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Mini Review

Metabolic Syndrome among Omani Adolescents: Prevention and Management

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Abstract

Metabolic syndrome (MS) has been associated with increased risks of cardiovascular diseases, type 2 diabetes, stroke, and numerous other chronic health conditions. The escalation of MS is primarily attributed to unhealthy lifestyle behavior, poor dietary choices, lack of physical activity, and a rise in sedentary habits. However, the importance of MS is underscored by its potential to contribute to a range of diseases, resulting in a cascade of harmful health consequences that go beyond individual components. The prevalence of MS is rising at an alarming rate in the gulf cooperation council (GCC) region including Oman. Early detection and intervention are critical, as the syndrome frequently remains undetected until it reaches advanced stages, thereby making timely and focused preventive strategies essential. Maintaining a healthy lifestyle is essential to prevent or delay the development of MS in at-risk individuals, as well as for averting cardiovascular disease and type 2 diabetes in those already diagnosed with MS. Healthcare providers ought to implement the most effective strategies for lifestyle changes that focus on preventing MS and improving cardiometabolic health in children and adolescents.

Keywords: *Metabolic Syndrome; Omani Adolescents; Physical Activity; BMI; Obesity*

Introduction

Metabolic Syndrome (MS) is characterized as a collection of cardio-metabolic disorders that elevate the likelihood of developing cardiovascular diseases and type 2 diabetes, which are among the primary causes of mortality globally [1]. The risk factors include central obesity, insulin resistance, impaired glucose tolerance and dyslipidemia [2]. The industrialized era and modern lifestyle are associated with deskbound routine and increased consumption of refined foods, consequently leading to increasing rates of obesity among young adults. Obesity is linked with low grade inflammation that leads to endothelial dysfunction and increased risk of cardiovascular disease and type 2 diabetes [3,4]. Study from NHANES revealed dramatic increase in the prevalence of MS in young individuals within the range of 20-39-year-old (from 16.2-21.3%), while among Asian and Hispanic race participants (from 19.9 to 26.2%; and 32.9-40.4%), respectively [5,6]. The identification of high-risk individuals will provide an opportunity to provide targeted counseling for relevant dietary and lifestyle changes [7].

Literature Review

Prevalence and epidemiology

The prevalence of MS among adolescents was 5.5% in high-income countries, and 7.0% in low-income countries. In addition, the prevalence of MS in children in northwestern Europe was found to be 8.2%. The highest prevalence in children was reported in countries namely, Nicaragua, Iran and Mexico (5.2, 8.8, and 12.3%), respectively, while among adolescents the trend was seen in Iran, United Arab Emirates and Spain (9.0, 9.8, 9.9%), respectively [8]. The prevalence of MS is rising at an alarming rate in the gulf cooperation council (GCC) region including, Oman, Saudi Arabia, and the United Arab Emirates. Moreover, it has been demonstrated that adult-onset type 2 diabetes and cardiovascular diseases are highly prevalent among these countries [9,10]. Study among Omani adults demonstrated high prevalence of MS and its components with one in four adults being categorized as having MS [11]. A survey report among Omani population showed high prevalence of biological risk factors including blood pressure, cholesterol, blood sugar level and overweight and obesity to be 33, 36, 16, and 66%, respectively [12]. The global prevalence of MS in young population is increasing. College students are an understudied population in respect to prevalence of MS. However, this is becoming increasingly prevalent even in young adults [13,14]. There are studies demonstrating that college students experience weight gain faster than average adults [15-17]. The same pattern has been observed in Omani students with increasing prevalence of overweight and obesity especially in males as compared to females [18]. One study reported high prevalence of insulin resistance (16%) and obesity (26%) among healthy young Omani medical students [19].

Lifestyle behavior, unhealthy diet and low level of physical activity are important attributable factors leading towards high prevalence of MS and associated symptoms. The predisposition to dysmetabolic syndrome in earlier life is a risk factor towards increased development of MS and CVD [20]. A recent study among Iraqi university students (18-25-year-old) were shown to have significantly high prevalence of MS (66.9% female and 33.1% male) with components such as high fasting blood glucose, and increased waist circumference. Moreover, the associated risk factors included female gender, increasing age, high BMI, low level of physical activity and fast food consumption. The study emphasized the need for early detection in order to minimize the future risk [21]. Based on NCEP-ATP III criteria, study performed by Campo-Arias., *et al.* demonstrated heterogeneity of MS prevalence among college students ranging from 0-19.2%. Lifestyle behaviors were shown to be causative factors for this variation [22]. Similar results obtained from Saudi, Egypt and US students also demonstrated the risk of developing prevalence of MS as 17.7, 16.7 and 15%, respectively [23-25]. The prevalence of MS was moderately high among university students in Sudan with a direct relation with BMI [26]. Risk factors such as physical inactivity, and lack of knowledge about healthy foods were shown to be associated with obese and overweight Omani college students [18]. A similar study demonstrated the same causal factors such as unhealthy diet behavior and lack of knowledge among obese Omani females (30-49 years) [27].

A recent study revealed that the prevalence of metabolic syndrome (MS) among obese adolescent students in northern Oman is 10.7%. The same study highlighted the importance of improving health-related fitness components to decrease the prevalence of MS [28]. Omani adolescent school children demonstrated a high prevalence of behavioral risk factors (such as physical inactivity, high BMI, fast food consumption, smoking) of CVD [29]. In general, the prevalence of MS in young population is low as compared to adult but in case of obese and overweight adolescents, its prevalence is presumably high (29%) [30,31]. Hence, early detection of MS and its components among the predisposed section of university student is crucial and would prove helpful for focused interventions and limiting the development of MS and related disease such as CVD and diabetes.

Prevention and management

Adolescence is considered the second window of opportunity in planning nutrition related interventions to improve the health outcomes later in life. Numerous studies have shown that early risk factor identification can contribute to planning preventive interventions and enhance quality of life [32]. The initial steps are to act on modifiable factors such as obesity, physical inactivity, and atherogenic diet through lifestyle changes. The lifestyle recommendations encompass the cessation of smoking, engaging in physical activity, adhering to

the Mediterranean diet with or without energy restriction and for individuals who are overweight or have obesity, following a healthy diet designed by a specialist to attain the desired Body Mass Index (BMI) (<25 kg/m^2) [33].

The role of dietary modification in managing MS has been shown to be positively associated with health indicators and several clinical and epidemiological studies had shown the beneficial effect of diet in reducing the prevalence of MS [34,35]. Previous studies demonstrate that in patient with MS, physical activity aids in decreasing body weight, improving peripheral insulin resistance, and reducing anxiety [36-38]. The prevention of excessive weight in children and adolescents is a critical goal and high adherence to diet quality has a positive effect on obesity measures and MS in children and adolescents. The prevalence of the MS was found to be high among obese children and adolescents [39]. The association of high BMI or obesity is not just limited to MS, but it also affects its diagnostic criteria (lipid profiles, WC, BP and FPG level) [40]. The nutritional shift occurring in Oman, marked by a rise in the intake of processed foods that are rich in saturated fats and sugars, alongside a decrease in traditional eating habits, could further exacerbate the increasing incidence of MS [41]. In the revised 2024 guidelines [42,43], the United States Preventive Services Task Force (USPSTF) emphasized the importance of early intervention when pediatric obesity is detected, advocating for intensive lifestyle therapy (ILT) to be initiated as early as 6 years of age. The recommendation for obesity screening using BMI calculations has been eliminated, as this is now considered a standard component of clinical practice. Hence, earlier intervention is beneficial to establish healthy habits early in a child's development [44] before puberty, which may contribute to a heightened long-term cardiometabolic risk [45].

Conclusion and Recommendation

By tackling MS at an early stage, encouraging healthier lifestyles, and enhancing access to healthcare, we can alleviate the impact of MS and avert its related complications, resulting in better health outcomes for adolescents and communities globally.

Healthcare providers in Oman should focus on personalized nutrition counseling, based on individual preferences, cultural factors, and medical conditions. Regular follow up and support from healthcare professionals, including dietitians, can help children and adolescent overcome barriers and maintain long-term healthy behaviors. Public health initiatives and policies play a crucial role in encouraging healthy dietary choices and decreasing the incidence of MS. Awareness campaigns in Omani schools and universities that highlight the significance of lifestyle and behavioral factors in the prevention and management of MS can enable individuals to make educated food choices and contribute to the reduction of its prevalence.

Conflict of Interest

The authors declare no potential conflict of interest.

Bibliography

1. World Health Organization. Noncommunicable Diaseases. [Accessed on 30 November 2025]. Available online: https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases.

2. Alberti KGMM., *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* 120.16 (2009): 1640-1645.

3. Obunai Kotaro., *et al*. "Cardiovascular morbidity and mortality of the metabolic syndrome". *The Medical Clinics of North America* 91.6 (2007): 1169-1184.

4. National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). "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) final report". *Circulation* 106.25 (2002): 3143-3421.

5. Nolan Paul B., *et al*. "Prevalence of metabolic syndrome and metabolic syndrome components in young adults: A pooled analysis". *Preventive Medicine Reports* 7 (2017): 211-215.

6. Hirode Grishma and Robert J Wong. "Trends in the prevalence of metabolic syndrome in the United States, 2011-2016". *JAMA* 323.24 (2020): 2526-2528.

7. VanWormer Jeffrey J., *et al*. "Lifestyle changes and prevention of metabolic syndrome in the Heart of New Ulm Project". *Preventive Medicine Reports* 6 (2017): 242-245.

8. Noubiap Jean Jacques., *et al*. "Global, regional, and country estimates of metabolic syndrome burden in children and adolescents in 2020: a systematic review and modelling analysis". *The Lancet. Child and Adolescent Health* 6.3 (2022): 158-170.

9. Shin Seungmin and Haemi Jee. "Prevalence of metabolic syndrome in the Gulf Cooperation Council countries: meta-analysis of cross-sectional studies". *Journal of Exercise Rehabilitation* 16.1 (2020): 27-35.

10. Al-Lawati Jawad A., *et al*. "Addressing the threat of chronic diseases in Oman". *Preventing Chronic Disease* 5.3 (2008): A99.

11. El-Aty Mahmoud Abd., *et al*. "Metabolic syndrome and its components: Secondary analysis of the World Health Survey, Oman". *Sultan Qaboos University Medical Journal* 14.4 (2014): e460-e467.

12. Al-Mawali Adhra., *et al*. "Prevalence of risk factors of non-communicable diseases in the Sultanate of Oman: STEPS survey 2017". *PloS one* 16.10 (2021): e0259239.

13. Eckel Robert H., *et al*. "The metabolic syndrome". *Lancet (London, England)* 365.9468 (2005): 1415-1428.

14. Lloyd-Jones Donald M., *et al*. "Consistently stable or decreased body mass index in young adulthood and longitudinal changes in metabolic syndrome components: the coronary artery risk development in young adults study". *Circulation* 115.8 (2007): 1004-1011.

15. Holm-Denoma Jill M., *et al*. "The "freshman fifteen" (the "freshman five" actually): predictors and possible explanations". *Health Psychology: Official Journal of the Division of Health Psychology, American Psychological Association* 27.1S (2008): S3-S9.

16. Levitsky D A., *et al*. "The freshman weight gain: a model for the study of the epidemic of obesity". *International Journal of Obesity and Related Metabolic Disorders: Journal of the International Association for the Study of Obesity* 28.11 (2004): 1435-1442.

17. Huang Terry T-K., *et al*. "Overweight and components of the metabolic syndrome in college students". *Diabetes Care* 27.12 (2004): 3000-3001.

18. Al-Kilani Hashim., *et al*. "Trends of obesity and overweight among college students in Oman: A cross sectional study". *Sultan Qaboos University Medical Journal* 12.1 (2012): 69-76.

19. Al-Farai Humaid H., *et al*. "Insulin resistance and its correlation with risk factors for developing diabetes mellitus in 100 omani medical students". *Sultan Qaboos University Medical Journal* 14.3 (2014): e393-e396.

20. Bitsori Maria and Anthony Kafatos. "Dysmetabolic syndrome in childhood and adolescence". *Acta Paediatrica (Oslo, Norway: 1992)* 94.8 (2005): 995-1005.

21. Zamil Alaa H and Seenaa S Amin. "The prevalence of metabolic syndrome among university students in Wasit, Iraq". *Saudi Medical Journal* 43.11 (2022): 1240-1247.

22. Campo-Arias A., *et al*. "Prevalence of metabolic syndrome among university students: A systematic review". *Revista de la Facultad de Medicina* 66.4 (2018): 629-633.

23. Mahrous OA., *et al*. "Epidemiology of metabolic syndrome in Menoufia University students". *Menoufia Medical Journal* 31.3 (2018): 839.

24. Balgoon Maha J., *et al*. "The correlation between obesity and metabolic syndrome in young female university students in the Kingdom of Saudi Arabia". *Diabetes and Metabolic Syndrome* 13.4 (2019): 2399-2402.

25. Olfert Melissa D., *et al*. "Metabolic syndrome prevalence in students attending West Virginia university". *Journal of Clinical Medicine* 7.12 (2018): 487.

26. Ahmed Mohammed Ahmed., *et al*. "Metabolic syndrome among undergraduate students attending medical clinics for obligatory medical screening". *Tropical Journal of Pharmaceutical Research* 14.2 (2015): 317-321.

27. Seth M. "Relationship between obesity, dietary behaviour and dietary intake in obese omani females (age 30 - 49 years): a cross-sectional study". *Mathews Journal of Nutrition and Dietetics* 4.1 (2020): 01.

28. Salim Alghafri Yasir., *et al*. "The prevalence and predictive risk factors of metabolic syndrome based on health-related fitness components in omani adolescents with obesity". *Iranian Journal of Public Health* 54.5 (2025): 1024-1033.

29. Peltzer K and Pengpid S. "Simultaneous behavioural risk factors of cardiovascular disease among in-school adolescents in Oman". In Adolescence: Behavioural Risk Factors of Non-Communicable Diseases. Nova Science Publishers, Inc. (2020): 69-81.

30. Dalleck Lance C and Emily Marguerite Kjelland. "The prevalence of metabolic syndrome and metabolic syndrome risk factors in college-aged students". *American Journal of Health Promotion: AJHP* 27.1 (2012): 37-42.

31. Luk Andrea O Y., *et al*. "Metabolic syndrome predicts new onset of chronic kidney disease in 5,829 patients with type 2 diabetes: a 5-year prospective analysis of the Hong Kong Diabetes Registry". *Diabetes Care* 31.12 (2008): 2357-2361.

32. Dupont Pierre. "Metabolic syndrome: pathways to early detection and risk management". *Journal of Metabolic Syndrome* 13.4 (2024): 386.

33. Pérez-Martínez Pablo., *et al*. "Lifestyle recommendations for the prevention and management of metabolic syndrome: an international panel recommendation". *Nutrition Reviews* 75.5 (2017): 307-326.

34. World Health Organization Study Group. World Health Organization. Technical Report Series. Geneva, Switzerland. Diet, Nutrition, and the Prevention of Chronic Diseases (2003): 916.

35. Chrysohoou Christina., *et al*. "Adherence to the Mediterranean diet attenuates inflammation and coagulation process in healthy adults: The ATTICA Study". *Journal of the American College of Cardiology* 44.1 (2004): 152-158.

36. Xie Yumeng., *et al*. "The effects and mechanisms of exercise on the treatment of depression". *Frontiers in Psychiatry* 12 (2021): 705559.

37. Myers Jonathan., *et al*. "Physical activity, cardiorespiratory fitness, and the metabolic syndrome". *Nutrients* 11.7 (2019): 1652.

38. Wewege Michael A., *et al*. "Aerobic, resistance or combined training: A systematic review and meta-analysis of exercise to reduce cardiovascular risk in adults with metabolic syndrome". *Atherosclerosis* 274 (2018): 162-171.

39. Weiss Ram., *et al*. "Obesity and the metabolic syndrome in children and adolescents". *The New England Journal of Medicine* 350.23 (2004): 2362-2374.

40. Teixeira Tatiana F S., *et al*. "Main characteristics of metabolically obese normal weight and metabolically healthy obese phenotypes". *Nutrition Reviews* 73.3 (2015): 175-190.

41. Aboul-Enein BH., *et al*. "Dietary transition and obesity in selected Arabic speaking countries: a review of the current evidence". *Eastern Mediterranean Health Journal* 22.10 (2017): 763-770.

42. O'Connor Elizabeth A., *et al*. "Interventions for weight management in children and adolescents: updated evidence report and systematic review for the US preventive services task force". *Journal of the American Medical Association* 332.3 (2024): 233-248.

43. US Preventive Services Task Force., *et al*. "Interventions for high body mass index in children and adolescents: US preventive services task force recommendation statement". *Journal of the American Medical Association* 332.3 (2024): 226-232.

44. Mura Paroche Manon., *et al*. "How infants and young children learn about food: a systematic review". *Frontiers in Psychology* 8 (2017): 1046.

45. Marcus Claude., *et al*. "Pediatric obesity-Long-term consequences and effect of weight loss". *Journal of Internal Medicine* 292.6 (2022): 870-891.

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