

*Invited Editorial*

**Overweight and Obesity in Childhood and Adolescence in Bangladesh and Its Consequences and Challenges.**

*Tahmina Joy Rashid<sup>1</sup>, Mainul Haque<sup>2</sup>*

**Keywords:** Overweight/Obesity, Health, and Economic Impacts, Challenges

*Bangladesh Journal of Medical Science Vol. 21 No. 04 October'22 Page : 667-675  
DOI: <https://doi.org/10.3329/bjms.v21i4.60245>*

Overweight and obesity are preventable public health issues with incidences and prevalence that have increased in the past decades, resulting in an obesity epidemic, overwhelming the burden of non-communicable diseases (NCDs) in most countries across the globe. There is alarmingly upsurge of overweight and obesity in the low-income and the middle-income countries (LMICs). Bangladesh reached the lower-middle-income status in 2015<sup>1</sup>. Bangladesh is home to a population of 164 million people<sup>2</sup>, with children comprising 40%<sup>3</sup> and adolescents comprising 21% of the total population<sup>4</sup>. The poverty rate has declined from 43.5% in 1991 to 14.3% in 2016, and additionally, the World Bank is expected to reduce it further to 11.9% by the end of the 2021-22 fiscal year<sup>1,5</sup>.

It has been documented that 39 million children under the age of 5 were globally overweight or obese in 2020. Over 340 million children and adolescents

aged 5-19 were overweight or obese in 2016<sup>6</sup>. Furthermore, it has been reported that over 1.9 billion adults are overweight, and 650 million are obese. Around 2.8 million people demises are delineated due to excessive amount of body fat. Overweight and obesity have become a significant public health delinquent in both high-income countries (HICs) and LMICs<sup>7</sup>. Overweight and obesity are demarcated by WHO as atypical or unnecessary fat buildup that only offers health hazards. A body mass index (BMI) above 25 is overweight, and above 30 is obese<sup>8</sup>. It has been reported that the rising incidence of Type 1 and 2 diabetes mellitus is associated with obesity, oversight, and high BMI<sup>9-11</sup>. The diabetic population in 2019 was 463 million around the globe and is anticipated to escalate to 578 and 700 million by 2030 and 2045, respectively<sup>12</sup>. It has been expected that 22.3 million Bangladeshi people will be living with diabetes by 2045 unless proper preventive

1. <sup>a</sup> Independent Medical Educationist, Researcher, and Consultant, Public Health and Medical Education Issues, Dhaka-1205, Bangladesh. <sup>b</sup> Professor and Former-Chairman, Department of Pharmacology and Therapeutics, Bangladesh Medical College and Hospital, Dhaka-1209, Bangladesh. **Orcid ID:** <https://orcid.org/0000-0002-3255-8880>.
2. Professor of the Unit of Pharmacology, Faculty of Medicine and Defence Health, Universiti Pertahanan Nasional Malaysia (National Defence University of Malaysia), Kem Perdana Sungai Besi, 57000 Kuala Lumpur, Malaysia. **Orcid ID:** <https://orcid.org/0000-0002-6124-7993>.

**Correspondence:** Cell Phone: + 60 10 926 5543. Email: [runurono@gmail.com](mailto:runurono@gmail.com). [mainul@upnm.edu.com](mailto:mainul@upnm.edu.com)

strategies has implemented stringently, resulting in the country will have the 7<sup>th</sup> highest diabetes prevalence rate worldwide<sup>13, 14</sup>. Ominously, because of the increasing prevalence of childhood obesity, a growing percentage of new cases of diabetes occur among the younger population<sup>15, 16</sup>. Childhood, adolescence, and adult obesity are equally prevalent in many European countries and around the globe<sup>17-20</sup>. Studies from India and Africa also indicate a similar trend<sup>21, 22</sup>. Analysis of 450 cross-sectional surveys from 144 countries with an estimate from 1990-2010 and a projection from 2015-2020 gave an alarming picture of preschool childhood overweight/obesity in Asia compared to other continents, with the highest occurrences in South Asia countries, including Bangladesh<sup>23</sup>. Recent studies regarding childhood obesity reported a frightening representation<sup>24, 25</sup>. There is a dearth of comprehensive literature published on childhood and adolescence overweight/obesity in Bangladesh. However, limited studies have been published. A review in 2014 on a total of 21 published studies in Bangladesh documented the prevalence of childhood and adolescence overweight ranged from less than 1-23% or more, and that of obesity ranged from less than 1-17.9% based on different reference standards, with higher percentage amongst urban children across different age groups and sexes. Still, the valid comparison was not feasible<sup>26</sup>. A study on urban children reported a 5-fold increase in these health problems in the past decades<sup>27</sup>. In addition, other studies documented 17.8% and 7.6% obesity in children of different age categories<sup>28,29</sup>, and one more study reported similar high cases<sup>30</sup>. A descriptive cross-sectional survey on 150 primary school children of Dhaka city, Bangladesh, found a prevalence of overweight and obesity respectively, 28% and 16% among the total 75 students in public schools and 36% and 25.3% respectively among the total 75 students in private schools. This study also determined preference for fast food, lack of exercise, and sufficient consumption of fruits and vegetables as contributory factors<sup>31</sup>.

It is reiterated that body mass index (BMI)(kg/m<sup>2</sup>) provides the most useful population-based measure of overweight and obesity<sup>32,33</sup>. For children under 5 years of age: overweight is weight-for-height >2 SD above, and obesity is weight-for-height > 3 SD above the WHO Child Growth Standards median. For children aged between 5-19 years(adolescents): overweight is the BMI for age> 1 SD above, and obesity is the BMI for age >2 SD above the WHO Growth Reference median<sup>34</sup>. Abdominal waist circumference is also an important marker of obesity<sup>35</sup>.

Obesity is etiologically related to varied biological, developmental, behavioral, genetic, and environmental factors<sup>36-38</sup>. Additionally, research demonstrates that the failure of proper communications between health-service providers and patients may reinforce stigma and low self-esteem, reduce motivation for weight loss, and potentially cause avoidance of routine preventive care<sup>39-41</sup>. The role of epigenetics, gut microbiome, intrauterine, and intergenerational effects have emerged as contributing factors to the problem<sup>42-45</sup>. Other factors, including small for gestational age (SGA) status at birth, formula rather than breastfeeding in infancy, and early introduction of protein in an infant's dietary intake, have been reportedly associated with weight gain that can persist later in adulthood<sup>36</sup>. Family history of obesity in parents and grandparents, dyslipidemia, and coronary heart diseases (CH) are determinants of early-onset and severe obesity problems and markers of risk for precocious obesity<sup>46</sup>. Children and adolescents in low- and middle-income countries (LMICs) are more vulnerable to the illness, being exposed to high-fat, high-sugar, high-salt, energy-dense, and poor-micronutrient foods, which tend to be lower in cost but also lower in nutrient quality<sup>47, 48</sup>. There is substantial evidence to associate soft drink consumption with weight gain. Soft drink intake is also related to an increased risk of diabetes mellitus, cardiovascular disease, and gout<sup>37,49, 50</sup>. The obesity-related childhood behavior is not only shaped by parental behavior but also by 5 critical

obesogenic environments: schools, television, the internet, retailers, and food advertising campaigns. The term “obesogenic environments” has been defined by Swinburn and colleagues as “the sum of the influences that the surroundings, opportunities or conditions of life have on promoting obesity”<sup>37,51-53</sup>.

Childhood obesity is a marker of adulthood obesity, premature death, and disability. There is an increased probability of cardiovascular diseases, breathing difficulties, fractures, insulin resistance, impaired glucose tolerance, and psychological effects (low self-esteem, low confidence, impairment in cognitive functioning (memory, attention, visuospatial ability, response inhibition), movements/functions. Clinical obesity in adolescents is linked to menstrual irregularities, sleep disorders, and metabolic syndrome<sup>21,54-59</sup>. It is further underpinned by serious terminal diseases such as cancers and type 2 diabetes mellitus, as reviewed in more than 1000 studies that reported the increased risk for at least 13 types of cancer<sup>60-62</sup>. These health disorders act as double edge sword, and increases financial overhead in both direct and indirect way on affected families. The direct cost is linked to healthcare expenditure from obesity and attributable diseases requiring attention and treatment (curative, rehabilitative, preventative care, ancillary services, and medical goods)<sup>63</sup>. The Direct Medical Cost = OAF × THE (OAF is obesity attributable fraction and THE is total therapeutic expenditure). There is a significant positive association between OAF and obesity prevalence<sup>63</sup>. Indirect costs represent the economic loss due to premature mortality and morbidity. They include the following components: financial loss from premature mortality, missed days of work (absenteeism), and reduced productivity while at work (presenteeism)<sup>63-65</sup>. Economic loss from premature mortality is calculated as the number of years of potential life lost by individuals (by age group and sex cohort) who died from obesity multiplied by the economic value of a life year<sup>63</sup>.

The national US rate of obesity among children

between 2 to 19 years climbed from 19.3% in 2019 to 22.4% in 2020, with the annual direct cost of obesity management estimated at \$14 billion during the pandemic<sup>66</sup>. The majority of industrialized, high-income-countries (HICs), predominantly west European countries, Canada, Australia, New Zealand, and Japan, have strategies to make available healthcare for the entire population regardless of socio-economic status (SES), employment status, or ability to pay principally based on government-financed<sup>67</sup>. The World Health Organization (WHO) defines universal healthcare as “ensuring that all people have access to needed health services (including prevention, promotion, treatment, rehabilitation, and palliation) of sufficient quality to be effective while also ensuring that the use of these services does not expose the user the financial hardship”<sup>68</sup>. A universal healthcare approach does not exist in the USA<sup>67,69</sup>.

The United Kingdom runs a state-supported universal healthcare strategy called the National Health Service (NHS)<sup>70</sup>. In Australia, healthcare is a mix of public and private services<sup>71</sup>. In certain countries of African continent had substantial improvement in primary health care (PHC) service. Thereby, PHC in these countries is affordable and reasonably good access to healthcare for most of the population. Nevertheless, such development is heavily dependent on international donor agencies<sup>72</sup>. In Bangladesh, there is a pluralistic health care system. The government health care expenditure has plunged from 6.2% to 4.3%, and the out-of-pocket payment (OPP) is 64.7%<sup>73</sup>.

Consumers know far less about the health and nutrition content of the foods than the suppliers. Environmental changes, effortless access to high-calorie fast foods, increased consumption of sugary beverages, and sedentary lifestyles are linked with rising obesity. The easy availability of high caloric fast foods, and super-sized food portions, are increasingly common choices due to their palatability and often being less expensive

than fruits and vegetables<sup>36</sup>. We can ask ourselves how to address the childhood obesity problem; by focusing on choices that one makes in the obesogenic environment or limiting access to the favorite weight-gaining food products available. Studies have shown the benefits of effective government legislation on access to harmful food products and taxes on sugar-containing beverages<sup>74,75</sup>. Parents must be aware of childhood overweight and obesity as severe health concerns to seek proper health services<sup>76,77</sup>. Parents should be proactive, unlike the common acute and chronic ailments of childhood and adolescence (such as asthma, diarrhea, fever, allergy, infections, etc.) to seek health services. Obesity and overweight are often blatantly ignored and delay early intervention, which inevitably increases the risk of significant health hazards<sup>78</sup>. In addition to behavioral and dietary recommendations, changes in the community-based interventions are crucial measures<sup>79,80</sup>.

The WHO introduced a voluntary target to stop the increase in obesity prevalence by 2025<sup>81</sup>. Unfortunately, the results show most countries have a less than 10% chance of meeting the 2025 target for halting the rise in obesity<sup>82</sup>. Country-level income inequality also influences obesity<sup>83,84</sup>. The socio-cultural landscape of LMICs and the epidemiological transition demands early prevention of childhood obesity and controlling the obesogenic environmental issues as a health economic approach<sup>64,85-88</sup>.

In its national strategy under the nutrition section, Bangladesh has stated vital processes: micronutrient supplementation of diet, community-based awareness campaigns, advocacy on good nutritional practices and healthy food, access to sports and physical activity in workplace and community recreational areas (e.g., parks)<sup>89</sup>. Routine assessment of all children must be standard clinical practice from very early childhood, and long-term sustainable changes are ingrained in the active participation of families, schools, and communities. In the footsteps of developed countries such as the US and the UK, in our country, we need to develop support innovations for businesses to

build healthier food industries, ensure the availability of healthy food choices in all public health settings, ensure more explicit food labeling, provide a suite of technology-based applications to make best options and establishment of local weight management services and doctors making referrals as needed.

Childhood overweight and obesity are preventable states of health that can be modified by addressing multiple factors that are the significant determinants of the conditions. Obesity has been declared an epidemic with urgent implications for affected countries, including western developed countries and countries in economic transition, quality of life, growth, and development of children with overweight and obesity problems, economic productivity, and premature loss of life. It is essential to take a holistic approach to manage this health problem. Children cannot make rational decisions about best practices in food habits. It is imperative to develop methods and strategies to motivate health-seeking behavior in the community so that parents and their children can actively participate in reducing the incidence and prevalence of obesity and obesity-related health disorders and their long-term irreversible consequences. Family physicians or pediatricians need to be proactive in identifying the overweight or obese child and then engaging the parents as partners in a management plan; hence, they should counsel parents to encourage and effectively alter their children's food habits through well-paced crucial family-based interventions. Bangladesh needs to develop and implement effective and pragmatic preventive health intervention programs with the long-term vision of reducing associated morbidity, mortality, and reducing financial overhead because of overweight/obesity related illness. Additionally, the country needs to ensure effective surveillance and monitoring.

### **Financial Support and Sponsorship**

This editorial was not funded.

### **Conflicts of Interest**

The authors declare there are no conflicts of interest.

## References

1. The World Bank. The World Bank in Bangladesh. Sher-e-Bangla Nagar, Agargaon, Dhaka 1207, World Bank in Bangladesh Country Office, Bangladesh. 2022. Available at <https://www.worldbank.org/en/country/bangladesh/overview#1> [Accessed May 20, 2022]
2. Central Intelligence Agency. The world factbook, 2020. Available at [https://www.cia.gov/library/publications/resources/the-world-factbook/geos/print\\_bg.html](https://www.cia.gov/library/publications/resources/the-world-factbook/geos/print_bg.html) [Accessed May 20, 2022].
3. United Nations Children's Fund (UNICEF). Children in Bangladesh. UNICEF is working with children across Bangladesh as they are the future agents of a growing nation. Available at <https://www.unicef.org/bangladesh/en/children-bangladesh> [Accessed May 20, 2022].
4. United Nations Children's Fund (UNICEF). Adolescents in development. On ground and on airwaves, UNICEF platforms prepare youths for positive action. Available at <https://www.unicef.org/bangladesh/en/adolescents-development> [Accessed May 20, 2022].
5. The Daily Star. Bangladesh's poverty declines to 11.9%: World Bank. 2022. Available at <https://www.thedailystar.net/business/news/bangladeshs-poverty-declines-119-wb-3004236> [Accessed May 20, 2022].
6. World Health Organization. Obesity and overweight. 2021. Available at <https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight#:~:text=Most%20of%20the%20world's%20population,Obesity%20is%20preventable.> [Accessed May 20, 2022].
7. Ahirwar R, Mondal PR. Prevalence of obesity in India: A systematic review. *Diabetes Metab Syndr.* 2019;**13**(1):318-321. doi: 10.1016/j.dsx.2018.08.032.
8. World Health Organization. Obesity. Available at [https://www.who.int/health-topics/obesity#tab=tab\\_1](https://www.who.int/health-topics/obesity#tab=tab_1). [Accessed May 20, 2022].
9. Al-Goblan AS, Al-Alfi MA, Khan MZ. Mechanism linking diabetes mellitus and obesity. *Diabetes Metab Syndr Obes.* 2014;**7**:587-591. doi:10.2147/DMSO.S67400
10. Lotfi Z, Aboussaleh Y, Sbaibi R, Achouri I, Benguedour R. Le surpoids, l'obésité et le contrôle glycémique chez les diabétiques du centre de référence provincial de diabète (CRD), Kénitra, Maroc [The overweight, the obesity and the glycemic control among diabetics of the provincial reference center of diabetes (CRD), Kenitra, Morocco]. *Pan Afr Med J.* 2017;**27**:189. French. doi: 10.11604/pamj.2017.27.189.9535.
11. Jih J, Mukherjea A, Vittinghoff E, et al. Using appropriate body mass index cut points for overweight and obesity among Asian Americans. *Prev Med.* 2014;**65**:1-6. doi:10.1016/j.ypmed.2014.04.010
12. Saeedi P, Petersohn I, Salpea P, Malanda B, Karuranga S, Unwin N, Colagiuri S, Guariguata L, Motala AA, Ogurtsova K, Shaw JE, Bright D, Williams R; IDF Diabetes Atlas Committee. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas, 9th edition. *Diabetes Res Clin Pract.* 2019;**157**:107843. doi: 10.1016/j.diabres.2019.107843.
13. Akter F, Haque M, Akter S, Uddin G, Chy N, Kalemeeera F, Kurdi A, Chowdhury K, Godman B. Assessing the management of patients with type 2 diabetes in Bangladesh during pre-and post-COVID-19 era and the implications: A pilot study. *J Appl Pharm Sci.* 2022;**12**(05):088–097. doi: 10.7324/JAPS.2022.120506.
14. International Diabetes Federation. Bangladesh Diabetes report 2000-2045. IDF Diabetes Atlas. 10<sup>th</sup> Edition, 2021. Available at <https://diabetesatlas.org/data/en/country/16/bd.html> [Accessed May 21, 2022]
15. Kahkoska AR, Dabelea D. Diabetes in Youth: A Global Perspective. *Endocrinol Metab Clin North Am.* 2021;**50**(3):491-512. doi: 10.1016/j.ecl.2021.05.007.
16. Buttermore E, Campanella V, Priefer R. The increasing trend of Type 2 diabetes in youth: An overview. *Diabetes Metab Syndr.* 2021;**15**(5):102253. doi: 10.1016/j.dsx.2021.102253.
17. Marques A, Peralta M, Naia A, Loureiro N, de Matos MG. Prevalence of adult overweight and obesity in 20 European countries. *Eur J Public Health.* 2014; **28**(2):295-300, doi:10.1093/eurpub/ckx143
18. Garrido-Miguel M, Oliveira A, Cavero-Redondo I, Álvarez-Bueno C, Pozuelo-Carrascosa DP, Soriano-Cano A, Martínez-Vizcaino V. Prevalence of Overweight and Obesity among European Preschool Children: A Systematic Review and Meta-Regression by Food Group Consumption. *Nutrients.* 2019;**11**(7):1698. doi: 10.3390/nu11071698.
19. Garrido-Miguel M, Cavero-Redondo I, Álvarez-Bueno C, Rodríguez-Artalejo F, Moreno LA, Ruiz JR, Ahrens W, Martínez-Vizcaino V. Prevalence and Trends of Overweight and Obesity in European Children From 1999 to 2016: A Systematic Review and Meta-analysis. *JAMA Pediatr.* 2019;**173**(10):e192430. doi: 10.1001/jamapediatrics.2019.2430.
20. Ng M, Fleming T, Robinson M, Thomson B, Graetz N, Margono C, Mullany EC, Biryukov S, Abbafati C, Abera SF, Abraham JP, Abu-Rmeileh NM, Achoki T, AlBuhairan FS, Alemu ZA, Alfonso R, Ali MK, Ali R, Guzman NA, Ammar W, Anwar P, Banerjee A, Barquera S, Basu S, Bennett DA, Bhutta Z, Blore J, Cabral N, Nonato IC, Chang JC, Chowdhury R, Courville KJ, Criqui MH, Cundiff DK, Dabhadkar KC, Dandona L, Davis A, Dayama A, Dharmaratne SD, Ding EL, Durrani AM, Esteghamati A, Farzadfar F, Fay DF, Feigin VL, Flaxman A, Forouzanfar MH, Goto A, Green MA, Gupta R, Hafezi-Nejad N, Hankey GJ, Harewood HC, Havmoeller R, Hay S, Hernandez L, Hussein A, Idrisov BT, Ikeda N, Islami F, Jahangir E, Jassal SK, Jee SH, Jeffreys M, Jonas JB, Kabagambe EK, Khalifa SE, Kengne AP, Khader YS, Khang YH, Kim D, Kimokoti RW, Kinge JM, Kokubo Y, Kosen S, Kwan G, Lai T,

- Leinsalu M, Li Y, Liang X, Liu S, Logroscino G, Lotufo PA, Lu Y, Ma J, Mainoo NK, Mensah GA, Merriman TR, Mokdad AH, Moschandreas J, Naghavi M, Naheed A, Nand D, Narayan KM, Nelson EL, Neuhauser ML, Nisar MI, Ohkubo T, Oti SO, Pedroza A, Prabhakaran D, Roy N, Sampson U, Seo H, Sepanlou SG, Shibuya K, Shiri R, Shiue I, Singh GM, Singh JA, Skirbekk V, Stapelberg NJ, Sturua L, Sykes BL, Tobias M, Tran BX, Trasande L, Toyoshima H, van de Vijver S, Vasankari TJ, Veerman JL, Velasquez-Melendez G, Vlassov VV, Vollset SE, Vos T, Wang C, Wang X, Weiderpass E, Werdecker A, Wright JL, Yang YC, Yatsuya H, Yoon J, Yoon SJ, Zhao Y, Zhou M, Zhu S, Lopez AD, Murray CJ, Gakidou E. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet*. 2014;**384**(9945):766-81. doi: 10.1016/S0140-6736(14)60460-8.
21. Jain P, Kaushik P. Cognitive and Psycho-Social Effects of Childhood Obesity. *Int J Indian Psychol*. 2016; **3** (4):148-158.
  22. Akowuah PK, Kobia-Acquah E. Childhood Obesity and Overweight in Ghana: A Systematic Review and Meta-Analysis. *J Nutr Metab*. 2020;**2020**:1907416. doi: 10.1155/2020/1907416.
  23. de Onis M, Blössner M, Borghi E. Global prevalence and trends of overweight and obesity among preschool children. *Am J Clin Nutr*. 2010;**92**(5):1257-64. doi: 10.3945/ajcn.2010.29786.
  24. Liu W, He MZ, Dambach P, Schwertz R, Chen S, Yu F, Marx M. Trends of overweight and obesity among preschool children from 2013 to 2018: a cross-sectional study in Rhine-Neckar County and the City of Heidelberg, Germany. *BMC Public Health*. 2022;**22**(1):941. doi: 10.1186/s12889-022-13302-w.
  25. Nordlund S, McPhee PG, Gabarin R, Deacon C, Mbuagbaw L, Morrison KM. Effect of obesity treatment interventions in preschool children aged 2-6 years: a systematic review and meta-analysis. *BMJ Open*. 2022;**12**(4):e053523. doi: 10.1136/bmjopen-2021-053523.
  26. Rahman S, Islam MT, Alam DS. Obesity and overweight in Bangladeshi children and adolescents: a scoping review. *BMC Public Health*. 2014;**14**:70. doi: 10.1186/1471-2458-14-70.
  27. Das SK, Chisti MJ, Huq S, Malek MA, Vanderlee L, Salam MA, Ahmed T, Faruque ASG, Al Mamun A. Changing trend of overweight and obesity and their associated factors in an urban population of Bangladesh. *Food Nutr*. 2013; **4** (3):678-689. doi:10.4236/fns.2013.46087.
  28. Sultana S. Prevalence and risk factor of childhood overweight and obesity in primary school children of Dhaka city. Master thesis. Institute of Health and Society, Department of General Practice and Community Medicine, Faculty of Medicine, University of Oslo; 2010. Available at <https://www.duo.uio.no/bitstream/handle/10852/30024/ShuhanaxSultana.pdf?sequence=1> [Accessed May 21, 2022].
  29. Rahman SMM, Kabir I, Bhuyan HM, Akter DB, Hossain SM. Prevalence and Determinants of Childhood Obesity in Dhaka City: Childhood obesity in Dhaka City. *Bangl Med Res Coun Bull*. 2019; **45**(2), 68-80. <https://doi.org/10.3329/bmrcb.v45i2.42534>.
  30. Bulbul T, Hoque M. Prevalence of childhood obesity and overweight in Bangladesh: findings from a countrywide epidemiological study. *BMC Pediatr*. 2014;**14**:86. doi: 10.1186/1471-2431-14-86.
  31. Hossain MT, Luies SK, Biswas T. Prevalence and Factors Associated with Overweight and Obesity among Primary School Children (9-14 Years) in a Selected Area of Dhaka, Bangladesh: A Cross-Sectional Study. *Indian J Community Med*. 2020;**45**(4):429-434. doi: 10.4103/ijcm.IJCM\_466\_19.
  32. Purnell JQ. Definitions, Classification, and Epidemiology of Obesity. [Updated 2018 Apr 12]. In: Feingold KR, Anawalt B, Boyce A, et al., editors. Endotext [Internet]. South Dartmouth (MA): MDText.com, Inc.; 2000-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK279167/> [Accessed on May 21, 2022]
  33. Løvsletten O, Jacobsen BK, Grimsgaard S, Njølstad I, Wilsgaard T, Løchen ML, Eggen AE, Hopstock LA. Prevalence of general and abdominal obesity in 2015-2016 and 8-year longitudinal weight and waist circumference changes in adults and elderly: the Tromsø Study. *BMJ Open*. 2020;**10**(11):e038465. doi: 10.1136/bmjopen-2020-038465.
  34. World Health Organization. Obesity and overweight. Fact Sheet. 2021. Available at <https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight> [Accessed May 21, 2022].
  35. Jensen MD, Ryan DH, Apovian CM, Ard JD, Comuzzie AG, Donato KA, Hu FB, Hubbard VS, Jakicic JM, Kushner RF, Loria CM, Millen BE, Nonas CA, Pi-Sunyer FX, Stevens J, Stevens VJ, Wadden TA, Wolfe BM, Yanovski SZ, Jordan HS, Kendall KA, Lux LJ, Mentor-Marcel R, Morgan LC, Trisolini MG, Wnek J, Anderson JL, Halperin JL, Albert NM, Bozkurt B, Brindis RG, Curtis LH, DeMets D, Hochman JS, Kovacs RJ, Ohman EM, Pressler SJ, Sellke FW, Shen WK, Smith SC Jr, Tomaselli GF; American College of Cardiology/American Heart Association Task Force on Practice Guidelines; Obesity Society. 2013 AHA/ACC/TOS guideline for the management of overweight and obesity in adults: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and The Obesity Society. *Circulation*. 2014;**129**(25 Suppl 2): S102-38. doi: 10.1161/01.cir.0000437739.71477.ee.
  36. Kansra AR, Lakkunarajah S, Jay MS. Childhood and Adolescent Obesity: A Review. *Front Pediatr*. 2021;**8**:581461. doi: 10.3389/fped.2020.581461.

37. Kaur H, Hyder ML, Poston WS. Childhood overweight: an expanding problem. *Treat Endocrinol.* 2003;**2**(6):375-88. doi: 10.2165/00024677-200302060-00002.
38. Ford ND, Patel SA, Narayan KM. Obesity in Low- and Middle-Income Countries: Burden, Drivers, and Emerging Challenges. *Annu Rev Public Health.* 2017;**38**:145-164. doi: 10.1146/annurev-publhealth-031816-044604.
39. Phelan SM, Burgess DJ, Yeazel MW, Hellerstedt WL, Griffin JM, van Ryn M. Impact of weight bias and stigma on quality of care and outcomes for patients with obesity. *Obes Rev.* 2015;**16**(4):319-26. doi: 10.1111/obr.12266.
40. Auckburally S, Davies E, Logue J. The Use of Effective Language and Communication in the Management of Obesity: the Challenge for Healthcare Professionals. *Curr Obes Rep.* 2021;**10**(3):274-281. doi: 10.1007/s13679-021-00441-1.
41. Stangl AL, Earnshaw VA, Logie CH, van Brakel W, C Simbayi L, Barré I, Dovidio JF. The Health Stigma and Discrimination Framework: a global, crosscutting framework to inform research, intervention development, and policy on health-related stigmas. *BMC Med.* 2019;**17**(1):31. doi: 10.1186/s12916-019-1271-3.
42. King SE, Skinner MK. Epigenetic Transgenerational Inheritance of Obesity Susceptibility. *Trends Endocrinol Metab.* 2020;**31**(7):478-494. doi: 10.1016/j.tem.2020.02.009.
43. Mohajer N, Joloya EM, Seo J, Shioda T, Blumberg B. Epigenetic Transgenerational Inheritance of the Effects of Obesogen Exposure. *Front Endocrinol (Lausanne).* 2021;**12**:787580. doi: 10.3389/fendo.2021.787580.
44. Wilkins AT, Reimer RA. Obesity, Early Life Gut Microbiota, and Antibiotics. *Microorganisms.* 2021;**9**(2):413. doi: 10.3390/microorganisms9020413. Ma RCW, Popkin BM. Intergenerational diabetes and obesity-A cycle to break? *PLoS Med.* 2017;**14**(10):e1002415. doi: 10.1371/journal.pmed.1002415.
45. Haire-Joshu D, Tabak R. Preventing Obesity Across Generations: Evidence for Early Life Intervention. *Annu Rev Public Health.* 2016;**37**:253-71. doi: 10.1146/annurev-publhealth-032315-021859.
46. Corica D, Aversa T, Valenzise M, Messina MF, Alibrandi A, De Luca F, Wasniewska M. Does Family History of Obesity, Cardiovascular, and Metabolic Diseases Influence Onset and Severity of Childhood Obesity? *Front Endocrinol (Lausanne).* 2018;**9**:187. doi: 10.3389/fendo.2018.00187.
47. Lassi Z, Moin A, Bhutta Z. Nutrition in Middle Childhood and Adolescence. In: Bundy DAP, Silva Nd, Horton S, et al., editors. *Child and Adolescent Health and Development.* 3rd edition. Washington (DC): The International Bank for Reconstruction and Development / The World Bank; 2017 Nov 20. Chapter 11. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK525242/> doi: 10.1596/978-1-4648-0423-6\_ch11 [Accessed May 22, 2022]
48. Trijsburg L, Talsma EF, de Vries JHM, Kennedy G, Kuijsten A, Brouwer ID. Diet quality indices for research in low- and middle-income countries: a systematic review. *Nutr Rev.* 2019;**77**(8):515-40. doi: 10.1093/nutrit/nuz017.
49. Bray GA. Let's treat obesity seriously. *Am Fam Physician.* 2010;**81**(12):1406-8.
50. Bray GA. Soft drink consumption and obesity: it is all about fructose. *Curr Opin Lipidol.* 2010;**21**(1):51-7. doi: 10.1097/MOL.0b013e3283346ca2.
51. Swinburn B, Egger G. Preventive strategies against weight gain and obesity. *Obes Rev.* 2002;**3**(4):289-301. doi: 10.1046/j.1467-789x.2002.00082.x.
52. Swinburn B, Egger G, Raza F. Dissecting obesogenic environments: the development and application of a framework for identifying and prioritizing environmental interventions for obesity. *Prev Med.* 1999;**29**(6 Pt 1):563-70. doi: 10.1006/pmed.1999.0585.
53. Hossain M, Zannat IA, Begum S, Rahman S. Risk Factors for Overweight and Obesity among Children and Adolescents in Bangladesh: A Hospital-Based Study. *Bangl J Child Health.* 2019; **43** (1): 9-14. doi: 10.3329/bjch.v43i1.41210.
54. Butler MG, Kimonis V, Dykens E, Gold JA, Miller J, Tamura R, Driscoll DJ. Prader-Willi syndrome and early-onset morbid obesity NIH rare disease consortium: A review of natural history study. *Am J Med Genet A.* 2018;**176**(2):368-375. doi: 10.1002/ajmg.a.38582.
55. Mamrot P, Hanć T. The association of the executive functions with overweight and obesity indicators in children and adolescents: A literature review. *Neurosci Biobehav Rev.* 2019;**107**:59-68. doi: 10.1016/j.neubiorev.2019.08.021.
56. Groppe K, Elsner B. Executive function and weight status in children: A one-year longitudinal perspective. *Child Neuropsychol.* 2017;**23**(2):129-147. doi: 10.1080/09297049.2015.1089981.
57. Meo SA, Altuwaym AA, Alfallaj RM, Alduraibi KA, Alhamoudi AM, Alghamdi SM, Akram A. Effect of Obesity on Cognitive Function among School Adolescents: A Cross-Sectional Study. *Obes Facts.* 2019;**12**(2):150-156. doi: 10.1159/000499386.
58. Wirt T, Schreiber A, Kesztyüs D, Steinacker JM. Early life cognitive abilities and body weight: cross-sectional study of the association of inhibitory control, cognitive flexibility, and sustained attention with BMI percentiles in primary school children. *J Obes.* 2015;**2015**:534651. doi: 10.1155/2015/534651.
59. Anderson YC, Kirkpatrick K, Dolan GMS, Woudes TA, Grant CC, Cave TL, Wild CEK, Derraik JGB, Cutfield WS, Hofman PL. Do changes in weight status affect cognitive function in children and adolescents with obesity? A secondary analysis of a clinical trial. *BMJ Open.* 2019;**9**(2):e021586. doi: 10.1136/bmjopen-2018-021586.

60. Lauby-Secretan B, Scoccianti C, Loomis D, Grosse Y, Bianchini F, Straif K; International Agency for Research on Cancer Handbook Working Group. Body Fatness and Cancer--Viewpoint of the IARC Working Group. *N Engl J Med*. 2016;**375**(8):794-8. doi: 10.1056/NEJMs1606602.
61. Boffetta P, McLerran D, Chen Y, Inoue M, Sinha R, He J, Gupta PC, Tsugane S, Irie F, Tamakoshi A, Gao YT, Shu XO, Wang R, Tsuji I, Kuriyama S, Matsuo K, Satoh H, Chen CJ, Yuan JM, Yoo KY, Ahsan H, Pan WH, Gu D, Pednekar MS, Sasazuki S, Sairenchi T, Yang G, Xiang YB, Nagai M, Tanaka H, Nishino Y, You SL, Koh WP, Park SK, Shen CY, Thornquist M, Kang D, Rolland B, Feng Z, Zheng W, Potter JD. Body mass index and diabetes in Asia: a cross-sectional pooled analysis of 900,000 individuals in the Asia cohort consortium. *PLoS One*. 2011;**6**(6):e19930. doi: 10.1371/journal.pone.0019930.
62. Schmidt M, Johannesdottir SA, Lemeshow S, Lash TL, Ulrichsen SP, Bøtker HE, Sørensen HT. Obesity in young men, and individual and combined risks of type 2 diabetes, cardiovascular morbidity, and death before 55 years of age: a Danish 33-year follow-up study. *BMJ Open*. 2013;**3**(4):e002698. doi: 10.1136/bmjopen-2013-002698.
63. Okunogbe A, Nugent R, Spencer G, Ralston J, Wilding J. Economic impacts of overweight and obesity: current and future estimates for eight countries. *BMJ Glob Health*. 2021;**6**(10):e006351. doi: 10.1136/bmjgh-2021-006351.
64. Sonntag D. Why Early Prevention of Childhood Obesity Is More Than a Medical Concern: A Health Economic Approach. *Ann Nutr Metab*. 2017;**70**(3):175-178. doi: 10.1159/000456554.
65. Hamilton D, Dee A, Perry IJ. The lifetime costs of overweight and obesity in childhood and adolescence: a systematic review. *Obes Rev*. 2018;**19**(4):452-463. doi: 10.1111/obr.12649.
66. State of Childhood Obesity. Available at <https://stateofchildhoodobesity.org/data/> [Accessed May 22, 2022]
67. Zieff G, Kerr ZY, Moore JB, Stoner L. Universal Healthcare in the United States of America: A Healthy Debate. *Medicina (Kaunas)*. 2020;**56**(11):580. doi: 10.3390/medicina56110580.
68. World Health Organization. Universal Health Coverage. Available at [https://www.who.int/healthsystems/universal\\_health\\_coverage/en/](https://www.who.int/healthsystems/universal_health_coverage/en/) [Accessed May 22, 2022]
69. Alspaugh A, Lanshaw N, Kriebs J, Van Hoover C. Universal Health Care for the United States: A Primer for Health Care Providers. *J Midwifery Womens Health*. 2021;**66**(4):441-451. doi: 10.1111/jmwh.13233.
70. Light DW. Universal health care: lessons from the British experience. *Am J Public Health*. 2003;**93**(1):25-30. doi: 10.2105/ajph.93.1.25.
71. Duckett S. Commentary: The Consequences of Private Involvement in Healthcare - The Australian Experience. *Healthc Policy*. 2020;**15**(4):21-25. doi: 10.12927/hcpol.2020.26228.
72. Azevedo MJ. (2017). The State of Health System(s) in Africa: Challenges and Opportunities. In: Historical Perspectives on the State of Health and Health Systems in Africa, Volume II. African Histories and Modernities. Palgrave Macmillan, Cham. doi: 10.1007/978-3-319-32564-4\_1.
73. Hassan MZ, Fahim SM, Zafr AHA, Islam MS, Alam S. Healthcare Financing in Bangladesh: Challenges and Recommendations. *Bangl J Med Sci*. 2016; **15**(4), 505-510. doi:10.3329/bjms.v15i4.21698.
74. Chaloupka FJ, Powell LM, Warner KE. The Use of Excise Taxes to Reduce Tobacco, Alcohol, and Sugary Beverage Consumption. *Annu Rev Public Health*. 2019;**40**:187-201. doi: 10.1146/annurev-publhealth-040218-043816.
75. Haque M, McKimm J, Sartelli M, Samad N, Haque SZ, Bakar MA. A narrative review of the effects of sugar-sweetened beverages on human health: A key global health issue. *J Popul Ther Clin Pharmacol*. 2020;**27**(1):e76-e103. doi: 10.15586/jptcp.v27i1.666.
76. Davidson K, Vidgen H. Why do parents enroll in a childhood obesity management program?: a qualitative study with parents of overweight and obese children. *BMC Public Health*. 2017;**17**(1):159. doi: 10.1186/s12889-017-4085-2.
77. Day RE, Bridge G, Austin K, Ensaff H, Christian MS. Parents' awareness and perceptions of the Change4Life 100 cal snack campaign and perceived impact on snack consumption by children under 11 years. *BMC Public Health*. 2022;**22**(1):1012. doi: 10.1186/s12889-022-12789-7.
78. Baur LA. Childhood obesity: practically invisible. *Int J Obes (Lond)*. 2005;**29**(4):351-2. doi: 10.1038/sj.ijo.0802931.
79. Nittari G, Scuri S, Petrelli F, Pirillo I, di Luca NM, Grappasonni I. Fighting obesity in children from European World Health Organization member states. Epidemiological data, medical-social aspects, and prevention programs. *Clin Ter*. 2019;**170**(3):e223-e230. doi: 10.7417/CT.2019.2137.
80. Pereira AR, Oliveira A. Dietary Interventions to Prevent Childhood Obesity: A Literature Review. *Nutrients*. 2021;**13**(10):3447. doi: 10.3390/nu13103447.
81. WHO. Global nutrition targets 2025: policy brief series (WHO/NMH/NHD/14.2). Geneva: World Health Organization; 2014. Available at <https://www.who.int/publications/i/item/WHO-NMH-NHD-14.2> [Accessed May 22, 2022]
82. Sahoo K, Sahoo B, Choudhury AK, Sofi NY, Kumar R, Bhadoria AS. Childhood obesity: causes and consequences. *J Family Med Prim Care*. 2015 Apr-Jun;**4**(2):187-92. doi: 10.4103/2249-4863.154628. PMID: 25949965; PMCID: PMC4408699..
83. Pickett KE, Kelly S, Brunner E, Lobstein T, Wilkinson RG. Wider income gaps, wider waistbands? An



- ecological study of obesity and income inequality. *J Epidemiol Community Health*. 2005;**59**(8):670-4. doi: 10.1136/jech.2004.028795.
84. Devaux M, Sassi F. Social inequalities in obesity and overweight in 11 OECD countries. *Eur J Public Health*. 2013;**23**(3):464-9. doi: 10.1093/eurpub/ckr058.
85. Spinola e Castro AM. Interventions for preventing obesity in children. *Sao Paulo Med J*. 2014;**132**(2):128-9. doi: 10.1590/1516-3180.20141322t2.
86. Morandi A, Tommasi M, Soffiati F, Destro F, Fontana L, Grando F, Simonetti G, Bucolo C, Alberti E, Baraldi L, Chiriacò A, Ferrarese N, Frignani G, Pasqualini M, Rossi V, Siciliano C, Zuccolo AM, Matticchio G, Vettori V, Danieli D, Guarda L, Iuliano M, Raimo F, Sirpresi S, Trevisan E, Vinco S, Maffei C. Prevention of obesity in toddlers (PROBIT): a randomised clinical trial of responsive feeding promotion from birth to 24 months. *Int J Obes (Lond)*. 2019;**43**(10):1961-1966. doi: 10.1038/s41366-019-0406-0.
87. Sonntag D, Schneider S, Mdege N, Ali S, Schmidt B. Beyond Food Promotion: A Systematic Review on the Influence of the Food Industry on Obesity-Related Dietary Behaviour among Children. *Nutrients*. 2015;**7**(10):8565-76. doi: 10.3390/nu7105414.
88. Döring N, Mayer S, Rasmussen F, Sonntag D. Economic Evaluation of Obesity Prevention in Early Childhood: Methods, Limitations, and Recommendations. *Int J Environ Res Public Health*. 2016;**13**(9):911. doi: 10.3390/ijerph13090911.
89. Ministry of Health and Family Welfare. National Strategy for Adolescent Health 2017-2030. Government of the People's Republic of Bangladesh. 2016. Available at <https://www.unicef.org/bangladesh/sites/unicef.org/bangladesh/files/2018-10/National-Strategy-for-Adolescent-Health-2017-2030.pdf> [Accessed May 22, 2022]
-