Snežana B. Knežević[1,2], Marijana C. Jandrić-Kočić[3,4]

OBESITY – THE MODERN AGE PANDEMIC OF SPECIAL SIGNIFICANCE

Abstract: The prevalence of obesity is growing rapidly in all regions of the world. This is of great importance for public health because morbidity associated with obesity and its complications reduces life expectancy and imposes unsustainable economic burdens on both society and health services. Reduced physical activity and unhealthy eating habits have led to an increase in obesity among young people in many countries which poses a significant health risk. Obesity significantly increases the risk of developing non-communicable diseases. Type 2 diabetes is increasingly being diagnosed in obese children and adolescents, and being overweight in childhood is associated with poor cardiovascular outcomes and increased adult mortality. Monitoring changes in the prevalence of obesity and its future impact on chronic diseases and life expectancy is essential to understanding the challenges and potential benefits of interventions.

Keywords: Obesity, epidemic, prevention, chronic non-communicable diseases

Introduction

The prevalence of obesity and overweight is rapidly increasing in all regions of the world. This is of great importance to public health because projections suggest that as obesity rates significantly rise, the morbidity associated with obesity and its complications will threaten the increase in life expectancy and impose unsustainable economic burdens on both society and healthcare services. Therefore, there is an urgent need for intervention to halt the growing epidemic (1). Obesity was initially defined by an analysis relating to mortality rather than morbidity, conducted by the US Metropolitan Life Insurance Company before

[1] Snežana B. Knežević, Health centre Kraljevo, Srbija, e-mail: lesta59@yahoo.com

[2] University of Kragujevac, Faculty of Medical Sciences, Kragujevac, Serbia

[3] Health center Krupa na Uni, Republic Srpska, Bosnia and Hercegovina

[4] University of Banja Luka, Faculty of Medicine, Banja Luka, Republic Srpska, Bosnia and Hercegovina

World War II. The value of body mass index (BMI) (kg/m2), adjusted for the person's clothing and footwear, set at approximately 25, defined the threshold above which mortality rates increased (2). A BMI value of 30 was 20% above this upper normal BMI limit. In 1995, the World Health Organization (WHO) accepted BMI as a method for assessing the degree of malnutrition and overweight, adopting a lower BMI limit of 18.5 to differentiate between normal and underweight (3). This BMI value became the threshold indicating malnutrition (4). Following a series of expert consultations on obesity, in 1997, overweight and obesity were recognized as global problems (5).

The Impact of Obesity on Health

Identifying the effects of being overweight on increased mortality requires many years of follow-up with a significant number of subjects and caution to eliminate other biases (6). Large studies with long-term follow-up periods show that mortality rates from all causes, including ischemic heart disease, are increased in the group of individuals with overweight (7), and integrated analyses of 33 cohort studies have shown that the risk of non-fatal and fatal cardiovascular diseases progressively increases with higher BMI, while the impact on hemorrhagic stroke is not evident until BMI exceeds 30 (8). Collaborative analyses of 57 prospective studies involving approximately 900,000 adults revealed that mortality was lowest at around 22.5-25 kg/m2 for both sexes (9) and that every 5 kg/m2 increase in BMI was associated with about a 30% higher overall mortality.

Comorbidities such as hypertension and diabetes in combination with higher body weight indicate the degree of cellular and organ damage and are far stronger predictors of premature death than BMI alone (10). Disability resulting from weight gain represents a significant social burden and affects younger individuals, disabling them physically, mentally, psychologically, socially, and economically. Type 2 diabetes is increasingly diagnosed in obese children and adolescents (11), and childhood overweight is associated with poor cardiovascular outcomes and increased adult mortality (12). Comorbidities that are intrinsically linked to higher BMI, such as diabetes, hypertension, gallstones, and coronary heart disease, are linearly associated with increasing BMI values (1).

There is a strong genetic influence on fat distribution, but smoking and alcohol consumption also increases the predisposition to abdominal obesity. Early nutritional and other disadvantages, partly manifested by low birth weight, are also associated with later abdominal obesity. The Indian, Chinese, and Latino populations with a history of early childhood malnutrition are particularly prone to abdominal obesity, with high waist circumference values even when BMI is below 25 (1). The WHO has developed statistical criteria for determining underweight and overweight children (3).

A child who has lower body weight for their age, height, or weight-for-height is classified as abnormal if it deviates more than -2 standard deviations for their age and sex. Thus, more than 2 standard deviations for weight-for-height is considered an indicator of overweight, based on reference data from complex, precise research data in the US but predominantly based on well-nourished infants considered to be healthy. Although obesity, measured by BMI, is an index of excess body fat, there are several ways to measure excess body fat, such as bioimpedance, densitometry, and plethysmography, but the latter two are costly and are not used for population studies. Evidence from various countries shows that weight tends to increase progressively as individuals age until it reaches its peak and then begins to decline, usually after the sixth decade of life. Most BMI data are based on height and weight self-reported by individuals, which underestimates the prevalence and complicates comparison with measured data in studies. Overweight and obesity have now become a global problem, and the threat of excess weight is starting to match the burden of cardiovascular diseases, where developing countries now bear about 80% of the global burden of non-communicable diseases (1).

The WHO report recommends global monitoring of the prevalence of overweight and obesity in adolescents (defined according to WHO growth criteria) and BMI measurements in adults (13). The economic development of a country, particularly population urbanization, is associated with a significant increase in the prevalence of obesity (14). In poorer communities, middle-aged women are the first to gain excess weight, and as the economy develops, women progressively become heavier than men. In developing societies, wealthier individuals have a higher prevalence of obesity, with the average body mass index of the population progressively increasing as national income reaches a gross domestic product of around $5000, peaking in women at $15,000 and in men at $17,000 (15).

Obesity significantly increases the risk of developing non-communicable diseases (16). There is evidence that obesity, particularly in the middle and later years of life, is a major risk factor for cognitive decline, both directly and indirectly, as obesity-related hypertension and type 2 diabetes increase the rate of vascular changes in the brain (17). The impact on respiratory function is important as both children and adults are unable to engage in vigorous physical activity. Obese adults who walk slowly already utilize up to 60% of their maximum exercise capacity. Therefore, obese adults often work less than normal because their physical exertion consumes a significant amount of energy. Weight gain is also a significant handicap for individuals with any degree of respiratory impairment. Patients with asthma and chronic obstructive pulmonary disease can significantly improve their exercise tolerance and comfort by losing weight. Weight gain also increases the risk of sleep apnea, which is associated with neck circumference and breathing disruption tendencies. Apnea typically occurs at night and may seem harmless, but it represents a significant medical handicap associated with drug-resistant hypertension due to the persistent activation of the sympathetic

nervous system from repeated episodes of oxygen deprivation. When severe, it is also associated with higher mortality rates and can lead to traffic accidents when obese individuals drive their cars (1).

Back and joint pain is another major problem that leads to increased work absenteeism among obese patients. The mechanical force exerted on the joints and the burden on the musculoskeletal system results in frequent work absences and reactive depression in many obese individuals (1).

Childhood Obesity

The International Obesity Task Force has developed an international classification system for overweight and obesity in children (18) based on body mass index (BMI) values (19). They defined the relationship between childhood and adulthood by using the BMI percentiles corresponding to 25 and 30 at the age of 18 and applying these percentiles across all age ranges in childhood to determine overweight and obesity separately for girls and boys. The WHO has developed a new approach for defining normal growth in children (20) using data from a large multinational study that includes children from California, Norway, India, Oman, Ghana, and Brazil. The WHO then developed a reference data set for the growth of children aged 5 to 20 years, still based on US data (21), which pediatricians consider unrealistic and confusing in everyday practice (22). Children classified as overweight according to the WHO classification show a higher tendency towards hypertension, higher levels of insulin and uric acid, and other indices of insulin resistance (23).

Children are not born obese, but they certainly become obese. Most studies show that body weight increases with age (24). Weight gain is also greater if there is already a problem with being overweight, and the likelihood of obesity is higher in girls than in boys. In children over 5 years old, having excess weight carries a risk of at least 40% that this excess weight/obesity will persist into adulthood, and by mid-adolescence, the risk increases to 60-75%. Barlow and Dietz (1998) focused their research on children over 3 years old, but there is now a very concerning increase in the prevalence of high birth weight and obesity in children aged 1 to 5 years (25). Most children aged 1 to 5 years with a BMI greater than 2 standard deviations are found in low-income countries with a significant increase in prevalence since 1990 (26). Weight gain in children causes many problems in early childhood, including, in severe cases of overweight, developmental abnormalities in weight-bearing joints and limbs. Metabolic problems such as insulin resistance, higher blood pressure, and dyslipidemia are also evident in overweight and obese children, even when they are young, and have higher BMI even within the normal range. Having a BMI of less than 2 standard deviations in children aged 7 to 13 years predicts early death and cardiovascular complications (27).

Genes influence human physiology and adaptation, but the rapid rise in obesity must be attributed to environmental factors rather than genetic influences, as the genetic pool remains relatively constant. Genetic factors are important in their influence on the predisposition to weight gain through gene-environment interactions. Studies on genes causing susceptibility to type 2 diabetes have identified a common variant of a gene associated with fat accumulation and obesity, as well as the MC4R gene that predisposes to diabetes through its influence on BMI. This becomes apparent from the age of 7 and reflects a specific increase in fat mass, possibly manifested through increased appetite (1).

Approximately 10% of boys and 9% of girls aged 5 to 17 worldwide are overweight or obese, totaling 118 million individuals. Among young children, evidence of decreasing trends is emerging (1). Analyses in nine countries, including England, the United States, Sweden, China, Australia, the Netherlands, and Switzerland, have also reported a decline in obesity among children and adolescents aged 2 to 19 years (28). These promising trends may not be sustained, and annual monitoring of health survey data is imperative to assess progress.

Although childhood obesity prevention is politically appealing, it is unlikely to bring about rapid changes in population health and will not significantly impact the healthcare costs of obesity-related epidemics such as diabetes and hypertension, thus having a negligible impact on disease burden over the next 40 years. However, interventions from the age of 18 onwards yield greater benefits, making a focus on adults particularly beneficial for several reasons: the incidence of obesity is highest in early adulthood with further progressive increase and is accompanied by an increased absolute risk of disease. Parents as adults can also serve as role models for their children (29).

Physical Inactivity

There is evidence that the processes of industrialization can contribute to the observed disparities in physical activity (30). Prolonged sitting time, with fewer contractions of skeletal muscles, can lead to reduced activity of lipoprotein lipase and triglyceride clearance, decreased oral glucose tolerance clearance, and lower insulin secretion stimulated by glucose (31). Moreover, time spent in a sedentary position is associated with increased cardiovascular and all-cause mortality (time spent watching television, total daily sitting time, and time spent sitting in cars) (32).

Reduced physical activity and unhealthy dietary habits have led to an increase in obesity among young people in many countries, which, if continued into adulthood (as is often the case), poses a significant health risk (33). The apparent thermodynamic principles of energy balance require changes in diet and reduced physical activity. Cheaper personal transportation options and mechanical and electrical aids to elim-

inate physical demands at home and work have resulted in a significant reduction in physical exertion. The advent of computers and television means that in many affluent societies, one can earn a good wage and enjoy leisure time without any physical effort. Children's habits are also being transformed by a significant secular increase in time spent watching television or playing video games (1).

Prevention of Obesity

Changes in population BMI at different ages emphasize the importance of addressing not only obesity but also overweight. Strategies can initially be considered based on correcting the major social forces currently promoting the epidemic, namely physical inactivity and energy intake. There are powerful environmental forces promoting weight gain that individuals do not control. Therefore, obesity is described as a passive normal response of people to the prevailing inappropriate environment.

Personal responsibility plays a crucial role in weight gain, but human biology is inundated with the effects of today's "obesogenic" environment, with abundant energy-dense food, motorized transportation, and sedentary lifestyles. Thus, the population becomes heavier simply by living in its environment. This means that those who successfully remain lean throughout their lives are either genetically fortunate or have advantages in education, social status, or financial means to withstand the influence of the environment and often create a healthy microenvironment for themselves.

The advent of automobiles, mechanical aids, computerization of various processes, and the emergence of internet communication has significantly contributed to a reduction in average physical activity levels by 750-1000 kcal/day over the decades. However, reversing these new habits as a coherent public health strategy is not the optimal choice. The challenge lies in combining current knowledge effectively, considering:

1. Most effective initiatives are based on coherent prevention research.
2. Most cost-effective initiatives.
3. Feasible initiatives based on the country's social organization characteristics, cultural perceptions, and political system.
4. Whether there are other political initiatives in areas impacting food and physical activity that need to be integrated or resolved if they contradict each other.

Currently adopted strategies largely depend on the political nature of the country, ranging from a utilitarian regulatory approach to a more common

non-interventionist approach emphasizing personal responsibility (1). The WHO has set a goal of reducing premature deaths from non-communicable diseases by 25% by 2025 and slowing down the further increase in adult and adolescent obesity (13).

The current focus on overweight/obesity in childhood is justified, despite limited early economic contributions, for several reasons:

- Neither the public nor the majority of policymakers blames individual children for their weight problems, and only a few try to attribute blame to their parents. This focus on childhood has a politically useful place in convincing the public and politicians to recognize the importance of environmental factors rather than individual factors and to do something other than advocating for treating an already established problem.
- It is recognized that excessive weight gain in older children leads to a far greater disease burden throughout their lives and a much higher likelihood of premature death.
- Focusing on children is also consistent with the routine practice that education is the key to the obesity problem, and there is merit in educating the child so they do not behave like their parents.
- If policymakers want to focus on a specific social group, then school-age children are a useful choice because they can be reached through school-based initiatives in most societies (1).

Conclusion

Monitoring changes in the prevalence of obesity and its future impact on chronic diseases and life expectancy is crucial for understanding the challenges and potential benefits of interventions. This is particularly relevant for children, in whom the health effects of obesity and overweight generally do not manifest until they reach adulthood. Obesity prevention requires rigorous integrated government policies that are greatly influenced by major global industries that are currently resistant to changing their practices.

References

1. Oxford Textbook of Global Public Health [Internet]. Oxford Textbook of Global Public Health. Oxford University Press; [cited 2022 Feb 19]. Available from: https://oxfordmedicine.com/view/10.1093/med/9780199661756.001.0001/med-9780199661756
2. James WPT. Research on obesity*. Nutr Bull. 1977;4(3):187–90.

3. WHO Expert Committee on Physical Status : the Use and Interpretation of Anthropometry (1993 : Geneva S, Organization WH. Physical status : the use of and interpretation of anthropometry , report of a WHO expert committee [Internet]. World Health Organization; 1995 [cited 2022 Mar 8]. Available from: https://apps.who.int/iris/handle/10665/37003
4. James WP, Ferro-Luzzi A, Waterlow JC. Definition of chronic energy deficiency in adults. Report of a working party of the International Dietary Energy Consultative Group. Eur J Clin Nutr. 1988 Dec;42(12):969–81.
5. WHO Consultation on Obesity (1999: Geneva S, Organization WH. Obesity : preventing and managing the global epidemic : report of a WHO consultation [Internet]. World Health Organization; 2000 [cited 2022 Mar 8]. Available from: https://apps.who.int/iris/handle/10665/42330
6. Greenberg JA. Correcting biases in estimates of mortality attributable to obesity. Obes Silver Spring Md. 2006 Nov;14(11):2071–9.
7. Batty GD, Shipley MJ, Jarrett RJ, Breeze E, Marmot MG, Davey Smith G. Obesity and overweight in relation to disease-specific mortality in men with and without existing coronary heart disease in London: the original Whitehall study. Heart Br Card Soc. 2006 Jul;92(7):886–92.
8. Asia Pacific Cohort Studies Collaboration. Body mass index and cardiovascular disease in the Asia-Pacific Region: an overview of 33 cohorts involving 310 000 participants. Int J Epidemiol. 2004 Aug 1;33(4):751–8.
9. Adams KF, Schatzkin A, Harris TB, Kipnis V, Mouw T, Ballard-Barbash R, et al. Overweight, obesity, and mortality in a large prospective cohort of persons 50 to 71 years old. N Engl J Med. 2006 Aug 24;355(8):763–78.
10. Padwal RS, Pajewski NM, Allison DB, Sharma AM. Using the Edmonton obesity staging system to predict mortality in a population-representative cohort of people with overweight and obesity. CMAJ Can Med Assoc J J Assoc Medicale Can. 2011 Oct 4;183(14):E1059-1066.
11. Park MH, Falconer C, Viner RM, Kinra S. The impact of childhood obesity on morbidity and mortality in adulthood: a systematic review. Obes Rev Off J Int Assoc Study Obes. 2012 Nov;13(11):985–1000.
12. Reilly JJ, Kelly J. Long-term impact of overweight and obesity in childhood and adolescence on morbidity and premature mortality in adulthood: systematic review. Int J Obes 2005. 2011 Jul;35(7):891–8.
13. World Health Assembly 66. Draft comprehensive global monitoring framework and targets for the prevention and control of noncommunicable diseases: formal meeting of the Member States to conclude the work on the comprehensive global monitoring framework, including indicators, and a set of voluntary global targets for the prevention and control of noncommunicable diseases: report by the Director-General [Internet]. World Health Organization; 2013 [cited 2022 Mar 8]. Report No.: A66/8. Available from: https://apps.who.int/iris/handle/10665/105633
14. Global nutrition dynamics: the world is shifting rapidly toward a diet linked with noncommunicable diseases - PubMed [Internet]. [cited 2022 Mar 8]. Available from: https://pubmed.ncbi.nlm.nih.gov/16895874/

15. Ezzati M, Vander Hoorn S, Lawes CMM, Leach R, James WPT, Lopez AD, et al. Rethinking the "diseases of affluence" paradigm: global patterns of nutritional risks in relation to economic development. PLoS Med. 2005 May;2(5):e133.
16. Lim SS, Vos T, Flaxman AD, Danaei G, Shibuya K, Adair-Rohani H, et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet Lond Engl. 2012 Dec 15;380(9859):2224–60.
17. Meta-analysis of Alzheimer's disease risk with obesity, diabetes, and related disorders - PubMed [Internet]. [cited 2022 Mar 8]. Available from: https://pubmed.ncbi.nlm.nih.gov/19358976/
18. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. BMJ. 2000 May 6;320(7244):1240–3.
19. Spruijt-Metz D. Etiology, Treatment and Prevention of Obesity in Childhood and Adolescence: A Decade in Review. J Res Adolesc Off J Soc Res Adolesc. 2011 Mar;21(1):129–52.
20. The WHO Child Growth Standards [Internet]. [cited 2022 Mar 8]. Available from: https://www.who.int/tools/child-growth-standards
21. de Onis M, Onyango A, Borghi E, Siyam A, Blössner M, Lutter C, et al. Worldwide implementation of the WHO Child Growth Standards. Public Health Nutr. 2012 Sep;15(9):1603–10.
22. Cole TJ, Lobstein T. Extended international (IOTF) body mass index cut-offs for thinness, overweight and obesity. Pediatr Obes. 2012 Aug;7(4):284–94.
23. de Onis M, Martínez-Costa C, Núñez F, Nguefack-Tsague G, Montal A, Brines J. Association between WHO cut-offs for childhood overweight and obesity and cardiometabolic risk. Public Health Nutr. 2013 Apr;16(4):625–30.
24. Singh AS, Mulder C, Twisk JWR, van Mechelen W, Chinapaw MJM. Tracking of childhood overweight into adulthood: a systematic review of the literature. Obes Rev Off J Int Assoc Study Obes. 2008 Sep;9(5):474–88.
25. Barlow SE, Dietz WH. Obesity evaluation and treatment: Expert Committee recommendations. The Maternal and Child Health Bureau, Health Resources and Services Administration and the Department of Health and Human Services. Pediatrics. 1998 Sep;102(3):E29.
26. de Onis M, Blössner M, Borghi E. Global prevalence and trends of overweight and obesity among preschool children. Am J Clin Nutr. 2010 Nov;92(5):1257–64.
27. Gunnell DJ, Frankel SJ, Nanchahal K, Peters TJ, Davey Smith G. Childhood obesity and adult cardiovascular mortality: a 57-y follow-up study based on the Boyd Orr cohort. Am J Clin Nutr. 1998 Jun;67(6):1111–8.
28. Rokholm B, Baker JL, Sørensen TIA. The levelling off of the obesity epidemic since the year 1999--a review of evidence and perspectives. Obes Rev Off J Int Assoc Study Obes. 2010 Dec;11(12):835–46.
29. Seidell JC, Nooyens AJ, Visscher TLS. Cost-effective measures to prevent obesity: epidemiological basis and appropriate target groups. Proc Nutr Soc. 2005 Feb;64(1):1–5.

30. Rind E, Jones AP. The geography of recreational physical activity in England. Health Place. 2011 Jan;17(1):157–65.
31. Bey L, Hamilton MT. Suppression of skeletal muscle lipoprotein lipase activity during physical inactivity: a molecular reason to maintain daily low-intensity activity. J Physiol. 2003 Sep 1;551(Pt 2):673–82.
32. Warren TY, Barry V, Hooker SP, Sui X, Church TS, Blair SN. Sedentary behaviors increase risk of cardiovascular disease mortality in men. Med Sci Sports Exerc. 2010 May;42(5):879–85.
33. World Health Organization, editor. Health21: the health for all policy framework for the WHO European Region. Copenhagen: World Health Organization, Regional Office for Europe; 1999. 224 p. (European health for all series).