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Original Article

A Cross-Sectional Study on Knowledge, Attitude, and Medication Adherence in Metabolic Syndrome Patients at a Tertiary Care Center in South India

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ABSTRACT

Background: Metabolic Syndrome (MetS) is a major risk factor for cardiovascular disease and type 2 diabetes. Assessing patients' knowledge, attitudes, and medication adherence is essential for effective management. **Materials and Methods:** A cross-sectional study was conducted over six months at a tertiary care hospital in South India. A total of 303 patients with MetS were evaluated using the SHIELD and MARS-5 questionnaires. Data were analyzed using descriptive statistics. **Results:** Overall, 65.0% of patients demonstrated poor knowledge, while 57.4% had a moderate attitude toward MetS. Medication adherence was inadequate, with only 24.4% reporting good compliance. Rural patients showed relatively better knowledge and attitudes but lower adherence compared to urban patients. **Conclusion:** Patients with MetS exhibited inadequate knowledge, moderate attitudes, and poor medication adherence. Targeted educational strategies and adherence-focused interventions are urgently needed to improve disease management and outcomes.

Keywords: Metabolic Syndrome, Knowledge, Attitude, Medication Adherence, South India.

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INTRODUCTION

Metabolic Syndrome (MetS) refers to a cluster of metabolic abnormalities associated with increased insulin resistance and increased risk of cardiovascular diseases (Alefishat *et al*., 2017). The concept of "metabolic syndrome" originated in 1988 when Gerald Reaven proposed the idea of "syndrome X," which is the development of multiple cardiovascular risk factors in an individual. Later, it became known as "the deadly quartet" by Kaplan and "a secret killer" by Foster, among other experts (Ananthy *et al*., 2021). Haffner *et al*., first defined this disorder as "insulin resistance syndrome," yet some individuals still use the term as a reference to the underlying cause of insulin resistance. However, the term "metabolic syndrome" is nowadays most commonly used to indicate a group of metabolic disorders that increase the risk of cardiovascular disease (Sarafidis and Nilsson, 2006). According to NCEP/ATP criteria, metabolic syndrome is defined as the presence of abdominal obesity (waist circumference: men>102 cm, women>88 cm), triglycerides (TG>150 mg/dL), high-density lipoprotein (HDL: men<40 mg/dL, women<50 mg/dL), blood pressure (>130/80 mmHg), fasting glucose (>110 mg/dL), and the presence at least 3 of the following 5 conditions (Hammad *et al*., 2011).

The prevalence rate of metabolic syndrome varies among different populations and includes numerous factors such as age, gender, cigarette smoking, physical inactivity, obesity, genetic variations, atherogenic diet, and a family history of premature cardiovascular diseases, are linked to metabolic syndrome (Alefishat *et al*., 2017). During the past two decades, there is an evident increase in the overall incidence of metabolic syndrome. The global diabetes and obesity epidemic is the reason for this upsurge. Metabolic syndrome epidemic proportions were predicted to be between 20 and 25 percent worldwide. Metabolic syndrome was expected to affect 12-37% of the Asian population and 12-26% of the European population, respectively, compared with throughout regions (Manaf *et al*., 2021).

Insulin resistance and metabolic syndrome are both prevalent conditions in India. According to studies, the adjusted age-related incidence of metabolic syndrome has been reported to be over 25% in urban Indian populations (Oyewande *et al*., 2020). Metabolic syndrome risk factors can be divided into two categories: modifiable and non-modifiable factors. Modifiable factors encompass physical inactivity, a sedentary lifestyle, urbanization, smoking, alcohol consumption, family income,

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and level of education. Non-modifiable factors include increasing age, female gender, and family history of diabetes. Age is an essential risk factor and significantly influences the prevalence of metabolic syndrome worldwide (Fahed *et al.*, 2022).

The pathogenesis of metabolic syndrome is mainly due to genetic abnormalities, increased calorie intake and reduced physical activity (Ihm, 2021). This, in turn, regulates adipose viscosity which activates ROS, LOX, and RAS pathways and mediates increased angiotensin II, inflammatory mediators (Interleukin 6, TNF-a, CRP, Fibrinogen), adipokines (leptin, adiponectin, chemerin) and increased Free Fatty Acids (FFA) by decreased glucose uptake, insulin and increased lipogenesis, gluconeogenesis and triglycerides. This leads to chronic inflammation, hormonal activation and insulin resistance which regulates metabolic syndrome and cause diabetes mellitus or cardiovascular disease conditions.

Hypertension is more prevalent among those with metabolic syndrome and it is a major risk factor for developing CVD (Hiserote and Clearfield, 2010). Stringent blood pressure monitoring of systolic between 120-139 mm Hg or diastolic between 80-89 mm Hg should be maintained and effective lifestyle modifications to prevent CVD (World Health Organization, 2023). Weight control, lipid control, and glucose control are as much important as maintaining good blood pressure control among individuals with metabolic syndrome. Pharmacological treatment involves angiotensin receptor blockers and Angiotensin-Converting Enzyme (ACE) inhibitors as initial anti-hypertensive drugs. Calcium channel blockers or low dose thiazide diuretics are recommended in addition to ARBs or ACE inhibitors (Sull *et al.*, 2014).

Fasting blood glucose level is the most basic indicator of diabetes. Impaired FBG is an intermediate state of abnormal glucose regulation that increases the risk of developing diabetes and associated vascular disease (Lee *et al.*, 2020).

The presence of diabetes is a criterion for metabolic syndrome. Diagnostic criteria for prediabetes include impaired fasting blood glucose, impaired glucose tolerance, and metabolic syndrome. The presence of at least two prediabetes criteria renders an individual at increased risk for type 2 diabetes, and when impaired fasting glucose is one of the criteria for a diagnosis of metabolic syndrome, the risk for diabetes is even stronger (World Health Organization, 2023). Thus, clinical implications of MetS should be focused on multi factorial interventions to reduce the risk of T2D (Lee and Sanders, 2012). Metformin has been approved for the treatment of prediabetes by the FDA and is a top-tier medication after lifestyle behavior modification, which should include exercise and meal planning education (Sull *et al.*, 2014).

There is strong evidence supporting the association between Obesity and insulin resistance, type 2 diabetes mellitus, and atherosclerotic cardiovascular disease. Specifically, abdominal obesity due to visceral fat accumulation is associated with increased cardiovascular risk independent of total body fat in adult populations (Armstrong, 2006).

Weight reduction is the priority in persons with abdominal obesity and metabolic syndrome. Over 6 to 12 months, total body weight should be decreased by 7 to 10 percent, which requires reducing caloric intake by 500 to 1,000 calories per day (Huang, 2009).

The key prediction factors of atherogenic dyslipidemia include high plasma Triglycerides (TG), low High-Density Lipoprotein (HDL), and increased Low-Density Lipoprotein (LDL) (Lopes *et al.*, 2008). Statins (HMG-Co A reductase inhibitors), and fibrates should be initiated only after an increase in LDL and TG is measured (Huang, 2009). Early diagnosis of patients with metabolic syndrome and the selection of appropriate treatment protocols is essential in both controlling and reducing the associated risk of Cardiovascular Disease (CVD). Lifestyle interventions such as diet, exercise, and weight control play an important role in the treatment of patients with metabolic syndrome.

Pharmacological therapy aims to treat the individual components of metabolic syndrome such as anti-hypertensives, hypolipidemic, Oral Hypoglycemic Agents (OHA), and insulin to prevent cardiovascular disease conditions (Alefishat *et al.*, 2017).

The components of metabolic syndrome include central obesity, insulin resistance, systemic hypertension, and atherogenic dyslipidemia. A cross-sectional study was conducted in the south Indian population to determine the knowledge about MetS and medication adherence by using questionnaires to prevent cardiovascular and metabolic complications. This study aimed to evaluate the knowledge, and attitude in metabolic syndrome patients with the presence of metabolic components and the influence of patient education in preventing cardiovascular and metabolic comorbidities.

MATERIALS AND METHODS

A Prospective Observational Cross-sectional Study was conducted at the Department of Endocrinology in a multi-specialty hospital in south India for a period of six months. Ethical approval was obtained from Kovai Medical Center and hospital ethical committee (REF: EC/AP/1038/04/2023). The sample size was calculated based on the previous study conducted by Alefishat *et al.*, and the study population was calculated with an estimated prevalence and confidence interval (95%) and the required sample size was calculated.

Eligibility

Patients presenting with more than three of the following conditions such as i) Elevated triglycerides 150 mg/dL, ii) Low HDL<40 mg/dL in men and<50 mg/dL in women, iii) elevated

fasting glucose (FBS)>100 mg/dL, iv) Blood pressure≥130/85 mmHg, v) A Waist circumferences of>40 inches in men and 35 inches in women were included. Patients with hypertensive urgency or emergency with blood pressure>180/110 mmHg, recent stroke or Myocardial Infarction (MI) within the past six months, Class III or IV Chronic Heart Failure (CHF), Unstable angina, Severe renal or hepatic disease, and pregnant women were excluded.

Study tools

Samples were included, and baseline data and demographic data were collected from patient medical records and blood biochemistry reports including FBS, Blood Pressure, HDL, LDL, and TG levels. Patient's knowledge and attitude towards metabolic syndrome were assessed by using the SHIELD questionnaire (mentioned in Table 1) and medication adherence was determined by the MARS 5 questionnaire (mentioned in Table 2). Patient demographic variables (age, gender, area of residency, education), and questionnaires were analyzed by using descriptive statistics by frequency and percentage in Microsoft Excel 2022.

RESULTS

This prospective observational cross-sectional study included 389 patients, and 303 patients were included based on exclusion criteria. Among the 303 samples, 179 were male, and 124 were female, with a percentage of 59% and 41%, respectively. Most of the patients were between the age group of 51 -70 years with 58% followed by 27% in 31-50 years of age among the total study population. Among the study population, 26.42% were graduated, 30.26% completed primary education, 23.43% completed secondary education and 19.8% were uneducated. Among area of residency wise distribution, 50.49% of patients Belong to rural areas and 49.50% of patients belong to urban areas were mentioned in Table 3.

By analyzing the components of metabolic syndrome, 85% of patients showed higher levels of HDL (high-density lipoprotein), followed by increasing BP and FBG of 83% each, and elevated TG 80.54% of the population as shown in Figure 1. All metabolic components have been elevated in 80.54% (n=244) of the study population.

On evaluating the knowledge of the study population, 9 patients (2.64%) had good knowledge, 98 patients (32.34%) had moderate knowledge and 197 patients (65.01%) had poor knowledge of metabolic syndrome. With good knowledge of patients 2 patients from urban and 7 patients from rural areas from them, 2 patients completed secondary level education and 7 patients were graduated. In 98 moderate knowledge, 31 (10.2%) patients were from urban, 67 (22.1%) patients from rural, among them 56 patients (18.48%) were from graduate, 12 (3.96%) patients completed primary education, 27 patients completed secondary education and 3 (0.99%) of them were uneducated. Among poor knowledge patients 196 (64.68%), 120 patients (39.6%) were from urban and 76 patients (25.08%) were from rural, from which 17 patients (5.61%) were graduated, 80 patients (26.4%) completed primary education, 42 patients (13.86%) completed secondary education and 57 patients (18.81%) were uneducated. This shows that rural patients have more knowledge about metabolic syndrome compared to the urban population, and it also reveals that there is a strong relationship between education level and knowledge of the patient.

On examining the attitude of the study population 14 patients (4.62%) had good attitude, 174 patients (57.42%) had moderate attitude and 115 patients (37.95%) had poor attitude. In good attitude patients, rural patients (2.97%) had more good attitude compared to urban population (1.32%) from them graduated patients had good attitude compared to Others, as illustrated in Table 4.

While analyzing the medication adherence of the study population, 84 patients (27.72%) had average adherence with high prevalence followed by 74 patients (24.42%) who had good compliance towards medication adherence, and 24 patients (7.92%) were found to be non-compliant towards medication among the study population. In the good compliance category, the urban population was more with 54 patients (17.82%) compared to the rural population of 20 patients (6.60%) among them 29 patients completed primary education (9.57%), 61 patients (20.13%) had poor knowledge This shows that there is no relation between education level knowledge and medication adherence of the patient mentioned in Table 5.

While comparing the knowledge and attitude of the patients with metabolic syndrome, 91 patients (30%) had adequate knowledge and 212 patients (70%) had inadequate knowledge of metabolic syndrome. Among 91 patients with adequate knowledge, 24 (7.92%) had positive attitudes and 67 (22.11%) had negative attitudes toward medication adherence. Of 212 patients, 43 (14.19%) patients had positive attitudes and 169 patients had negative attitudes mentioned in Figure 2. This shows that most of the patients had inadequate knowledge and a negative attitude towards metabolic syndrome.

Knowledge and attitude were compared with medication adherence of the study population showed that patients who are all good compliance with medication have inadequate knowledge and negative attitudes towards metabolic syndrome demonstrated in Figure 3.

In overall comparing the knowledge, attitude, and medication adherence of (n=303) study population, the study results suggest that medication adherence was good in patients with inadequate knowledge and poor attitude. Patients who are all graduated had moderate to good knowledge and attitude towards metabolic syndrome but poor medication adherence.

DISCUSSION

Metabolic syndrome is a major global health concern, with prevalence increasing among middle-aged (51-60, 31.02%) and older adults (61-70, 27.06%). In our study of 303 patients, males (59.07%) outnumbered females (40.92%), consistent with evidence that prevalence rises with age and underscoring the need for early detection to reduce cardiovascular risks. A notable finding was the low level of awareness, with 65.01% of patients showing poor knowledge. This deficit hampers early detection, lifestyle modification, and management. Similar results were reported by Alefishat *et al.*, (2017), who found that limited knowledge reduced adherence to both medications and lifestyle changes, while Kassahun *et al.*, (2016) demonstrated that poor knowledge among diabetic patients was associated with inadequate self-care and low adherence.

Attitudes also influenced disease management, as 57.42% of our patients exhibited only a moderate attitude toward metabolic syndrome, reflecting willingness but limited engagement. Prior studies in hypertensive and diabetic patients support this, showing that forgetfulness, financial constraints, and negative attitudes reduce adherence (Pirasath, 2017; Assunção *et al.*, 2017). Despite awareness of hyperlipidemia, adherence in our study was low (41.3%), a finding consistent with Akhir *et al.*, (2020), who noted suboptimal adherence even among informed patients. In contrast, (Lopes *et al.*, 2008) observed higher adherence, suggesting variability across populations. Using the MARS scale, we found 27.72% of patients had only average adherence, reinforcing the need for improved strategies. Similar to Usman and Auwal (2019) and Ono *et al.*, (2016), our findings emphasize that inadequate knowledge and moderate attitudes continue to hinder effective management.

Rural-urban disparities were evident, with rural patients showing poorer knowledge (39.6%) but slightly better adherence (17.82%) than urban patients (15.84%). These results reflect previous findings by Kakumani and Waingankar (2016), who attributed poor adherence in rural areas to illiteracy, limited trust in medical care, financial challenges, and restricted access to specialists. Education level also influenced outcomes, as graduates demonstrated better awareness (18.4%), while those with only primary education showed more moderate attitudes (15.51%) but poorer adherence (9.57%). This indicates that while education enhances knowledge, adherence and attitudes are shaped by broader cultural, economic, and systemic factors. Overall, our study highlights the need for targeted educational and behavioral interventions to improve knowledge, foster positive attitudes, and enhance adherence in managing metabolic syndrome.

Table 1: SHIELD questionnaire

Sl. No.	Questions	Already Doing It [2]	I know I should [1]	Don't Bother Me [0]
Knowledge (2 marks)				
1.	I have heard about metabolic syndrome	2	1	0
2.	I understand what metabolic syndrome is	2	1	0
3.	Diabetes is only a sugar disease	2	1	0
4.	Type 2 diabetes is not as serious as type 1 diabetes	2	1	0
5.	This inability to keep weight off is due to a hormone or metabolism problem	2	1	0
6.	Obesity could aggravate or contribute to the onset of chronic disease	2	1	0
Attitude (1 mark)				
Sl. No.	**Questions**	**Already Doing It [1]**	**I Know I should [0]**	
7.	I expect my health to get worse	1	0	
8.	I seem to get sick a little easier than other people	1	0	
9.	How concerned are you that your health problems will get worse over time?	1	0	
10.	Would you say your health is excellent, very good, good, fair, or poor?	1	0	
11.	Compared with 12 months ago, how would you rate your health today?	1	0	

Knowledge Score: 9-12 (Good);5-8 (Moderate);0-4 (Poor) [>6 - Adequate, <6 - Inadequate]
Attitude: 4-5(Good); 2-3 (Moderate); 0-1 (Poor) [>3 - Positive, <3 - Negative]

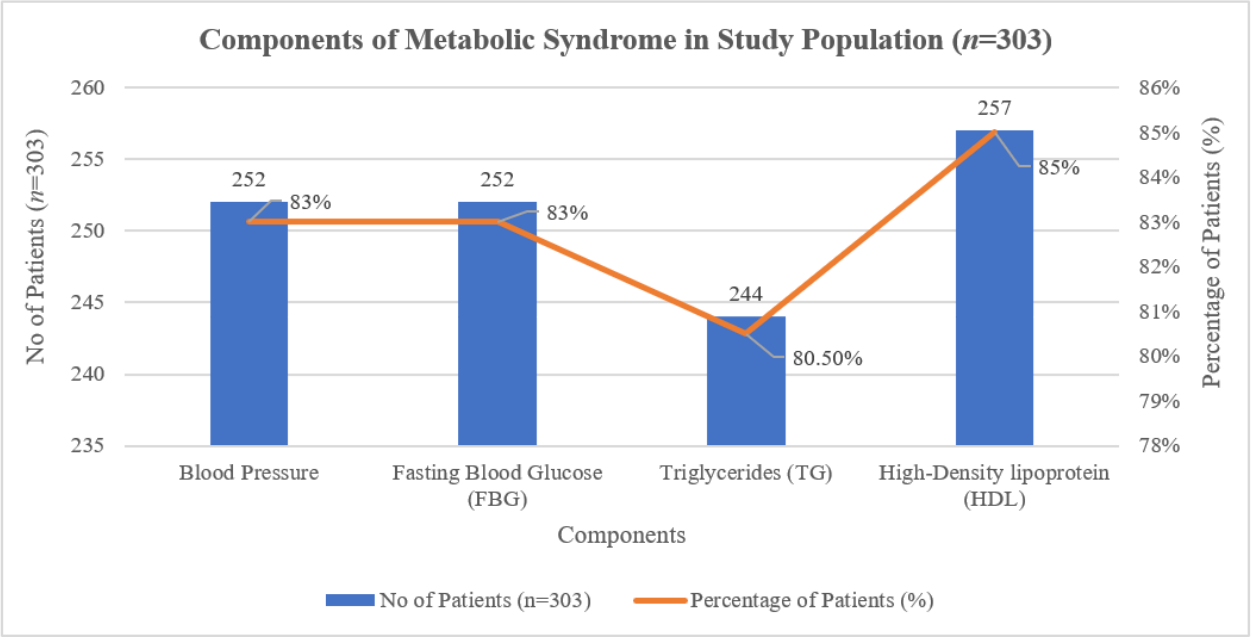

Figure 1: Metabolic syndrome components in the study population (*n*=303).

Table 2: MARS-5 questionnaire.

Sl. No.	Questions	Yes (1)	No (0)
1.	Do you ever forget to take your medications?	1	0
2.	Are you careless at times about taking your medication?	1	0
3.	When you feel better, do you sometimes stop taking your medications?	1	0
4.	Sometimes if you feel worse when you take the medicine, do you stop taking it?	1	0
5.	I take my medication only when I am sick	1	0

0 - Compliance; 1 - Satisfactory; 2 - Average; 3 - Poor; 4 - Non-compliant.

Table 3: Baseline demographics of the study population (*n*=303).

Characteristics		Study Population (*n*=303)	Percentage of Population (%)
Gender	Male	179	59
	Female	124	41
Education	Graduated	80	26.5
	Primary	92	30
	Secondary	71	23
	Uneducated	60	20
Area of residency	Rural	153	50
	Urban	150	50
Age group (Years)	<30	8	3
	31 - 50	81	27
	51- 70	176	58
	>70	38	12

Table 4: **Knowledge and Attitude of study population comparing with demographics (*n*=303).**

Factors		Knowledge wise Distribution			Attitude wise Distribution		
		Good (n) %	Moderate (n) %	Poor (n) %	Good (n) %	Moderate (n) %	Poor (n) %
Total no of patients (*n*=303)		9 (2.64%)	98 (32.34%)	196 (64.68%)	14 (4.62%)	174 (57.42%)	115 (37.95%)
Area of residency	Urban	2 (0.66%)	31 (10.2%)	120 (39.6%)	4 (1.32%)	89 (29.37%)	60 (19.80%)
	Rural	7 (2.3%)	67 (22.1%)	76 (25.08%)	9 (2.97%)	82 (27.06%)	59 (19.47%)
Education	Graduated	7 (2.35%)	56 (18.48%)	17 (5.61%)	8 (2.64%)	45 14.85%)	27 (8.91%)
	Primary	0	12 (3.96%)	80 (26.4%)	3 (0.99%)	47 (15.51%)	42 (13.86%)
	Secondary	2 (0.66%)	27 (8.8%)	42 (13.86%)	2 (0.66%)	44 (14.52%)	25 (8.25%)
	Uneducated	0	3 (0.99%)	57 (18.81%)	0	35 (11.55%)	25 (8.25%)

Table 5: **Medication adherence of the study population compared with demographics (*n*=303).**

Medication Adherence		Compliance (n) %	Satisfactory (n) %	Average (n) %	Poor (n) %	Non-Compliance (n) %
Total no of patients (*n*=303)		74 (24.42%)	73 (24.9%)	84(27.72%)	48(15.84%)	24(7.92%)
Area of residency	Urban	54 (17.82%)	35 (11.55%)	36 (11.88%)	20 (6.6%)	8 (2.64%)
	Rural	20 (6.60%)	37 (12.21%)	48 (15.84%)	28 (9.24%)	17 (5.61%)
Education	Graduated	6 (1.98%)	9 (2.97%)	21(6.93%)	30 (9.90%)	14 (4.62%)
	Primary	29 (9.57%)	26 (8.58%)	27 (8.91%)	5 (1.65%)	5 (1.65%)
	Secondary	19 (6.27%)	18 (5.94%)	20 (6.60%)	10 (3.30%)	4 (1.32%)
	Uneducated	20 (6.60%)	19 (6.27%)	16 (5.28)	3 (0.99%)	2 (0.66%)
Knowledge	Good	0	2 (0.66%)	2 (0.66%)	2 (0.66%)	3 (0.99%)
	Moderate	13 (4.29%)	22 (7.26%)	26 (1.98%)	25 (8.25%)	12 (3.96%)
	Poor	61 (20.13%)	48 (15.84%)	56 (18.48%)	21 (6.93%)	10 (3.3%)
Attitude	Good	2 (0.66%)	3 (0.99%)	4 (1.32%)	3 (0.99%)	1 (0.33%)
	Moderate	39 (12.87%)	44 (14.52%)	51 (16.83%)	29 (9.57%)	8 (2.64%)
	Poor	33 (10.89%)	25 (8.25%)	29 (9.57%)	16 (5.28%)	16 (5.28%)

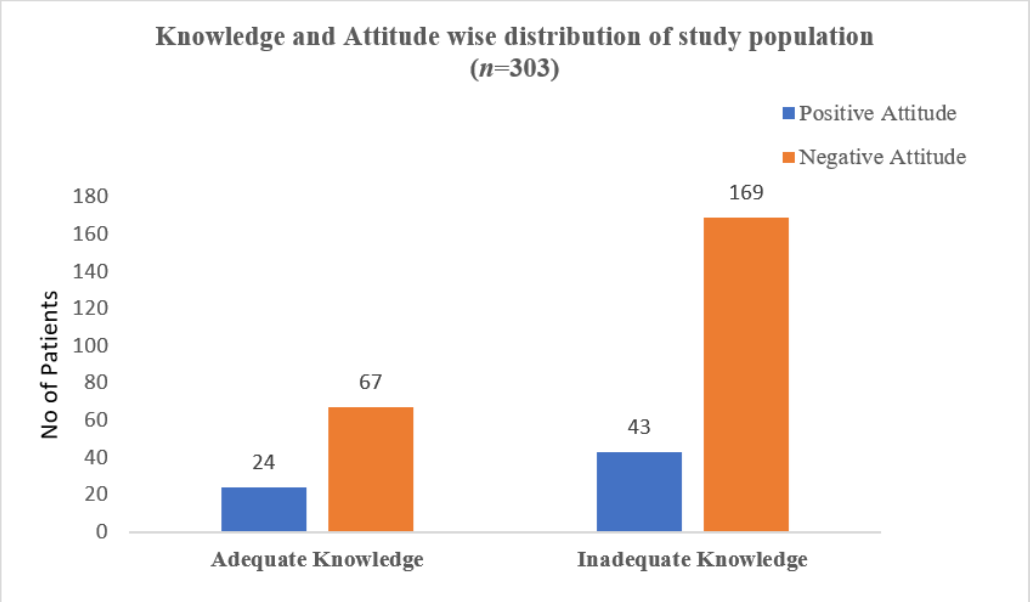

Figure 2: Knowledge and Attitude wise distribution of study population (*n*=303).

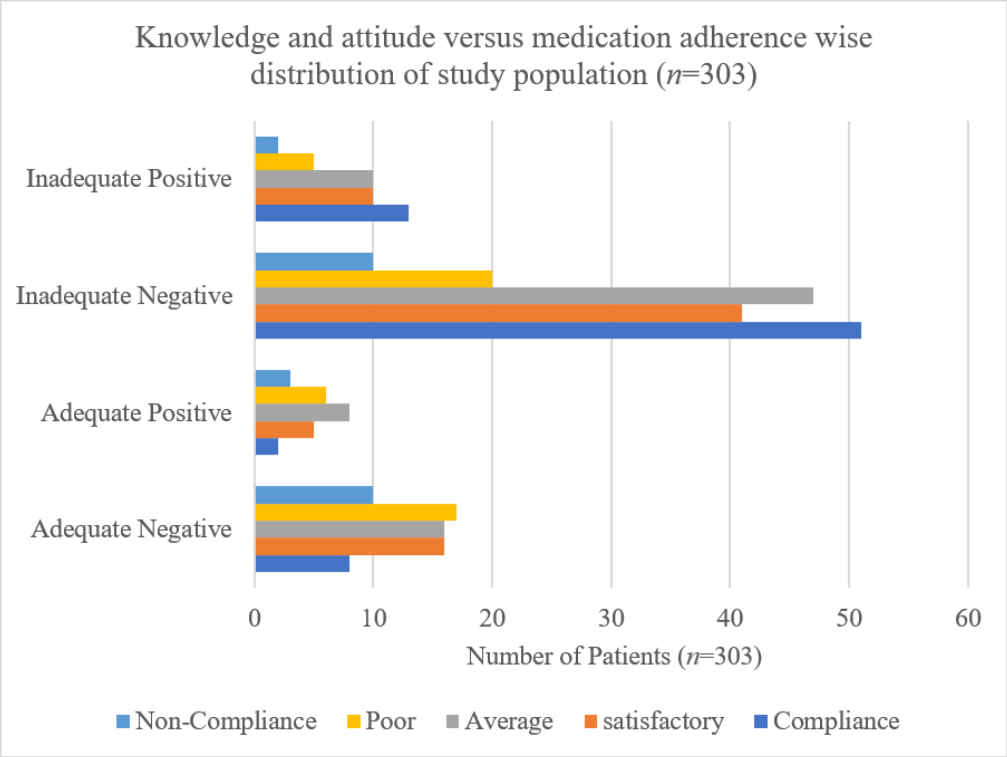

Figure 3: Knowledge and attitude versus medication adherence-wise distribution of study population.

CONCLUSION

This study highlights the pivotal role of patient knowledge, attitudes, and adherence in managing metabolic syndrome. Poor knowledge, moderate attitudes, and suboptimal adherence were major barriers to effective management of metabolic syndrome in our cohort. Rural-urban and educational disparities further influenced these outcomes, highlighting the importance of targeted educational and adherence-enhancing interventions. Tailored strategies addressing sociodemographic factors are essential to improve long-term disease control and reduce complications.

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ABBREVIATIONS

ACE: Angiotensin-Converting Enzyme; **ARBs:** Angiotensin Receptor Blocker; **BP:** Blood Pressure; CHF: Chronic Heart Failure; **CRP:** C-Reactive Protein; **CVD:** Cardiovascular Disease; **EC:** Ethical Committee; **FBG:** Fasting Blood Glucose; **FFA:** Free Fatty Acids; **FDA:** Food and Drug Administration; **HDL:** High-Density Lipoprotein; **IL-6:** Interleukin 6; **LDL:** Low-Density Lipoprotein; **LOX:** Lipoxygenase; **MARS:** Medication Adherence Rating Scale; **MetS:** Metabolic Syndrome; **MI:** Myocardial Infarction; **NCEP/ATP:** National Cholesterol Education Program / Adult Treatment Panel; **OHA:** Oral Hypoglycemic Agents; **RAS:** Renin-Angiotensin System; **ROS:** Reactive Oxygen Species; **SHIELD:** Study to Help Improve Early evaluation and management of risk factors Leading to Diabetes; **T2D:** Type 2 Diabetes; **TG:** Triglycerides; **TNF-α:** Tumor Necrosis Factor-alpha; **WHO:** World Health Organization.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

SUMMARY

This cross-sectional study evaluated knowledge, attitudes, and medication adherence among 303 patients with metabolic syndrome. Most participants had poor knowledge (65.01%) and moderate attitudes (57.42%), which adversely affected adherence, with only 24.42% showing good compliance. Rural patients demonstrated better attitudes but faced adherence barriers due to healthcare access and socioeconomic constraints. Educational status influenced awareness but did not ensure better adherence. These findings highlight the need for structured education, lifestyle support, and adherence-focused interventions to improve long-term outcomes.

REFERENCES

Akhir, N. H. M. D., Hadi, A. A., & Zainuddin, N. (2020). Hyperlipidaemia patients attending the IIUM Family Health Clinic, Kuantan: A survey on their medication adherence and knowledge on hyperlipidaemia. International Journal of Allied Health Sciences, 4(2), 1223–1235.

Alefishat, E. A., Abu Farha, R. K., & Al-Debei, M. M. (2017). Self-reported adherence among individuals at high risk of metabolic syndrome: Effect of knowledge and attitude. Medical Principles and Practice, 26(2), 157–163. https://doi.org/10.1159/000453037

Ananthy, V., Priyadharsini, R. P., & Subramanian, U. (2021). Pathogenesis, diagnosis, and management of metabolic syndrome: A comprehensive review. SBV Journal of Basic, Clinical and Applied Health Science, 4(2), 39–45. https://doi.org/10.5005/jp-journals-10082-03111

Armstrong, C. (2006). AHA and NHLBI review diagnosis and management of the metabolic syndrome. American Family Physician, 74(6), 1039–1046.

Ascaso, J., Gonzalez Santos, P., Hernandez Mijares, A., Mangas Rojas, A. M., Masana, L., Millan, J., Pallardo, L. F., Pedro-Botet, J., Perez Jimenez, F., Pintó, X., Plaza, I., Rubiés, J., & Zúñiga, M. (2007). Management of dyslipidemia in the metabolic syndrome: Recommendations of the Spanish HDL-Forum. American Journal of Cardiovascular Drugs, 7(1), 39–58. https://doi.org/10.2165/00129784-200707010-00004

Assunção, S. C., Fonseca, A. P., Silveira, M. F., Caldeira, A. P., & Pinho, L. (2017). Knowledge and attitude of patients with diabetes mellitus in Primary Health Care. Escola Anna Nery, 21(4), Article e20170208. https://doi.org/10.1590/2177-9465-ean-2017-0208

Fahed, G., Aoun, L., Bou Zerdan, M., Allam, S., Bou Zerdan, M., Bouferraa, Y., & Assi, H. I. (2022). Metabolic syndrome: Updates on pathophysiology and management in 2021. International Journal of Molecular Sciences, 23(2), 786. https://doi.org/10.3390/ijms23020786

Hammad, E. A., Yasein, N., Tahaineh, L., & Albsoul-Younes, A. M. (2011). A randomized controlled trial to assess pharmacist-physician collaborative practice in the management of metabolic syndrome in a university medical clinic in Jordan. Journal of Managed Care Pharmacy, 17(4), 295–303. https://doi.org/10.18553/jmcp.2011.17.4.295

Hiserote, P., & Clearfield, M. B. (2010). Treating risk components of the metabolic syndrome. Journal of Osteopathic Medicine, 110(s33), e6–e13. https://doi.org/10.7556/jaoa.2010.20015

Huang, P. L. (2009). A comprehensive definition for metabolic syndrome. Disease Models and Mechanisms, 2 (5–6), 231–237. https://doi.org/10.1242/dmm.001180

Ihm, S.-H. (2021). Pathophysiology and optimal management of hypertension in patients with cardiometabolic syndrome. Cardiometabolic Syndrome Journal, 1(1), 46–65. https://doi.org/10.51789/cmsj.2021.1.e3

Kakumani, K. V., & Waingankar, P. (2016). Assessment of compliance to treatment of diabetes and hypertension amongst previously diagnosed patients from a rural community of Raigad District of Maharashtra. The Journal of the Association of Physicians of India, 64(12), 36–40. https://pubmed.ncbi.nlm.nih.gov/28405986

Kassahun, T., Gesesew, H., Mwanri, L., & Eshetie, T. (2016). Diabetes-related knowledge, self-care behaviours and adherence to medications among diabetic patients in Southwest Ethiopia: A cross-sectional survey. BMC Endocrine Disorders, 16(1), 28. https://doi.org/10.1186/s12902-016-0114-x

Lee, L., & Sanders, R. A. (2012). Metabolic syndrome. Pediatrics in Review, 33(10), 459–66; quiz 467. https://doi.org/10.1542/pir.33-10-459

Lee, M.-K., Han, K., Kim, M. K., Koh, E. S., Kim, E. S., Nam, G. E., & Kwon, H.-S. (2020). Changes in metabolic syndrome and its components and the risk of type 2 diabetes: A nationwide cohort study. Scientific Reports, 10(1), 2313. https://doi.org/10.1038/s41598-020-59203-z

Lopes, N., Zanini, A. C., Casella-Filho, A., & Chagas, A. C. P. (2008). Metabolic syndrome patient compliance with drug treatment. Clinics, 63(5), 573–580. https://doi.org/10.1590/s1807-59322008000500002

Manaf, M. R. A., Nawi, A. M., Tauhid, N. M., Othman, H., Rahman, M. R. A., Yusoff, H. M., Safian, N., Ng, P. Y., Manaf, Z. A., Kadir, N. B. A., Yanasegaran, K., Basir, S. M. A., Ramakrishnappa, S., & Ganasegeran, K. (2021). Prevalence of metabolic syndrome and its associated risk factors among staff in a Malaysian public university. Scientific Reports, 11(1), 8132. https://doi.org/10.1038/s41598-021-87248-1

Ono, B. E., Cobra, C. R., Castro, C. C., Margarido, E. S., & Silva, R. D. (2016). Knowledge, attitudes, and metabolic control of diabetic and cardiac patients. Revista da Rede de Enfermagem do Nordeste (Rev Rene), 17(6), 750–757. https://doi.org/10.15253/2175-6783.2016000600013

Oyewande, A. A., Iqbal, B., Abdalla, L. F., Karim, F., & Khan, S. (2020). An overview of the pathophysiology of metabolic changes and their sequence of occurrence in obese diabetic females: A narrative review. Cureus, 12(10), Article e10849. https://doi.org/10.7759/cureus.10849

Pirasath, S., & Sundaresan, T. (2021). Knowledge, awareness, and adherence to medication among hypertensive patients in a tertiary care center, Eastern Sri Lanka: A descriptive cross-sectional study. Sage Open Medicine, 9, Article 20503121211012497. https://doi.org/10.1177/20503121211012497

Sarafidis, P. A., & Nilsson, P. M. (2006). The metabolic syndrome: A glance at its history. Journal of Hypertension, 24(4), 621–626. https://doi.org/10.1097/01.hjh.0000217840.26971.b6

Sull, J. W., Kang, D. R., & Jee, S. H. (2014). Association between fasting blood glucose levels and arterial stiffness in healthy Korean men and women. Journal of Preventive Medicine and Public Health, 39(2), 105–110. https://doi.org/10.3961/jpmph.2006.39.2.105

Usman, M. N., & Auwal, F. (2019). Medication adherence and its associated factors among hypertensive patients in a tertiary health facility in Minna, North Central, Nigeria. Archives of Clinical Hypertension, 3(1), 3–7. https://doi.org/10.17352/ach.000021

World Health Organization. (2023). Hypertension. https://www.who.int/news-room/fact-sheets/detail/hypertension

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