

EDITORIAL COMMENT

The Increasing Prevalence of Metabolic Syndrome in Korea



A Multifarious Disease With a Multifactorial Etiology*

Andrea J. Lobene, PhD, RD

The metabolic syndrome (MetS) is a cluster of interrelated cardiometabolic conditions that increase one's risk of developing cardiovascular diseases and type 2 diabetes. Diagnosing MetS¹ requires ≥ 3 of the following 5 conditions: 1) increased waist circumference, as determined by population- and country-specific standards; 2) elevated serum triglycerides (≥ 150 mg/dL); 3) reduced high-density lipoprotein cholesterol (< 40 mg/dL in men and < 50 mg/dL in women) or currently taking medication for dyslipidemia; 4) elevated blood pressure ($\geq 130/85$ mm Hg); and 5) elevated fasting serum glucose (≥ 100 mg/dL) or currently taking glucose-lowering medication. For each additional condition of MetS, the relative risk of a major cardiovascular event is shown to increase by 22%.² Knowing this, it is concerning to see that the prevalence of MetS is increasing around the world. Notably, some countries and some subpopulations within countries are experiencing greater increases in MetS than others. In the United States, for example, the prevalence of MetS is increasing at a faster rate among Asian and Hispanic adults than in other racial/ethnic groups or in the overall population.³ In the Asia-Pacific region, country-specific estimates report 11.9% to 49.0% of the adult population has MetS, with notable increases in the prevalence of MetS in East Asia in particular.⁴ These trends warrant further investigation.

Several factors contribute to the development of MetS, including obesity and lifestyle factors such as

diet and physical activity. These factors themselves are affected by socioeconomic influences. Countries undergoing rapid economic changes may simultaneously experience drastic changes in lifestyle behaviors among its population, and in turn see drastic changes in chronic disease incidence and prevalence. South Korea serves as a unique case study on these interrelated effects, given its transition from a low-income to a high-income economy within the past few decades. Indeed, its classification was upgraded from a developing country to a developed country by the United Nations Conference on Trade and Development in 2021, the first country to be promoted since the conference's establishment in 1964. Concurrent with South Korea's rapid economic growth was a drastic nutrition transition, driven by numerous factors, including the adoption of Western food products, an increase in agriculture, and the increased percentage of women in the workforce.⁵ Beginning in the late 1960s, intakes of processed foods and animal products increased, and intakes of plant foods decreased. Around this time, the predominant cause of death shifted from infectious diseases to cardiovascular disease, which has remained the top cause of death ever since. Continued research into the impact of economic transition on lifestyle factors and subsequent health outcomes will provide valuable insight for other countries experiencing similar socioeconomic changes.

Previous studies have examined trends in MetS in South Korea, but gaps in the literature remain. A study by Lim et al⁶ found that MetS prevalence in adults increased from 24.9% in 1998 to 31.3% in 2007; a subsequent study by Lee et al⁷ found that MetS prevalence in adults increased from 28.84% in 2009 to 30.52% in 2013. Although these studies also looked at trends in individual MetS components, they did not examine changes in any potential contributors such as lifestyle and socioeconomic factors, and only looked at a relative short period of time. In this issue

*Editorials published in *JACC: Asia* reflect the views of the authors and do not necessarily represent the views of *JACC: Asia* or the American College of Cardiology.

From the Department of Kinesiology and Applied Physiology, University of Delaware, Newark, Delaware, USA.

The author attests she is in compliance with human studies committees and animal welfare regulations of the author's institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the [Author Center](#).

of *JACC: Asia*, Park et al⁸ examined changes in MetS prevalence from 2001 to 2020, as well as changes in the MetS components and contributing lifestyle factors using data from the Korean National Health and Nutrition Examination Surveys (KNHANES). KNHANES is a cross-sectional survey that is conducted annually by the Korea Disease Control and Prevention Agency to evaluate the overall health of the noninstitutionalized South Korean population. A sophisticated sampling design is used, and data are weighted to ensure the dataset is nationally representative. The current analysis included 98,489 respondents aged ≥ 20 years from the 2001 to 2020 cycles.

The overall age-adjusted prevalence of MetS increased significantly from 27.1% in 2001 to 33.2% in 2020; however, women actually experienced a significant decrease in MetS prevalence (from 28.2% to 26.2%), whereas men experienced a large increase (from 25.8% to 40.0%). These changes may be driven by sex-specific changes in the prevalence of different MetS components, which in turn are likely influenced by dietary and lifestyle changes. The prevalence of elevated serum glucose levels increased overall, but to a much greater extent in men (from 19.5% to 44.9%) compared with women (from 19.4% to 29.7%). This change occurred in parallel with an increase in sugar-sweetened beverage consumption, and despite an increase in antidiabetic drug use, suggesting that not all those with diabetes were controlling serum glucose levels successfully. The prevalence of high waist circumference also increased to a greater extent in men (from 22.1% to 45.3%) compared with women (from 28.5% to 30.1%). Waist circumference is an indicator of abdominal obesity; notably, body mass index increased significantly in men only during this period. The prevalence of hypertriglyceridemia also increased to a greater extent in men (from 43.2% to 48.2%) compared with women (from 28.3% to 29.9%), which aligned with an increase in fat intake. In contrast, the prevalence of low high-density lipoprotein cholesterol decreased overall, but to a much greater extent in women (from 60.8% to 33.0%) compared with men (from 35.9% to 24.2%). This discrepancy may be due in part to a slightly greater increase in lipid-lowering medication use in women compared with men, especially in the latter decade. In addition, the prevalence of high blood pressure decreased to a greater extent in women (from 36.6% to 31.5%) compared with men (from 46.6% to 46.1%). Interestingly, the use of antihypertensive medication increased to a greater extent in men, but sodium

intake decreased to a greater extent in women. Other notable lifestyle changes include a drastic decrease in smoking prevalence in men (from 58.4% to 33.6%), which remained low in women (5.7% in 2001 and 2020), and a similar increase in sedentary time among both men and women.

A strength of the study is the use of a high-quality, nationally representative dataset. Another strength of the study is the availability of 20 years of data, allowing us to see trends in MetS over a longer period of time compared to previous studies. However, this study is not without limitations. Self-reported dietary intake is subject to underreporting, which occurs to a greater extent in participants with obesity.⁹ The use of highly skilled and trained staff members to collect self-reported dietary intake, as is done in KNHANES, helps to ensure the data are as accurate as possible. Beyond this inherent limitation, the current analyses would have benefitted from a more thorough exploration of the statistical associations between changes in lifestyle factors and changes in MetS. In addition, although the article introduces the importance of understanding how rapid socioeconomic changes influence lifestyle and health status, no analysis of concurrent changes in socioeconomic variables was reported, although data on socioeconomic status are collected as part of KNHANES.¹⁰ Such analyses would have provided invaluable context for the trends in MetS and its components, in line with the aims of the article.

Overall, this study provides valuable insight into how the cardiometabolic health of South Korean adults has changed over the past 2 decades. These trends should continue to be monitored for decades to come, and similar analyses should be conducted in other countries, given the increasing burden of chronic disease worldwide. These findings provide justification and impetus for developing strategies and implement effective clinical and public health interventions for improving cardiometabolic health and decreasing disease risk.

FUNDING SUPPORT AND AUTHOR DISCLOSURES

Dr Lobene is currently supported by a postdoctoral fellowship from the American Heart Association (23POST1009835).

ADDRESS FOR CORRESPONDENCE: Dr Andrea J. Lobene, Department of Kinesiology and Applied Physiology, University of Delaware, 100 Discovery Boulevard, STAR Tower 3rd Floor, Newark, Delaware 19713, USA. E-mail: alobene@udel.edu.

REFERENCES

1. Alberti KG, 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;120:1640-1645.
2. Guembe MJ, Fernandez-Lazaro CI, Sayon-Orea C, et al. Risk for cardiovascular disease associated with metabolic syndrome and its components: a 13-year prospective study in the RIVANA cohort. *Cardiovasc Diabetol*. 2020;19:195.
3. Hirode G, Wong RJ. Trends in the prevalence of metabolic syndrome in the United States, 2011-2016. *JAMA*. 2020;323:2526-2528.
4. 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.
5. Kim S, Moon S, Popkin BM. The nutrition transition in South Korea. *Am J Clin Nutr*. 2000;71:44-53.
6. Lim S, Shin H, Song JH, et al. Increasing prevalence of metabolic syndrome in Korea: The Korean National Health and Nutrition Examination Survey for 1998-2007. *Diabetes Care*. 2011;34:1323-1328.
7. Lee SE, Han K, Kang YM, et al. Trends in the prevalence of metabolic syndrome and its components in South Korea: findings from the Korean National Health Insurance Service Database (2009-2013). *PLoS One*. 2018;13:e0194490.
8. Park D, Shin M-J, Després J-P, Eckel RH, Tuomilehto J, Lim S. 20-year trends in metabolic syndrome among Korean adults from 2001 to 2020. *JACC: Asia*. 2023;3:491-502.
9. Ravelli MN, Schoeller DA. Traditional self-reported dietary instruments are prone to inaccuracies and new approaches are needed. *Front Nutr*. 2020;7:90.
10. Kweon S, Kim Y, Jang MJ, et al. Data resource profile: the Korea National Health and Nutrition Examination Survey (KNHANES). *Int J Epidemiol*. 2014;43:69-77.

KEY WORDS blood pressure, dyslipidemia, glucose, KNHANES, metabolic syndrome, waist circumference