

Fundamental Factors of Overweight, Obesity, and Metabolic Syndrome in Cardiovascular Disease (Key Points that Healthcare Providers, Public Health Policymakers, and the General Public Should Know about the CVD-Obesity Connection)

Nicholas A Kerna^{1*}, Uzoamaka Nwokorie^{2,3}, Abdullah Hafid^{2,3}, Emmanuella Solomon^{2,3} and Priscilla Anusiem^{2,3}

¹SMC–Medical Research, Thailand

²University of Health and Humanities, Tortola, BVI

³University of Science, Arts and Technology, Montserrat, BVI

*Corresponding Author: Nicholas A Kerna, POB47 Phatphong, Suriwongse Road, Bangkok, Thailand 10500.

Contact: medpublab+drkerna@gmail.com.

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Abstract

Overweight, obesity, and metabolic syndrome are significant risk factors in developing cardiovascular disease. It would be time-consuming and a substantial undertaking for most healthcare practitioners (or medical students or residents), to read or review numerous articles to investigate the hallmarks of obesity and the obesity epidemic as they relate to cardiovascular disease and disorders. However, such information is invaluable in coping with cardiovascular disease (as a patient), treating heart patients (as a physician or healthcare provider), or developing public health policies (as a government official, agency, or NGO). Based on an extensive review of the literature on overweight, obesity, and metabolic syndrome, this paper acts as a review, summary, and practical resource, highlighting key points and hallmarks of these risk factors for cardiovascular disease and related disorders.

Keywords: Adiposity; Bariatric; Childhood Obesity; Diabetes; Epigenomics; Metabolic Syndrome; Overweight; Pandemic

Abbreviations

AMA: American Medical Association; BMI: Body Mass Index; BP: Blood Pressure; CCO: CVD: Cardiovascular Disease; CHD: Coronary Heart Disease; DM: Diabetes Mellitus; DSM-IV-TR: Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition-Text Revision; HF: Heart Failure; FDA: (U.S.) Food and Drug Administration; IR: Insulin Resistance; MS: Metabolic Syndrome; NGO: Non-Governmental Organization; PCP: Primary Care Provider; WHO: World Health Organization

Introduction

According to Carbone *et al.* (2019): “Obesity is associated with an increased risk of developing cardiovascular disease (CVD), particularly heart failure (HF) and coronary heart disease (CHD)” [1]. Khan *et al.* (2018) performed a population-based study consisting of 190672 in-person examinations and concluded, “compared with individuals with a normal BMI (defined as a BMI of 18.5 to 24.9), lifetime risks for incident CVD were higher in middle-aged adults in the overweight and obese groups” [2]. Numerous studies have confirmed their finding and stated that overweight, obesity, and metabolic syndrome are causative factors in developing cardiovascular disease, heart failure,

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coronary heart disease, and vascular disorders. Class 2 and 3 obesity are considered higher risk factors in developing cardiovascular disease and disorders. Obesity is characterized most commonly by body mass index (BMI). The three classes of obesity and overweight are listed as follows:

- Overweight (not obese), if BMI is 25.0 to 29.9
- Class 1 (low-risk) obesity, if BMI is 30.0 to 34.9
- Class 2 (moderate-risk) obesity, if BMI is 35.0 to 39.9
- Class 3 (high-risk) obesity, if BMI is equal to or greater than 40.0 [3].

BMI is used widely as a risk factor for developing other diseases as well as determining public health policies [4]. BMI is calculated as the ratio of height and weight, expressed as kg/m^2 .

This paper reflects extensive research on overweight, obesity, and metabolic syndrome as significant risk factors for cardiovascular disease, and their main concepts extracted and summarized. As a practical resource and reference, key points regarding these overweight, obesity, and metabolic risk factors for cardiovascular disease and disorders are enumerated below.

Discussion

1. Obesity is the most significant public health issue in the developed world, affecting all socioeconomic backgrounds and ethnicities [5]. However, social class and BMI are highly correlated [6].
2. The World Health Organization (WHO) predicts that obesity will replace undernutrition and infectious diseases as the most significant cause of ill health [6].
3. Nearly 900 million people around the world are undernourished, while 1.9 billion are overweight [7].
4. In 2003, obesity was the second only to smoking as the leading cause of preventable death [8].
5. The annual nationwide obesity-related absenteeism cost ranges between \$3.38 billion (\$79 per obese individual) and \$6.38 billion (\$132 per obese individual) in the United States [9].
6. A study examining Duke University employees found that people with BMIs over $40 \text{ kg}/\text{m}^2$ filed twice as many workers' compensation claims as those employees with healthy BMIs. The BMI-over- $40 \text{ kg}/\text{m}^2$ group also had more than twelve times as many days absent [10].
7. In 2014, the European Court of Justice ruled that morbid obesity is a disability [11].
8. A 2006 review identified ten putative contributors to the recent increase in obesity:
 - Insufficient sleep
 - Endocrine disruptors (environmental pollutants that interfere with lipid metabolism)
 - Decreased variability in ambient temperature

- Decreased rates of smoking (as smoking suppresses appetite)
 - Increased use of medications that can cause weight gain (e.g., atypical antipsychotic drugs prescribed for mental disorders)
 - Proportional increases in ethnic and age groups that tend to be heavier
 - Pregnancy at a later age (which might cause susceptibility to obesity in the offspring)
 - Epigenetic risk factors passed on generationally
 - Natural selection for higher body mass index (BMI)
 - Assortative mating leading to increased concentration of obesity risk factors (which would increase the number of obese people by increasing population variance in weight) [12].
9. Obesity is not regarded as a psychiatric disorder and, therefore, is not listed in the DSM-IV-TR (Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition-Text Revision) as a psychiatric illness, although the risk of overweight and obesity is higher in patients with psychiatric disorders (and vice versa) than in persons without psychiatric disorders [13].
 10. Different people exposed to the same environment have different risks of obesity due to their underlying genetics [14].
 11. BMI changes over time have been found among friends, siblings, and spouses [6].
 12. Stress appears to increase the risk of obesity within all social classes [15].
 13. Psychosocial factors, such as low self-esteem and depression, can provoke an eating disorder precipitating increased caloric intake and weight gain [16].
 14. There is a documented association between specific viruses and obesity in humans [17].
 15. Flora in the gut has been shown to differ between lean and obese individuals, suggesting that variant gut flora may contribute to or cause obesity [18].
 16. A deficiency in leptin signaling—via leptin deficiency or leptin resistance—leads to overfeeding and might be the cause of specific genetic and acquired forms of obesity [18].
 17. An excess of body weight (adiposity) is associated with diabetes mellitus, heart disease, fatty liver disease, obstructive sleep apnea, asthma, osteoarthritis, and some forms of cancer [6].
 18. Obesity is a reversible risk for cardiovascular disease [19].
 19. Individuals with a BMI equal to or greater than 25 are deemed overweight; those with a BMI of 30 or more are considered obese [20,21].
 20. Diet, exercise, and specific pharmacologic agents can reduce specific risk factors for cardiovascular disease [22,23].
 21. Weight loss can significantly improve metabolic syndrome [24].

22. Specific dietary changes can improve metabolic syndrome, such as reducing the dietary intake of saturated fat (to lower triglyceride levels), sodium (to lower blood pressure), and high-glycemic-index carbohydrate (to prevent or lessen insulin resistance) [22,25].
23. A 5% weight loss can improve a patient's health and diminish specific obesity-related symptoms and comorbidities [23].
24. Most patients find weight loss laborious (modifying diet and performing exercise are challenging to many individuals) [25].
25. Pharmacotherapy and bariatric surgery are necessary for patients who do not achieve weight-loss goals through lifestyle interventions [24].
26. The U.S. Food and Drug Administration (FDA) has approved four medications for weight loss: Lorcaserin, Phentermine/Topiramate, Naltrexone/Bupropion, and Liraglutide; also, Orlistat was approved in 1999. These medications promote weight loss by decreasing the absorption of fat through the intestines [21,23]. Orlistat in labeled Xenical (120 mg); the over-the-counter version is labeled Alli (60 mg).
27. The prescription use of these medications does not cause permanent biological changes or have long-lasting effects once the medicines are stopped [26].
28. Bariatric surgery, for an appropriate surgical candidate, can result in stable weight loss and the reduction of obesity-related comorbidities [24].
29. For a patient's health and well being, a commitment to a positive lifestyle is vital.
30. Obesity is a complex and chronic disease; treatment options should be customized and targeted to the individual patient [27].
31. Currently, an evidence-based obesity algorithm for weight loss is recommended (see Supplementary Information) [26,28].
32. Healthcare providers should prescribe patient-specific and evidence-based strategies, with patient safety at the forefront (see Supplementary Information) [16,22,24].
33. The global incidence of overweight and obese individuals has grown exponentially, from an epidemic to a pandemic [29].
34. Adult obesity is now considered a chronic disease [30].
35. Worldwide, obesity has more than doubled since 1980 [31,32].
36. Class 2 and 3 obesity are associated with significantly higher all-cause mortality rates [33].
37. In 2001, obesity was designated as a health epidemic. The U.S. Surgeon General's "Call to Action" policy was developed to prevent and reduce overweight and obesity [34].
38. In 2008, the medical costs attributable to obesity in the U.S. were an estimated \$147 billion [35].
39. Since 2010, obesity has been recognized as a chronic disease [36].

40. In 2013, the American Medical Association (AMA) classified obesity as a disease [37].
41. The fundamental cause of overweight and obesity is an energy imbalance between calories consumed and calories expended [38].
42. Although the fundamental cause of overweight and obesity is an energy imbalance (calories consumed versus calories expended), numerous diverse and interconnected factors contribute to obesity, such as diet, lifestyle (sedentary), social determinants, infective agents, underlying illnesses, pharmaceutical side effects, genetics, and epigenomics [39].
43. Specific medications can promote obesity, such as some drugs which are prescribed for certain psychological conditions, diabetes mellitus, pain, blood pressure, convulsions, birth control, and neurological disorders [40-43].
44. There are numerous pathophysiological mechanisms in the development and persistence of obesity [44,45].
45. Since 2000, the prevalence of obesity among children and adolescents has increased nearly three-fold [46,47].
46. Childhood obesity is associated with a higher risk of adult obesity, which can lead to disability and premature death [46-48].
47. Diabetes mellitus and cardiovascular disease are the leading comorbidities associated with excess weight [49-51].
48. Obesity leads to a cluster of disorders, which comprise metabolic syndrome; thus, obesity is considered a predictor for DM and CVD [52-54].
49. The WHO defines overweight and obesity as an accumulation of fat in excess, that presents a health risk [55].
50. The primary measurement for evaluating the general population is the body mass index (BMI) [3,4].
51. BMI is a person's weight (in kilograms) divided by the individual's height (in meters) squared: weight (kg)/height (m²) [3,4].
52. Patients should be educated early about the connection between their lifestyle and health risks [55].
53. An increase in physical activity and a decrease in caloric intake (by reducing portion sizes) has been found to improve metabolic syndrome, even in the absence of weight loss [56-58].
54. Lifestyle interventions comprising diet modification, physical activity, and behavior therapy are vital in the management and reduction of obesity [59,60].
55. Caloric restriction is the most critical component in achieving weight loss through negative energy balance, whereas, sustained physical activity is essential in maintaining weight loss [59-61].
56. Permanent weight loss can be achieved through behavioral reduction in food intake and increase in energy expenditure [59-62].
57. Primary care providers (PCPs) should stay current on obesity management through conferences, seminars, and continuing education [63-65].
58. Physician reimbursement is one key to successful weight management programs in a primary care setting [66-70].

59. Government support and insurance reimbursement could significantly contribute to reducing comorbidities of obesity as well as providing for novel medications and public awareness programs [71].
60. “Obesity acceptance” as promulgated by “political correctness” should be balanced by encouraging genuine acceptance and self-esteem and developing a positive body image through achieving and maintaining a healthy weight [72].
61. Primary care practitioners, public policymakers, and social movements are key factors in promoting positive lifestyles and healthful habits to reverse the global obesity crisis [73].

Conclusion

In the United Kingdom, cardiovascular disease is responsible for nearly one-third of all deaths. Reducing risk factors, such as overweight, obesity, and metabolic syndrome, can impact the incidence of cardiovascular disease positively, and lessen the suffering and associated costs to affected individuals, the insurance industry, and governments [74]. Overweight, obesity, and metabolic disorders are significant risk factors for developing cardiovascular disease. Obesity is a global pandemic. Thus, healthcare practitioners, government officials and policymakers, and the general public can benefit from knowing the fundamental factors of overweight, obesity, and metabolic syndrome associated with cardiovascular disease as presented herein.

Conflict of Interest Statement

The authors declare that this paper was written in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Supplementary Information

The American College of Cardiology/American College of Endocrinology (AACE/ACE) Consensus Conference on Obesity (CCO) has prepared a definitive obesity algorithm for primary care providers formulated on evidence-based medical practice (<https://www.aace.com/files/obesity/final-appendix.pdf>).

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