Epidemiological Transition in Indonesia and Its Prevention: A Narrative Review

Tri Siswati [a*], Bunga Astria Paramashanti [b], Muhammad Primiaji Rialihanto [a] and Lukman Waris [c]

[a] *Poltekkes Kemenkes Yogyakarta, Tata Bumi Street No. 3, Sleman, Daerah Istimewa Yogyakarta, 55293- Indonesia.*
[b] *Department of Nutrition, Faculty of Health Sciences, Universitas Alma Ata, Brawijaya Street No. 99, Bantul, Daerah Istimewa Yogyakarta, 55183 -Indonesia.*
[c] *Department of Public Health, Universitas Faletehan, Cilegon Road Km. 06, Serang, Banten, 42161-Indonesia.*

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Review Article

ABSTRACT

Introduction: Indonesia is undergoing an epidemiological transition, changing from a public health problem with the prevalence of a dominant infectious disease to a non-communicable disease. Some of the causes of this transition include technological advances, economy, modern transportation, lifestyle, changes in food consumption and others
Objective: This paper aims to describe epidemiological transition and its prevention in Indonesia.
Methods: A narrative review was conducted by searching in databases including Web of Science, PubMed, Scopus, and Google Scholar search engine from 2001 to 2020 with the following search terms: nutrition transition, dietary transition, shifting epidemiology, epidemiological transition.
Results: Indonesia has experienced the epidemiological transition from infections to non-communicable diseases (NCDs). All types of NCDs have increased in the last three decades. NCDs also occur among the younger population despite preventability. The promotion of healthy lives and well-being to decrease NCDs in Indonesia delivered through early detection of their risk factors through Integrated Guidance Post (Posbindu)

*Corresponding author: E-mail: tri.siswati@poltekkesjogja.ac.id;

Conclusion: An epidemiological shift has occurred in Indonesia. In the 1990s, infectious diseases outnumbered but however, noncommunicable diseases will be the most common, by the 2020s. Early detection is required to prevent their development.

Keywords: Epidemiology; transition; NCDs; review; prevention.

ABBREVIATIONS

NCDs   : Non communicable diseases
Posbindu PTM : Pos   Pembinaan   Terpadu
*   Penyakit Tidak Menular*
DM   : Diabetes Mellitus
CVD   : cardiovascular diseases

1. INTRODUCTION

The transition of epidemiology is a shift in health problems and public health, from nutrition-related problems in infectious to non-infectious diseases or NCDs [1]. In the past, health problems and infections were generally due to the body's low resistance to disease causes and susceptibility to infection [2].

Malnutrition and NCDs are now mainly related to lifestyle. A diet high in carbohydrates, protein, fat, and low fibre and a sedentary lifestyle (e.g., excessive sitting, less physical activity) is the cause of weight gain and the onset of the occurrence of non-communicable diseases [3]. Several factors related to the nutritional shift include economic growth, modern technology, transportation, lifestyle, demography, and long consequences of life expectancy rate [4,5]. Abdel Omran first published the theory of epidemiology transitional in 1971 [1]. Conceptually, burden malnutrition affected primary mortality and morbidity, shifting from communicable diseases to NCDs [1]. The original formulation of Omran's Five propositions includes 1) The theory of epidemiologic transition, which begins with the principal premise that mortality is based on factors. 2) During the transition, a long-term shift occurs in mortality and disease patterns whereby pandemics of infection are gradually displaced by degenerative as the primary cause of death. 3) During the epidemiologic transition, the most profound changes in health and disease patterns obtain among children and young women, 4) The shifts in health and disease patterns that characterize the epidemiologic transition are closely associated with the demographic and socioeconomic transitions and modernization, 5) Three basic models of the epidemiologic transition.

In Indonesia, almost all diseases related to nutrition shifting are increasing. For example, the prevalence of obesity, diabetes mellitus, hypertension, stroke, cancer, and kidney has risen in the last few surveys, as detailed in Fig 1.

This study aimed to describe epidemiological transition and its prevention, which is an important issue, provide the future strategy for best overcoming NCDs, and contribute literature.
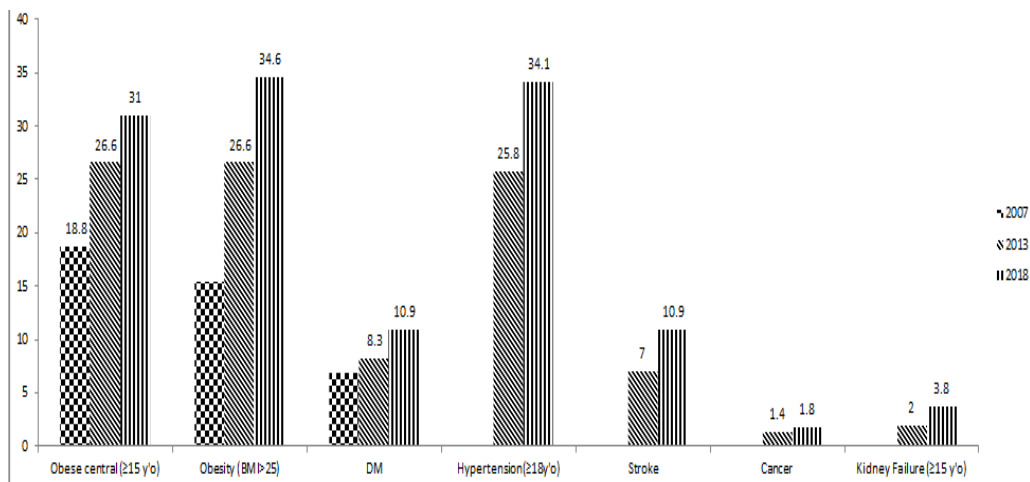
Fig. 1. The trend of NCDs in Indonesia from 2007-to 2018
Source: Ministry of Health, 2018

2. METHODS

We performed a literature search of published manuscripts on nutritional and epidemiology. A literature review was conducted by searching the materials published in databases including Web of Science, PubMed, Scopus, and Google Scholar search engine from 2001 to 2020 with the following search terms: nutrition transition, dietary transition, shifting epidemiology, epidemiological transition. Verbatim key messages were organized by prevalence (non communicable diseases, communicable diseases, injuries), determinant (growth economics, technology and urbanization, also lifestyle and food pattern changes, and prevention (medical check-up, prevent smoke, physical activity, balance diet, sleep and stress management).

3. RESULTS AND DISCUSSION

3.1 Nutritional and Epidemiological Transitions in Indonesia

Epidemiological transition is a change in the prevalence of public health problems from infectious diseases to non-communicable diseases. It is strongly related to modernization, technological progress, transportation, economic improvement, demographic changes and shifts in life expectancy [1], [2], [6]. Progress in the field of transportation, for example, currently various alternative modes of transportation for school children and adults/workers are vast, and there is a shift from active modes of transportation such as walking and bicycles to passive modes of transportation such as driving. This phenomenon also occurs in other countries such as Amerika Serikat [7,8], Netherland [9], Columbia [10] and other countries including Indonesia [11,12]. In the nutrition sector, this shift was observed from the 1970s until now in the form of increased processed foods, vegetable oils, sweet foods, pasta foods and western foods, and a reduction in physical activity [13]. This change began to appear in the 1990s with the emergence of diabetes, hypertension, and obesity globally, especially in low-income countries [13]. In the medical sector, the discovery of drugs, laboratory research, and advanced technologies allow society to detect disease prevention, reduce disability and dependence on medicine, and premature death [14,15].

Globally, there are three phases of epidemiology transition in developing countries, including Indonesia [6]: a)The age of pestilence and famine/outbreak and starvation phase (17th to 20th century). In this phase, the mortality rate is high, even life expectancy is below 40 years old, and growth people uncontrol. Diseases causal are bacteria, malnutrition, endemic and communicable diseases; b)The age of receding pandemics/Endemic decline. Middle of 20 century- in this phase, the mortality rate decreased and followed the increasing life expectancy rate by 55 years old. This shifting was from communicable to NCDs; c)The age of triple health burden. Occurring by the end of the 20th and early 21st centuries, this phase is characterized by common nutritional problems (infection, malnutrition, and maternal death); an increase in non-communicable diseases (such as cancer, diabetes, heart disease, and mental illness) and new-emerging diseases (in the form of health problems related to globalization, climate change and lifestyle).

Globally, the epidemiological transition is being experienced by several countries in the world [4], as detailed in Fig. 2.
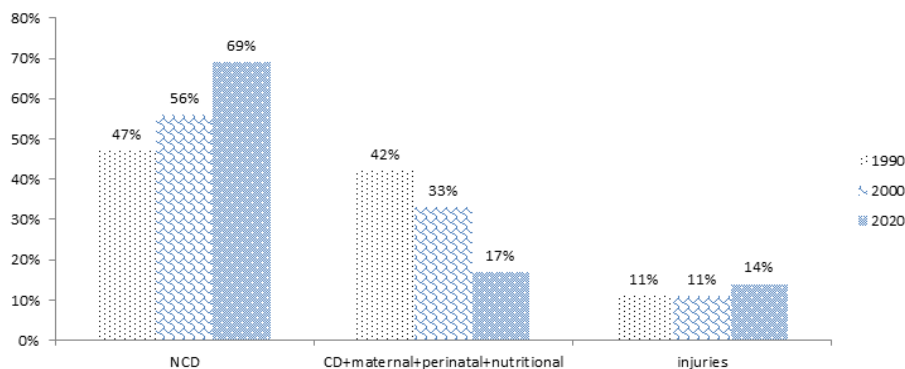

Fig. 2. The transition of disease epidemiology in some developing countries in the world
Source: doi 10.1186/1475-9276-4-2

In Indonesia, based on surveys from 1990-to 2015, Indonesia is also experiencing changes in disease patterns (Fig 3).
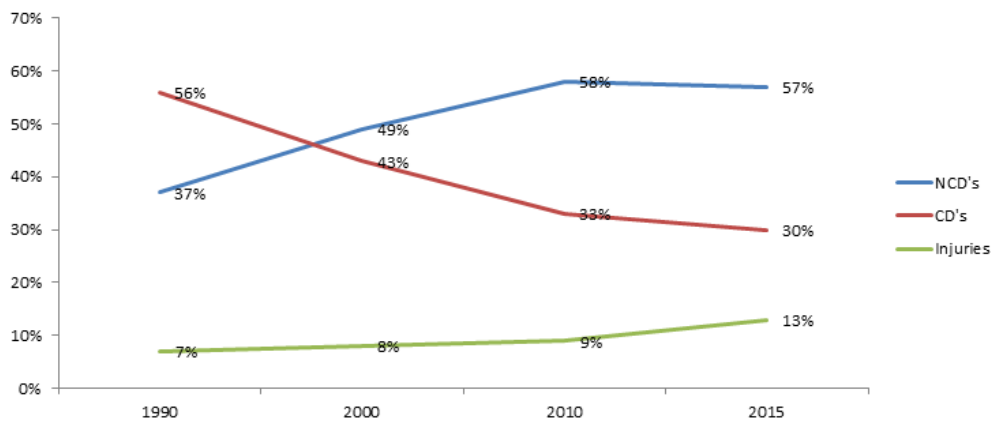
3.2 Determinant of Transitional Nutrition Epidemiology

The ecological theory predicts how the epidemiological transition began [16]. This theory states that non-communicable diseases experienced by a person occur because of their behaviour over many years, from when they were children to adults [1,17]. Such behaviour leads to the development of excess weight (Fig 4).

3.3 Several Factors Affect Shifting Epidemiology, as Follows:

3.3.1 Growth economics, technology and urbanization

The social-economic and environmental surrounding is close factor-related to obesity. Better economic status is considering risk factors diet change from a high fibre diet to low fibre and high-calorie intake [18]. The economic situation affects a good diet by following good nutrition and health knowledge [19,20].

Fig. 3. Epidemiological transition in Indonesia
Source: https://www.cdc.gov/globalhealth/health
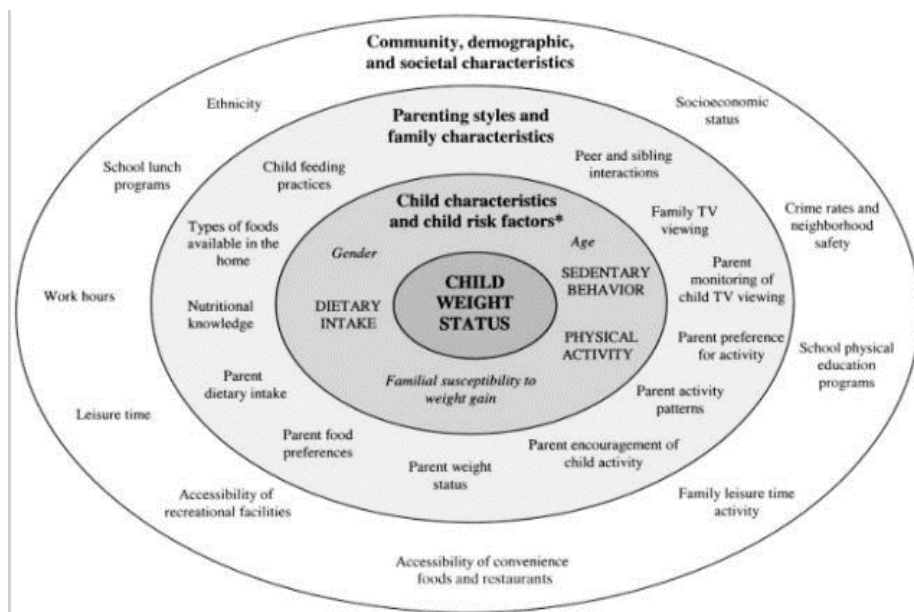
Fig. 4. The theory of ecological NCDs
Source:https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2530932/

Urbanization impacts obesity by causing people to have better economic levels, the capability to pay, and food access, and are more likely to have a sedentary lifestyle [18]. A simple illustration is when people live in their villages, spending a lot of time farming, gardening, raising livestock, walking, using bicycle transportation, and other physical activities. However, this activity is no longer continued when moving to a city. As a result, energy expenditure is reduced and leads to overweight [21].

On the one hand, technological developments are increasingly rapid and provide extraordinary benefits in everyday life, including in the health sector. However, on the other hand, technological developments have contributed to an increase in life expectancy while at the same time increasing the prevalence of non-communicable diseases, which now suffer a lot in the productive age population [22].

Modern Technological developments also improve transportation modes, resulting in a shift in energy expenditure. At school age, we can observe this using active transportation such as walking, cycling, or public transportation, switching to passive transport such as riding a motorbike or private car. Technology is associated with reduced physical activity, especially at a young age. If children spent a lot of time watching television in the past, now they play a lot with gadgets and laptops, contributing to the emergence of sitting disease, social problems, and mental health. The existence of food advertisements and food delivery services also contributes to obesity and a sedentary lifestyle. Of course, this habit provides an opportunity for non-communicable diseases earlier [23,24].

3.3.2 Lifestyle and food pattern changes

The transition of nutritional epidemiology is influenced by consumption patterns, namely the shift in consumption from traditional to western consumption patterns, which tend to be high in carbohydrates, saturated fat, trans fat, multi-processed manufactured foods and hydrogenated fats [25]. This weight gain tends to occur in families with low economic income. They tend to choose foods high in carbohydrates and fat (high carbo-high fat) with relatively affordable prices [26]. Basic Health Survey (Riskesdas) 2018 showed that 95.5% of Indonesian people >5 years old had consumed fewer fruits and vegetables [27]. Fruits and vegetables provide a source of fibre in the daily diet, making the fullness last longer. A high fibre diet decreases the risk of obesity [28], DM incidence, lower blood glucose [29]; prevent hypertention [30]; CVD [31]; cancer [32], and stroke [33].

During the COVID-19 pandemic, several studies stated that eating disorders occurred as a coping mechanism or emotional eating to release anxiety due to the impact of the pandemic, which is related to an increase in food intake, resulting in overweight and obesity [34]. In general, adolescents choose unhealthy foods like sugary, salty, and fast foods that contribute to weight gain [35]. In addition, western food advertisements offer variants, new flavours, and affordable prices to increase consumers' appetites, which later correlated with an increase in central obesity and the risk of NCDs [36].

Sedentary behaviour contributes to the increase in the obesity-a state of entry for the occurrence of NCDs. A sedentary lifestyle is related to low energy expenditure. The 2018 Riskesdas has reported that sufficient routine exercise is only carried out by 33.5% of the ten-year-old Indonesian population [27]. The research results on young adult subjects stated that the COVID-19 pandemic was associated with decreased physical activity, increased sedentary lifestyle and extended sleep duration [37].

With the COVID-19 pandemic, many children study at home using their cellphones or computers. This situation impacts reducing the energy that comes out because of excessive sitting or lying down. In addition, they tend to extend the time they use their cellphones/laptops to play games or have fun with their cellphones [38]. On the one hand, cellphone utilization can impact mental [39] and cope with eating as its compensation [40]. All of these factors contribute mutually to obesity at an early age. Apart from cell phones, watching television for a long time is also associated with the risk of being overweight [41-43] and selecting passive transportation modes for school-age children [44-46]. Both changes in diet and a sedentary lifestyle can simultaneously cause fat deposits to become central obesity in all age groups, both in rural and urban areas [47].

4. NON-COMMUNICABLE DISEASES PREVENTION

Almost all non-communicable diseases are preventable through various efforts such as a

healthy lifestyle, good diet, optimal stress management, risk factor control and early detection of NCDs [4,5]. Therefore, the Indonesian Ministry of Health has released the famous acronym "CERDIK", a memorable slogan to prevent NCDs. CERDIK stands for regular health monitoring, avoiding cigarette smoke, routine physical activity, a well-balanced diet, sleeping enough, and managing stress.

4.1 Routine Medical Check-Up

At the community level, prevention of NCDs is carried out with community-based health efforts through Integrated post services for NCDs (Posbindu PTM). Activities di Posbindu PTM include five service desks: include registration, risk factor interviews, anthropometric measurements, checking blood pressure and blood sugar, counselling, education, and follow-up [48].

Hence Posbindu PTM is held monthly. However, the monitoring frequency depends on early detection results, as detailed in Table 1.

4.2 Prevent Smoke Exposure

Smoking is a severe public health problem in Indonesia and several countries globally. The number of smokers in Indonesia continues to increase, and the age of first smokers shifts to a younger generation. In Indonesia, based on the 2013 and 2018 Riskesdas survey, the prevalence of smokers after >10 years old has increased from 28.8% to 29.3%. In detail, smokers aged 8-10 years old in Indonesia increased by 7.2% in 2013 [49] to 8.8% in 2016 [50] and 9.1% in 2018 [27]. Even Indonesia is the highest prevalence of adult smokers country in ASEAN, with as many as (33%) [51] and the third rank biggest smokers in the world after China dan Rusia [52] and the youngest smokers in the world [53]. Globally, more than 8 million people die every year, 7 million due to active smoking and 1.2 million due to passive smoking. It is estimated that the number of deaths due to smoking will be more than 9 million in 2030, with the highest number of fatalities in middle-poor countries [54].

Several studies have proven the link between smoking habits and the development of non-communicable diseases [54,55]. For example, smoking increases the risk of obesity as in studies in the United Kingdom among adults [56],

West Iraq at the age of 35-65 years old [57], and women aged 40-70 years old in Norwegia [58].

WHO has provided practical and cost-effective strategies to improve smoking prevention through MPOWER, with details: Monitor tobacco use and prevention policies, Protect people from tobacco use, Offer help to quit tobacco use, Warn about the dangers of tobacco, Enforce bans on tobacco advertising, promotion and sponsorship, Raise taxes on tobacco [54]. However, according to WHO, only Brazil and Turkey have fully implemented the MPOWER method with the highest achievement indicators among other countries.

4.3 Physical activity

Exercise is a message of balanced nutrition. Exercise can increase energy expenditure, reduce the risk of obesity, increase fitness, productivity [59] and stress release [60]. In addition, exercise is correlated with controlling weight gain, blood sugar levels [61], improving profile lipide [62], preventing hypertension, preventing coronary heart diseases and blood vessels [63], increasing fitness level [45], [64], dan body flexibility [65]. The recommendation for exercise is 30 minutes per day for five days a week. Exercise does not just expend energy, such as homework activities, but a physical activity that can increase cardiovascular performance4 [66].

4.4 Balance Diet

We have Balanced Nutrition Guidelines on control the diet-related issues, including four main pillars: consumption of various foods, clean and healthy lifestyle, and maintaining body weight and physical activity. Balanced Nutrition Guidelines contain ten messages: 1) be grateful and enjoy the variety of food, 2) eat lots of vegetables and fruit, 3) eat protein, 4) eat vary of carbohydrates, 5) limit consumption of sweet, salty and fatty, 6) breakfast, 7) drinking safe water, 8) read the food labels, 9)wash your hands using soap and running water, 10) physical activity and maintain body weight.

Research in Indonesia states that the consumption of rice and unhealthy foods in Indonesia must be reduced. In contrast, in terms of production, trade and food processing, it is necessary to prioritize diversification, bio-fortification, and stimulation of consumers in

Table 1. The frequency and time of monitoring risk factors

Risk factors	Healthy people	People with risk factors	People with NCDs
Fasting blood glucose	Every three year	Yearly	Monthly
2 hours postprandial blood glucose	Every three year	Yearly	Monthly
Random blood glucose	Every three year	Yearly	Monthly
Total cholesterol	Every three year	Every six month	Every three month
Trygleseride	Every five year	Every six month	Every three month
Blood tension	Monthly	Monthly	Monthly
BMI	Monthly	Monthly	Monthly
Waist circumference	Monthly	Monthly	Monthly

Source: Ministry of health, 2019

choosing, consuming and getting used to healthy and nutritious foods [67].

In general, properly balanced diet practices, increased physical activity, weight management, and abstinence from tobacco/substance use and alcohol play an improtant role in preventing and controlling NCDs [68].

4.5 Sleep Hours

Sleeping is a critical component of maintaining health and fitness. However, sleep includes both quantity and quality components, and the amount of sleep is different for each age group. For example, children (6-12 years old) need 10 hours, adolescents (12-18 years old) need 8-9 hours, adults (18-40 years old) need 7-8 hours and the elderly 6-7 hours. Meanwhile, sleep quality was measured by not often waking up when sleeping, waking up refreshed in the morning and sleeping easily 30 minutes after lying down.

Insufficient sleep is correlated with increased sympathetic nervous system activity, pituitary hypothalamus, metabolism, and altered immune response. In adulthood, short-term sleep disturbances are associated with increased stress responses, decreased quality of life, emotional and mood disturbances, cognitive decline, memory and performance. In adolescence, lack of sleep can cause mental health disorders, decreased cognitive function, learning achievement, and deviant behaviour. In the long term, disturbed sleep patterns can cause hypertension, dyslipidemia, metabolic syndrome, heart disease, weight gain, type 2 diabetes and gastrointestinal disorders [69].

4.6 Stress Management

Chronic distress is associated with an increased risk of obesity and its comorbidities. Stress is related to behavioural regulation, endocrine system, metabolism, immune, and cardiovascular disease. Uncontrolled pressure and long-term/chronic causes of several pathological conditions, including anxiety, psychosomatic disorders, metabolic syndrome, behavioural disorders, osteoporosis and impaired immune function. Stress is characterized by emotional eating/eating disorders, choosing certain foods, difficulty sleeping, impulsive behaviour, anxiety, etc. Stress disrupts hormonal regulation, triggers the release of more cortisol and catecholamines, and increases insulin levels, resulting in central obesity, diabetes and metabolic syndrome. In children and adolescents who are developing, the secretion of cortisol due to stress can interfere with growth and development, cognitive, puberty and optimal body height [70]. In today's life, stress is unavoidable, so efforts are needed to release tension, for example, recreation, gardening, playing with pets, sharing hobbies, and so on [71]. In addition, we can do a self-assessment of mental health conditions. Various instruments can be downloaded for free. One of the instruments is the Patient Health Questionnaire-9 (PHQ-9), a psychometric tool often used for depression screening [7].

5. CONCLUSION

There has been an epidemiological transition. In the 1990s, infectious diseases were more prevalent than non-communicable diseases. But starting in the 2020s, the most prevalent diseases are non-communicable diseases such

as obesity, DM, hypertension, heart disease, and stroke. NCDs are preventable diseases, but we need to provide early detection to prevent the development of NCDs. Preventing NCDs includes health status monitoring, avoiding tobacco, regular physical activity, a balanced diet, sleep quantity and quality, and stress management.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

ACKNOWLEDGEMENT

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Omran A. The Epidemilogical Transition: A Theory of Epidemiological Population Changes. Milbank Mem Fund Q 1971; 49(1):509–38. A
2. Wahdan MH. The epidemiological transition. East Mediterr Heal Journal,. 1996;2(1):80–20.
3. Shetty. Nutrition transition and its health outcomes. Indian J Pediatr. 2013;Mar;80 Sup.
4. Boutayeb A, Boutayeb S. The burden of non communicable diseases in developing countries. Int J Equity Health. 2005;4:1–8.
5. Islam SMS, Purnat TD, Phuong NTA, Mwingira U, Schacht K, Fröschl G. Non Communicable Diseases (NCDs) in developing countries: A symposium report. Global Health. 2014;10(1).
6. Frenk J G-DO. The triple burden disease in developing nations. Harvard Int Rev. 2011;33:36–40.
7. Ham SA, Martin S, Kohl HW. Changes in the percentage of students who walk or bike to School-United States, 1969 and 2001. J Phys Act Heal. 2008;5(2):205–15.
8. Gordon-Larsen P, Nelson MC, Beam K. Associations among active transportation, physical activity, and weight status in young adults. Obes Res. 2005;13(5):868–75.
9. Fishman E, Böcker L, Helbich M. Adult active transport in the Netherlands: An analysis of its contribution to physical activity requirements. PLoS One. 2015; 10(4):1–14.
10. Sirard JR, Riner WF, McIver KL, Pate RR. Physical activity and active commuting to elementary school. Med Sci Sports Exerc. 2005;37(12):2062–9.
11. Sari HP, Anggraeni L, Purnamadewi YL. Analisis Pilihan Moda Transportasi Masyarakat di Kota Bogor [Internet]; 2019. Available:https://repository.ipb.ac.id/handle/123456789/97851
12. Rachmi CN, Li M, Alison Baur L. Overweight and obesity in Indonesia: prevalence and risk factors—a literature review. Public Health. 2017;147:20–9.
13. Popkin BM, Adair LS, Ng SW. Global nutrition transition and the pandemic of obesity in developing countries. Nutr Rev. 2012;70(1):3–21.
14. Crimmins EM. Lifespan and healthspan: Past, present, and promise. Gerontologist. 2015;55(6):901–11.
15. Nchez HB n-S, Soneji S, Crimmins and EM. Past, Present, and Future of Healthy Life Expectancy. Cold Spring Harb Perspect Med. 2016;19(4):468.
16. Davison KK, Birch LL. Childhood overweight: A contextual model and recommendations for future research. Obes Rev. 2001;2(3):159–71.
17. Gassner L, Zechmeister-Koss I, Reinsperger I. National Strategies for Preventing and Managing Non-communicable Diseases in Selected Countries. Front Public Heal. 2022;10 (February):1–10.
18. Mehboob, B., Safdar, N. F., & Zaheer S. Socio-economic, environmental and demographic determinants of rise in obesity among Pakistani women: A Systematic Review. J Pak Med Assoc. 2016;66(9):1165–72.
19. Braveman P, Gottlieb L. The social determinants of health: It's time to consider the causes of the causes. Public Health Rep. 2014;129(Suppl2):19–31.
20. Braveman P. Accumulating Knowledge on the Social Determinants of Health and

Infectious Disease. Public Health Rep. 2011;3(126):28–30.

21. Assah FK, Ekelund U, Brage S, Mbanya JC, Wareham NJ. Urbanization, physical activity, and metabolic health in sub-Saharan Africa. Diabetes Care. 2011; 34(2):491–6.

22. Mishra S. Does modern medicine increase life-expectancy: Quest for the Moon Rabbit? Indian Heart J. 2016;68(1):19–27.

23. Habinger JG, Chávez JL, Matsudo SM, Kovalskys I, Gómez G, Rigotti A, et al. Active transportation and obesity indicators in adults from latin america: Elans multi-country study. Int J Environ Res Public Health. 2020;17(19):1–12.

24. Brown V, Moodie M, Mantilla Herrera AM, Veerman JL, Carter R. Active transport and obesity prevention - A transportation sector obesity impact scoping review and assessment for Melbourne, Australia. Prev medicine. 2017;96:49–66.

25. Albala C, Vio F, Kain J, Uauy R. Nutrition transition in Chile: determinants and consequences. Public Health Nutr. 2002;5(1a):123–8.

26. Jenkins RH, Vamos EP, Taylor-Robinson D, Millett C, Laverty AA. Impacts of the 2008 Great Recession on dietary intake: a systematic review and meta-analysis. Int J Behav Nutr Phys Act. 2021;57.

27. Ministry of Health. Basic Health Research 2018. Jakarta, Indonesia; 2018.

28. Hadrévi J, Søgaard K, Christensen JR. Dietary Fiber Intake among Normal-Weight and Overweight Female Health Care Workers: An Exploratory Nested Case-Control Study within FINALE-Health. J Nutr Metab; 2017.

29. McRae MP. Dietary Fiber Intake and Type 2 Diabetes Mellitus: An Umbrella Review of Meta-analyses. J Chiropr Med. 2018;17(1):44–53.

30. Abbasnezhad A, Falahi E, Gonzalez MJ, Kavehi P, Fouladvand F, Choghakhori R. Effect of different dietary approaches compared with a regular diet on systolic and diastolic blood pressure in patients with type 2 diabetes: A systematic review and meta-analysis. Diabetes Res Clin Pract. 2020;163(108108).

31. McRae MP. Dietary Fiber Is Beneficial for the Prevention of Cardiovascular Disease: An Umbrella Review of Meta-analyses. J Chiropr Med [Internet]. 2017;16(4):289–99.

32. McRae MP. The Benefits of Dietary Fiber Intake on Reducing the Risk of Cancer: An Umbrella Review of Meta-analyses. J Chiropr Med [Internet]. 2018;17(2):90–6.

33. Tong TYN, Appleby PN, Key TJ, Dahm CC, Overvad K, Olsen A, et al. The associations of major foods and fibre with risks of ischaemic and haemorrhagic stroke: A prospective study of 418 329 participants in the EPIC cohort across nine European countries. Eur Heart J. 2020; 41(28):2632–40.

34. Czepczor-Bernat, K., Modrzejewska, J., Modrzejewska, A., & Matusik P. Do COVID-19-Related Stress, Being Overweight, and Body Dissatisfaction Contribute to More Disordered Eating in Polish Women?-A Cluster Analysis Approach. Int J Environ Res Public Health. 2021;18(24).

35. Mason, T. B., Barrington-Trimis, J., & Leventhal AM. Eating to Cope With the COVID-19 Pandemic and Body Weight Change in Young Adults. J Adolesc Health. 2021;68(22):277–83.

36. Kopp W. How western diet and lifestyle drive the pandemic of obesity and civilization diseases. Diabetes, Metab Syndr Obes Targets Ther. 2019;12:2221–36.

37. Zheng C, Huang WY, Sheridan S, Sit CHP, Chen XK, Wong SHS. COVID-19 pandemic brings a sedentary lifestyle: A cross-sectional and longitudinal study. Int J Environ Res Public Health; 2020.

38. Surekha BC, Karanati K, Venkatesan K, Sreelekha BC, Kumar VD. E-Learning During COVID-19 Pandemic: A Surge in Childhood Obesity. Indian J Otolaryngol Head Neck Surg. 2021;1(7).

39. Rashid SMM, Mawah J, Banik E, Akter Y, Deen JI, Jahan A, et al. Prevalence and impact of the use of electronic gadgets on the health of children in secondary schools in Bangladesh: A cross-sectional study. Heal Sci Reports. 2021;4(4):1–9.

40. Farhangi MA, Dehghan P, Jahangiry L. Mental health problems in relation to eating behavior patterns, nutrient intakes and health related quality of life among Iranian female adolescents. PLoS One. 2018; 13(4):1–15.

41. Talukder A, Das Gupta R, Hashan MR, Haider SS, Sajal IH, Sarker M. Association between television viewing and overweight and obesity among women of reproductive age in Timor-Leste: Evidence from the demographic health survey 2016. BMJ Open. 2021;11(8):1–11.

42. Braithwaite I, Stewart AW, Hancox RJ, Beasley R, Murphy R, Mitchell EA. The Worldwide Association between Television Viewing and Obesity in Children and Adolescents: Cross Sectional Study. PLoS One. 2013;8(9).

43. Al-Hanawi MK, Chirwa GC, Pemba LA, Qattan AMN. Does prolonged television viewing affect Body Mass Index? A case of the Kingdom of Saudi Arabia. PLoS One. 2020;15(1):1–14.

44. Sarmiento OL, Lemoine P, Gonzalez SA. Relationships between active school transport and adiposity indicators in school-age children from low-middle and high-income countries. Int J Obes Suppl. 2015;5(S2):S107–14.

45. Noonan RJ, Boddy LM, Knowles ZR, Fairclough SJ. Fitness, fatness and active school commuting among liverpool schoolchildren. Int J Environ Res Public Health. 2017;14(9).

46. García-Hermoso A, Quintero AP, Hernández E, Correa-Bautista JE, Izquierdo M, Tordecilla-Sanders A, et al. Active commuting to and from university, obesity and metabolic syndrome among Colombian university students. BMC Public Health. 2018;18(1):1–7.

47. Jezewska-Zychowicz M, Gębski J, Guzek D, Świątkowska M, Stangierska D, Plichta M, et al. The associations between dietary patterns and sedentary behaviors in polish adults (Lifestyle study). Nutrients. 2018; 10(8):1–16.

48. Ministry of Health. Guidance Book of Non Comminucable Diseases 2019. Jakarta, Indonesia; 2019.

49. Ministry of Health Basic Health Research 2013. Jakarta, Indonesia; 2013.

50. Ministry of Health. National Health Indicators Survei (Sirkesnas) 2016. Jakarta, Indonesia; 2016.

51. WHO report on the global tobacco epidemic. Electronic Nicotine Delivery Systems (ENDS) are addictive and not. Heal Promot; 2021.
Available:https://www.who.int/teams/health-promotion/tobacco-control/global-tobacco-report-2021

52. Strategies ACSI and V. The Tobacco Atlas. 2022. Available from: https://tobaccoatlas.org/

53. WHO. Tobacco; 2021.
Available from: https://www.who.int/news-room/fact-sheets/detail/tobacco

54. WHO. Global NCD Target: Reduce Tobacco Use. World Heal Organ. 2016;2014–5.
Available from: http://www.who.int/beat-ncds/take-action/policy-brief-reduce-tobacco.pdf

55. Dare S, Mackay DF, Pell JP. Relationship between smoking and obesity: A cross-sectional study of 499,504 middle-aged adults in the UK general population. PLoS One. 2015;10(4):1–12.

56. Rezaei S, Hajizadeh M, Pasdar Y, Moradinazar M, Hamzeh B, Najafi F. Association of smoking with general and abdominal obesity: Evidence from a cohort study in West of Iran. J Res Health Sci. 2018;18(1):1–5.

57. Hjellvik V, Selmer R, Gjessing HK, Tverdal A, Vollset SE. Body mass index, smoking, and risk of death between 40 and 70 years of age in a Norwegian cohort of 32,727 women and 33,475 men. Eur J Epidemiol. 2013;28(1):35–43.

58. Ostendorf DM, Caldwell AE, Creasy SA, Pan Z, Lyden K, Bergouignan A, et al. Physical Activity Energy Expenditure and Total Daily Energy Expenditure in Successful Weight Loss Maintainers. Obesity. 2019;27(3):496–504.

59. Childs E, de Wit H. Regular exercise is associated with emotional resilience to acute stress in healthy adults. Front Physiol. 2014;5(May):1–7.

60. Hamasaki H. Daily physical activity and type 2 diabetes: A review. World J Diabetes. 2016;7(12):243.

61. Wang Y, Xu D. Effects of aerobic exercise on lipids and lipoproteins. Lipids Health Dis. 2017;16(1):1–8.

62. Nystoriak MA, Bhatnagar A. Cardiovascular Effects and Benefits of Exercise. Front Cardiovasc Med. 2018;5(September):1–11.

63. de Vries OM, Johansen H, Fredwall SO. Physical fitness and activity level in Norwegian adults with achondroplasia. Am J Med Genet Part A. 2021;185(4):1023–32.

64. Gando Y, Sawada SS, Momma H, Kawakami R, Miyachi M, Lee IM, et al. Body flexibility and incident hypertension: The Niigata wellness study. Scand J Med Sci Sport. 2021;31(3):702–9.

65. WHO. Physical activity; 2020.
Available from: https://www.who.int/news-room/fact-sheets/detail/physical-activity

66. de Pee S, Hardinsyah R, Jalal F, Kim BF, Semba RD, Deptford A, et al. Balancing a sustained pursuit of nutrition, health, affordability and climate goals: exploring the case of Indonesia. Am J Clin Nutr. 2021;114(5):1686–97.

67. Passi SJ. Prevention of Non-communicable Diseases by Balanced Nutrition: Population- specific Effective Public Health Approaches in Developing Countries. Curr Diabetes Rev. 2017; 13(5):461–76.

68. Medic G, Wille M, Hemels MEH. Short- and long-term health consequences of sleep disruption. Nat Sci Sleep. 2017;9:151–61.

69. Pervanidou P, Chrousos GP. Stress and obesity/metabolic syndrome in childhood and adolescence. Int J Pediatr Obes. 2011;6(1):21–8.

70. Worthen M, Cash E. Stress Management. In StatPearls. StatPearls Publishing. In StatPearls. StatPearls Publishing; 2021.

71. Kurt Kroenke MD, Robert L, Spiitzer MD,, Jonet BW WD. The PHQ-9 Validity of a Brief Depression Severity Measure. JGIM. 2001;16:606–13.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/87044