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REVIEW ARTICLE

Obesity in children and adolescents in Thailand: Access and education issues for programming and policy in a post COVID-19 epoch

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ABSTRACT

The crisis of obesity has been rapidly increasing in severity across the world. The purpose of this article is to explore the nature of the obesity epidemic, with attention to elements likely to persist in Thailand, and to develop policy and practice elements that could be implemented in a post-Covid environment. To develop the background for this work a review of access to healthcare, access to healthy foods, and the relationships of obesity and socioeconomic and cultural factors is provided. This review shows that in Thailand, the population at risk of obesity are more concentrated in urban areas where access to unhealthy food choices is ubiquitous. While obesity is highly correlated with low socioeconomic status and income in the U.S., the reverse is more often the case in Thailand, particularly among boys. Complicating the challenge of obesity has been the COVID-19 epidemic, as literature has linked obesity to an increased number of cases and deaths from COVID-19, with earlier findings across the world reporting that obesity in general increases complications related to many similar respiratory viruses. Access to health care is recognized as a gateway to population health as preventative care is less costly, easier to deliver, and if distributed as needed, can be effective in preventing large scale disease progression. These findings are used to develop suggestions for policy and practice that leverage historical successes in major public health initiatives undertaken by the Thai government. Moreover, since traditional statistical analyses do not take into account the role of spatial effects such as spatial dependence and spatial heterogeneity, there is an opportunity to incorporate novel methods in analyses of obesity in Thailand given that the spatial associations with prevalence of obesity are well known. Thailand has made many successful national efforts to reduce obesity across the nation with significant results.

The aim of this paper is to provide policy and intervention suggestions that can leverage that success with the growing understanding of the relationship between access, education, and obesity. Thailand's history of public health success suggests that the obesity crises may be largely prevented if those national resources are brought to bear with an interdisciplary and long-term plan.

Keywords: COVID-19, Location Science, Obesity, Spatial Statistics, Thailand

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INTRODUCTION

The crisis of obesity is well-established globally and has brought increased risk for chronic disease and complications from infectious disease.[1] In the U.S., there are clear associations with low socio-economic status and greater obesity, particularly in rural areas.[2] By contrast, in Thailand, the population at risk of obesity is more concentrated in urban and suburban areas where access to unhealthy food choices is ubiquitous. Even with greater access to healthcare and education, easier access to unhealthy food overcomes these socioeconomic advantages. Conversely, rural populations with traditional healthy diets are at less risk for obesity, despite their generally lower incomes and educational status.[3–6]

Thailand is uniquely positioned to address the problem of obesity given the nature of the population at risk and the national propensity to successfully address large scale public health issues. In Thailand more recent reports reveal that childhood obesity increased significantly over the last two twenty years from 5.8% in 1997 to 9.2% in 2019.[7,8] However, Thailand has a history of extraordinary success in promoting public health through effective social media campaigns, control policies, and a strong public health system. Combined with the national health insurance program these measures have had an immense public health benefit.[9] This mix of regulation, education, and health care is the key to combatting the rise in obesity and associated greater health risks.

This article explores the nature of the obesity epidemic, with attention to elements likely to persist in Thailand. We review access to healthcare, acess to healthy foods, and explore the relationships of obesity and socioeconomic and cultural factors. We pay particular attention to the impact of COVID-19 and explore the nature of the obesity epidemic, with attention to elements likely to persist in Thailand, and to develop policy and practice elements that could be implemented in a post-Covid environment. This paper is important for suggesting methods and new knowledge that may improve policy and practice for obesity prevention.

Background

The causes of malnutrition are multifaceted[10], and often the result of social, cultural, economic, and environmental factors. As undernutrition continues to be a problem in low- and middle-income countries, the newer problem of overnutrition has been documented all over the world. Referred to as the *nutrition transition*, this epidemiological trend is defined as changes in the nutritional status and dietary intake and is caused by economic, environmental, demographic, and cultural shifts.[11] Obesity has been linked to chronic illnesses worldwide; now rising rates of obesity-related illnesses are appearing in economically transitioning countries.[12] Globally, overweight and obesity have affected 1.9 billion adults, and are linked to more deaths worldwide than underweight.[13]

Much of the transition is due to changes in diet and activity influenced by an improved economy and urbanization[14], particularly as many have been displaced from rural communities. Urbanization increases access to high calorie processed foods and creates greater sedentism. While the more general cause of obesity can be explained in individuals as an equation of excess energy in versus energy out, the means to intervene in communities and populations requires a deeper contextual and sociocultural perspective.

Complicating the challenge of obesity has been the COVID-19 epidemic as obesity has been linked to an increased number of cases and deaths from COVID-19. This is particularly the case within the U.S., having one of the highest global rates of obesity and COVID-19 deaths. The epidemiological linkage of obesity and COVID-19 is still relatively unknown, yet earlier

reports have shown that obesity in general increases complications of respiratory viruses that are similar to COVID-19 including SARS and MERS. Those with elevated central obesity have have an increased risk of mortality due to infectious diseases.[15] Further, obesity is associated with increased inflammation that can impair the body's immune responses to infections.[16]

While co-morbidities related to obesity increase aggravation of COVID-19, there are also indications that obesity itself may directly link to COVID-19 symptoms and death.[17,18] Thus adding complication to the nutrition transition may include the rise in the number and complications of communicable diseases such as COVID-19.

There are many knowledge gaps in understanding the causes, co-morbidities, and means to prevent obesity, particularly related to social determinants and more recently the impact of both chronic and infectious disease with the rise of COVID-19.

Objective

The objective of this article is to use the literature review findings to develop suggestions for policy and practice that leverage historical successes in major public health initiatives undertaken by the Thai government.

Methods

As this paper is using existing literature to develop suggestions for policy and practice, the methods consist solely of a literature review. Multiple search databases were used including Medline, PubMed, SCOPUS, and CINAHL. Keyword searches included: COVID-19, Location Science, Obesity, Spatial Statistics, and Thailand. While over 100 articles were identified for all topics, many fewer were identified being specific to Thailand, for example for the keywords, obesity and Thailand, in CINAHL, resulted in 242 articles. The authors reviewed these articles and summarized the results findings to better understand the nature of the obesity epidemic in Thailand. In this article we present those summaries.

Obesity in Thailand

Thailand has undergone significant economic growth since 1999, and with that success has come improved healthcare, transportation, and quality of life. In 2005, the Gross Domestic Product (GDP) in Thailand was $189.3 billion U.S., and in 2018 the Thai GDP was $505 billion U.S.[19] Part of this growth has included globalization efforts such as much greater commitment to the ASEAN charter, where Thailand has been a major player and leader.[20]

Yet Thailand has not been immune to the negative outcomes of obesity and chronic disease. Sakamoto et. al. reported that the prevalence of childhood obesity among preschoolers living in the Saraburi Province to be 22.7% among an urban sample and 7.4% among a rural sample.[21] Aekplakorn, et al. reported that obesity has increased in Thailand more than 2.5 times over the past 23 years.[7] Kosulwat reported many improved demographic trends over the last three decades in Thailand including increases in life expectancy at birth and decreases in infant mortality. These improvements are particularly evident in the industrial centers of Thailand. However, these transitions have brought increases in obesity and overweight attributed to higher intakes of fat, protein, and processed foods.[22]

Economists Teerawattananon and Luz reported that the obesity prevalence in Thailand may have grown at the same rate as the Thai per capita GDP which is also comparable with the growing number of Thai people living in urban areas.[23] In 2009, in urban areas, 41% of

females and 28% of males were found to be obese. The prevalence of obesity in adult males reflects a trend from previous years and rose to 33%, while the prevalence in females increased only slightly to 43%.[23] Thailand has now become second only to Malaysia regarding prevalence of obesity in Asia[24].

Bio-social Determinants of Obesity among Children and Adolescents in Thailand

Pawloski et. al. reported a rise in obesity in adolescent girls in Thailand from 2000 to 2010 and noted that early menarche was a predictor of obesity in adolescence.[12] Early menarche is associated with shorter stature and higher risk of obesity. Pengpid and Peltzer reviewed behavioral factors that increased the risk for obesity in almost 6,000 adolescents across Thailand. They found a high number of risk factors related to personal behavior and the environment including lack of peer support, school truancy, psychological distress, older age, and being male.[25] Pengpid found additional predictors of obesity included low fruit consumption, sedentary behavior, being physically attacked, and lack of parental bonding.[26] Pawloski found that older adolescent girls felt more pressure to stay thin, particularly if they were interested in dating boys or if they were from a more educated or higher socioeconomic status family. Quantitative data supported these findings, as obesity trends for girls declined from ages 10 to 18 years, yet increased in boys.[27] Evidence has shown that growth patterns between Thai boys and girls vary significantly, such that girls had normal-to-low BMI for age percentiles in later adolescence while boys had high BMI for age percentiles.[27,28]

In Thailand social factors also play a role regarding differences among gender. For example, Thai women are often responsible for domestic chores, and wealthier households have servants who often do more high energy expenditure tasks. Such factors can explain why studies in Thailand show that higher socioeconomic status is associated with an increased risk of obesity in men and yet a decreased risk of obesity in women.[29] In general, family income has been shown to be higher for Thai obese children and adolescents. However, unlike the U.S. where obesity is highly correlated with low socioeconomic status and income, the reverse is more often the case in Thailand, particularly among boys.

Location and Access Issues in Thailand

Geography and Obesity

Obesity is becoming problematic in remote locations in Thailand, however, obesity impacts urban areas at a greater rate,[30] as documented by increasing rates of obesity over six years in urban areas.[6] Early urban exposure has also been described as a risk factor for obesity in Thailand.[4]

Food Access

One determinant of obesity is increased access to low nutrient-dense foods. Studies concerning availability of foods in Thailand have noted that prepared food is available everywhere and often preferred as Thai food is difficult to prepare. Food is also considered a major part of the social culture in Thailand and is provided at social events. Food carts and street food are nearly ubiquitous; often placed in front of schools.[3] Many children and adolescents have easier access to processed foods such as potato chips and sodas and in many cases, fast foods are considered high status and preferred over traditional Thai foods and snacks.

Access to Healthcare

Access to primary health care is less costly, easy to deliver, and can be effective in preventing large scale disease progression.[31] Adequate access to health care promotes resilience in population health, by ensuring the capacity of the health care system is sufficient to absorb and respond to population health problems.[32] Barriers to access may result in delayed care, forgone care, and ultimately no preventative care which undermines population health and resilience. Research from geography and public health show that the proper placement of healthcare facilities and services can help overcome barriers to healthcare access by increasing the use of nearby services, leading to improved public health outcomes. While Thailand provides universal healthcare, there may be gaps related to health education and health promotion services. Although it is agreed that access to health care is beneficial, consensus as to how to effectively measure spatial accessibility has not been reached or incorporated into a best practice workflow for health care administrators.

Spatial accessibility relies on three variables: availability of providers, the population demand for services, and the travel impedance (distance or time) between patient and provider.[33] Much of healthcare access research focuses on disparities in access and health outcomes in rural areas in the US[34] and less developed areas in Thailand[35], Central America[36], Africa[37]. The obesity crisis is unique in that access to more processed energy-dense food choices is more prevalent in urban settings where access to healthcare and education opportunities are also more prevalent. In this case one must consider both access to the negative and positive influences. As rates of obesity are higher in urban areas of Thailand, yet are rising as well in rural areas where health resources and information are less accessible, multidimensional strategies for assessing the geographic patterns of obesity including the risk environments that are likely to contribute to higher burden of disease may offer a framework for targeted response.

Risk Environment Framework

Multiple dimensions of the social determinants of health should be considered when evaluating the obesogenic risk environment.[38,39] Social factors such as age are important to consider as children lack nutritional knowledge, and may benefit from targeted obesity prevention campaigns.[40] The urban environment or proximity to an urban environment may also be a risk factor; exposure to an obesogenic food environment is more likely in urban areas.[41] A local food environment can be understood with residential healthy foods surveys.[42] Available recreational activities, including accessible green spaces, and transport environments are physical factors to consider. Socioeconomic status is also a contributing factor as increased economic prosperity is associated with the transition from physically demanding manual labor to decreased energy demanding work.[10] Policy related variables may include factors such as access to healthcare providers or exposure to existing nutritional education programs.

Geographic Methodological Tools & Techniques for Obesity Risk Assessment

Spatial Data Analysis

Regression analyses have been used to assess the influence that social, physical, economic, and policy determinants have on health outcomes. Understanding these relationships enables policymakers to identify and predict areas of high risk. However, traditional statistical analyses do not take into account the role of spatial effects which may invalidate the results, yielding biased or inconsistent estimates.[43] Spatial dependence refers to the structure of the correlation

or covariance between random variables at different locations and is determined by the relative position in geographic space; spatial heterogeneity refers to the uneven distribution of a trait, event, or relationship across space.[44,45] Geographically weighted regression (GWR) offers a way to model parameter variability across space.[46] A GWR model creates a family of local regression models while OLS generates a single linear model for the entire dataset assuming relationships are constant over space.[44] The family of local linear models produces a surface of location-specific parameter estimates.[47] The GWR method has been applied in many domains; in the context of obesity, park proximity, natural amenities, and education were key determinants found to have a negative relationship with obesity prevalence.[48] One study in Taiwan utilized GWR to identify an area-specific association of township disadvantage (poverty, minority composition, and social disorder) and elevated obesity risk, thus advocating for area-specific strategies to curb obesity.[49]

A problem associated with the GWR method is the assumption that all processes being modeled operate at the same spatial scale[46], however, in the context of obesity it is likely that the complex assortment of influences may each vary at different scales.[50] A recent extension to GWR – multiscale (M)GWR – overcomes this limitation.[51] The less restrictive nature of assumptions in the MGWR method can minimize over-fitting, reduce bias in parameter estimates and mitigate the influence of collinearity.[47] Oshan et al found a mix of global and local processes best modeled obesity rates, providing more nuanced results that include determinant-specific spatial contexts.[50] Understanding the multi-scale differences has implications for policy development through a mix of programs to target populations, communities, or individuals.

Measurements of access

The accessibility to resources is a key concept embedded in many of the potential determinants of health, but what does access mean and how is it determined? Access can generally be defined as the ease with which people can reach opportunities and services.[52] With advances in spatial analyses and geographic information systems (GIS), numerous quantitative physical access measurements have been developed. There is a subset of metrics which can inform studies of obesity where access to healthy and unhealthy foods, education, and healthcare are of primary concern.

Spatial access metrics can be categorized into area-based and distance-based.[53] A frequently used area-based access measurement, the provider to population ratio, is simply the ratio of provider supply to population within a contained administrative boundary.[54] This measure is used by the U.S. Department of Health and Human Services to set minimal standards of supply and to identify underserved areas.[55] This measure is recommended for geographic analysis of food environments by the U.S. National Cancer Institute as it reflects the relationship between a population and its available food sources.[42] A straightforward distance-based access measurement is the distance to nearest provider method. This approach measures the distance from an enumeration unit centroid to the nearest provider.[31] This approach is less realistic for urban areas with many providers, but may be suitable for rural areas as the nearest provider is likely to be the most used.[56] This approach may be the best option for less developed areas, particularly in low and low-middle income countries where travel infrastructure or terrain may be unstable.[57]

In areas with detailed geospatial data, more sophisticated measures of spatial access may be employed, considering the three components of spatial access—supply, demand, and travel impedance. The floating catchment area (FCA) family of models, which leverage the

interaction of supply, demand, and distance, provide an easy to interpret supply to population output ratio. [58] More specifically, the Two-Step FCA (2SFCA) model developed by Luo and Wang [59] provides a supply-to-demand ratio within floating distance catchment zones for each demand location. The Enhanced 2SFCA (E2SFCA) developed by Luo and Qi [60] takes the method further by using a distance decay weight between 0 and 1 as an inverse function of travel distance from a facility. The E2SFCA was developed and directly applied to access measurement to primary care physicians[60], but other applications include access to quality foods (finding a rural-urban disparity in food store accessibility)[61], and access to transit.[62] The Modified (M)2SCA, takes into consideration the spatial configuration of resources in the context of optimal location-allocation of healthcare resources[63], and the three-step (3S)FCA considers competition among facilities.[64] Such a metric could be useful in assessing competition in an urban food environment in regard to obesogenic determinants.

Added impact of COVID-19

In Thailand, the extensive network of healthcare facilities contributed to the success of case finding, contact tracing, and containment efforts regarding the COVID-19 pandemic. Local health officers and village health volunteers worked in concert with the Ministry of Public Health's investigation team to find active cases and contact tracing, and were actively promoting public health measures and messages for social/physical distancing, including providing support to those traveling back to their local community. The Thai health sytem, providing universal health financing, allows the Government to quickly offer free COVID-19 tests and medical care, through the public health insurance program.

The COVID-19 pandemic has almost reached its two-year anniversary, and the experience in Thailand has been a model regarding equity for many health care systems. For example, one vulnerable population is the overseas migrant workers of which Thailand has over four million[65], many of whom entered the country illegally and therefore do not have health insurance coverage. Their working and living conditions are often conducive to exposure and spread of infectious disease. Though the Ministry of Public Health sent a message to the wider public that all migrants regardless of legal status can have free COVID-19 tests and treatment.

One bigger challenge to health equity, and ultimately health outcomes, will likely stem from the social and economic implications from the pandemic and its policy responses such as partial lockdown restrictions. Potential delays in treatment may result in increased health complications and severity of diseases, particularly for chronic disease sufferers of the poor and marginalized populations, and obesity can only complicate these challenges. Inadequate social protection coupled with inadequate social support from the government to mitigate the impacts of economic recession and rising unemployment means more households and children will be pushed into poverty.[66]

Existing nutrition intervention programs in Thailand and further implications for nutrition education programming and policy

Thailand has already made many successful national efforts to reduce obesity across the nation with significant results. Programs have included interventions from the Thai National Food Committee. Programming included 1) developing current indicators and standards for nutritional status, 2) dietary guidelines targeted at age groups, 3) recommendations for targeted age groups for nutrition education programs, 4) increases in fruit and vegetable consumption efforts, 5) efforts to decrease sugar, sodium, and fat in diets, 6) an expansion of the school nutrition programs implemented by Her Royal Highness Princess Maha Chakri Sirindhorn, 7)

an expansion of the Thai Ministry of Public health to add community based nutrition programs to hospitals, 8) a national annual survey of nutritional health, and 9) programs to provide food security during times of national crisis[67]. Drawing from our review, we next identify implications for nutrition education programming and policy specific to Thailand.

Interprofessional Approach

As the problem of obesity is multifaceted, intervetions should use an interprofessional and multidisciplinary approach. While there are many clinical implications from the literature reported here in terms of the causes of obesity in Thailand and the impact of the dual burden of disease, this paper clearly underscores the need for an interprofessional and multidisciplinary approach. We have seen the need for not only dietitians and other health practitioners and clinicians to identify and develop sound nutrition programs and policy, but also epidemiologists, infectious disease experts, geographers, anthropologists, economists, government policy makers, and industry and business experts. Further, such experts can help to identify the very specific contextual challenges that Thailand faces concerning the understanding of diet and nutrition and appropriate nutrition intervention programs.

The use of healthcare access models and tools

Models of access to healthcare can inform the practice of health promotion and prevention programs. They are, in fact, ideal for understanding how to prioritize and where to locate nutrition intervention programs designed to reduce risk from obesity. This is due to the clear association of higher obesity levels with specific places, and the ability to identify the locations of populations that have characteristics associated with higher risk. These measures of access allow public health practitioners to target populations that would most benefit from interventions, such as where to locate prevention programming and nutrition educators. Such methods have been used in many healthcare settings which look at access to healthcare, however, very few have been incorporated in the development of nutrition intervention programs.

Current context of COVID-19 and emerging infectious diseases

There is a clear connection between obesity and COVID-19 cases and deaths, thus such risk should be included in educational programming and messaging as infectious diseases reflect a more urgent and overwhelming strain on the healthcare system. Further, understanding the risk of an acute illness may have a greater impact on children and adolescents, who often see chronic diseases as not immediately relevant to their lives. Thailand might also consider using its successful programming to ensure food security during other times of crises, as in natural disasters like Thailand's floods. Such programs should consider the importance of high nutrient-dense foods as well.

Age, Gender, and Socio-cultural determinants

Thailand has made many successful programs including the development of food guidelines based on age and the implementation of programs in schools. Prioritizing nutrition programming and policy among children is of issue as obesity continues to rise, raising the risk of chronic diseases to occur earlier in life.

As most children consume food and snacks in or around school, continuing successful nutrition education programming in schools is critical. While multiple factors influence obesity in children, it is important to understand the influence of parental factors. As adolescents gain more independence and make decisions about what they eat, it becomes more important to

focus on personal and environmental determinants of obesity. Thus the use of the theory of planned behavior has been a successful method for reducing weight in Thai adolescents.[68]

In addition to age, understanding the impact of gender is key to the development of successful nutrition intervention programs. Programs should be tailored to both age and gender as we have seen greater prevalence of obesity among adolescent boys compared to girls, and girls are more impacted by the status of being thin and body image concerns. In adult populations, gender roles can impact the kinds of recommendation for activities to increase energy expenditure as many women may be responsible for household activities. Yet also impacting gender roles in Thailand is socioeconomic status, which would include the ability to have servants in the home and lower workloads and energy expenditure. Also, understanding shopping behaviors is important as access to low nutrient-dense foods does not necessarily mean those foods are being consumed.

CONCLUSION

This article has examined the challenges concerning obesity in Thailand particularly regarding the impact of biocultural determinants, location, and healthcare access. While the causes of obesity are complex, this paper identifies many considerations when prioritizing target populations in order to develop sound nutrition interventions. It also provides suggestions concerning the available tools to help interprofessional teams develop and design appropriate nutrition interventions in Thailand, most specifically to location and spatial analyses.

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DECLARATION

The authors attest that the manuscript is previously unpublished, not currently under consideration elsewhere and will not be submitted for publication elsewhere regardless of language and is submitted only to the HWEJ.

HUMAN SUBJECTS PROTECTION PERMISSION AND WAIVER

As this is a review article, no human subjects data were collected, and thus no human subjects ethical review was necessary.

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