Original Research Article

Occurrence of the metabolic syndrome in newly diagnosed hypertensive adult Gujarati patients in G. K. General Hospital, Bhuj

Aalisha U. Dodhiya1*, Darshan Patel2

1Gujarat Adani Institute of Medical Sciences, Bhuj, Kutchh, Gujarat, India
2Department of Biochemistry, 1Gujarat Adani Institute of Medical Sciences, Bhuj, Kutchh, Gujarat, India

Received: 20 October 2020
Revised: 19 November 2020
Accepted: 20 November 2020

*Correspondence:
Aalisha U. Dodhiya,
E-mail: dodhiyaalisha@gmail.com

ABSTRACT

Background: A study of 30 newly diagnosed hypertensive Gujarati patients visiting the OPD of G. K. General Hospital, Bhuj, Gujarat, India was carried out. The main aim of the study was to estimate the occurrence of metabolic syndrome in newly diagnosed hypertensive patients

Methods: The study was carried out in a period of 2 months and data was collected after obtaining prior consent of patients and IEC approval. Blood pressure, waist circumference and BMI (body mass index) of the selected patients were measured while blood sample was collected for the laboratory investigations. The data collected was analysed using appropriate software

Results: On observation, out of 30 hypertensive patients 22 (73.33%) patients suffered from metabolic syndrome. Also in patients suffering from metabolic syndrome, along with hypertension 63.63% (n=14) patients suffered from hypertriglyceridemia, 68.18% (n=15) patients had low HDL cholesterol, 77.27% (n=17) patients had high FBS, 72.72% (n=16) patients had abnormal BMI and 63.63% (n=14) patients had abnormal waist circumference.

Conclusions: This very high occurrence values signifies the need of study with larger sample size based on region for further evaluation to treat the high risk patients on early diagnosis.

Keywords: Metabolic syndrome, Hypertension, Diabetes mellitus, Cardiovascular disease

INTRODUCTION

Metabolic syndrome (MS) is a cluster of metabolic abnormalities that increases (approximately doubles) the risk of cardiovascular morbidity and mortality.1-5 It includes various combinations of elevated blood pressure (BP), atherogenic dyslipidemia, obesity, abnormal glucose tolerance and insulin resistance as well as such other abnormalities as pro-inflammatory and prothrombotic states.2,3 Also, the risk of developing type 2 diabetes mellitus (T2DM) is increased 5 fold in the presence of MS.3

Hypertension (HTN) exerts a public health burden on the status of cardiovascular and healthcare systems in India.6,7 57% of all stroke deaths and 24% of all coronary heart disease (CHD) are due to HTN in India.8

High BP is one of the key features of the MS. The clinical guidelines for the management of hypertension underscore the importance of identifying metabolic syndrome as a group in hypertensive patients at high risk for the development of cardiovascular disease (CVD).9

When HTN and other metabolic risk factors co-exist in an individual, they potentiate one another leading to a synergism that increases the total CVD risk well above
Hypertension is one of the common cardiovascular risk factors. This is important because it is largely preventable by lifestyle measures. However, the magnitude of the metabolic syndrome in Gujarati population is not precisely known. Therefore, the study was designed to investigate the occurrence of metabolic syndrome in hypertensive patients.

Aim and objectives

Aim and objectives of the current study was to estimate the occurrence of metabolic syndrome in newly diagnosed hypertensive Gujarati patients.

METHODS

Study type, place and duration

Presented study was an observational study, conducted at G. K. General Hospital, Bhuj, Kutch, Gujarat, India, from June 2017 to July 2017.

Inclusion criteria

Inclusion criteria for current study were; adult patients with essential hypertension (as per the criteria defined by JNC) who visited the medicine OPD (outdoor patient department) and NCD (non communicable disease) clinic of G. K. general hospital, Bhuj (during the period of 2 months June-July).

Exclusion criteria

Exclusion criteria for current study were; patients who had a known history of diabetes mellitus before the diagnosis of HTN and those with findings suggesting secondary hypertension such as reno-vascular, renal parenchymal, thyroid or adrenal diseases. Patients with, congestive cardiac failure, pre-existing macro-vascular condition. Any severe illness (such as malignancy, severe infection, respiratory disease, liver disease), impairment of speech, hearing, vision, or cognition. Continuous or periodic use of corticosteroids. Pregnant females or who had given birth within the preceding six weeks. Hypertensive patients were evaluated to define whether they fulfill the criteria for metabolic syndrome in accordance with the definitions of the National cholesterol education program (NCEP) and adult treatment panel III (ATPIII).\(^2\) NCEP/ATPIII defines metabolic syndrome as the presence of three or more of the following associated conditions; abdominal obesity (waist circumference >102 cm in men, >88 cm in women), serum triglycerides equal to or greater than 150 mg/dl, HDL cholesterol less than 39 mg/dl in men and 45 mg/dl in women, systolic blood pressure equal to or greater than 130 mmHg and/or diastolic blood pressure equal to or greater than 85 mmHg and fasting plasma glucose >110 mg/dl or use of hypoglycaemic medication.

IDF (International diabetes federation) criteria for metabolic syndrome include BMI (body mass index) instead of waist circumference.

Measurement of blood pressure

The Blood pressure of the patients visiting the OPD of G. K. general hospital was measured using sphygmomanometer. Blood pressure (both systolic and diastolic) was measured in both of the arms (in brachial artery) and the average of the two readings was taken. BP was measured in sitting position after making sure of providing ten minutes relaxation to the subjects prior to the first reading and interval of five minutes between the two readings.

Measurement of waist circumference

The waist circumference of the patients was measured at the approximate midpoint between the lower margin of the last palpable rib and the top of the iliac crest in standing erect position with the arms at the sides but away from the waist, feet positioned close together, and the weight evenly distributed across the feet. The waist circumference was measured with a stretch resistant measuring tape (keeping parallel to the floor) in centimetre. The subject was advised to relax and take a few deep, natural breaths before the measurement was done for the accuracy of the measurement.

For the measurement of BMI height and weight was measured:

Height was measured by making the patient upright, barefoot on the ground with the heels, buttocks and shoulder touching the wall and head in Frankfurt plane. The height was measured in meter with stadiometer.

Weight was measured using weighing balance in kilograms (kg). Body mass index (BMI) was calculated based on formula;

\[
BMI = \frac{weight \ in \ kg}{height \ in \ meter^2}
\]

Other variables those were determined for each patient includes: name, age, sex, address and contact number.

For the investigation of metabolic syndrome and biochemical tests of lipid, 12 hours of overnight fasting is required before the blood collection. Therefore patients
were asked to come with fasting. Blood sample for the test of fasting glucose was collected in fluoride bulb, while for the test of lipid profile in plain bulb. Serum was separated after centrifugation at 3000 rpm for 5 minutes and it was used for the analysis. Samples from the patients were drawn with their prior consent after informing them the purpose and nature of the study. The biochemical tests of the blood samples collected were performed with the method described in Table 1.

### Table 1: Biochemical tests and respective methods used.

| Biochemical tests        | Method used                              |
|--------------------------|------------------------------------------|
| Fasting plasma glucose   | Glucose oxidase-peroxidase method         |
| Serum triglycerides      | Glycerol-3-phosphate oxidase (GPO) method |
| High density lipoprotein | Phosphotungstunic acid method             |

The reference range for the diagnosis of metabolic syndrome from the lipid profile test was taken as mentioned in Table 2.

### Table 2: Normal blood pressure range.

| Blood pressure | SBP (mmHg) | DBP (mmHg) |
|----------------|------------|------------|
| Normal         | <120       | <80        |

The reference range for the diagnosis of metabolic syndrome from the lipid profile test was taken as mentioned in Table 3.

### Table 3: Normal range of lipid profile.

| Lipid          | Value (mg/dl) |
|----------------|---------------|
| Serum triglyceride | 80/180       |
| HDL cholesterol  | Male 35-65    |
|                 | Female 40-70  |

The reference range for the fasting plasma glucose was taken as mentioned in Table 4.

### Table 4: Normal range of plasma glucose.

| Plasma glucose | Value (mg/dl) |
|----------------|---------------|
| Reference range| 70-100        |

### Statistical analysis

Results are analysed using appropriate statistical methods, Epi info software and Microsoft excel.

### RESULTS

In the present study, out of 30 hypertensive patients selected for the study, occurrence of metabolic syndrome was found to be 73.3% (n=22) according to NCEP ATP III criteria while 70% (n=21) according to IDF criteria.

### Table 5: Mean and standard deviation of different variables in hypertensive patients, (n=30).

| Variables              | Mean  | SD    |
|------------------------|-------|-------|
| Age (years)            | 57.50 | 7.798 |
| SBP (mmHg)             | 157.63| 28.699|
| DBP (mmHg)             | 93.67 | 15.877|
| Height (cm)            | 162.42| 9.999 |
| Weight (kg)            | 72.713| 14.120|
| BMI                    | 27.5910| 5.05990|
| Waist circumference    | 98.22 | 10.777|
| S. Triglyceride (mg/dl)| 150.48| 91.898|
| HDL-C (mg/dl)          | 39.23 | 9.676 |
| FBS (mg/dl)            | 127.53| 48.187|

Regardless of metabolic syndrome, out of 30 patients, in total (n=14) (Table 6) patients suffered from hypertriglyceridemia, (n=16) (Table 7) had low HDL cholesterol, (n=18) (Table 8) patients had high FBS, (n=17) (Table 9) patients had abnormal waist circumference and (n=18) (Table 10) patients had abnormal BMI along with hypertension.

### Table 6: Association of hypertriglyceridemia and metabolic syndrome.

| Crosstab | Metabolic syndrome | Total |
|----------|--------------------|-------|
|          | 0                  | 1     |
| Hypertiglyceridemia | 8      | 8     |
|          | 1                  | 14    |
| Total    | 8                  | 22    | 30   |

*0=no. of patients not suffering from the given variable, 1=no. of patients suffering from given variable, Pearson Chi-square value=9.545, degree of freedom (df)=1, p value=0.002 (p<0.05 is significant).

### Table 7: Association of low HDL and metabolic syndrome.

| Crosstab | Metabolic syndrome | Total |
|----------|--------------------|-------|
|          | 0                  | 1     |
| Low HDL  | 0                  | 7     |
|          | 1                  | 15    |
| Total    | 8                  | 22    | 30   |

*0=no. of patients not suffering from the given variable, 1=no. of patients suffering from given variable, Pearson Chi-square value=7.308, degree of freedom (df)=1, p value=0.007.

In these patients suffering from metabolic syndrome, along with hypertension 63.63% (n=14) patients suffered from hypertriglyceridemia (Table 6), 68.18% (n=15)
patients had low HDL cholesterol (Table 7), 77.27% (n=17) patients had high FBS (Table 8), 72.72% (n=16) patients had abnormal BMI (Table 10) and 63.63% (n=14) patients had abnormal waist circumference (Table 9).

### Table 8: Association of high FBS and metabolic syndrome.

| Crosstab          | Metabolic syndrome | Total |
|-------------------|--------------------|-------|
| High FBS          | 0                  | 1     |
|                   | 7                  | 5     | 12 |
| Total             | 1                  | 1     | 17 | 18 |

*0=no. of patients not suffering from the given variable, 1=no. of patients suffering from given variable, Pearson Chi-square value=10.256, degree of freedom (df)=1, p value=0.001.

### Table 9: Association of waist circumference estimate and metabolic syndrome.

| Crosstab          | Metabolic syndrome | Total |
|-------------------|--------------------|-------|
| Waist circumference| 0                  | 1     |
|                   | 5                  | 8     | 13 |
|                   | 1                  | 3     | 14 | 17 |
| Total             | 8                  | 22    | 30 |

*0=no. of patients not suffering from the given variable, 1=no. of patients suffering from given variable, Pearson Chi-square value=1.632, degree of freedom (df)=1, p value=0.201.

### Table 10: Association of BMI estimate and metabolic syndrome.

| Crosstab          | Metabolic syndrome | Total |
|-------------------|--------------------|-------|
| BMI estimate      | 0                  | 1     |
|                   | 6                  | 6     | 12 |
|                   | 1                  | 2     | 16 | 18 |
| Total             | 8                  | 22    | 30 |

*0=no. of patients not suffering from the given variable, 1=no. of patients suffering from given variable, Pearson Chi-square value=5.568, degree of freedom (df)=1, p value=0.018.

According to the study carried out for 200 patients in 2004 in North Indian at a tertiary care hospital, the prevalence of metabolic syndrome was higher in women 62.92% as compared to men 37.08%. In reported study, the most common abnormality found was high waist circumference (seen in 91.01%), followed by low HDL-C (in 40.5%), an abnormal triglyceride level (in 32%) and abnormal FBS (in 34%). It was also found that the abnormal HDL-C was the most common abnormality in men and abnormal waist circumference was the most common abnormality in women. Comparing it with present study the occurrence of metabolic syndrome was higher in males (n=14) compared to females (n=8). Also the most common abnormality in patients of metabolic syndrome, along with hypertension was high FBS (n=17) 77.27% followed by low HDL (n=15) 68.18%, and hypertriglyceridemia and waist circumference (n=14) 63.63% in both.

While in US adults, the prevalence of metabolic syndrome was found to be around 28% for men and 30% for women as shown by the National health and nutrition examination survey (NHANES) carried out by Ford et al. Also it was found that the low HDL-C was most common abnormal parameter in both male and female.

In a study conducted in Chinese population, hypertension was linked to metabolic syndrome in women but not in men and also suggested the role of sympathetic activity in pathogenesis of hypertension in women may be more dependent on insulin resistance than in men. In another recent study of 200 patients carried out in 2015 by Akholkar et al. Prevalence of metabolic syndrome was 44.5% out of which a higher prevalence was found in women (62.92%) as compared to men (37.08%). Based on it, they also attributed that the fact that an abnormal waist circumference of 88 cm and low HDL-C of ≤50 gm% is achievable in females.

### DISCUSSION

Several studies shows that at similar BMI and lower average waist circumference levels, body fat, abdominal adiposity, and cardiovascular risk factors are higher in South Asians compared to Caucasians. A study has reported significantly high odds ratio (OR) for hypertension and hypertriglyceridemia even at a lower waist circumference range (70-80) in Indians. While in present study out of 22 patients of metabolic syndrome, 8 patients had normal waist circumference and 14 patients had abnormal waist circumference (Table 5). Even in South Asian studies adults as well as children have shown that hyperglycemia, hypertension and hypertriglyceridemia occur at a lower levels of BMI and waist circumference. This correlates well with the Y-Y hypothesis whereby the researches Yagnik and Yudkin were found to have a similar BMI of 22.3 kg/m², but the body fat percentages in the two differ widely at 21.2% in Yagnik and 9.1% in Yudkin. In South Indian study, prevalence of metabolic syndrome was estimated to be 25.8%, 23.2% and 18.3% according to IDF, world health organization (WHO) and NCEP ATPIII criteria respectively. While in present study very high occurrence of metabolic syndrome is seen, 73.33% according to NCEP ATPIII criteria and 70% according to IDF criteria.
Energy dense imbalance foods (high calories, carbohydrates, saturated fats, and low fiber) are being consumed increasingly in the Indian subcontinent.36 Overall, increasing carbohydrate and fat intake, along with decreased fiber intake is likely to contribute to obesity, the metabolic syndrome and type 2 diabetes mellitus (T2DM) in Asian Indians.37 A study signifies the importance to identify the adults at risk for T2DM and CHD at an early age and use appropriate prevention strategies while pathological stages are still reversible.38,39 In order to prevent metabolic syndrome, a multipronged approach is essential which includes behaviour modification, dietary modifications, increase in physical activities, prevention of smoking and alcohol excess. For this, population based community intervention programs are needed successfully to prevent metabolic syndrome.40

This is better explained by a non-pharmacological community based intervention study, reduction of fasting blood glucose levels and improved obesity measures of pre-diabetic and diabetic subjects from South India were seen with improvement of the dietary patterns.41 For physicians treating individuals at high risk, aggressive life style modification will remain mainstay, until such individuals reach thresholds for drug therapy.42 However, due to the time period of the study and also the study population being the newly diagnosed hypertensive patients visiting OPD of hospital lack of enough sample size was the limitation. Region based studies with larger sample size need to be conducted for the accurate results and early treatment to prevent the occurrence of metabolic syndrome in high risk hypertensive patients.

CONCLUSION

In the present study very high occurrence of metabolic syndrome 73.33% (N=22) out of 30 newly diagnosed hypertensive Gujarati patients visiting the OPD of G. K. general hospital, Bhuj. However, a study with larger sample size is needed to be conducted.

ACKNOWLEDGEMENTS

Authors would like to thank entire staff of Gujarat Adani institute of medical sciences and especially to Dr. Gurudas Khilnani, whose encouragement and mentoring has been valuable. Authors would like to extend their gratitude to Dr. Shreyash Mehta, associate professor in department of community medicine, who helped for statistical analysis. Authors would like to express special thanks also go to NCD (non communicable diseases) clinic for helping me and providing their best efforts that were much needful. Authors would also like to thank Dr. Ajeet Khilnani, associate professor in department of ENT, who kept me inspiring in research and publication activities. Dr. Jitendra Patel, associate professor in department of physiology also helped to sustain a positive atmosphere to carry out research right from beginning. Authors would like to acknowledge Arpan Panchal and Vraj Shah who provided a positive atmosphere and helped me in the best way that could be done.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Reaven GM. Role of insulin resistance in human disease. Diabetes. 1988;37:1595-607.
2. Expert panel on detection, evaluation and treatment of high blood cholesterol in adults. 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. 2001;285(19):2486-97.
3. Cornier MA, Dabelea D, Hernandez TL, Lindstrom RC, Steig AJ, Stob NR, et al. The metabolic syndrome. Endocr Rev. 2008;29:777-22.
4. 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. Circulation 2005;112:2735-52.
5. Gami AS, Witt BJ, Howard DE, Erwin PJ, Gami LA, Somers VK, et al. Metabolic syndrome and risk of incident cardiovascular events and death: a systematic review and meta-analysis of longitudinal studies. J Am Coll Cardiol. 2007;49:403-14.
6. Leeder S, Raymond S, Greenberg H, Liu H. A race against time, the challenge of cardiovascular disease in developing economies. Available at: http://www.ccdcindia.org/wp-content/uploads/2015/12/A-RACE-AGAINST-TIME.pdf. Accessed on 20 August 2020.
7. Srinath RK, Shah B, Varghese C, Ramadoss A. Responding to the threat of chronic diseases in India. Lancet 2005;366:1744-9.
8. Gupta R. Trends in hypertension epidemiology in India. J Hum Hypertens. 2004;18:73-8.
9. European Society of Hypertension, European Society of Cardiology guidelines for the management of arterial hypertension. Available at: https://www.escardio.org/Guidelines/Clinical-Practice-Guidelines/Arterial-Hypertension-Management-of. Accessed on 20 August 2020.
10. Kannel WB. Risk stratification of dyslipidemia: insights from the Framingham Study. Curr Med Chem Cardiovasc Hematol Agents. 2005;3:187-93.
11. 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.
12. Balkau B, Charles MA. Comment on the provisional report from the WHO consultation, European group
for the study of insulin resistance (EGIR). Diabet Med. 1999;16:442-3.

13. Einhorn D, Reaven GM, Cobin RH, Ford E, Ganda OP, Handelsman Y, et al. American college of endocrinology position statement on the insulin resistance syndrome. Endocr Pract. 2003;9:237-52.

14. Ford ES, Giles WH, Dietz WH. Prevalence of the metabolic syndrome among US adults: findings from the third National health and nutrition examination survey. JAMA. 2002;287:356-59.

15. Mokdad AH, Bowman BA, Ford ES, Vinicor F, Marks JS, Koplan JP. The continuing epidemics of obesity and diabetes in the United States. JAMA. 2001 ; 286:1195-200.

16. Ferrannini E, Natali A, Capaldo B, Lehtovirta M, Jacob S, Yki-Jarvinen H. Insulin resistance, hyperinsulimemia, and blood pressure: role of age and obesity, European Group for the study of insulin resistance (EGIR). Hypertension. 1997;30:1144-9.

17. Kaplan MN. Primary hypertension: pathogenesis. In: Kaplan’s clinical hypertension. 8th ed. Philadelphia: Lippincott Williams and Wilkins; 2002: 109-110.

18. Cuspidi C, Meani S, Fusi V, Severgnini B, Valerio C, Catini E, et al. Metabolic syndrome and target organ damage in untreated essential hypertensives. J Hypertens. 2004;22:1991-8.

19. Schillaci G, Pirro M, Vauord G, Gemelli F, Marchesi S, Porcellati C, et al. Prognostic value of the metabolic syndrome in essential hypertension. J Am Coll Cardio. 2004;119:1817-22.

20. Sorkhou EI, Al-Qallaf B, Al-Namash HA, Ben-Nakhi A, Al-Batish MM, Habiba SA. Prevalence of metabolic syndrome among hypertensive patients attending a primary care clinic in Kuwait. Med Princ Pract. 2004;13:39-42.

21. Siddique MA, Sultan MAU, Haque KHMS, Zaman MM, Ahmed CM, Rahim MA, et al. Clustering of metabolic factors among the patients with essential hypertension. Bangladesh Med Res Counc Bull. 2008;34:71-5.

22. Adegoke OA, Adedoyin RA, Balogun MO, Adebayo RA, Bisiriyu LA, Salawu AA. Prevalence of metabolic syndrome in a rural community in Nigeria. Metab Syndr Relat Disord. 2010;8:59-62.

23. Yasein N, Ahmad M, Matrook F, Nasir L, Froelicher ES. Metabolic syndrome in patients with hypertension attending a family practice clinic in Jordan. East Mediterr Health J. 2010;16:375-80.

24. Chobanian AV, Bakris GL, Black HR. The seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure: the JNC 7 report. JAMA. 2003;289:2560-72.

25. Banerji MA, Faridi N, Alturi R, Chaiken RL, Lebovitz HE. Body composition, visceral fat, leptin and insulin resistance in Asian Indian men. J Clin Endocrinol Metab. 1999;84:137-44.

26. Chandalia M, Abate N, Garg A, Stray-Gundersen J, Grundy SM. Relationship between generalized and upper body obesity to insulin resistance in Asian Indian men. J Clin Endocrinol Metab. 1999;84:2329-35.

27. Chowdhury B, Lantz H, Sjostrom L. Computed tomography-determined body composition in relation to cardiovascular risk factors in Indian and matched Swedish males. Metabolism. 1996;45:634-44.

28. Vikram NK, Pandey RM, Misra A, Sharma R, Devi JR, Khanna N. Non-Obese (body mass index ≤25 kg/m2) Asian Indians with normal waist circumference have high cardiovascular risk. Nutrition. 2003;19:503-9.

29. Misra A, Wasir JS, Vikram NK. Waist circumference criteria for the diagnosis of abdominal obesity are not applicable uniformly to all populations and ethnic groups. Nutrition. 2005; 21:969-76.

30. Mehta S. Relationship between measures of fatness, lipids and ethnicity in a cohort of adolescent boys. Ann Nutr Metab. 2002;46:192-9.

31. WHO Expert Consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet. 2004;364: 157-63.

32. Deepa M, Farooq S, Datta M, Deepa R, Mohan V. Prevalence of metaboliv syndrome using WHO, ATPIII and IDF definitions in Asian Indians: The Chennai urban rural epidemiology study (CURES-34). Diabetes Metab Res Rev. 2007;23:127-34.

33. Chandra KK, Mahotra S, Gupta M, Ubolwega A, Jain S, Kunari S, et al. Prevalence of metabolic syndrome among patients with essential hypertension in the hypertension clinic of a North Indian tertiary care hospital. Indian J Cardiol. 2004; 7:27-31.

34. Chen CH, Len KC, Tsai ST, Chou P. Different association of hypertension and insulin related metabolic syndrome between men and women in 8437 non-diabetic Chineese men. Am J Hypertens. 2000;61:29-37.

35. Akholkar PJ, Gandhi AA, Shah CM. The Metabolic syndrome among hypertensive patients: a cross sectional study. Int J Adv Med. 2015;2:188-91.

36. Wasir JS, Misra A. The metabolic syndrome in asian Indians: The impact of nutritional and socio-economic transition in India. Metab Syndr Relat Disord. 2004;2:14-23.

37. Misra A, Khurana L, Ishwarlal S, Bhardwaj S. South Asian diets and insulin resistance. Br J Nutr. 2009;10:465-73.

38. Warnberg J, Marcos A. Low-grade inflammation and the metabolic syndrome in children and adolescents. Curr Opin Lipidol. 2008;19:11-5.

39. Singhal N, Misra A, Shah P, Gulati S, Bhatt S, Sharma S, et al. Impact of intensive school-based nutrition education and lifestyle interventions on insulin resistance, β-cell function, disposition index, and subclinical inflammation among Asian Indian adolescents: A controlled intervention study. Metab Syndr Relat Disord. 2011;9:143-50.

40. Pandit K, Goswami S, Ghosh S, Mukhopadhyay P, Chowdhury S. Metabolic syndrome in South Asians. Indian J Endocr Metab. 2012;16:44-55.
41. Balagopal P, Kamalamma N, Patel TG, Misra R. A community based diabetes intervention and management education program in a rural village in India. Diabetes Care. 2008;31:1097-104.

42. Prabhakaran D, Reddy KS. The metabolic syndrome: looking beyond the debates. Clin Pharmacol Ther. 2011;90:19-21.

Cite this article as: Dodhiya AU, Patel D. Occurrence of the metabolic syndrome in newly diagnosed hypertensive adult Gujarati patients in G. K. general hospital, Bhuj. Int J Res Med Sci 2020;8:4460-6.