



Research Article

Assessing Knowledge Gaps and Predictors of Metabolic Syndrome Awareness Among Health Science Students in South India: An Analytical Cross-Sectional Study

Kripa Padmanabhan¹, Mahesh Ragavan¹, Sharanyapriya Pandi², Anil Chankaramangalam Mathew^{*3}

¹Intern, PSGIMSR, Coimbatore

²Assistant Professor, PSG College of Physiotherapy

³Professor of Biostatistics, Department of Community Medicine, PSG Institute of Medical Sciences and Research Coimbatore

Background: Metabolic syndrome (MetS) is a cluster of metabolic abnormalities that increases the risk of cardiovascular disease and type 2 diabetes mellitus. With the growing burden of non-communicable diseases in India, awareness among health science students is essential for prevention and early intervention. This study assessed awareness of MetS-related conditions and factors associated with knowledge levels. **Methods:** An analytical cross-sectional study was conducted among 156 health science students aged ≥ 18 years in a tertiary institution in Coimbatore, Tamil Nadu. A pre-validated questionnaire with 90 items across seven domains was used to assess knowledge. Anthropometric measurements were recorded. Data were analyzed using descriptive statistics, independent *t*-test, chi-square test, Poisson regression, and ANOVA. Interaction analysis examined gender differences in academic progression. **Results:** Overall awareness was moderate, with mean scores ranging from 61.53% to 72.22% across domains ($p < 0.001$). Highest awareness was observed for stroke (72.22%) and hypertension (70.40%), while lower awareness was noted for myocardial infarction (61.53%) and diabetes-related complications. BMI (RR = 0.992; $p = 0.009$), year of study (RR = 1.053; $p < 0.001$), and family history of high cholesterol (RR = 1.080; $p = 0.015$) were significantly associated with knowledge. Female students had higher knowledge in hypertension ($p = 0.027$). About 19.9% scored below 50%. No significant interaction between gender and year of study was observed. **Conclusion:** Health science students demonstrated moderate awareness with notable gaps in understanding complications and disease linkages, indicating the need for targeted educational interventions.

Keywords: Metabolic syndrome, awareness, health science students, knowledge, cross-sectional study.

INTRODUCTION

Metabolic syndrome (MetS) is a cluster of interrelated metabolic abnormalities that collectively increase the risk of atherosclerotic cardiovascular disease, insulin resistance, and type 2 diabetes mellitus.(1) According to the National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III), MetS is diagnosed when at least three of the following are present: central obesity, elevated triglycerides, reduced high-density lipoprotein cholesterol, elevated

blood pressure, and impaired fasting glucose(2-3). The syndrome reflects a complex interplay of genetic predisposition, obesity, physical inactivity, and metabolic dysregulation. The underlying aetiology of MetS is unknown but its manifestation has been linked to obesity, lack of physical activity and genetic predisposition. The crux of the syndrome is a build-up of adipose tissue and tissue dysfunction that in turn leads to insulin resistance (4). Proinflammatory cytokines to name a few- leptin, adiponectin, TNF, resistin released from the adipose tissue also play a

role. Insulin resistance can be acquired or may be due to genetic predisposition (4). Metabolic syndrome has become a major global public health concern. It has been estimated that nearly one quarter of the world's adult population have metabolic syndrome (5-9). Several epidemiological studies have reported increasing prevalence across different population (10-13). Prevalence of MetS in adult population of India (age adjusted prevalence) was found to be 31% in women and 18.5% in men (7). Prevalence in adolescent population of India is 5.2% (7). Besides many studies have shown that MetS is common not only among adults but also among younger persons. Studies have shown that the prevalence of MetS among younger persons ranged from 0.6% to 13% (14-17). Individuals with MetS appear to have a two-fold increase in risk for CVD and four-fold increase in risk for type 2 diabetes in later life. Many college students experience life style shifts due to irregular eating habits, junk and fast food consumption, lack of physical activity, increased screen time, stress and poor sleep. These habits increase the risk of MetS. Since India is seeing increasing cases of obesity, diabetes, and hypertension in younger population, awareness among students helps reduce this growing burden. College age is a crucial stage, where life style behaviours are formed. Promoting knowledge about metabolic syndrome can help students about healthy habits that last throughout adulthood. To the extent of our knowledge, not many studies were done among college students to determine their knowledge regarding MetS. Current literature indicates that most college students are unaware about MetS or CVD risk factors (18). Some studies reported false beliefs about CVD complications (19,20). It is also important to identify the components where the students have average or poor knowledge which help to prioritize the prevention strategies. Raising awareness about MetS based on students' pre-existing knowledge is essential to enhance students' wellness. The objectives of the study were to assess the awareness of conditions relevant to metabolic syndrome among health science students, identify factors associated with knowledge levels among them and examines the domain specific gaps. This will help to ascertain the need for redesign of tailored health promotion programs based on students' pre-existing knowledge to improve students' overall health and to correlate the

knowledge with gender, family history and their weight status.

MATERIALS AND METHODS

Design and settings:

This analytical cross-sectional study was conducted in PSG college of Physiotherapy located in Coimbatore, Tamil Nadu. A total of 156 students aged 18 years and above and who were willing to be a part of the study were included and they were briefed about the protocol and objectives of the study. They were not offered any incentives for their participation.

Sample size and sampling procedure

With an expected awareness of 75%, and with an allowable error of 10% of this prevalence, the required sample size was 140. In PSG college of Physiotherapy, the total undergraduate students are 173. With an expected non-response of 20%, we have decided to do the study for the entire students. In first year few students belong to the age below 18 years and those children were excluded. Since the study attempted to include the entire eligible population, the calculated sample size served only as reference.

Data collection:

The validated questionnaire used in this study was adopted from a previously published studies assessing awareness of metabolic syndrome and its related conditions among college students (18,19). The internal reliability of the questionnaire was tested and Cronbach's alpha was 0.822. The questions were administered to a small group of 10 students to ensure adequate understanding of the items in the questionnaire and to ensure clarity and contextual relevance. Prior to the study we have obtained institution Human Ethics committee permission (PSG/IHEC/2023/Appr/Exp/187). Students agreed to participate were asked to sign a consent form and then came to department laboratory for anthropometric measurements. Height, weight, waist circumference were measured. Height was taken with stadiometer. Students were asked to take off their shoes for height measurement. Body Mass Index (BMI) was calculated which is further analysed to assess the nutritional status and predisposition to metabolic

syndrome. Following which a self-administered structured questionnaire consisting of 90 questions regarding to risk factors of metabolic syndrome, the outcome and treatment, and a description of physical changes relevant to metabolic syndrome is distributed among health science students of PSG College of Physiotherapy. The questions were divided into seven categories ie. Diabetes, Adiposity, Hypertension, High serum cholesterol, Arteriosclerosis, Stroke and Myocardial infarction. The response options to the questions are “true”, “false” or “do not know”. The correct responses are scored one point and the incorrect and “do not know” responses are scored zero points. The delineation of the levels of students’ knowledge for each question was assessed as the percentage told as correct response.

Statistical analysis:

Data were analyzed using SPSS version 24. Descriptive statistics were used to summarize participant characteristics and knowledge scores. Independent t-test and chi-square tests were applied to compare continuous and categorical variables, respectively. The total knowledge score (count of correct responses) was used as the dependent variable. Poisson regression analysis was performed to identify factors associated with knowledge scores, after assessing for over dispersion. No significant over-dispersion was observed (dispersion parameter ≈ 1), and hence Poisson regression was used. Independent variables included age, gender, body mass index (BMI), year of study, and family history of chronic diseases. Analysis of variance (ANOVA) was used to compare domain-specific knowledge scores across different conditions. Post hoc comparisons were conducted using the Least Significant Difference (LSD) method. A knowledge gap index was calculated based on the proportion of participants scoring less than 50%. Interaction analysis was performed to examine whether the association between academic year and knowledge differed by gender. A p-value < 0.05 was considered statistically significant.

RESULTS

A total of 156 health science students participated in the study, of whom 38% were males and 62% were females. The age of the participants ranged from 18 to 21 years. The mean ($\pm$ SD) height, weight, body mass

index (BMI), and waist circumference were 165.96 ± 7.2 cm, 59.87 ± 10.11 kg, 21.69 ± 3.5 kg/m², and 32.89 ± 2.90 inches, respectively (Table 1). The prevalence of family history of chronic diseases among participants was as follows: diabetes (39.7%), hypertension (36.1%), heart disease (11.5%), obesity (16.7%), and increased cholesterol (16%). Sex wise distribution of family history of chronic diseases were presented in Table 2. The overall awareness of conditions related to metabolic syndrome was moderate. The average percentage of correct responses ranged from 61.53% to 72.22% across different domains. The highest awareness was observed for stroke (72.22%), hypertension (70.40%), and cholesterol (70.38%), whereas lower awareness was noted for myocardial infarction (61.53%), diabetes (66.34%), adiposity (66.90%), and arteriosclerosis (67.91%) (Table 3). Analysis of variance (ANOVA) demonstrated a statistically significant difference in knowledge scores across domains ($F = 6.208$, $p < 0.001$). Post hoc analysis showed that knowledge related to acute conditions such as stroke was significantly higher compared to chronic conditions, including diabetes ($p = 0.003$) and adiposity ($p = 0.008$). Overall, 19.9% of participants had poor knowledge, defined as a score of less than 50% (knowledge gap index). Knowledge scores showed a consistent increasing trend with academic progression across all domains. Students in the final year demonstrated higher mean percentage scores compared to those in earlier years, suggesting a cumulative effect of education and training (Table 3). It was found that BMI, year of study, and family history of increased cholesterol were significantly associated with knowledge scores. Each unit increase in BMI was associated with a small decrease in knowledge score (Rate Ratio [RR] = 0.992, $p = 0.009$). Students in higher academic years had significantly higher knowledge scores, with a 5.3% increase per year of study (RR = 1.053, $p < 0.001$). Additionally, participants with a family history of increased cholesterol had higher knowledge scores compared to those without such history (RR = 1.080, $p = 0.015$). Female students demonstrated significantly higher knowledge scores than males in the domain of hypertension ($p = 0.027$). However, no statistically significant gender differences were observed in other domains (Table 4). Interaction analysis between gender and year of study was not statistically

significant ($p = 0.431$) indicating that the improvement in knowledge with academic progression was similar for both males and females. Although students with a family history of chronic diseases tended to have slightly higher knowledge scores, these differences were not statistically significant across most conditions (Table 5). Similarly, no significant differences in knowledge scores were observed between students with BMI ≥ 25 kg/m² and those with BMI < 25 kg/m² across the different domains (Table 6). Item-wise analysis revealed important gaps in specific areas of knowledge. While a high proportion of students correctly identified common symptoms of diabetes, such as frequent urination (97%), only 25% were aware that diabetes could lead to eye disorders. Similarly, awareness regarding complications of hypertension was limited, with only 28% recognizing its association with eye disorders and 38% identifying its role in causing renal damage. Knowledge of atypical presentations of myocardial infarction was also poor, with only 18% correctly identifying that pain may radiate to the abdomen (Table 7).

DISCUSSION

An important finding of the present study is the fragmented nature of knowledge among students. While awareness of individual conditions such as stroke and hypertension was relatively high, understanding of their interrelationships and long-term complications was limited. This suggests that current teaching may emphasize isolated disease entities rather than an integrated conceptual framework of metabolic syndrome. Such fragmented understanding may reduce the effectiveness of future healthcare professionals in delivering comprehensive preventive care. Integrating case-based learning and interdisciplinary teaching approaches may help bridge this gap. Metabolic syndrome represents a major global public health concern because of its strong association with cardiovascular disease, type 2 diabetes mellitus, and other metabolic disorders. Since health science students represent future healthcare professionals, their awareness and understanding of metabolic syndrome and related cardio-metabolic conditions and its associated risk factors are crucial for effective prevention, early detection, and health promotion. In this study, the

overall awareness among students was moderate, with most average scores ranging between 61% and 72% across different conditions. The finding is consistent with Indian studies conducted among medical and allied health science students which report moderate but incomplete knowledge of non-communicable disease risk factors (21). The findings of the present study should be interpreted in the context of India's rapidly increasing burden of metabolic syndrome and related non-communicable diseases. Despite being health science students, the presence of only moderate awareness and significant knowledge gaps raises concerns regarding their preparedness to contribute effectively to preventive health care. Strengthening undergraduate curricula with integrated, application-oriented teaching on metabolic syndrome may play a crucial role in addressing this gap. The average percentage of correct response by condition varied from 61.53% to 72.22%. The higher awareness regarding stroke and hypertension may be attributed to greater emphasis on these conditions in public health education and clinical discussions. Cardiovascular diseases are often highlighted in health campaigns and medical training, which may explain why students demonstrate relatively better knowledge in these areas. Similar findings have been reported in previous studies where students showed greater familiarity with common cardiovascular risk factors compared to metabolic disorders and their complications (22). The study also found that knowledge scores increased with the year of study. Students in higher academic years demonstrated significantly higher knowledge scores compared to first-year students. This trend reflects the progressive acquisition of medical knowledge through academic training and clinical exposure. As students advance through their courses, they encounter more detailed information about metabolic diseases, cardiovascular risk factors, and preventive strategies. Similar patterns have been observed in studies conducted among medical and allied health students, where academic exposure significantly influenced awareness levels. Another important finding from the Poisson regression analysis was that BMI and family history of increased cholesterol were significantly associated with knowledge scores. Students with higher BMI have lower awareness and those with a family history of increased cholesterol tended to have higher awareness levels. Previous research has also

suggested that individuals with a personal or familial risk of chronic diseases are more likely to have better knowledge and awareness regarding related health conditions. However, gender differences in knowledge were minimal in the present study. Although female students demonstrated slightly higher knowledge scores in hypertension compared to males, the difference was statistically significant only for this condition. Overall, both male and female students exhibited similar levels of awareness regarding most metabolic syndrome components. This finding is consistent with several studies that have reported no major gender differences in health knowledge among students in health-related academic programs but contradicts the findings of Najal Y et.al. (18) Interestingly, the presence of family history of chronic diseases such as diabetes, hypertension, or heart disease did not significantly influence the knowledge scores for most conditions. Although students with a family history tended to have slightly higher scores, the differences were not statistically significant. This suggests that personal exposure to these diseases does not necessarily translate into greater awareness unless accompanied by structured health education. In the present study, only 25% reported that eye disorders can be consequences of diabetes. Diabetes is well known to cause several ocular complications including diabetic retinopathy, cataract and glaucoma which can eventually lead to vision impairment if not detected early. The finding highlight the need for targeted health education programs in colleges to improve awareness about diabetes and its complications including eye disorders. In this study only 28% of the participants reported that hypertension can lead to eye disorders and only 38% reported that it can cause renal damage. Hypertension is a major non-communicable disease that can affect multiple organs including eye and kidneys. Persistent high blood pressure can lead to hypertensive retinopathy which damages the blood vessels of the retina and may result visual impairment if not detected and treated early. Similarly, hypertension is a well-established risk factor for renal damage as prolonged elevated blood pressure can impair kidney function. The relatively low awareness among college students indicate their limited exposure regarding the long-term complications of hypertension. We observed that only 18% reported that while suffering myocardial infarction, pain may

radiate into the stomach indicating limited awareness of the atypical symptoms of myocardial infarction. Health science students play an important role in promoting preventive health behaviors in the community. Adequate awareness regarding metabolic syndrome is essential for early detection of risk factors and implementation of lifestyle interventions. Educational programs focusing on metabolic syndrome, obesity, physical inactivity, and cardiovascular risk factors should therefore be integrated more effectively into undergraduate health curricula. Awareness programs, workshops, and screening initiatives in college settings can further improve knowledge and encourage healthier lifestyle practices among students. The present study has certain limitations. First, the study was conducted in a single institution, which may limit the generalizability of the findings. Findings may not represent other health disciplines such as medical or nursing students. Second, the study relied on self-reported questionnaire responses, which may be subject to reporting bias. Third, the cross-sectional design limits the ability to establish causal relationships between variables and knowledge levels. Despite these limitations, the study provides valuable insights into the awareness of metabolic syndrome-related conditions among health science students. The findings highlight the presence of moderate knowledge levels with specific gaps in understanding certain conditions and complications. In conclusion, health science students demonstrated moderate awareness of conditions related to metabolic syndrome, with significant gaps in understanding complications and disease interrelationships. Knowledge levels improved with academic progression, highlighting the importance of structured educational exposure. However, the presence of misconceptions and fragmented understanding underscores the need for integrated, application-oriented teaching strategies. Strengthening targeted health education interventions within undergraduate curricula may enhance students' preparedness for effective prevention and management of non-communicable diseases.

REFERENCES

1. Alberti KGMM, Zimmet P, Shaw J. The metabolic syndrome—A new worldwide definition. *Lancet*. 2005;366(9491):1059–1062.
2. Grundy SM, Brewer HB Jr, Cleeman JI, Smith SC Jr, Lenfant C. Definition of metabolic syndrome: Report of the National Heart, Lung, and Blood Institute/American Heart Association conference. *Circulation*. 2004;109(3):433–438.
3. Eckel RH, Grundy SM, Zimmet PZ. The metabolic syndrome. *Lancet*. 2005;365(9468):1415–1428.
4. Kaur J. A comprehensive review on metabolic syndrome. *Cardiol Res Pract*. 2014; 2014:943162.
5. Cameron AJ, Shaw JE, Zimmet PZ. The metabolic syndrome: prevalence in worldwide populations. *Endocrinol Metab Clin North Am*. 2004;33(2):351–375.
6. Misra A, Khurana L. Obesity and the metabolic syndrome in developing countries. *J Clin Endocrinol Metab*. 2008;93(11 Suppl 1): S9–S30.
7. Prasad DS, Kabir Z, Dash AK, Das BC. Prevalence and risk factors for metabolic syndrome in Asian Indians: A community study. *J Cardiovasc Dis Res*. 2012;3(3):204–211.
8. 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(3):356–359.
9. Ranasinghe P, Mathangasinghe Y, Jayawardena R, Hills AP, Misra A. Prevalence and trends of metabolic syndrome among adults in the Asia-Pacific region: A systematic review. *BMC Public Health*. 2017; 17:101.
10. Kolovou GD, Anagnostopoulou KK, Salpea KD, Mikhailidis DP. The prevalence of metabolic syndrome in various populations. *Am J Med Sci*. 2007;333(6):362–371.
11. Cornier MA, Dabelea D, Hernandez TL, Lindstrom RC, Steig AJ, Stob NR, et al. The metabolic syndrome. *Endocr Rev*. 2008;29(7):777–822.
12. Kassi E, Pervanidou P, Kaltsas G, Chrousos G. Metabolic syndrome: Definitions and controversies. *BMC Med*. 2011; 9:48.
13. O'Neill S, O'Driscoll L. Metabolic syndrome: A closer look at the growing epidemic and its associated pathologies. *Curr Vasc Pharmacol*. 2015;13(1):1–18.
14. Cook S, Weitzman M, Auinger P, Nguyen M, Dietz WH. Prevalence of a metabolic syndrome phenotype in adolescents: Findings from the Third National Health and Nutrition Examination Survey, 1988–1994. *Arch Pediatr Adolesc Med*. 2003;157(8):821–827.
15. Friend A, Craig L, Turner S. The prevalence of metabolic syndrome in children: A systematic review of the literature. *Metab Syndr Relat Disord*. 2013;11(2):71–80.
16. Saklayen MG. The global epidemic of the metabolic syndrome. *Curr Hypertens Rep*. 2018;20(2):12.
17. Gupta R, Deedwania PC, Gupta A, Rastogi S, Panwar RB, Kothari K. Prevalence of metabolic syndrome in an Indian urban population. *Int J Cardiol*. 2004;97(2):257–261.
18. Najal Y, Carrie B, Melyssa R et al. Assessment of college students' awareness and knowledge about conditions relevant to metabolic syndrome. *Diabetol Metab Syndr*. 2014;6(111).
19. Recker RM, Bromme R, Jucks R. College student's knowledge of concepts related to metabolic syndrome. *Psychol Health Med*. 2008;13(3):367–379.
20. Collins KM, Dantico M, Sherer NB, Mossman KL, J. *Community Health*. 2004;29(5):405–420.
21. Rathok GG, Vadodariya NJ, Thakor N. Assessment of knowledge regarding hypertension and its preventive measures among students of Government Science College of North Gujarat region, India. *Int.J.Adv. Med*. 2019;696): 67-70.
22. Thankappan KR, Shah B, Mathur P, Sarma PS et.al. Risk factors profile for chronic non-communicable diseases. 2009;131(10,53-63).

Cite: Kripa Padmanabhan, Mahesh Ragavan, Sharanyapriya Pandi, Anil Chankaramangalam Mathew*, Assessing Knowledge Gaps and Predictors of Metabolic Syndrome Awareness Among Health Science Students in South India: An Analytical Cross-Sectional Study, *Int. J. Med. Pharm. Sci.*, 2026, 2 (7), 141-146. <https://doi.org/10.5281/zenodo.21128917>