

Determinants of obesity among children and policy and program responses in Thailand.

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Thailand

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A Thesis submitted in partial fulfillment of the requirement for the degree of Master of Public Health

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The thesis "Controlling the Non-communicable diseases among Buddhist Monks in Thailand: Social Determinants and Process.

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List of Abbreviations

Abbreviation	Stand for
ADHD	Attention deficit hyperactivity disorder
CGD	Comptroller General's Department
CSMBS	Civil Servant Medical Benefit Scheme
BMI	Body mass index
BON	Bureau of Nutrition
DALY	Disability-Adjusted Life-Year
DDC	Department of Disease Control
DOH	Department of Health
DPAC	Diet and Physical Activity Clinic
FBT	Fatless Belly Thais
Thai FDA	Food and Drug Administration in Thailand
TPAG	Thai Physical Activity Guideline
FTO	Fat mass and obesity-associated protein
GDA	Guideline Daily Amount
GDP	Gross Domestic Product
HESRI	Ministry of Higher Education, Science
HITAP	Health Intervention and Technology Assessment Program
HTA	Health Technology Assessment
LD	Linkage disequilibrium
MCH	Maternal and child health
MOE	Ministry of Education
MOF	Ministry of Finance
MOI	Ministry of Interior
MOPH	Ministry of Public Health
NCD	Non-communicable disease
NGO	Non-government organization
NHSO	National Health Security Office
PARC	Physical Activity Research Center
PHO	Partially hydrogenated oils
PPP	Purchasing-Power-Parity
P&P	Health promotion and disease prevention
SD	Standard Deviation
SDG	Sustainable development goal
SSB	Sugar-Sweetened Beverage
SSO	Social Security Office
SSS	Social Security Scheme

ThaiHealth	Thai Health Promotion Foundation
THB	Thai Baht
TPAG	Thai Physical Activity Guideline
UCS	Universal coverage scheme
USD	U.S. Dollar
VU	Vrije University
WH	Weight-for-Height
WHO	World Health Organization

Glossary

Obesity and Overweight: an excess accumulation of adipose tissue in the body to the extent that physical health may be adversely affected, whereas the term “overweight” describes the excess body weight to height (1). Regarding the Clinical Practice Guidelines for the Prevention and Treatment of Childhood Obesity, the Committee on Pediatric Obesity in Thailand assesses obesity in children based on the median of weight-for-height (WH) and body mass index (BMI), meanwhile, the severity of the obesity assessment tool in children will % WH (2).

Criteria for obesity diagnosis in children using BMI

	Normal	Overweight	Obesity
Weight	≥ median -2 SD and ≤ median + 2 SD	> median + 2 SD and ≤ median + 3 SD	> median + 3 SD
Height	≥ median -1 SD and ≤ median + 1 SD	< median + 1 SD and < median + 2 SD	≥ median + 2 SD

Criteria for severity of obesity in children using % WH

	Overweight	Obesity	Morbid obesity
% WH	> 110 - 140	> 140 - 200	> 200

Children: in this study refers to people aged between 1-12 years, including toddlers aged 1-3 years, preschool-aged 3-5 years, and grade-schooler aged 5-12 years.

Developmental growth: MOPH defines it is not only weight and height but gross motor, fine motor, receptive language, expressive language, personal and social, as well as executive functions of the brain (3).

Enough physical activity: WHO recommends children and adolescents aged 5-17years should do at least 60 minutes of moderate to vigorous-intensity physical activity daily (4).

National health policy: a formal statement or procedure within an institution that defines goals, priorities, and the parameters for action in response to health needs, within the context of available resources. In Thailand, most national health policies were developed parallely with strategy; sometimes they were disseminated together as national policy and strategy.

National strategy: based on national health policy, a set of decisions that includes the broad lines of action required in all sectors involved to give effect to the national health policy and indicates the problems and ways of dealing with them. It was mentioned above that most national policies were disseminated together with the strategy in a Thai setting.

Action: an activity or set of activities aimed at modifying a process, course of action, or sequence of events in order to change one or several of their characteristics, such as performance or expected outcome. For example, it is used in public health to describe a program or policy designed to have an impact on an illness or disease.

Abstract

Background: Thailand is facing a problem of childhood obesity and has become the third highest in Southeast Asia. Obesity has both short- and long-term consequences to children's health, resulting in many health conditions and premature deaths.

Objectives: To explore the drivers of childhood obesity and analyze existing national policies, strategies, and actions of childhood obesity prevention in order to advise policymakers on taking appropriate actions in Thailand.

Methodology: Literature about social determinants of obesity among Thai children was reviewed through online databases and search engines. Both Thai and English studies published from 1988-2018 were included. National policies, strategies, and actions of childhood obesity were reviewed and identified flaws and enablers. Then, empirical evidence was reviewed to find measures that are recommended to tackle the identified gap.

Result: Individual factors of Thai children (i.e., eating behavior and exercise) are a crucial determinant of obesity which is influenced by internal factors (i.e., a distinct of age and sex) and external factors (i.e., parenting, social and community support, and general-socio economic, culture, and environmental condition). The current policy and strategy in response to childhood obesity in Thailand are developed by multisector collaboration, which relies on international guidelines and practices. However, some actions are desirable to improve for more effective, and the Thai government should develop some actions responding to the gaps of the determinant of obesity among Thai children.

Conclusion: Thai government should implement positive incentives in order to tackle childhood obesity. Moreover, monitoring and evaluation systems, supporting nutritionists in primary care, conducting routine nutrition training, creating appropriate media increasing knowledge and awareness regarding obesity, and supporting research on effective and cost-effective actions, are needed to invest by the government.

Keywords: obesity, children, health promotion, disease prevention, Thailand

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¹ Excluding figure, table, picture, reference, and annex

Introduction

Childhood obesity is a significant public health issue worldwide. Thailand has an increasing number of overweight and obesity among children. Children are ages of developing physical, emotional, intellectual, and personality, which deserve to get well care and nutritious food in order to prevent illness in the future. Obesity does not cause only physical problems but mental, intellectual, and developmental disorders. Therefore, children who are going to be an essential group in developing countries must have wellbeing. It is interesting to review risk factors affected by obesity among children, existing policies and actions in prevention of the risks, and evidence specific to children in obesity prevention in order to inform policymakers in Thailand for further health system development.

This thesis is both personally and professionally motivated. I have four-year-old and seven-year-old nieces who are studying at an elementary school. The oldest niece is overweight, and the little niece is categorized as obese, while their parents have normal weight. One thing I observed from them, generic is not a factor causing their conditions, but it might be external factors like a sedentary lifestyle related to their parents and the environment. I think childhood is a great time to raise healthy eating and physical activity habits, which are critical for optimal child health, growth, and development. Shortly, I will marry and have a child; it is an excellent opportunity to study this kind of issue. At the same time, I am a researcher at the Health Intervention and Technology Assessment Program (HITAP) where it is a non-profit organization emphasizing Health Technology Assessment (HTA). As I work closely with policymakers for supporting the empirical evidence, I realize that they finally decide policy based on scientific evidence. Therefore, this comprehensive review will be useful for informing policymakers on time in the circumstance of the high pervasiveness of obesity among children and need a dire strategy to explain it.

Chapter 1 Country Overview

1.1 Geography

Thailand is a country located in the Centre of Mainland South-East Asia. It borders Myanmar and Laos to the North, Laos and Cambodia to the East, Myanmar and the Andaman Sea to the West, and southwardly Malaysia together with the Gulf of Thailand. The country covers an approximate area of 514,000 square kilometers, divided into 77 provinces across six geographical regions where Bangkok, a part of the central region, is a capital city (*Figure 1*) (5).

1.2 Demography

In 2018, the estimation of Thailand's population was 68,414,135 million (49% male and 51% female) with the annual population growth of 0.3% (6) The proportions by age structure from the 25-54 years as the largest (46%), followed by the 0-14 years (17%), 15-24 years (14%), 55-64 years (12%) and the 65-and-over years as the smallest (11%). The highest population density is concentrated in urban areas, particularly Bangkok (10.2 million) and other major provinces (5.2 million). Over the past decades, the majority of Thailand's total population has been classified as rural.

1.3 Economy

Thailand's economic growth was 3.8% in 2018 with the Purchasing-Power-Parity (PPP) based on Gross Domestic Product (GDP) of USD 19 thousand per capita (7). The significant economic contributions since 2017 include the value of export, import, and tourism, accounting for USD 217 billion, USD 203 billion, and USD 32 million, respectively (8). Besides, 1) the expansion of Thailand's service sector, 56% to GDP followed by industrial (35%) and agricultural sector (9%) (5) and 2) the implementation of governmental reform towards the utility of technological advancement (e.g., Thailand 4.0 Policy) in businesses further accelerate the economy despite the ongoing unemployment (1% to GDP), public debt (42%) and household debt (68% to GDP) (8).



Figure 1 Map of Kingdom of Thailand

1.4 Language

While people across Thailand's six geographical regions and along borders may communicate numerous minor languages, including Lao Esan, Pak Tai, Kham Muang, Yawi, Etc. (9). Central Thai is considered as the sole official language in Thailand. Further, English becomes a second language limited mostly to the privileged class (6) and is one of the compulsory subjects in most levels of the country's education. However, Thailand is still ranked very low in English proficiency compared to other non-English-speaking countries all over the globe (10).

1.5 Education

Thailand's education includes formal, non-formal, and informal (10). The formal education comprises the basic and the higher level and is only mandatory up to 12 years of primary education (pre-school to lower secondary level), being fully sponsored in public schools by the government. Children start to go to kindergarten at age 3 to 5 years (called *Anuban*) and continue their study at the elementary level (called *Prathom*) for 6 years, then lower-secondary level (called *Matthayom*). After graduated *Matthayom* 3, pupils can pursue upper-secondary education in a general track (university-preparatory) or vocational track (11). Education in Thailand is provided mainly by the Thai government through the Ministry of Education (MOE), about THB 368 billion in 2020 (12). There are two main types of schools

in Thailand, public schools administered by the government and private sector schools run for-profit and non-profit. Most of the kindergarten and elementary pupils are studying in public school (75%), while 25% of them are in private school (13). Moreover, all public kindergartens and elementary schools get financial support from the central government to provide free lunch. The policy has been established by MOE since 1952 in order to encourage all Thai children to enter into the educational system without any financial burdens to their parents. Until 2003, the responsibility to support free lunch in schools was transferred to the local government (14). Overall, statistics in 2018 illustrates that 94% of the total population aged 6 years and above (95% males and 93% females) in Thailand can read and write (15).

Table 1 Thai education system

Approximate age	Grade	Level of education	Vocational education	Free education	Free lunch	
3		Kindergarten (Anuban)		yes	yes	
4						
5						
6	1	Elementary (Prathom)				
7	2					
8	3					
9	4					
10	5					
11	6					
12	7	Lower-secondary (Matthayom)				Lower vocational and technical
13	8					
14	9					
15	10					
16	11					
17	12	Undergraduate	Tertiary vocational			
18						
19						
20						
21						

Source: adapted from Kongkiat Kespechara. Using Tag-Bot and Learning Analytic to evaluate Media Literacy in Rural Primary Schools in Thailand. In: 2nd Annual Learning & Student Analytics Conference. Amsterdam, The Netherlands; 2018. (16)

1.6 Religion

According to the data collected in 2015, the majority of religion among the Thai population was Buddhist (94%), followed by Muslims (4%), Christians (1.2%), other (0.2%) and none (0.1%) (5).

1.7 Health

The total life expectancy at birth in 2016 was estimated at 75 years (72 years in males and 78 years in females) (3). In 2019, the total fertility rate was estimated at 1.52 children born/woman, and the infant mortality rate (per 1000 live births) was 8% (17). Non-communicable diseases (NCDs) were caused by metabolic risks, environmental/occupational risks, and behavioral risks (18). NCDs and risk factors contributed to 37% and 40% of total Disability-Adjusted Life-Years (DALYs) among age groups 0-4 and 5-14, respectively (19). Obesity is a key factor related to NCDs in Thailand. The 4th National Health Examination Survey (2009) figured that Thai children aged 1-5 years were overweight 3.5% and obesity 8.5%. In 2019, the percentage of overweight/obesity among children under the age of 5 years had excess the standard ($\geq 10\%$), averages 11% of the total number of screening (20). (Figure 2)

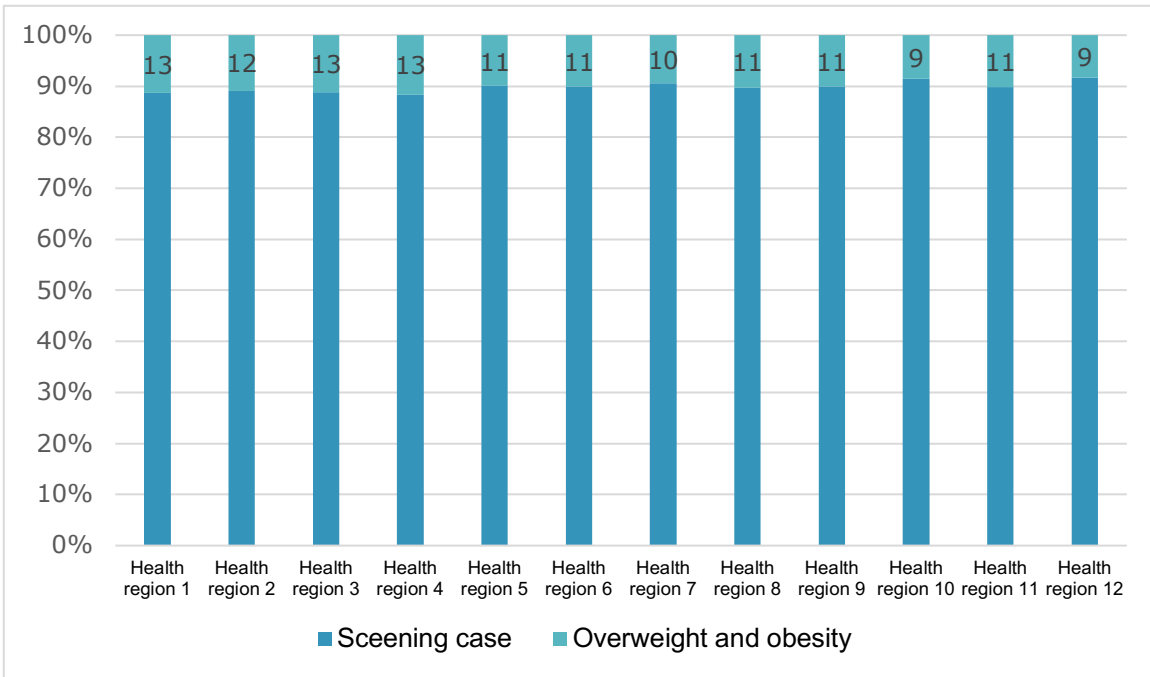


Figure 2 Percentage of overweight/obesity among children under the age of 5 years in 2019, divided by health region

1.7.1 Health facility

Public healthcare facilities are categorized into levels – primary, secondary, and tertiary care. (Figure 3) Primary care includes public health center where solely out-patient care is available, and health promotion and disease prevention program is highlighted in this level. Meanwhile, secondary care refers to community Hospitals and general hospitals – both in and out-patient care are delivered, but medical items are different depending on the size of the hospital (number of beds). The last, tertiary hospital means university hospitals, regional hospitals, and specialized hospitals, serving advanced medical care in 4 regions in Thailand (except Bangkok) (21).

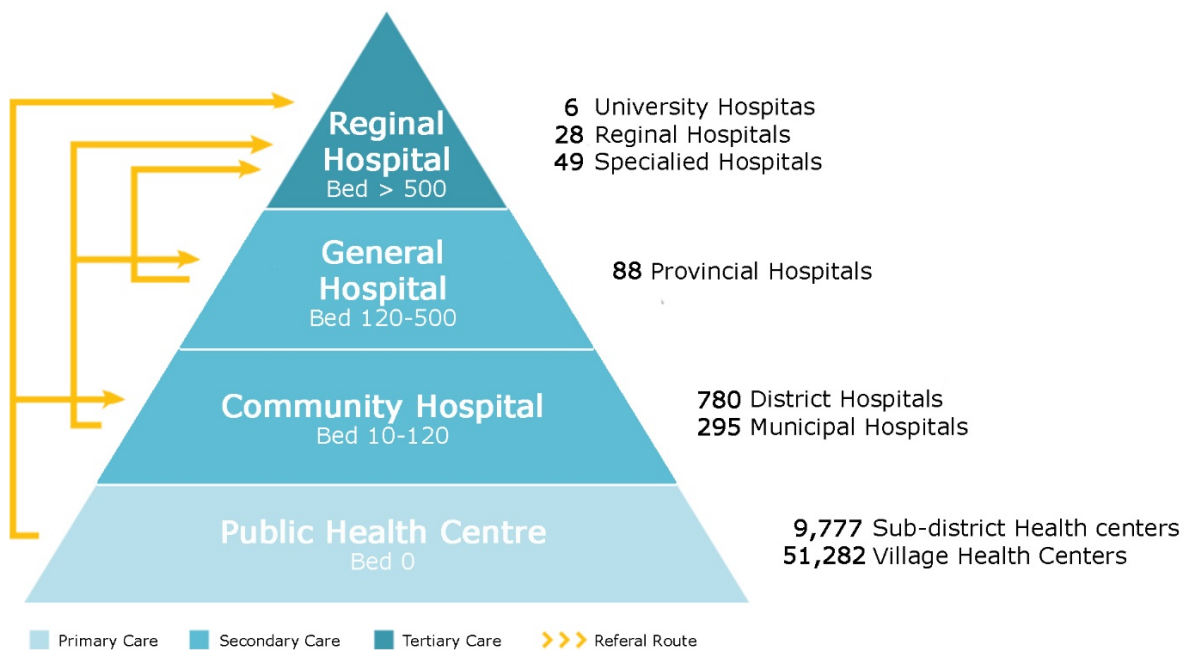


Figure 3 Number of Public Health Facilities in Thai Health System, 2015

1.7.2 Human workforce

Five major areas in the field of health include doctors, dentists, pharmacists, nurses, and midwives, and have increased in the last three decades. In 2015, the total number of health workers in Thailand were 184,487, calculated to proportion per capita was 2,399 doctors per person, 8,395 dentists per person, 5,562 pharmacies per person, 492 nurses per person, and 9,423 midwives per person. There was 64.4% of those working in the public health sector. Distribution of health workers is still a problem in the kingdom, although the proportion of health workers per population has improved in all regions (21).

1.7.3 Health financing system

In 2015, Thailand spent total health expenditure on 3.76% of GDP, averaged per capita was USD 216. The government contributed to the total health expenditure was USD 167 per capita (or 77%) during the same year (22). There are three public health insurance schemes in Thailand - Universal Coverage Scheme (UCS), Social Security Scheme (SSS), and Civil Servant Medical Benefit Scheme (CSMBS) which are different legislation, administration, sources of finance, and payment methods (23). (Annex 1) The UCS is the most significant health scheme which covers almost 90% of children, the rest is CSMBS because parents are government officers.

The Thai health system separated the role of health providers and purchasers to increase accountability and transparency. Ministry of Public Health (MOPH) plays an essential role in health providers, and it is also a regulatory agency setting norms and standards of healthcare services. By contrast, the purchasers who play a role in purchasing health care services based on evidence and the health needs of their citizens will be different following the health scheme due to different finance pooling systems – contributory and non-contributory. Therefore, funding management and responsive organization are different.

National Health Security Office (NHSO) uses capitation payment linked with the number of registered members in an area to purchase both essential services and health promotion and disease prevention programs under the UCS. In 2019, the amount spent on general out-patient services THB 1,179 per head, in-patient services THB 1,295 per head, specific vertical programs, e.g., high-cost care, disease management programs, health promotion, and disease prevention program THB 431 per head (or 13% of health budget), and other services THB 521 per head (17). Meanwhile, the direct budget to the Department of Health (DOH), the primary central agency responding to maternal and child health under MOPH, got THB 19 million in 2019 (24). In the case of the external source of money, World Health Organization (WHO) collaboration with MOPH plans to spend THB 95 million to achieve nine targets of the National Non-communicable diseases Prevention and Control Strategy (2017-2021) (25).

1.7.4 Leadership and governance

Thailand is attempting to achieve the mortality targets for NCDs following the Sustainable Development Goals (SDG 3.4). NHSO has a purchasing strategy to improve the detection, screening, prevention, and compelling coverage of several NCDs. MOPH has indicated in the Thailand Healthy Lifestyle Strategy (2011-2020) about the target of healthcare development to deal with five critical NCDs and risk factors in Thailand. The critical risk factors include diabetes, high blood pressure, heart disease, stroke, and cancers, to reduce morbidity, mortality, health complications, disability, and health expenditure, further healthy diet, physical activity, and mental health are planned to promote within ten years of the plan (26).

Thailand's national government organization is divided into three types: the central government (ministries, bureaus, and departments), provincial government (provinces and districts,) and local government (Bangkok, Pattaya city, provincial administrative organizations, etc.)(19). According to the public health administration, MOPH has been generated a regional health system to decentralize the administration into 13 health regions, managing its specific health problems and increasing the quality of care. Due to the decentralized system, hospitals and health centers at the provincial level can prioritize the problem correctly to their setting and select the interventions from the recommended program where guidelines to conduct a central agency like MOPH develops activities (23). Seven responsibilities were transferred for health services to local government organizations e.g., promotion of maternal and child health and promotion of health for children and the elderly (27).

Chapter 2 Problem Statement, Justification, Objectives, Methodology

2.1 Problem statement

Economic and social changes around the world affect lifestyles, one effect being in the form of excess food intake and decreased rates of physical activity, leading to rapid rates of obesity and chronic NCDs. In 2013, WHO highlighted that 42 million children under the age of 5 were overweight and obese, particularly in urban settings of low- and middle-income countries (28). Thailand has the third-highest number of obese youths aged between 5 and 19 years old in Southeast Asia, after Malaysia and Brunei.

Statistics show an increasingly prevalent trend in overweight and obesity among Thai children between 2001 and 2009 (29). The Holistic Development of Thai Children study in 2001 showed that overweight and obesity among preschoolers was 3% and 7.9%, respectively (30). In 2003, the 5th National Food and Nutrition Survey showed the percentage of overweight Thai children was approximately 2.6%, while obesity was 4.0% (31). The 4th National Health Examination Survey (2009) showed that overweight and obesity among Thai children were 3.5% and 8.5%, respectively. The above surveys show a worrisome trend in which Thailand could miss its target of improving nutrition and achieving food security by 2030.

Obesity has both short- and long-term consequences to children's health, which will lead to becoming obese as adults, resulting in various health problems and premature deaths (32). Obese children are prone to muscle development deficiency as well as the risk of having high levels of insulin, glucose, and cholesterol in the bloodstream (33). High cholesterol causes cardiovascular disease, high blood pressure, type 2 diabetes, as well as certain types of cancer (34). Meanwhile, obese children will have abnormal levels of carbon dioxide in their bloodstream, which can hinder their learning process, especially in mathematics, and cause them to have attention deficit hyperactivity disorder (ADHD) (35). Obese children also tend to suffer from low self-esteem and are prone to depression, stress, and lack of confidence, causing them to isolate themselves and become incapable of adapting to society (36).

The Institute for Health Metrics and Evaluation reports a high body mass index contributes to the 18.6 DALYs lost per 100,000 children under 5 years of age in Thailand in 2017 (37). Although there is no economic impact of obesity among children, all age groups of the obesity in Thailand impact cost to society approximately \$404 million annually, from which \$186 million are spent on direct health care cost for both out-patient and in-patient and the remaining \$218 million on indirect costs such as premature mortality and hospital-related absenteeism (38).

2.2 Justification

Regarding the problem statement, it may be justifiable given that childhood overweight and obesity have immediate and long-term effects on health and wellbeing. Those who have been overweight or obese since childhood seem to have more adverse severe consequences later in life. Obesity will have a direct impact on both physical and mental health as well as society. Obesity in children can be caused by many factors and need to be explicitly considered from a Thai perspective in order to be relevant to obesity among Thai children. Thailand has attempted to address NCDs, of which overweight and obesity are important risk factors. As it can be seen from the National Non-Communicable Diseases Prevention and Control Policy (2017-2021), which was created with the aim of reaching high-risk groups such as obesity, tobacco use, and alcohol drinker, and using a multisectoral approach to work on NCD risk factors prevention and control (39).

As the number of obese children in Thailand is increasing, the existing national policies and programs of obesity prevention should be reinvestigated to find its barriers and enablers. Also, etiology evidence on the determinants of overweight and obesity among Thai children should be reviewed in order to propose comprehensive policy solutions to those determinants based on international recommendations and local studies.

2.3 Objectives

To explore the drivers of childhood obesity and analyze existing national policies, strategies, and actions of obesity prevention in order to advise policymakers on taking appropriate actions in Thailand.

- To identify and examine the determinants of obesity among children in Thailand.
- To review existing national policies, strategies, and tackling actions for obesity in children.

- To identify flaws and enablers of national policies, strategies, and actions of obesity among children in Thailand.
- To review evidence on the measures which are used to tackle the identified gap.
- To provide recommendations to assist future policy developers in decision-making in public health.

2.4 Methodology

2.4.1 Search strategy

This study is a literature review on social determinants of obesity among Thai children. Domestic and international publications on PubMed, Google, the Journal of the Medical Association of Thailand, the Thai Digital Collection (ThaiLis database), and Vrije University (VU) online databases identified by considering the Dahlgren and Whitehead's health determinants model (see the detail of search terms in Annex 2). Studies published in Thai and English between 1988-2018 were included in the study. Digital snowballing functions via related citations on PubMed were used to search articles relevant to the original search, accompanied by manual searching.

National policies, strategies, acts, laws, government meeting minutes, government activity reports, policy statement drafts, guidelines, protocols, as well as news were reviewed and identified flaws and enablers of national policies, strategies, and actions of obesity among children in Thailand.

Empirical evidence was retrieved from both domestic and international studies with the same inclusion criteria and sources as mentioned above. Also, international guidelines, best practices, and peer review documents were reviewed.

2.4.2 Conceptual framework

To complete the study purposes, the Dahlgren and Whitehead's health determinants model (40) was adapted for a comprehensive review of factors influencing childhood overweight and obesity. (**Error! Reference source not found.**) This framework is widely used in the analysis of many health problems, including obesity, in order to understand the complexity of factors contributing to the disease. The framework explains the social determinant of health, starting from the innermost circle, i.e., fixed personal factors such as gender, age, genetic or innate traits. The next circle in Figure 4 consists of factors related to individual lifestyles, such as diet and physical activity. The third circle is the influence of social and community networks, which correspond to the behaviors of individuals and may or may not support health. This study includes family, child caretakers, and teachers as social and community networks of children. The fourth circle is a structural factor influencing an individual's ability to maintain a healthy lifestyle, living and working conditions, health care, and housing, for instance. The outermost circle comprises general factors from society, culture, and environment, which can influence the factors from the inner levels.

In order to conform with the main focus of this study, children's health, the educational level, and employment of family members were considered instead. School conditions were substituted as working conditions and environment, considering that children spend most of their time there.

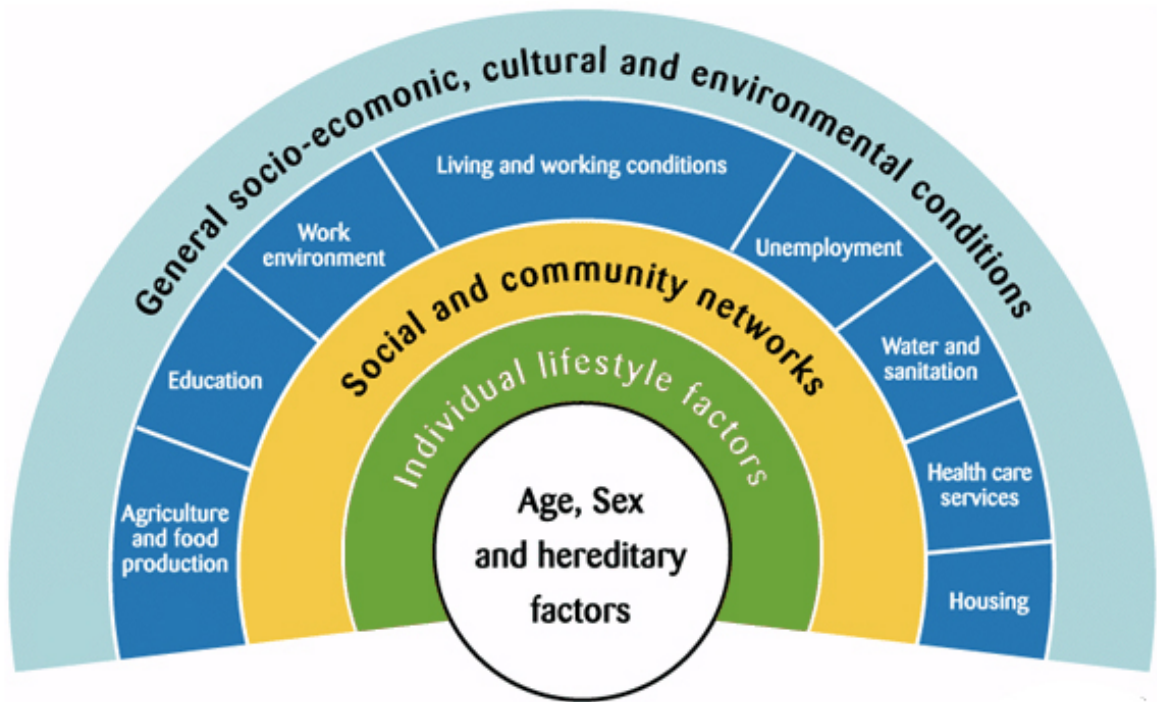


Figure 4 Dahlgren and Whitehead's health determinants model

3.1 Determinants influencing overweight/obesity of children in Thailand**3.1.1 Age, sex, and hereditary factors**

Elementary school children (6–11 years old) were found to have the highest percentage of overweight, whereas obesity was found to be prominent in preschool children (3–5 years old). Overweight and obesity were significantly higher among boys than girls (41) even though girls have higher relative fat mass and a distinct fat distribution pattern compared to boys during infancy and childhood (42). Similarly, Thai girls spend less than 3 days per week doing 60 min of moderate-intensity physical activity (43) while boys often went out and spent more time outdoor than girls, but these sedentary behaviors do not exert significant risk for being overweight among boys (44).

Genetic factors are unchangeable. According to a study in Thailand, 30–70 percent of obesity among preschool and elementary school children were hereditary. Children with obese parents are 5 times more likely to become obese themselves. If both parents are obese, the likelihood of becoming obese increases up to 13 times (45). Other genetically linked causes of child obesity have been reported. A vital gene variant associated with obesity is the fat mass and obesity-associated protein (known as the FTO gene) – which controls appetite and body metabolism. FTO variants are not only strongly associated with increased BMI and risk of obesity in groups with European and American ancestry, but also Thai. The FTO variants were significantly associated with Thai children between 8–20 years of age. Strong linkage disequilibrium (LD) in the first intron of the FTO gene increases the risk of child obesity by 2.42 times (46). A relevant study shows that FTO variants are associated with BMI in children older than 7 years of age (47).

3.1.2 Individual lifestyle factors

Obesity caused by children's behavior often stems from the behavior of family members, such as diet and exercise habits. According to a survey of the food intake of preschool children in a year, 40% receive inappropriate foods – the number of crunchy snacks and soft drinks consumed by children increased to 1.8 and 1.5 times, compared by year, respectively (48). Although there is no study showing the relationship between snack/sweet beverage consumption and obesity among Thai preschool children, irregular snacking has been reported to be significantly related to obesity in 3-year-old children in Japan (49).

Thai children aged 6–14 years old spend more than an hour a day playing games and more than two hours a day. Time spent on electronic media usage not only reduces time allocated to physical activities, but also increases consumption of fast foods and overly-sweetened beverages among Thai children, which are induced by the value of 'modern' lifestyles, social events celebration in fast-food restaurants, and advertising, as well as by the convenience, fast and taste (50). This affects the balance between incoming and outgoing energy of this age group (44).

Food responsiveness and enjoyment of food are associated with obesity among Thai preschools. One-thirds children aged 1-5 years had only their favorite foods and parents often use those foods to soothe their children's negative emotions or distress (51). The study found that Thai preschools enjoyed sweetened milk, yogurt, sweets, candy toffees, chocolate, and ice-cream 3-7 times/week (52). Food responsiveness is an obese individual factor related to food cues in the internal (i.e., satiety sensitivity; hunger signal; leisure activity) and external environment (e.g., a fast food store opening in the neighborhood; access to new forms of transport) (53).

3.1.3 Social and community network

Dietary behavior and physical activity of members in the family also influence the habit of children of the same household, especially preschoolers, (54) since parents need to prepare food for their children, and children's activities are typically controlled by the parents. To promote physical activity of preschoolers, parents must allocate their time to encourage their children to exercise in public parks or playgrounds. One of the major categories which impact the socio-cultural aspect of physical activity is social support from parents and/or peers. There are strong associations between parenting practices and children's physical activity (55).

Breastfeeding is promoted among Thai society because it is an essential factor to avoid overweight in infants. Non-breastfed infants are more likely to become overweight, accounting for 20%. It is because mothers gave breast-milk substitutes to their babies too often and in excess (56). Infants from low-income families are less likely to be breastfed because the mother has spent more time working in order

to earn money. Furthermore, they are more likely to have a low birth weight and be fed sugary foods and drinks, which raises the likelihood of obesity and tooth decay (57). As a result, although infants from poor families in Thailand are more likely to have low birth weight, they are likely to become overweight later on.

3.1.4 Education and unemployment

Education and employment of parents and caregivers are key influences on children's behavior. In Thailand, 66% of preschool and 74% of elementary school students were looked after by their mothers in many aspects –showering, eating, homework, and going to bed. Mothers with higher education tend to have higher scores of health promotion for their kids regarding the survey (58). Educated mothers often promote healthy habits by providing healthy foods and controlling proper portions of food, snacks, and beverages (59). Children with parents in health professions such as doctors, nurses, and nutritionists will tend to have appropriate dietary behaviors, owing to their parent's knowledge of nutrition (60).

Meanwhile, 34% of Thai preschool and 26% of elementary school children were taken care of by their grandparents or other caregivers, depending on the socioeconomic status of the family. In low-income families, parents need to work, thereby leaving their children in the care of others, which is not necessarily better than being cared for by their parents directly. If the caregivers themselves do not have a good health background, there is a high risk of the children under their care becoming overweight (61).

Full-time housewives are associated with the obesity of children in Thailand. A study reported that families with employed mothers are more likely to have obese children (62). This is because employed mothers do not have time to cook nutritious food for their children and are more likely to take their children to eat out at restaurants (61).

3.1.5 School environment

A student health survey in large schools in Bangkok found that private schools tend to have a higher number of overweight/obese students than public schools (63) even though private schools tend to offer a wide array of extracurricular activities and many world-class facilities (i.e., big football fields, tennis courts, swimming pools) for their students (64). A study has highlighted that school environmental factors, for instance, school curriculum, playground equipment, and school safety issues can lead to an increase in physical activity, which is a key to maintaining a normal weight (55). However, this is not the case among Thai students at private schools.

3.1.6 Living and school conditions

The building environment is recognized as a determinant of obesity due to its influence on food intake and physical activity (65,66). It is comprised of homes, buildings, streets, open spaces, and infrastructure, including transportation systems, as well as their design, configuration, and ease of connectivity (65). There is growing evidence that specific building environment characteristics impact physical activity and food intake, which affects body weight (67). In Thailand, 68% of elementary school students live in detached houses that have space bigger than 5 square meters, including gardens, except for those living in Bangkok, which mainly consists of townhouses that lack space do children to do outdoor activity. Only 45% of all families have child-oriented resources such as playgrounds, libraries, or public reading areas for children (68).

Geographic access to healthy, affordable, and nutritious food has a great influence on the community's nutritional environment linked to the building environment. The majority of Thai households are located near markets and shops, with easy access to foods as well as snacks and beverages (68). At the same time, Thai people in communities also have easy access to health centers, with an average distance of 3.85 km from their homes. Health centers play an important role in providing primary healthcare and disease prevention (69). If there was a campaign on overweight and obesity prevention for children in the community, health centers would be crucial in providing them access.

In Bangkok, the higher housing density and less access to green space increase the risk of obesity in children. People living closer to green spaces are more physically active and consequentially their children have been found to gain significantly less weight. Playing outdoors, exercising, and access to green space have also all been found to support good mental health and development in children (57). Children living in Bangkok have the highest percentage of overweight and obesity when compared to other regions. Childhood obesity was found to be 22.7% and 7.4% in urban and rural areas respectively (58). This reflects the different types of transportation in urban and rural areas of Thailand.

Whereas 80% of schools are public schools located in rural (often remote) areas, (70) in which students walk or cycle to school, the remaining 20% are public schools located in urban areas, in which students have easy access to public transportation, or are brought to school by their parents. As Thailand becomes increasingly urbanized, a more comfortable lifestyle leads to people's lack of physical movement (71,72).

In Thailand, there is a school meal policy that preschoolers and school students must have lunch provided for at their kindergarten and elementary schools, respectively (73). A study from Kai, et al. reported that dishes offered to schoolchildren contain a high amount of fat, due to the preferred choice of food by preschoolers and students, and insufficient quantities of vegetables and fruits, which are relatively expensive. School teachers hesitate to procure meals and dishes rich in vegetables and fruits (74); thus, this could be one of the determinants of overweight and obesity among Thai children. In some countries such as Australia, parents prepare lunchboxes for their children to eat at preschool (75), and thus, the nutritional value of the lunch depends on parents' education (healthy food knowledge) and employment (free time for food preparation) as aforementioned.

3.1.7 General-socio economic, culture, and environmental condition

Socioeconomic and environmental changes affect obesity in children. Parents with secure well-paying jobs will be able to provide healthy foods and support the physical activities of their children (76). A study on the relationship between family income and food consumption behavior of schoolchildren found that children from high-income families have better eating habits than those from low-income families (71,77). Private school students, who are mostly from high-income families, have a higher incidence of overweight/obesity than public school students. This is evidence of a link between household income and children's health; children from poor families having a higher risk of malnutrition, tooth decay, and injury, for example (57). This may be because wealthy families may provide foods exceeding children's needs, especially high energy foods. Due to economic changes, parents need to work in order to earn money and thus do not have time to cook for themselves, as well as for their children. Most families buy Western instant foods to eat without even considering the ingredients and benefits that will be gained from them (77).

Parents can be good role models by maintaining healthy eating habits and physical activity, and provide a home environment that supports such lifestyles (e.g., type of foods purchased; presence of home gym) (78). This is more relevant in children from middle to high socioeconomic environments compared to their low socioeconomic environment counterparts (60). There is a worrisome trend of a widening inequality gap in terms of access to food. The problem of food access continues to be a significant consequence of social inequality, as the poor have limited food choices and often do not get enough, while the rich enjoy privileged access to more massive amounts and diverse varieties of food (79).

Generally, weight is considered to be a natural part of social conversations in many Asian cultures, including Thailand. While chubby children are considered cute, there is an opposite and negative reaction to overweight and/or obese adults, although there is no pushback on these perceptions. Parents, particularly those in the countryside of Thailand perceive overweight children cute. In Thai culture, people spoil their youngest boy and only one child in every matter, even more than with just good foods, so they tend to be fatter than others because of too much indulgence (80). Moreover, the norm of Thai parents uses food to reward or change the behavior of their children; it was related to infant weight gain (51).

It is undeniable that the internet and other media play an important role in the daily routines of all age groups. A study by Jaichuen, et al. found that snack and soft drink entrepreneurs target their marketing on preschoolers and use television advertisements as the main media to stimulate the consumption of sweets since it is the easiest way to reach children. Such advertising is regarded as an environmental condition related to the dietary behavior of children in Thailand (81). Consistently, another study by Chaiyasung, et al. found the influence of snack and soft drink advertising media on the food consumption behavior of overweight students to be statistically significant. It has been predicted that around 48% of children influenced by media have become overweight (82). Moreover, there is a strong association of obesity to community wealth and television coverage. This may be explained by the fact that fast foods are heavily marketed on Thai television. Children living in communities with greater media exposure and easily accessible fast food stores could have a greater consumption of food products with low nutritional value (83).

Many studies in high-income countries suggested that deprived households tend to have unhealthy food environments compared to their wealthier counterparts (84). With fewer grocery stores and more convenience stores, residents in poor communities of high-income countries find it difficult to purchase

affordable, healthy foods. However, this situation is likely to be different in developing countries, since sources of energy-dense foods, such as fast foods, are more prominent in wealthier communities. Children from households of higher socioeconomic status in Thailand are more likely to consume more calories in total, as well as a greater proportion of calories from fats and proteins.

3.2 Policy, strategy, and actions controlling obese children in Thailand

In this part, existing policies, strategies, programs, and interventions in place in sorting out obesity in Thai children are listed to identify barriers and enablers in current responses. The policies and strategies of NCD prevention and control at the national level are stated in the first section, and the details of strategic plans and interventions related to the identified factors of obesity among Thai children are demonstrated in subheadings with a critical assessment of barriers and enablers.

For the country's development, Thailand has the 20-year National Strategy (2017-2036), which is a master plan of development in Thailand for steering the country towards security, prosperity, and sustainability. Many policies and strategies initiated by the government are based on this 20-year National Strategy. In terms of health, the National Health Policy (2016-2036) is considered as a roadmap that will be used to implement the health policy within the period of 20 years from 2016 to 2036. Additionally, the roadmap has a strategy for health promotion and disease prevention (P&P) excellence, emphasizing a plan of quality of life promotion among all age groups and a plan to prevent and control NCD risk factors where obesity is one key of NCDs (21). Both physical and mental maturity of children aged 0-5 and the appropriate height and weight of school children are defined as programs in P&P excellence. (more detail in Annex 3)

Regarding the National Health Policy, MOPH by the Department of Disease Control (DDC) has established the National Non-Communicable Diseases Prevention and Control Strategy (2017-2021). Nine targets are adapted for NCDs in Thailand based on the WHO Global Action Plan for the Prevention and Control of NCDs (more detail in Annex 4), and one of the nine targets to be achieved by 2021 is to halt the rise in diabetes and obesity (85). The policy of obesity and diabetes prevention and control has been implemented in Thailand for more than ten years with collaboration with various stakeholder groups (86). Also, such programs and interventions related to the strategic plan emphasize prevention and treatment services in healthcare settings.

Moreover, DOH has established the National Strategic Plan of Physical Activity Promotion (2018-2530) that aims to encourage people to regularly do physical activity and reduce sedentary behaviors related to their routine specific to each age group. The Strategic Plan was linked to support the National Strategy (2017-2036), the National Economic and Social Development Plan (2017-2021), and many global strategies, such as the Global Action Plan on Prevention and Control of NCDs (2013-2020) created by WHO, and SDGs of the United Nations (UN) (87). For childhood, programs and interventions exclusively focus on increasing physical activity in schools.

Lastly, Thailand has established a long-term National Food and Nutrition plan (20 years) for executives to make decisions and continuously support policies, programs, and budgets, with the aim of sustainable reduction of malnutrition. As a consequence of the plan, the 5-year strategic plan of National Food and Nutrition (2018-2023) has been developed to improve food management in various dimensions: food security, food quality, food safety (88). In terms of obesity prevention among children, programs, and interventions referred to the strategic plan is mainly involved in the improvement of food quality and food safety in schools.

Regarding the national policies and strategies, actions directly leading to obesity among children were divided into three approaches – food system and physical activity environment, lifestyle, and a healthcare approach.

I. Actions that influence food system and physical activity environment

Reducing the risk factors associated with obesity: Thai government encourages entrepreneurs to voluntarily join the operation with significant tastes in food, such as sweet, oily, and salty, in order to promote that all products or all high-risk products will meet the standards of food preparation (86). Even though the measure still lacks widespread adoption because there is no reward or incentive from the government in encouraging food businesses to reduce the number of risky tastes, some companies are exploring ways to produce a healthier product in order to maintain positive sales growth (89).

Measures nutrition labeling: In Thailand, nutrition labeling is applied to all snacks (including peas and nuts, seaweed, and fish snacks), chocolate in all its forms, bakery products, semi-processed foods, and chilled and frozen ready-to-eat meals by using the Guideline Daily Amount (GDA), showing the amount of energy, fat, sugar, and sodium content (Annex 5) (86). One year after the law had become effective (2013), about 75% of the targeted snacks rapidly developed GDA labels for their food packages. Initially, MOPH had attempted to propose traffic light symbols on foods containing high fat, sugar, or sodium, but the food industry sector argued that the traffic light symbols might induce consumers to consume

too much “green foods” which can affect other food products’ sales. Currently, GDA labeling is implemented in Thailand, and it has been widely promoted to the Thai population. For school students, the knowledge of GDA is being transmitted through “Oryor noi” or the Youth FDA (Food and Drug Administration) volunteer project and the “DekThaiDD” (Healthy Thai Kids) project developed by a commercial. However, tackling health literacy in healthy food as well as GDA among the Thai population needs to be assessed in order to evaluate the policy (90).

Marketing control on food: Currently, Thailand focuses on food products that might affect high-risk groups, such as children and infants. Breastfeeding during the first 6 months after birth is recommended for mothers as it can reduce the risk of obesity and diabetes in long term (91). Hence, the advertising of breast-milk substitutes is being controlled and its direct advertising and content are limited in order to support the breastfeeding campaign. However, indirect advertising of breast-milk substitutes (e.g., incentives, free samples, donation of formula, and promotional gifted) still has a major influence on mothers’ perspective that power milk is equivalent or might be better than breast milk. Then, they might make a decision to stop breastfeeding for their child (92).

Although snack and soft drink advertising media have an impact on the food consumption behavior of overweight children, the Thai government still does not control the advertisement of those products – averaging 1-2.9 non-core food advertisements on TV per hour and the most frequently advertised food products were sugar-sweetened drinks. Hence, the government and related agencies should control the frequency and nature of unhealthy on-air food marketing to protect the health of Thai children (93).

Accessibility management of hazardous products related to obesity: Since 2017, Thailand has collected the tax on ready-to-eat foods or drinks that contain sugar higher than the defined criteria. This would not happen without the collaboration of MOPH and MOF. Many countries are applying taxation of sugary foods and beverages as it is recommended as a useful measure for obesity and NCD prevention. In the Thai setting, a small increase in tax may have a small impact on the retail price and might not lead to any positive changes in unhealthy behavior. A challenge for sugary taxation is to appropriately redesign the rate of sugary tax and be aware of opposition from the private sector (e.g., promoting deregulation and criticizing the evidence available) (94).

With the collaboration between MOPH and MOE, soft drinks, such as Coca-Cola and Pepsi, are limited to sale in order to promote healthy eating behaviors among schoolchildren. A ban on soft drinks provides a good example of a successful policy driven by Non-government organizations (NGO). Though MOE is willing to be responsive and accountable for its implementation of the policy for banning sugary drinks in schools, the governance structure is ineffective in implementing, monitor, and evaluate the policy. This made it challenging to track policy progress. Although there were national surveys on health, all of them exclusively focused on measuring food consumption behaviors and health outcomes, which are not necessary for monitoring and assessing the progress in nutrition. Moreover, the policy is not prioritized by the government – lacks certain regulations to ban the sale of soda and other sweetened beverages as well as snacks containing high sugar, sodium, and fat in schools, and lacks enforcement. Thus, these efforts are still not enough to get MOE’s attention to promote the policy that would ban such sugary products in all public elementary schools throughout the country. Thus, some private schools, public elementary schools, and non-MOE run public schools voluntarily banned the sale of soda (94).

Recently (January 2019), Thailand has banned the domestic use and import of partially hydrogenated oils (PHO), the primary source of trans-fat which is the main cause of obesity in both children and adults. It is an enabler of the policy that FDA prepared related procedures well before enforcing the rule – e.g., inspection and examination work of production plants, imported cargoes, and markets suspected to have trans fats contaminated food and beverage products. Nonetheless, Thai consumers are still being confused that all foods do not contain trans-fat. Therefore, it is important to educate people that some types of foods naturally generate trans-fat, for example, dairy products from animals. Therefore, FDA rapidly promoted the knowledge about trans-fat using the statement of “No partially hydrogenated oils that is the main source of trans fat” to communicate with consumers (95).

Providing high quality and safety of school lunch: as mentioned previously in the education overview the Thai government provides budget support for free lunch in public kindergartens and elementary schools. (approximately THB 13 per meal per student). Additionally, there is an issue about food quality and nutrition problems for free school lunch. This is because of the limited budget and the food procurement process. To clarify, only a few schools prepare lunch for students in the school kitchen. Conversely, most schools tend to prepare their meals using external vendors. With the limited budget from bidding the lowest price in the bidding process, the school cookers or vendors are not able to

afford to provide high quality or nutritious foods for the current food procurement (86). In 2013, the Thai government increased the budget of school lunch from THB 13 to THB 20 per meal per student (96). However, the increasing amount is not in line with the actual food price in the market.

Due to the limited budget which is allocated for school lunch (THB 20 per meal per student), DOH encourages local authorities to procure only one catering business to cook foods for all kindergartens and elementary schools in their area. Besides, this policy is developed based on a bulk purchasing approach, which means purchasing larger quantities in order to get a lower unit price. Hence, this policy can help solve the problem of small size schools that have an inadequate budget to purchase high-quality ingredients. Furthermore, the problem of large size schools is also solved because there will be no need to procure a food vendor which is difficult to control the quality and safety of food. After all, it can guarantee that the central kitchen per district can provide the same standard quality of foods.

Moreover, there is an attempt in creating the specification of school cookers or food vendors for the bidding process; for example, the vendor must cook fish and egg menus for at least two meals per week (97).

Building public spaces (parks or sports exercise or mass sports): A good example of this is a project which was implemented by ThaiHealth. The project is called "1 park one field one route". To illustrate, each province will enable exercise for health division for the whole population of Thailand.

Developing transportation systems: Ministry of Transport and Communications has created bicycle lanes more than 500 kilometers long in Thailand, and also facilitated bicycle parking in public areas. This idea will be used to encourage people to use bicycles link to other public transports and increase physical activity (86). However, there is an opportunity for inequality – only big cities like Bangkok and Chiang Mai have bicycle lanes. Besides, External factors, such as hot temperature and air pollution, are a part of failure for using bicycles or walking as routine transportation, as well as other outdoor activities (98).

Supporting systems in the promotion of physical activity: communication campaigns, information systems, monitoring and evaluation systems as well as research system are planned to develop based on the National Strategic Plan of Physical Activity Promotion. The Physical Activity Research Center (PARC) was established to strengthen the system in the promotion of physical activity in Thailand. Besides, PARC is responsible for studying and giving funds to the research which helps increase physical activity of the Thai population. For children issues, the results of physical activity surveys from each research institute are not consistent. Besides, national survey study and effective program of physical activity for this group are still lacking.

II. Actions that influence lifestyle

Controlling the menu of free school lunch: there are a nutritional computer program and a developing lunch menu database which will be used to identify the nutrient appropriation of lunch menu to Thai students – called "Thai School Lunch Program" (99). The lunch menu is proposed and published by two main agencies: DOH and the Mahidol University's Institute of Nutrition. Additionally, this action cannot be effectively implemented in whole areas due to the voluntary policy and budget limitation (86). Although schools can request extra budget from the local government and/or voluntary contribution from parents, the lunch menu management in schools does not have enough engagement. However, some public kindergartens and elementary schools are not aware of the school lunch planning software or training for catering staff (73). The size and location of kindergartens are significantly related to the success of the policy. According to the Thai School Lunch Program, small kindergartens in rural areas face many difficulties in serving meats. Besides, they tend to be far from markets which makes it difficult to buy fresh fruits/vegetables. Moreover, they also have an inadequate budget for purchasing small amounts of ingredients at reasonable prices (100). There is a suggestion that the agencies should develop a variety of lunch menus based on local materials and ingredients.

Promoting physical activity in school: Thailand has started the promotion of physical activity in schools throughout the whole country by collaborating with MOPH and MOE. For example, increasing activities during the school day (e.g., extracurricular activity, volunteer activity, club activity, changing classroom every hour, using stairs instead of taking elevators), and adjusting the environment within and around the school fence to maximize the space in schools in order to promote physical activity. A goal of this action is to reach 100% of the level of schools promoting physical activity. However, the main problem is lacking in the tracking data. Besides, there is no precise detail of physical activity that needs to be promoted at school, for example, the effective kind and the timing of activities.

Promoting physical activity in the community: Many organizations are playing an important role in enhancing physical activity in the community, particularly local government mostly supported funds. (e.g., sports tournaments for school students and teens). Similar to the physical activity programs in school, tracking data and detail of physical activity specific to each age group are still required.

Increasing knowledge and awareness of risk behaviors related to obesity: an attempt to translate academic or scientific information in public communication via short text, using symbols to convey the content of the campaigns. There is a mixed variety of channels in the communication campaigns, including public media, printing media, as well as gifts (86).

An outstanding campaign that is related to risk behaviors of obesity is the “Fatless Belly Thais (FBT) policy” which aims to promote healthy lifestyle behaviors – eating, exercise, and emotional control healthy eating. This policy is an instance of a successful network collaboration between non-governmental, non-health, and governmental sectors, expanding the project to the national scale. Since 2009, the FBT policy has been emphasized in six priority settings, which are health service centers, local organizations, schools, communities, businesses, and NGOs. Nonetheless, this policy has encountered many challenges, such as a change in the implementing agency, insufficient budget allocation to support implementation, and the difficulty in evaluating the effectiveness of the campaign (94).

III. Actions that influence health system

NHSO determined national health benefit packages of health promotion and disease prevention based on specific age groups: infants, children aged 1-6 years, teens aged 6-18 years, adults aged 15-59 years, and elderly aged above 60 years (101). For infants and children, there is a maternal and child health (MCH) handbook or “Pink Book” which is used for monitoring weight and height and other necessary health records (e.g., vaccination). Furthermore, the Pink Book contains information about health education, for instance, healthy foods for children, to parents (Annex 6) (102). However, only 64% of mothers regularly record and take a benefit of the Pink Book, while the rest of them do not recognize the importance of the Pink book. Some mothers even lost and forgot the Pink Book once they need to use it for following up on their children’s health conditions at hospitals. Furthermore, the pink book is not accepted for regular use because it is much tricky in information which might cause confusion from the contents (103).

The Diet and Physical Activity Clinic (DPAC) was introduced by DOH in 2006 in order to provide healthcare services and education for promoting healthy diets and sufficient physical activity for people who have high risks of obesity and NCDs, and patients through health centers. Currently, the DPACs are expanding to most of the public hospitals and health centers under MOPH in 2014 (approximately 98%). Even though DOH has modified the FBT implementation to be more specifically focused on the community rather than focused only at a health facility and also set a key performance indicator (KPI) which is waist circumference measurement; however, with the declining support from provincial leaders and the removal of the indicator due to measurement difficulty made the DPAC at community finally fall (94).

Additionally, the developmental growths of children and teens are monitored and evaluated at health facilities and schools. In terms of preventing obesity, BMI and %WH are evaluated by health professionals whenever visiting hospitals. The evaluation uses Thai standards growth developed by the Bureau of Nutrition (BON), MOPH (Annex 7) (104). However, MOPH only monitors children aged under 5 years old by determining that the hospitals under MOPH need to submit the service data through MOPH’s online database. In the fiscal year of 2017, the percentage of children aged under 5 years old that were screened for developmental growth was 73.3 (105).

At school, elementary students in grade 5-6 and high-school students in grade 7-12 will get a student’s health record booklet using for self-assessment, including BMI and %WH (Annex 8) (101). The health record booklet is promoted under the health promotion school project initiated by DOH, which does not consider only the overweight/obesity problem, but hygiene and mental health are included. There is a reward system linked to performance for participants of the project in order to promote the action, namely bronze, silver, and gold reward (106). An evaluation of the health record booklet shows that there was a lack of continuity of health data records in schools. Furthermore, the missing student’s health data in some semesters was found. Also, the growth assessment data was missing. Teachers recorded students’ weight and height in MOE’s database but did not record them in the booklet. Moreover, students recorded their weight and height in the booklet, but they did not know how to interpret the data correctly, thus, they did not know whether their health conditions are normal or abnormal (107).

Nowadays, there is a development of educational tools to share more knowledge of promoting physical activity in the public health system. The process helps suggest the physical activities which are suitable for the professional group and each age group through the development of guidelines. The guidelines also promote physical activity topics concerning the Thai Physical Activity Guideline (TPAG) (86).

DOH enforced the local government to support the budget in hiring nutritionists in primary care which is a gatekeeper who will firstly contact with the community. Additionally, nutritionists are required to train school cookers or food vendors and to monitor their performance or the quality of the foods. However, this action has not been implemented yet because there are several organizations in charge in the process of making decisions – such as the Ministry of Interior (MOI) (decentralization), MOF (budget and human resource), and MOPH (training course development) (88).

Table 2 Summary actions controlling obese children in Thailand

Actions that influence food system and physical activity environment	Actions that influence lifestyle	Actions that influence health system
<ul style="list-style-type: none"> • Reduce the risk factors associated with obesity • Control nutrition labeling • Control on food marketing • Manage the accessibility of hazardous products related to obesity • Provide high quality and safety of school lunch • Build public spaces • Develop transportation systems • Support systems in the promotion of physical activity 	<ul style="list-style-type: none"> • Control menus of free school lunch • Promote physical activity in school • Promote physical activity in the community • Increase knowledge and awareness of risk behaviors related to obesity 	<ul style="list-style-type: none"> • Monitor the developmental growth of children aged under 5 years by using maternal and child health (MCH) handbook • Provide the Diet and Physical Activity Clinic (DPAC) • Monitor the developmental growth of student by using the health record booklet • Develop Thai Physical Activity Guideline (TPAG). • Promote nutritionists in primary care

3.3 Evidence on approaches and strategies to tackle policy and action response gaps in Thailand

At the beginning of this section, the existing national policies, strategies, and actions are evaluated to identify the gaps, and the evidence on measures which are used to tackle the gaps are reviewed based on contextualization for its feasibility and applicability to the context of Thailand.

The findings in the previous section showed that translating the policies and strategies into the programs and interventions for preventing childhood obesity needs a multisectoral approach, where some policy actions in Thailand are lacking clarity of detail, key responsible actor, monitoring, and evaluation system as well as budget. Furthermore, some policy actions that require the participation of food industry sectors need to add an intervention to incentivize them to make a successful implementation. It is obvious that voluntary action from corporates is not effective for policy implementation; meanwhile the enforcement of the government authority is still not strong enough for some mandatory actions. Moreover, many policies that are in the process do not yet have a monitoring system that is used for evaluating their effectiveness and impact. Thus, some policies require research and development to promote knowledge and to translate the policies into proper actions; in particular the policies that are decentralized from central to local authorities spend their budget.

Thailand found difficulty in encouraging entrepreneurship to reduce the number of risky foods that would affect their sales performance. Additionally, the Incentivizing Food Systems Transformation launched by World Economic Forum, in collaboration with McKinsey & Company, reports four pathways for creating the incentives needed to transform food systems to meet the food safety and security needs: 1) the government should reform the public investment and policies by increasing the positive incentives to produce and consume more healthy food, 2) companies should prioritize environmental, social and financial outcomes and redesign new business models to produce safety and healthy product, 3) investors should consider investing in companies targeting environmental and social outcomes alongside with financial returns, and 4) consumers should focus more on environmentally and socially responsible and nutritious products (108). For public investment and policies, positive incentives targeting supply may also be offered to the companies which are manufacturing healthy products by offering direct assistance or fiscal measures. For example, give research support and provide further assistance for healthy product development and reduce the cost of advertising alternative products so that real food alternatives can be subsidized or promoted (109). Thailand, where most children enjoy SSBs, thus, the soda ban policy in schools is not prioritized and loosely enforced by the government. However, some public schools voluntarily banned soda. Additionally, three key success factors lead to a successful implementation. These factors are found from an evaluation study of the soda, sweets, and snack ban in Thai elementary schools, namely 1) the supports from school director who focuses on student health issues 2) the collaboration of teachers to educate about the harms of SSBs 3) the supports from academic knowledge, various media, and actions monitoring from the public health center the in community. With these key success factors, the soda ban policy can be implemented widely, although it is a voluntary approach (110). Moreover, tracking the progress of the soda ban policy in schools is difficult. Therefore, policymakers find it is hard to make the existing policies have greater health gains and to allocate higher investment. Furthermore, the School Lunch Project Fund Management Committee suggests that a registry database should be developed in order to effectively monitor schools' policy implementation. Plus, it is also essential for the schools to set a key performance indicator for rewarding the schools which are successful in doing the promotion school project of DOH. Concurrently, national surveys on nutrition in children should be invested in order to provide more information for policy impacted measures (111).

Schools are considered as the main avenue to control childhood obesity because it is where the students' dietary can be controlled. Besides, their physical activities and awareness of obesity can also be promoted. A systematic review of the strategies and actions which help control childhood obesity shows that many countries have applied school-based programs to deal with the obesity of children (112). In terms of dietary, some parts of the world (e.g., the United State and Australia) are conducting National School Lunch Program or National Healthy School Canteen to provide nutritionally balanced diets and low-cost or free lunches to children in public and nonprofit private schools (113,114). However, there is no clear evidence showing the effectiveness of the school lunch program on school students' obesity reduction. Besides, a conflict that shows that the participation of the school lunch program is not associated with lower BMI is also found (115). In terms of physical activity, many countries create programs for promoting physical activity in schools in many different ways. To clarify, some show a significant change in BMI, while some do not (112). However, schools are in a uniquely favorable

position for increasing physical activity in the curriculum in order to ensure that the students will have enough physical activity as WHO recommended (116).

Children in the schools with a comprehensive PA promotion program are reported to significantly do more moderate PA than the schools without the program (117). In Thailand's context, there is a study showing an effective comprehensive program for elementary school students which helps prevent obesity by an improvement of nutritional knowledge, the energy obtained from food per day, and body fat percentage, and also can fulfill the gap of the policy. The comprehensive program comprises 1) adding nutritional curriculum 2) promoting a healthy diet 3) the integration of nutrition content in all subjects 4) conducting growing vegetables program 5) establishing health day or health corner 6) publishing newsletters and 7) doing morning exercise. However, the comprehensive program will not be effective without the collaboration of all teachers in schools (particularly the school director) and the consistency of the project implementation (118).

Healthcare facility plays an important role in providing care to families and children. According to the above policy reviewing on childhood obesity prevention, Thailand has the screening intervention for obesity among children at all healthcare levels, the monitoring tools on growth development both in healthcare and school settings, as well as the DPAC which is a specialized clinic for behavioral modification. However, weight loss medications or bariatric surgery, which is also an effective treatment (119–121), has not yet been included in the health benefits package for severe pediatric obesity to access the interventions.

Beyond the school-based and clinic-based programs, the systematic review of the strategies and actions which help control childhood obesity shows that many countries adopt family-based programs to support the obesity treatment in children. For instance, educating and changing parents' behaviors to become a child's role model so that they can help the child develop healthy eating and physical activity habits in order to prevent obesity (112). Furthermore, the family-based programs which are used for obesity prevention among children should be developed and applied in Thailand's context as the previous sector discovers that parents (including their education and employment) are an important determinant of health.

Chapter 4 Discussion, Conclusion, and Recommendation

4.1 Discussion

Thailand is currently experiencing a problem with childhood obesity and its profound adverse consequences to children when they become adults. Eating behavior and exercise are key determinants of obesity in children. These individual traits are highly influenced by the child's internal characteristics (i.e., age and sex), as well as external factors (i.e., parenting style, social and community support, culture, environment, and general socio-economic condition).

Many pieces of evidence show parents have a major influence on their children's behavior in terms of eating and exercise habits. In Thailand, school conditions and the environment are seen as important determinants of childhood obesity. Students in public schools cannot choose their lunch, which can lead to either overnutrition or undernutrition in children. Different types of schools also have different extracurricular activities and facilities, influencing the amount of time the students spend on physical activities. Furthermore, in this globalization era, advertisements for snacks, soft drinks, and fast food are easily accessible on the Internet and television, enticing children to veer away from healthy eating. Urbanization, improved infrastructures, and transportation, which are designed to make people's lives more convenient, likewise lead to unhealthy physical habits. All these factors affect the children's consumption behavior and physical activity, thus causing a high incidence of obesity among children nowadays.

The Thai government has placed great importance on childhood obesity, as mentioned in the government's national strategy. Aside from the MOPH, other government authorities, professional communities, and civil societies are also involved in addressing childhood obesity. Many policies and actions were initiated and enforced by NGOs, which led to their successful implementation in Thailand. The existing policies and strategies are developed based on the National Strategy. In addition, global policies highly affect Thailand's national policy and strategy development. For example, the National Non-Communicable Diseases Prevention and Control Strategy in Thailand has been established based on the goals and actions of the WHO Global Action Plan for the prevention and control of NCDs. Similarly, Thailand's National Strategic Plan of Physical Activity Promotion was adapted from the WHO Global Strategy on Diet, Physical Activity, and Health, which describes the actions needed to support

healthy diets and regular physical activity. These national strategic plans have taken into account the needs of the population in each age group. Therefore, Thailand has sufficient policies and strategies that tackle the problem of childhood obesity.

Globally, the WHO Commission on Ending Childhood Obesity recommends taking actions against childhood obesity, namely 1) the promotion of physical activity and early nutrition (i.e., breastfeeding and complementary feeding), 2) restrictions on promotional marketing, 3) additional taxes on sugar-sweetened beverages, 4) proper food package labeling, 5) monitoring of childhood obesity, and 6) creation of a health-conscious environment in schools by providing healthy food and drink options, promoting physical activity, and providing health education (122). Currently, Thailand is implementing all these recommended actions. In China, five types of policies were introduced to prevent obesity at the national level, including 1) school-focused policy, 2) package labeling and restaurant-focused policy, 3) marketing policy, 4) pricing policy, and 5) nutrition education and national dietary guidelines (123). Among these five policy types, Thailand has not applied the pricing policy because the private sector strongly opposes it and the government is aware of its negative effects on all levels of the Thai society (124).

Thailand has implemented actions that follow WHO's recommendations and are mostly similar to those in neighboring Asian countries like China. However, these actions need to be improved and developed contextually to Thai childhood behaviors. For example, Thai children are fond of watching TV where the on-air time often advertised snack and SSBs. If the government would implement positive incentive schemes that reduce the advertising costs for healthy food, entrepreneurs may be encouraged to produce and advertise such products more, and also its media may exposure to Thai children who are fond of watching television. Thus, Thai children would respond more favorably to healthy snacks and nutritious products. A similar scheme is implemented in France, where a 50% reduction in the advertising costs of fruits and vegetables is offered to entrepreneurs. Evidence shows that positive incentive policies are better than negative ones, like taxation on unhealthy products, because it attacks the principles or moral involvement of the companies, which leads to increased opposition from the private sector (109).

Another important aspect is Thailand's lack of effective monitoring and evaluation system, making it difficult to modify existing policies due to the scarcity of relevant information. Experts recommend investing in national surveys on children's nutrition in order to provide enough information for policy development. A previous study on adulthood obesity in Thailand showed a similar issue and suggested the utilization of nationally representative data from surveys, such as the National Health Examination Survey and the National Survey on Food and Nutrition, for tracking the outcomes of the policies preventing obesity (124). In addition, a study on the key factors for school health policy implementation in Thailand suggested that the government should set up an institutionalized capacity-building system in order to strengthen the monitoring and evaluation system of school health activities (106). The WHO technical meeting on School Health in 2015, an institutionalized capacity-building system was also reported as an essential factor for a successful school health implementation (125). Furthermore, Thailand has a big potential to develop a database to monitor particular school health interventions with the collaboration of MOE, which is responsible for the promotion of health to students, and the Ministry of Higher Education, Science, Research and Innovation (HESRI), which is the expert in big data in Thailand.

The procurement process and budget of the school lunch program in Thailand should be improved in order to provide good-quality and nutritious food for children. Although no evidence illustrates the advantages of having a school lunch program in both domestic and international settings, such a program can be beneficial to the Thai society. Aside from providing good-quality and nutritious food to children, a well-subsidized school lunch program helps low-income Thai people to gain more access to education by reducing their everyday costs (126). Nonetheless, to be successful in controlling the free school lunch program, DOH, the organizer responsible for this matter, should develop a variety of lunch menus based on local ingredients. According to the National School Lunch Program in the United States, the food menu can be flexible but should satisfy the daily nutritional standards (127). As a start, MOE should find a way to attract all kinds of schools in Thailand to voluntarily participate in the school lunch program. For long-term sustainability, MOPH should also support the primary care nutritionists in educating the teachers and school cooks about food nutrition, instead of relying on the local government to do this task. In addition, MOPH should consistently support the schools by providing a nutrition training program for the teachers and school cooks. Unfortunately, the current training program is on a case-to-case basis. In addition, a local study confirms that when teachers have sufficient knowledge

about nutrition, the number of overweight and obese kindergarten students decreases due to controlled over the dietary fat intake and improved weight outcomes (128).

According to the National Non-communicable Diseases Prevention and Control Strategy (2017 – 2021), increased knowledge and awareness of risk behaviors is crucial to minimize obesity. Several health promotion projects, such as putting up obesity-related posters, have been implemented and used as tools to educate the people. However, this approach may be ineffective to combat childhood obesity since preschool children still cannot read or understand the language very well. Therefore, more appropriate media that provide more pictures and colors are desirable.

In its current form, the policies and strategies to combat childhood obesity in Thailand seem to emphasize prevention and health promotion, but not treatment. In the future, effective treatments such as weight loss medication or bariatric surgery should be considered to include in the health benefits package for severe obesity patients that they can be able to receive treatments for free. NHSO, a key decision-maker in the development of health benefit packages, should urgently conduct a cost-effectiveness study of the new treatments in the Thai context in order to be strong evidence for policy making decisions.

As mentioned earlier, parents greatly influence the eating and exercise habits of their children. They act as role models for their children by showing them their healthy behaviors. However, family-based programs are still lacking in Thailand. Hence, family-based programs must be clarified through research, taking note of the differences in education and employment of the parents (129). NGOs, who act as initiators in many health programs, can be responsible for this task with the financial support from Thaihealth, who plays an important role in P&P in Thailand.

4.2 Conclusion

Childhood obesity is a growing problem in Thailand. There are several determinants associated with obesity in Thai children, with the parents and the school environment being the most relevant. The policy and strategy in response to childhood obesity in Thailand have been developed by multisector collaboration, including not only the government health sector, but also other government authorities, professional communities, and civil societies. Currently, Thailand has already implemented the action plan following the WHO's recommendations on ending childhood obesity; however, some actions need further desirable improvements from the government. Moreover, Thailand should increase the investment in research to identify effective family-based programs because they are the critical determinants influencing the eating and exercise habits of children. Thailand has also emphasized on obesity prevention and health promotion, but not treatment. Thus, further evidence that proves the cost-effectiveness of effective treatments in the Thai setting must be provided before including such measures in the national health benefit package.

4.3 Recommendations

In order to tackle the obesity pandemic among Thai children, this study proposes the following recommendations for the government to fulfill the identified gaps in the existing policies, strategies, and actions:

- I. The government should implement positive incentives that target supply to encourage entrepreneurship to produce healthy foods in order to create an environment suitable for Thai people's healthy dietary habits.
- II. MOE, in collaboration with HESRI, should set up an institutionalized capacity-building system in order to strengthen the process monitoring and evaluation of school health activities, which Thailand is lacking nowadays.
- III. The government should improve the procurement process and increase the budget for the school lunch program in order to procure food vendors/cooks and high-quality and nutritious food for children.
- IV. DOH should develop a variety of nutritious lunch menus based on contextual materials and ingredients so that all participating schools in every part of Thailand can apply these lunch menus.
- V. MOE should find an effective way to attract both public and private schools in Thailand to voluntarily participate in the school lunch program in order to manage the school lunch menu with proper nutrition.

- VI. MOPH should support the budget and hire nutritionists in every primary care setting and set up a routine training course regarding nutrition in order to educate both teachers and food vendors/cooks instead of the local government for more sustainability.
- VII. ThaiHealth should support appropriate media that utilize pictures and noticeable colors for increasing the knowledge and awareness regarding obesity among preschool children.
- VIII. NHSO should consider the cost-effectiveness of effective treatments such as weight loss medications or bariatric surgery for severe obesity patients in Thailand, in order to include them into the health benefits package.
- IX. Thaihealth should provide financial support to NGOs for researching the effectiveness of family-based programs in the Thai setting, considering the differences in the educational level and employment status of parents.

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Annex 1 Details of the three public health insurance schemes in Thailand

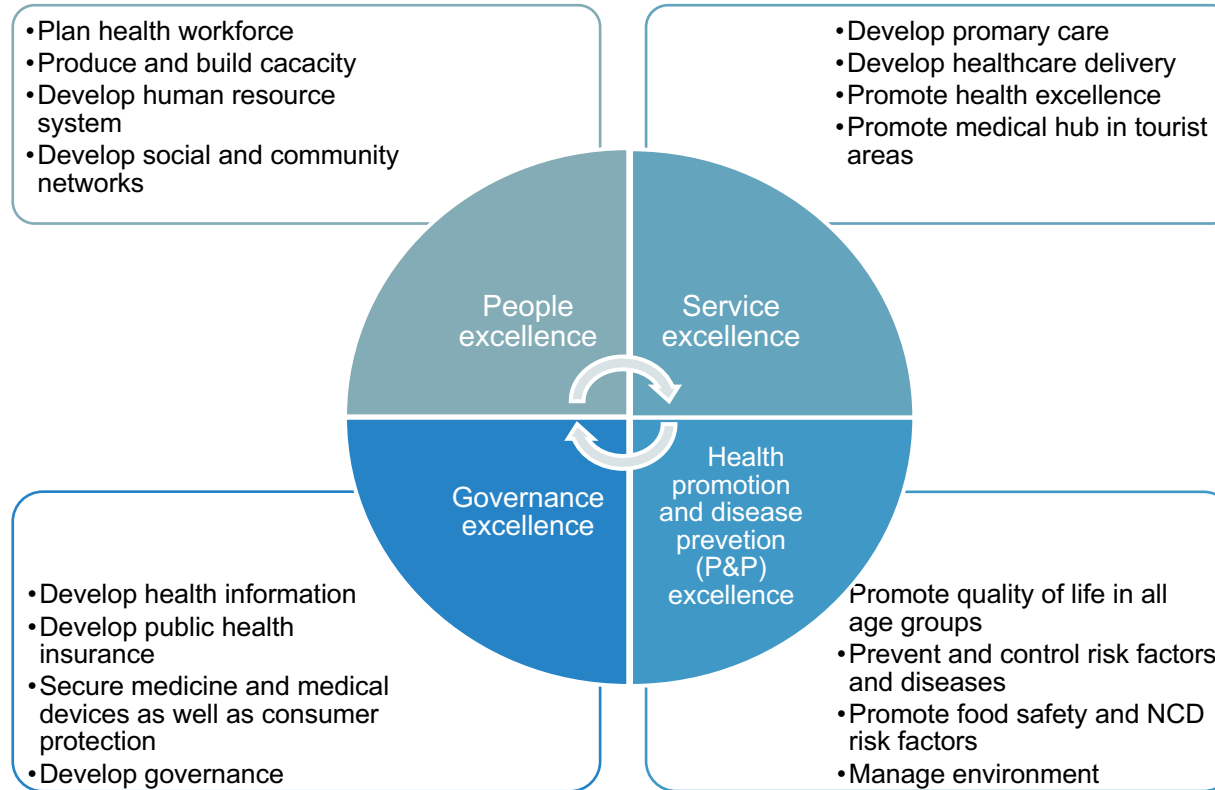
Characteristics	Universal Coverage Scheme	Social Security Scheme	Civil Servant Medical Benefit
Legislation	National Health Security Act 2002	Social Security Act 1990	Royal Decree 1980
Purchaser	National Health Security Office (NHSO)	Social Security Office (SSO), Ministry of Labor	Comptroller General's Department (CGD), Ministry of Finance (MOF)
Source of finance	Tax-based, non-contributory	Tripartite contribution by the employer, employee, and government	Tax-based, non-contributory
Budgeting	Closed-ended budget	Closed-ended budget	Open-ended budget
Health expenditure (Data in 2016)	2,227 Baht per capita	3,556 Baht per capita	16,240 Baht per capita
Payment method	<ul style="list-style-type: none"> - Outpatient and prevention and health promotion: capitation - Inpatient: diagnostic-related groups with a global budget - The fee schedule for specific high-cost procedures 	<ul style="list-style-type: none"> - Outpatient: capitation; inpatient: diagnostic-related groups within global budget 	<ul style="list-style-type: none"> - Outpatient: fee-for-service; inpatient: diagnostic-related groups with multiple cost bands

Annex 2 Search terms

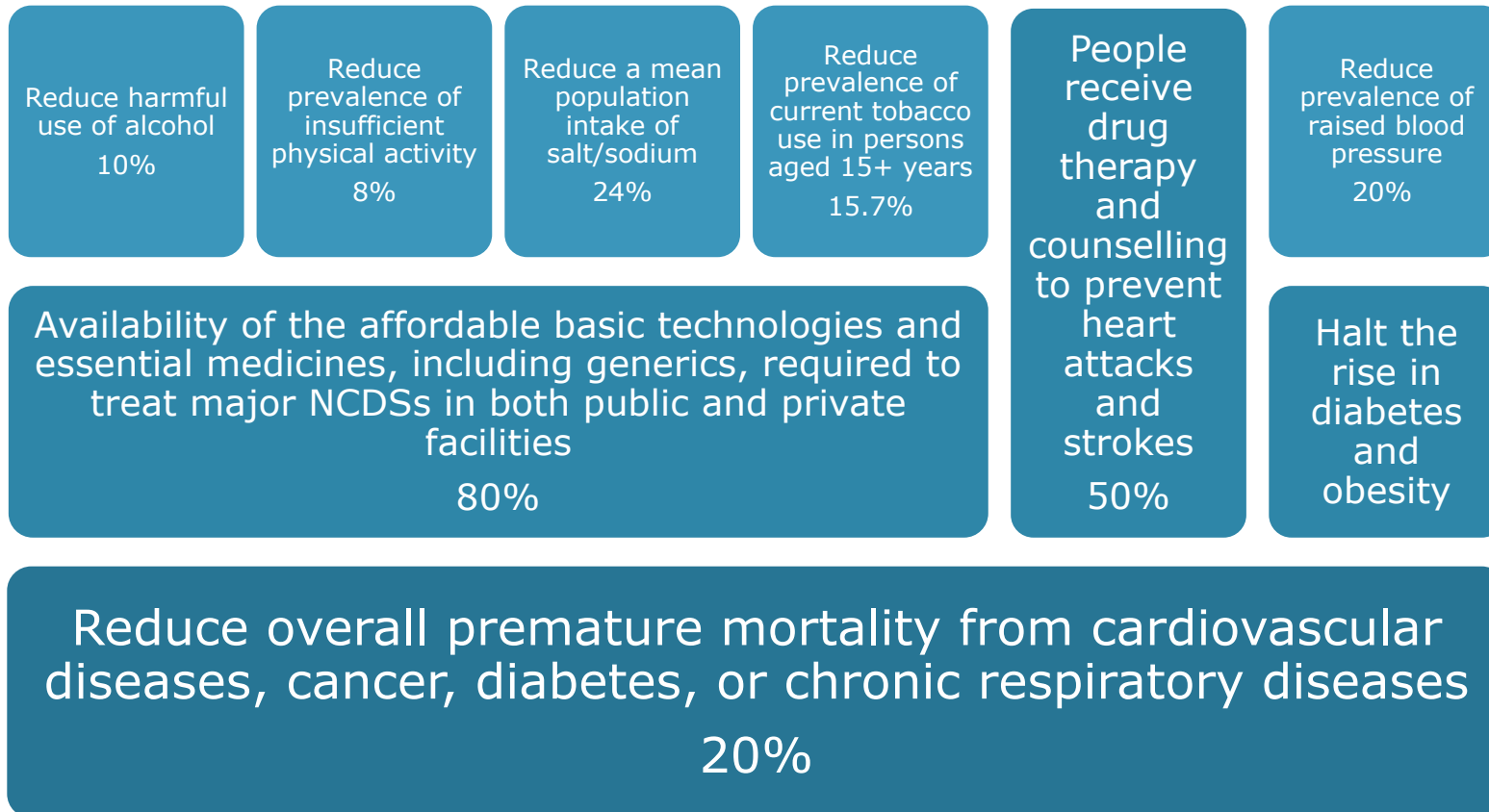
Search terms for literature/document review in this study were identified and categorized in the table. Boolean operators were used to combining the search terms; same categories connected by OR, while different categories connected by AND.

Categories	Sub-categories	Search terms
Age, sex, hereditary factors	-	Age, sex, genetic disease, genetic disorder, gene, chromosomes, biological factors
Individual lifestyle	Dietary behavior	Diet, dietary risk, food consumption behavior, unhealthy diet, unhealthy dietary, nutrient intake
	Physical activity	physical movement, lifestyle, habit
Social and community networks	Parents	Parent education, parent occupation, family support, child caretaker, teacher
Living and working conditions	School conditions	Public school, private school, school rule, school regulation
	Housing	Home, habitation, residence, neighborhood, community
	Health care service	Screening, annual checkup, health promotion, NCD prevention and control
General socio-economic, cultural and environmental conditions	Socio-economic	Economic, political, socio-economic status, wealth, parent income
	Culture	Beliefs, spirituality, ethnicity, race, religion
	Environment	Urbanization, urban, rural, infrastructure, parks, playgrounds, sports fields
Population	-	People aged 1-12 years, children, toddler, preschool, grade schooler
Setting	-	Thailand, Thai, kingdom of Thailand

Annex 3 A Roadmap of Health Implementation in Thailand



Annex 4 NCD Indicators of Nine Targets of National Non-communicable diseases Prevention & Control Strategic Plan 2017-2021 in Thailand



Annex 5 Example of Guideline Daily Amount (GDA) labels in Thailand

Nutritive values per package
Consumption should be split into 2.5 times

Energy	Total sugar	Total fat	Sodium
410 kcal	0 g	22 g	310 mg
*21%	*0%	*34%	*13%

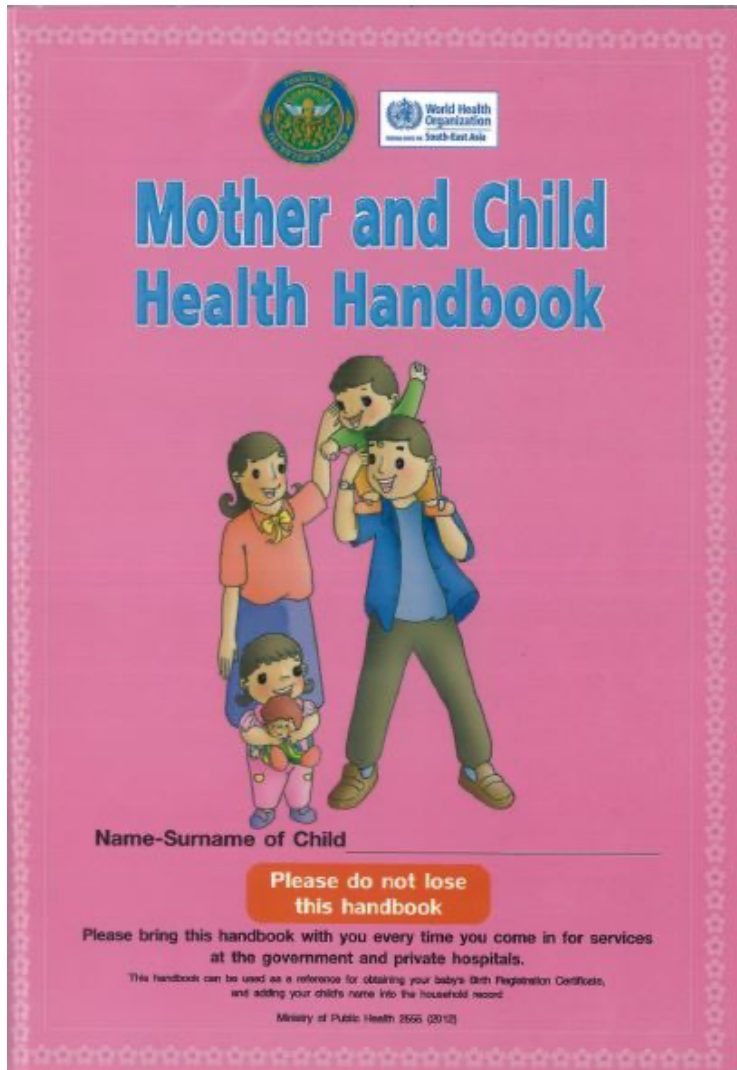
*calculated as percentage of recommended daily intake

GDA label translated from a snack



GDA label on real snacks

Annex 6 Mother and Child Health Handbook in Thailand

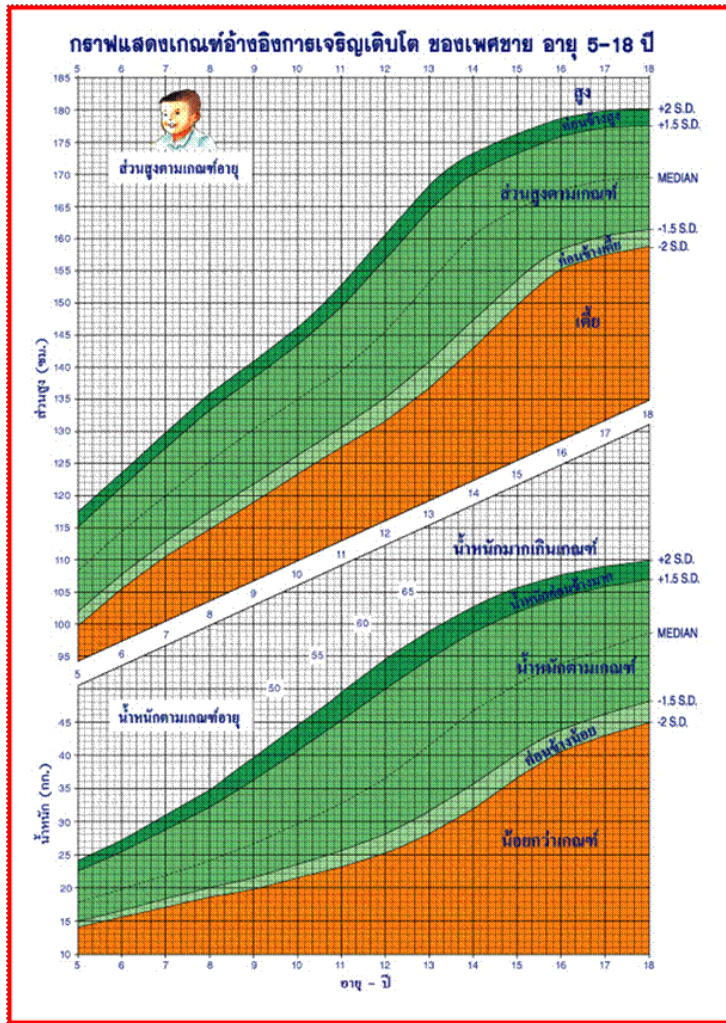


English version

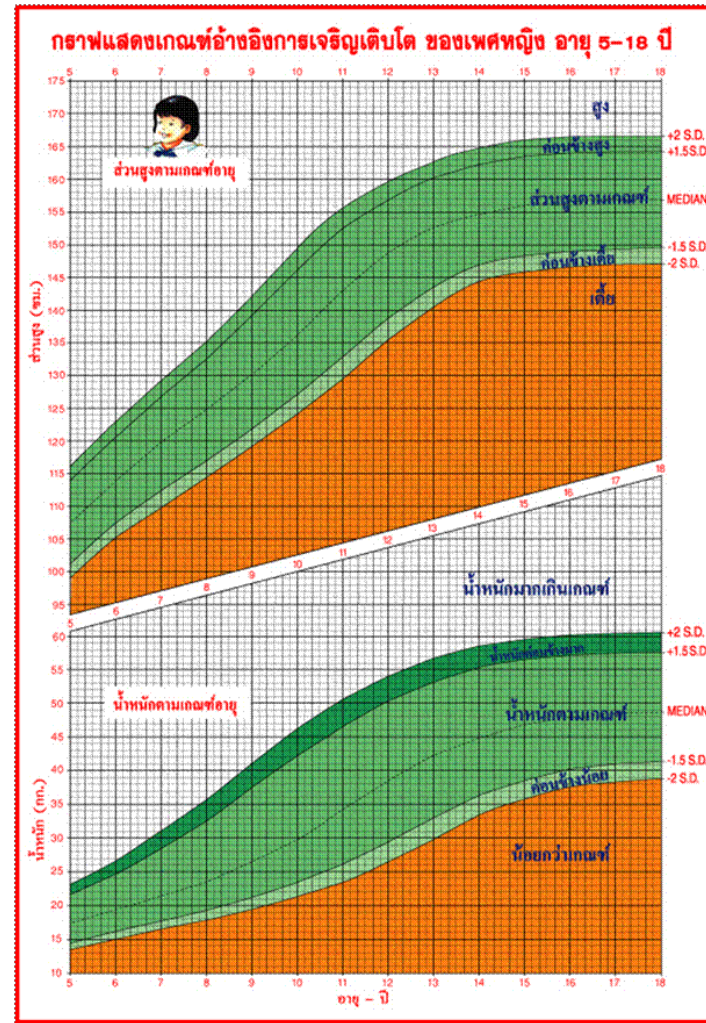


Thai version

Annex 7 Weight-for-Height (WH) standard for self-assessment of Thai students aged 5-18 years



WH standard for male students



WH standard for female students

Annex 8 Student health record booklets for self-assessment of Thai students



Health record booklets for students grade 5-6



Health record booklets for students grade 7-12