are illustrated in Figure 2 and Figure 3, respectively. The prevalence of physical activity levels (PAL) among the younger generation, including high and moderate was lower compared to their parental generation. On the other hand, the prevalence of low levels of PAL was higher compared to their parental generation.

**Table 2: Clinical characteristics of the study population**

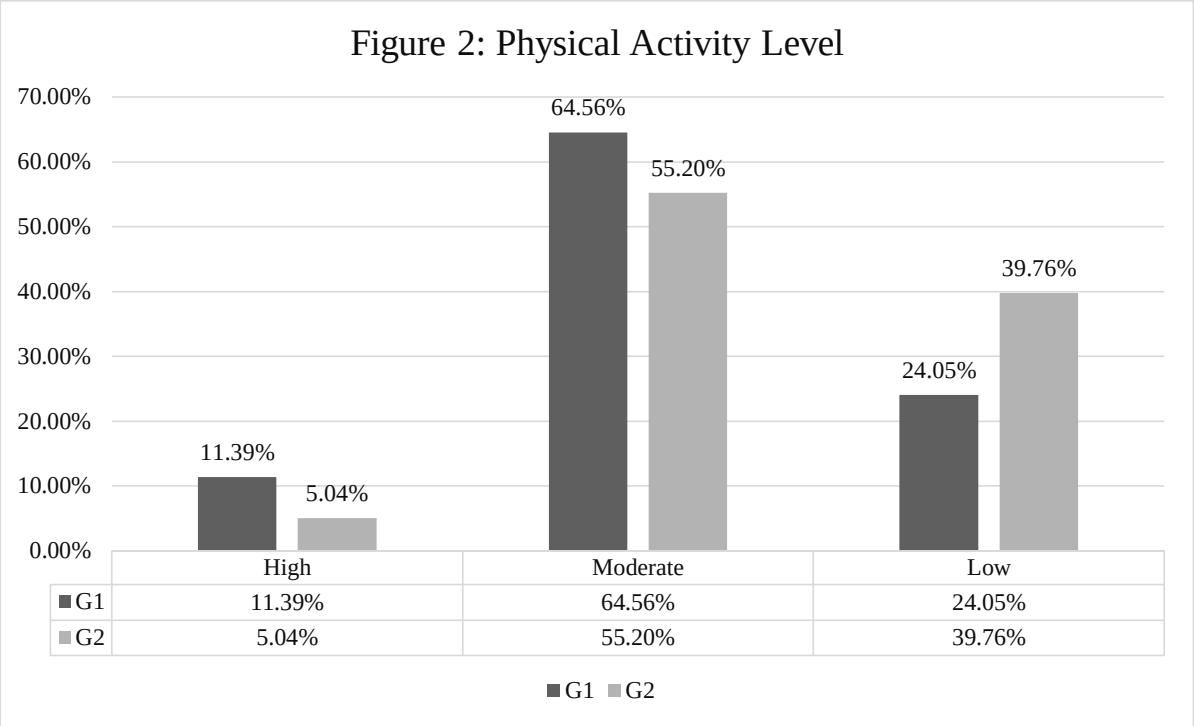
| Parameters | Male | | | Female | | |
|---|---|---|---|---|---|---|
| | Parental generation (n=42) | Younger generation (n=67) | P Value | Parental generation (n=37) | Younger generation (n=52) | P Value |
| BMI (kg/m²) | 24.07±3.95 | 24.23±3.90 | 0.835 | 24.28±3.72 | 23.02±3.29 | 0.103 |
| WC (cm) | 82.83±11.45 | 80.06±10.82 | 0.212 | 80.85±9.59 | 75.86±10.37 | 0.022 |
| SBP (mm Hg) | 138.86±17.98 | 132.21±12.01 | 0.022 | 140.78±25.59 | 122.54±14.84 | 0.000 |
| DBP (mm Hg) | 90.36±12.44 | 81.57±9.73 | 0.000 | 88.27±13.66 | 78.37±11.28 | 0.001 |
| FBG (mg/dl) | 122.26±26.22 | 117.07±21.82 | 0.288 | 132.76±28.18 | 121.56±20.90 | 0.045 |
| TG (mg/dl) | 109.48±33.55 | 141.69±86.29 | 0.023 | 173.43±112.33 | 213.19±118.59 | 0.112 |
| HDLc (mg/dl) | 42.95±10.66 | 49.00±14.59 | 0.014 | 50.89±17.85 | 48.19±15.89 | 0.464 |

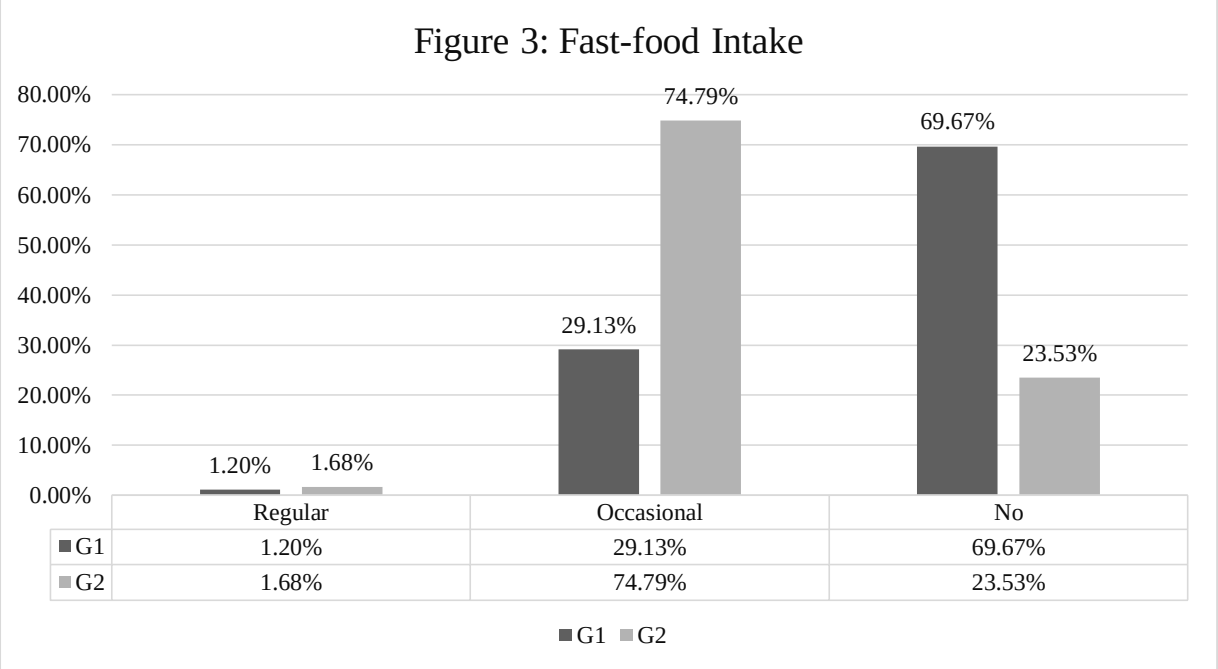
*Values are given mean ± SD (Standard deviation), BMI = Body mass index, WC = Waist circumference, SBP = Systolic blood pressure, DBP = Diastolic blood pressure, FBG = Fasting blood glucose, TG = Triglycerides, HDLc = High-density lipoprotein cholesterol.*

**Figure 1: Prevalence of MetS and its Components**



*Vol.2 No.2 (2023)*
*ISSN: 2583-0370*




The prevalence of regular and occasional fast-food intake was higher in the younger generation compared to their parental generation.

## DISCUSSION

According to our findings, 52.02% of the study population exhibits metabolic syndrome on the basis of the NCEP ATP-III (2005) guidelines. The prevalence of metabolic syndrome was 26.77% among the parental generation (G1) and 25.25% among the younger generation (G2). Previous studies found last two decades not only the urban population affected by MetS, but it is also affecting the rural and tribal populations as well. Krishnamoorthy et al., [12] observed in India the pooled prevalence of MetS among the urban population was 32% while in the rural population was 22% and in the tribal population, it was 28%. Bandela et al., [23] observed in the Kurnool district of Andhra Pradesh the prevalence of MetS in urban, rural, and tribal populations were 42.15%, 31.97%, and 21.80% respectively. This study shows smoking, alcohol consumption, and physical inactivity were high in rural and tribal populations.

Previously, Totos were Jhum cultivators, Hunter-gatherers, and Copper collectors [24]. Presently, the parental generation of this community is mainly engaged in agriculture but the next generation (younger generation) males are engaged in agriculture, construction labourers, business, 100-day workers, and govt. services on the other hand females are engaged mainly in household work, sometimes in agriculture, business, and 100 days of work. Studies based on health found MetS inversely related to physical activity level and intake of fast-food [25-26]. According to our findings, the younger generation was more physically inactive, and eat more fast food compared to their parental generation. The older generation of this community still practices their traditional lifestyle whereas the younger generation is become more modernized due to the excess of modern amenities. So, the risk factors of MetS actually catch the younger generation much early. In their study, Mahajan et al. [26] observed that the prevalence of metabolic syndrome is rapidly increasing in rural areas of India. Traditional communities of rural areas are adopting habits that were not originally theirs. This lifestyle change is a leading cause of MetS and its associated risk factors in rural areas of India.

## CONCLUSION AND LIMITATIONS

Hypertension and hyperglycaemia were the most common factor affecting the estimates of MetS in this particular population. Studies have shown a high prevalence of hypertension and diabetes mellitus in this population. We must consider certain limitations when interpreting the findings of our study. The sample size used was relatively small. Since our study was based on the population, a larger sample size would have led to a better interpretation of the results.

## FUNDING

Subhrajyoti Das received financial support from the Indian Council of Social Science Research (ICSSR) Centrally-Administered Full-Term Doctoral Fellowship as a Doctoral Fellow (File No. RFD/2022-23/GEN/HLTH/233), New Delhi 110067, India.

## CONFLICT OF INTEREST

Authors declare no conflict of interest

**REFERENCES**

1. Moller DE, Kaufman KD. Metabolic syndrome: A clinical and molecular perspective. *Annual Review of Medicine*. 2005; 56: 45-62.
2. Chowdhury MZI, Anik AM, Farhana Z, Bristi PD et al. Prevalence of metabolic syndrome in Bangladesh: a systematic review and meta-analysis of the studies. *BMC Public Health*. 2018; 18: 308.
3. Grundy SM. Metabolic syndrome: a multiplex cardiovascular risk factor. *Journal of Clinical Endocrinology & Metabolism*. 2007; 92: 399-404.
4. Alberti KGMM, Eckel RH, Grundy SM et al. Harmonizing the metabolic syndrome: a joint interim statement of the international diabetes federation task force on epidemiology and prevention; National heart, lung, and blood institute; American heart association; World heart federation; International atherosclerosis society; And international association for the study of obesity. *Circulation*. 2009; 120(16): 1640–1645.
5. Alberti KG, Zimmet PZ. Definition, diagnosis and classification of diabetes mellitus and its complications. Part 1: Diagnosis and classification of diabetes mellitus provisional report of a WHO consultation. *Diabet Med.* 1998;15: 539-53.
6. Grundy SM, Cleeman JI, Daniels SR, Donato KA, Eckel RH, Franklin BA et al. Diagnosis and management of the metabolic syndrome: an American Heart Association/National Heart, Lung, and Blood Institute Scientific Statement (executive summary). *Circulation*. 2005; 112: e285–e290.
7. Alberti G, Zimmet P, Shaw J. The IDF consensus worldwide definition of the metabolic syndrome. *Obesity and metabolism*. 2005; 2(3): 47–9.
8. Alberti KGMM, Eckel RH, Grundy SM, Zimmet PZ, Cleeman JI et al. Harmonizing the metabolic syndrome: a joint interim statement of the international diabetes federation task force on epidemiology and prevention; National heart, lung, and blood institute; American heart association; World heart federation; International atherosclerosis society; And international association for the study of obesity. *Circulation*. 2009; 120(16): 1640–1645.
9. Kahn R, Buse J, Ferranninie E, Stern M. The metabolic syndrome: time for a critical appraisal: joint statement from the American Diabetes Association and the European Association for the Study of Diabetes. *Diabetes Care*. 2005; 28(9): 2289- 304.
10. Yi Y, An J. Sex Differences in Risk Factors for Metabolic Syndrome in the Korean Population. *International Journal of Environmental Research and Public Health*. 2020; 17: 9513.
11. Montano D. Association Between Socioeconomic Determinants and the Metabolic Syndrome in the German Health Interview and Examination Survey for Adults (DEGS1) – A Mediation Analysis. *The review of diabetic studies: RDS*. 2017; 14: 279-294.
12. Krishnamoorthy Y, Rajaa S, Murali S et al. Prevalence of metabolic syndrome among adult population in India: A systematic review and meta-analysis. *PLoS ONE*. 2020; 15(10): e0240971. https://doi.org/ 10.1371/journal.pone.0240971.
13. Zafar KS, Pious T, Singh PS, Gautam RK et al. Prevalence of metabolic syndrome in a rural population- a cross sectional study from Western Uttar Pradesh, India. *International Journal of Research in Medical Sciences*. 2017; 5(5): 2223-2228.
14. Wani ZA, Bhat RA. A Cross-Sectional Analysis of Metabolic Syndrome Factors in North Indian Adult Population of Kashmir. *Sub-Saharan African Journal of Medicine*. 2014; 1(2): 95-99.

15. Kandpal V, Sachdeva MP, Saraswathy KN. An assessment study of CVD related risk factors in a tribal population of India. *BMC Public Health*. 2016; 16: 434.
16. Kaur J. Assessment and Screening of the Risk Factors in Metabolic Syndrome. *Medical sciences*. 2014; 2: 140-152.
17. Dhabriya R, Agrawal M, Gupta R, Mohan I, Sharma KK. Cardiometabolic risk factors in the Agarwal business community in India: Jaipur Heart Watch-6. *Indian heart journal*. 2015; 67: 347-350.
18. Sneha M, Arlappa N, Suryanarayana P, Balakrishna N, Santosh VS. Prevalence of metabolic syndrome among urban older adults of Hyderabad metropolitan city in South India. *Journal of Nutrition and Obesity*. 2017; 1(1): 101.
19. Das M. Ethnic Predisposition to Cardiovascular Disease Risk among the Toto of West Bengal, India: A Longitudinal Study. *Journal of Life Science*. 2017; 9(1): 11-17.
20. Lohman TG, Roche AF, Martorell R. Anthropometric Standardization Reference Manual. Champaign, IL: *Human Kinetics Books*. 1988.
21. Das M, Pal S, Ghosh A. Synergistic effects of ACE (I/D) and ApoE (HhaI) gene polymorphisms among the adult Asian Indians with and without metabolic syndrome. *Diabetes Research and Clinical Practice*. 2009; 86; e58 - e61.
22. Mohan V, Deepa R, Deepa A, Somannavar S, Datta M. A simplified Indian Diabetes Risk Score for screening for undiagnosed diabetic subjects. *Journal of Association of the Physicians of India*. 2005; 53: 759-763.
23. Bandela PV, Dongre NN, Ambekar JG, Prasad KD, Devaranavadagi BB. Study of Metabolic Syndrome and Its Components Among Kurnool District Population of Andhra Pradesh with Different Ethnic Backgrounds. *Journal of Cardiovascular Disease Research*. 2017; 8(3): 83-88.
24. B Majumder. A sociological study of Toto folk tales. *The Asiatic Society*. 1991; ISBN no. 9789381574096, 2013. [http://www.exoticindiaart.com/book/details/sociological-study-of-toto-folktales-NAG552/ (Date: 09.07.2023)]
25. Das S, Pati M, Saren R, Mistry S, Das M. Increase in prevalence of metabolic syndrome and its determinants, and impact of lifestyle factors: a population-based cohort study among the adult Toto of West Bengal, India. *Journal of Cardiovascular Disease Research*. 2021; 12(03): 1875-1884.
26. Mahajan N, Kumari A, Kshatriya GK. Prevalence of metabolic syndrome in adolescents of India and the associated risk factors: A systematic review. *Human Biology Review*. 2016; 5(4): 405-421.