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Abstract

Background: The burden of noncommunicable diseases (NCDs) is increasing worldwide, including in Thailand. One risk factor for NCDs is an unhealthy diet. Thus, this study aimed to investigate the factors affecting the consumption of an unhealthy diet and determine the proactive policies that support factors inhibiting an unhealthy diet.

Methods: We investigated the factors affecting unhealthy diet consumption behavior by multiple linear regression analysis by surveying 970 Thai patients with early-stage NCD. In addition, we investigated appropriate policy proposals by conducting in-depth interviews with 20 key informants.

Results: Knowledge (−0.247, 95% confidence interval (CI) −0.285 to −0.210), family and reference person (−0.170, 95% CI −0.275 to −0.065), health awareness (−0.111, 95% CI −0.148 to −0.074), and education (−0.062, 95% CI −0.092 to −0.032) were significantly related to the inhibition of unhealthy diet consumption. Four proactive policies supporting those factors include the following: (1) reforming the national curricula to include scientific knowledge and health literacy, (2) educating social influencers to help advocate accurate information, (3) creating an easily accessible public food database, and (4) designing consumer-friendly front-of-package labels.

Conclusions: Although strengthening health literacy involves many factors and requires cooperation from many sectors, it may be a solution for a sustainable fight against NCDs.

Keywords: consumption, diet, health behavior, health literacy

INTRODUCTION

Noncommunicable diseases (NCDs) kill 41 million people each year, equivalent to 74% of all deaths globally.[1] It is estimated that 1.7 million of these NCDs deaths occur in people younger than 30 years of age, and 23.0 million NCDs deaths occur in people aged 70 years and older.[2] NCDs pose a significant financial burden on nations' health care budgets and welfare, such that an increase in costs occurs with increased disease severity and years lived with the disease. The global impact of NCDs is predicted to result in a constant rise in health care expenditure in the coming years.[3] In Thailand, NCDs, such as cancer, diabetes, ischemic heart diseases, and cerebrovascular diseases, are the predominant killers, causing an estimated 400,000 deaths each year (or 74% of all deaths).[4] According to the Ministry of Public Health of Thailand, NCDs accounted for 75% of deaths in Thailand, or about 320,000 deaths per year or an average of 37 deaths from NCDs per hour.[5] In 2007, Thailand spent $36.5 million on inpatient medical care for NCDs.[6]

Thailand has responded to this issue by implementing a national strategic plan for NCDs and related risk factors, such as the Thailand Healthy Lifestyle Strategic Plan 2011–2020, the Strategic Plan for Managing Overweight and Obesity Problems 2010–2019, and Strategies for Reducing Salt and Sodium Consumption in Thailand 2016–2025.[7] To be consistent with the sustainable development goal of reducing premature mortality due to NCDs by one-third by 2030, Thailand has implemented a 5-year action plan for the prevention and control of national NCDs (2023–2027). Strategy 2 of this plan places emphasis on promoting health literacy (HL), awareness, and the values of prevention and control of NCDs among the Thai population.[8] Despite the serious implementation of policies for managing health problems, sickness due to NCDs has been increasing among the working-age population and young adults, resulting in a greater than 50% increase in the proportion of the population experiencing premature mortality.[9] The results of the National Health Examination Survey among Thai people aged 15 years and older in 2008–2009, 2014–2015, and 2019–2020 showed increasing trends in overweight, abdominal obesity, and hypercholesterolemia, which were consistent with trends in the prevalence of diabetes and hypertension in the Thai population.[8] In addition, the results of a survey of people's food consumption behavior in 2017 indicated that among the Thai population, 77.4% consumed high-fat food, 76.2% nonalcoholic beverages (i.e., soft drinks, soda, coffee, milk tea, etc.), 59.3% delicatessen food, 48.3% snacks, and 20.5% fast food each week. This information reflects the fact that most Thai people regularly consume foods and drinks with high energy density and that these foods and drinks contain

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high amounts of fat and sugar—factors that promote the overweight and obesity crisis in Thai society.[10]

In countries where food is quite varied and easily accessible, such as Thailand,[11,12] the consumption of an unhealthy diet has been primarily driven by the easy accessibility of street foods, such as the snacks, sugary drinks, and highly energy-dense items sold at tuck shops and convenience stores.[13,14] Thailand has approximately 111,370 street food businesses and 18,000 convenience store outlets[15,16] that people can visit day and night. Due to some weaknesses in Thailand's street food regulations, such as variation in regulations between regions and municipalities, loopholes arise for food trucks that typically operate as caravans, frequently moving from one location to another. In addition, there is no limit on the number of permits issued to street food vendors in each area of Thailand. In comparison, the mobile food-vending regulations in New York City in the United States have a much more robust framework and greater apparent effectiveness, as they are explicit and strict in limiting the number of permits given for vendors and sales areas.[17] These weaknesses in Thailand's street food regulations may lead to the uneven enforcement of regulations between cities and between vendors,[18] including difficulties in monitoring and inspecting the food quality. This is reflected in the survey results on the hygienic practices of street food vendors in four countries (China, Thailand, Greece, and Poland). Researchers found that in European Union countries, equipment hygiene and food preparation had generally higher conformity to the Codex Code of Practice general principles on food hygiene than in Asian countries.[19] Hereby, the effect is that Thai individuals can easily get unhealthy food due to the absence of restrictions on the quantity of street food vendors and insufficient oversight about the hygiene and nutritional quality of street food.

The defining attributes of street food, processed foods, instant foods, ready-to-eat meals, fast food, and Western-style cuisine include unhealthy components such as elevated levels of fat (especially saturated fat), high sodium content, added sugars, and high energy density, all of which contribute to an unhealthy diet and the development of NCDs.[13,14,20–24] Despite widespread awareness of these facts, research indicates a significant increase in the variety and volume of unhealthy food products sold globally and a yearly rise in the total consumption of unhealthy food among the world's population.[25] This may result from urbanization, technological progress, and changing lifestyles.[26] Consequently, dietary trends have shifted increasingly towards a modern dietary framework.[27–29] This dietary pattern has been linked to increased health issues, including chronic diseases such as diabetes, cardiovascular diseases, and obesity.[26,30]

The prevalence of overweight individuals has been documented in Mexico, the United States, and Australia as 34.90%, 31.80%, and 39.10%, respectively.[29] The obesity prevalence was also high in the Asia-Pacific region, where almost one in three adults were obese in Australia, Fiji, and New Zealand in 2016. In these countries and Asia-Pacific territories, the prevalence of overweight adults was also high at greater than 60%. Between 2010 and 2016, the increase in the prevalence of obesity in lower-middle-income and low-income countries and territories increased on average by 61% among children and adolescents (from 2.7% to 4.4%) and by 28% among adults (from 6.8% to 8.7%). In Vietnam, the prevalence of overweight has increased rapidly among children, adolescents, and adults. This prevalence also grew quickly by 55% among children and adolescents in India (from 4.4% to 6.8%) and Cambodia (from 7.3% to 11.3%), and a significant increase was also observed among adults in Lao PDR (23%, from 20.6% to 25.4%), Bangladesh (22%, from 16.4% to 20%), and Thailand (22%, from 26.7% to 32.6%) in the same period.[31] Moreover, many studies reported that most Thai people have a relatively low level of HL,[32,33] which reinforces the difficulty individuals have in taking care of their own health among the shifts in dietary patterns and the easy accessibility of unhealthy food in Thailand mentioned above. In addition, various factors influence individuals' food choice and diet consumption, such as economic status, family, mood and emotional state, taste of food, knowledge of nutrition, age, educational level, food access, advertising and promotion, food prices, health awareness, lifestyle, and food environment.[34] These numerous factors may lead to unhealthy behaviors and inappropriate diet consumption, which has intensified the development of NCDs.[35]

Thus, the issues discussed above raise the question: What factors can inhibit an unhealthy diet consumption leading to NCDs? The identification of these factors could provide information that the government can use to discover more effective solutions to preventing NCDs, thus improving the people's quality of life and also reducing expenditures of curing illnesses associated with NCDs. Therefore, in this study, we aimed to study the factors affecting unhealthy diet consumption behavior and to explore appropriate proactive policy proposals that can hinder the unhealthy diet consumption behavior.

METHODS

Ethical approval

This study was approved by the Committee for Research Ethics (Social Science), Mahidol University, under the project "The proactive policies for tackling risk factor of non-communicable diseases (NCDs) problems in the dimension of unhealthy diet" code No. MU-SSIRB: 2018/189.1408 approved on August 14, 2018. Informed consent was obtained from all participants included in the study.

Study design

First, we conducted a quantitative study to determine the factors associated with consuming an unhealthy diet. To achieve this, we administered a questionnaire to survey and collect data. We performed multiple regression analysis to analyze the factors affecting the behavior of unhealthy diet consumption. Second, we conducted a qualitative study to determine the proactive policy proposals that support factors that can inhibit unhealthy diet consumption that leads to NCDs. This included conducting in-depth interviews with 20 informants. This study was conducted between July 2020 and July 2021.

Data collection and sampling group

First, we administered a questionnaire to survey and collect data on the factors affecting unhealthy diet consumption behavior in patients with NCDs at an early stage who were able to live normally. We asked each respondent about their preliminary health status, including body mass index (BMI), waist circumference, blood pressure, fasting glucose levels, and whether they were taking antihypertensive medications, hypolipidemic drugs, or insulin injections. Inclusion criteria were patients with NCDs who had early-stage diabetes (fasting glucose levels of 126 to 200 mg/dL),[36] obesity (BMI > 25 kg/m^2 or waist circumference between 90 and 120 cm), or hypertension (systolic pressure between 140 and 159 mm Hg).[37] We selected the sample population using quota sampling based on the highest numbers of deaths from NCDs in five regions (central, eastern, northern, northeastern, and southern) as reported by the National Statistical Office, which accumulated nationwide data for a total of 144,470 individuals.[38] We used Yamane's sample size formula to determine the sample size.[39] We obtained a required sample size of 399 individuals; however, to increase statistical reliability, we increased the sample size by three replications[40,41] for a total sample size of 1,197.

We distributed the questionnaire in various public or community places to recruit respondents. Both a paper and a digitalized questionnaire were collected through face-to-face communication. We used the digitalized questionnaire when possible through electronic communication devices (i.e., areas with a Wi-Fi signal) and the paper questionnaire for areas without a Wi-Fi signal. We excluded from the sample a random selection of the population with congenital diabetes (type 1 diabetes) and patients with NCDs who had complications with an undefined cause directly related to NCDs. To achieve the sample size target, attrition of sampling selection was conducted based on the criteria that the replacement represents the population demographics prone to NCDs.

Second, to determine the proactive policy proposals that support factors inhibiting the consumption of an unhealthy diet that leads to NCDs, we conducted in-depth interviews with 20 informants. In Thailand, the management of NCDs is achieved through a network involving many agencies and sectors. Thus, to approach potential key informants, snowball sampling was the most appropriate sampling method,[42] and we used this method to obtain a sample of informants from the following three sectors: public sector (Ministry of Public Health, Ministry of Agriculture and Cooperatives, Ministry of Commerce, Ministry of Interior, Ministry of Education, Tambon Health Promote Hospital, Sub-district Administrative Organization, and the Provincial Agricultural Office), private sector (food product companies, beverage product companies, fast food companies, and farmers), and civil society, representing the interests of health promotion and disease prevention.

Data collection instruments

First, in the study of unhealthy diet consumption factors, we designed and developed a questionnaire divided into four parts.

Part 1: Biographical information of the respondents, including demographic characteristics; this information was recoded to dummy scores for age, income level, and educational level.

Part 2: Factors influencing the decision to purchase or consume which consisted of 5 questions: the first question is the picture of foods high in sugar, the second question is the picture of foods high in sodium, the third question is the picture of foods high in fat, the fourth question is the picture of foods with trans-fat, and the fifth question is the food products without nutrition label and Food and Drug Administration certification. These categories were based on the books *Metabolic Syndrome*[43] and *Food and Nutrition Knowledge for All Ages*.[44] The respondents selected the foods they used to or used to buy or eat. They were also asked to provide a score for each reason behind their decision, such as easy to buy, cheap/more cost-efficient, like its advertisement or promotion, trust in the brand, looks delicious/want to eat, good for health, family/acquaintance/influencers recommended to buy, and other reasons (the respondents were able to specify additional reasons by themselves).

Part 3: General knowledge of nutrition and NCDs was included in 10 questions, including "What food should people with diabetes not eat?" "What food should people with kidney disease not eat?" and "Are NCDs contagious or not?".

Part 4: A virtual supermarket or a part of the questionnaire consisting of food images. Respondents were asked to choose 10 different foods in this virtual supermarket from among 10 product categories (beverages, condiments, dairy products, dessert, fresh products, fruits, main dishes, side dishes, snack food, and vegetables).[45] Respondents made two choices in each category: one of a healthy food and one of an

unhealthy food (i.e., salad vs. French fries, sugar-sweetened beverages vs. drinking water, generic vegetables vs. organic vegetables, sweetened condensed milk with trans-fat vs. sweetened condensed milk without trans-fat, etc.). The food choices were based on the books *Metabolic Syndrome*[43] and *Food and Nutrition Knowledge for All Ages*.[44] We used the unhealthy food choices scores as the dependent variable for the multiple linear regression (MLR) analysis.

The questionnaire was tested for validity by evaluating the index of item-objective congruence (IOC). Four experts reviewed and rated the questionnaire. Including the finding of the correspondence index between the question and objectives to check the content accuracy, understanding, and clarity of the language used in each question, all questions in this questionnaire had an IOC value greater than 0.75. The alpha coefficient method was used to determine reliability.[46] The questionnaire was administered to at least 30 people, not in the research sample. We calculated Cronbach's alphas values of 0.73, 0.78, and 0.81 for questionnaire parts 2, 3, and 4, respectively.

Second, to study proactive policy proposals, we designed a semi-structured interview form to conduct in-depth interviews with informants. We discussed with and asked informants for their opinions about relevant proactive policy proposals, the study results of unhealthy diet consumption factors, the possibility of policy implementation, cooperation, and relevant issues.

The semi-structured interview form was tested for validity by evaluating the IOC. Three experts reviewed and rated the interview form, including checking the content accuracy, understanding, and clarity of the language used in each question. All questions of this interview form had an IOC value of 1.0.

Data analysis

First, to analyze the factors affecting unhealthy diet consumption, we categorized the collected data and used descriptive statistics to describe the demographic characteristics of the sample population. The data were transformed into dummy variables before being used in the MLR analysis.[47] The independent factors from part 1 of the questionnaire were converted as follows: age, ≤20 years = 1, 21 to 40 years = 2, 41 to 60 years = 3, and ≥61 years = 4; income per month, ≤10,000 Baht = 1, 10,001 to 20,000 Baht = 2, 20,001 to 30,000 Baht = 3, and ≥30,001 Baht = 4; education, lower than primary education = 1, primary education = 2, secondary education = 3, diploma/high vocational certificate = 4, and bachelor's degree or higher = 5. Independent factors from part 2 of the questionnaire, namely, health awareness, goods prices, product brands, family and reference person, product approach, advertising and promotion, mood and emotion, and lifestyles, were formatted on an ordinal scale based on the score provided by respondents for each reason behind their decision in buying or consuming unhealthy food products, using a 5-point Likert scale (with 5 referring to a reason being the *most significant* toward purchasing decisions of the food and 1 referring to a reason being the *least significant* toward purchasing decision of the food). As for the independent factor knowledge, the data formatted on a ratio scale were derived from the scores rated by the respondents in part 3 of the questionnaire concerning general knowledge of nutrition and NCDs, which included 10 questions with 0.5 points each, for a total score of 5. The dependent variable unhealthy food choice score was calculated from the scores in part 4 of the questionnaire, whereby selection of one image of unhealthy food was counted as 1 point. We used the computer software package SPSS V.20 for the analysis.

Second, to synthesize the information obtained in the proactive policy proposal study, we transcribed the audio files of the informants from all three sectors (at least one informant from each sector). Then, present the summary findings of the appropriate proactive policy proposals.

RESULTS

Unhealthy diet consumption factors

The survey results showed that of 1,197 respondents, 970 (81.04%) provided complete information. Table 1 summarizes the demographic data of the sample population.

The analysis of the multiple regression equation showed that the independent variables with the top three highest scores were product approach, advertising and promotion, and goods prices, with mean scores of 4.78, 4.23, and 4.03, respectively. In contrast, the independent variables with the top three lowest scores were family and reference person, health awareness, and knowledge, with mean scores of 1.05, 1.54, and 2.03, respectively. The dependent variable, unhealthy food choice scores, had a mean score of 3.96 (see Table 2). The correlations among the independent variables were less than 0.50; thus, they were determined to be free from multicolinearity.[48,49]

Next, we tested the effect of each factor on unhealthy food choice score using the backward method of MLR. This method begins with all variables in the model and then excludes variables based on their nonsignificance, retaining important variables that influence the outcome.[50] The results of the analysis showed that the 10 variables influencing the unhealthy food choice scores, namely, product approach, goods price, advertising and promotion, mood and emotion, income, lifestyles, education, health awareness, family and reference person, and knowledge, had p values less than 0.05 (see Table 3). This is reflected in the following predicted equation of unhealthy food choice:

$$\begin{aligned} &Unhealthy\ food\ choice \\ &= 0.941 + 0.464\ Product\ approach + 0.167\ Goods\ price \\ &+ 0.135\ Advertising\ and\ promotion \\ &+ 0.095\ Mood\ and\ emotion + 0.047\ Income \\ &+ 0.038\ Lifestyles - 0.062\ Education \\ &- 0.111\ Healthy\ awareness \\ &- 0.170\ Family\ and\ reference\ person - 0.247\ Knowledge \quad (1) \end{aligned}$$

This predicted equation resulted in R^2 and adjusted R^2 values of 0.658 and 0.655, respectively, with a standard error value of 0.464. Adjusted R^2 is a corrected goodness-of-fit (model accuracy) measure for the model equation and is used to compare the explanatory power of the model equation.[51,52] In this case, it is the equation of unhealthy food choice. Therefore, it can be inferred that the 10 independent variables of the unhealthy food choice's equation can be used to explain the variance of the unhealthy food choice behavior (or dependent variable) with an accuracy of 65.5%.

Appropriate proactive policy proposals

Referring to the predicted equation of unhealthy food choice, four factors inhibit the consumption of an unhealthy diet: knowledge (−0.247, 95% confidence interval [CI]: −0.285 to −0.210), family and reference person (−0.170, 95% CI: −0.275 to −0.065), health awareness (−0.111, 95% CI: −0.148 to −0.074), and education (0.062, 95% CI: −0.092 to −0.032).

This result caught our attention with regard to determining appropriate proactive policy proposals for addressing the risk factors of an unhealthy diet associated with NCDs. Thus, we discussed the findings of this quantitative study with key informants in an in-depth interview. The results of the qualitative study revealed the perspectives of several key informants in terms of the four factors that are components of HL.

As stated by one educational specialist, "It is an issue of the health literacy enhancing to make healthy food choices. If asked that it can be improved or not? I can reply that it could be done but have to wait for the moment because it relate with many factors." One local public health specialist said, "I think strengthening the health literacy is very important. In my point of view, the eating habits cannot be only adjusted on a patient's aspect, but it is necessary to change and reform in a lot of things."

The opinions of the key informants regarding the appropriate proactive policy proposals that can strengthen and support the adequate HL of the population are summarized below.

Reform the national curricula to include scientific knowledge and understanding and HL. One teacher said, "Once, I taught the students how to read products' labels. It is obvious that they mostly don't read because they don't understand, but we can guide them in the classroom

TABLE 1. Demographic characteristics of the sample (N = 970)

Variable	%
Gender	
Male	40.93
Female	59.07
Age, years	
≤20	2.89
21–40	38.66
41–60	39.28
≥61	19.17
Occupation	
Student	11.13
Teacher	1.86
Medical staff	3.09
Bureaucrat	6.91
State enterprise employee	11.96
Private company employees	19.79
Laborer	0.72
Merchant	8.97
Private business owner/freelancer	18.45
Farmer	2.99
House husband/housewife	10.31
Retired/unemployed	3.82
Education	
Lower than primary education	2.68
Primary education	27.21
Secondary education	33.20
Diploma/high vocational certificate	23.20
Bachelor's degree or higher	13.71
Income (per month), THB	
≤10,000	18.97
10,001–20,000	56.39
20,001–30,000	22.89
≥30,001	1.75

TABLE 2. Means and standard deviations of each factor of unhealthy food choice (N = 970)

Variable	Mean ± SD
Unhealthy food choice score	3.96 ± 0.79
Age	2.77 ± 0.83
Income	2.20 ± 0.81
Education	3.38 ± 1.14
Health awareness	1.54 ± 0.95
Goods price	4.03 ± 0.69
Product brand	3.93 ± 0.56
Family and the reference person	1.05 ± 0.27
Product approach	4.78 ± 0.59
Advertising and promotion	4.23 ± 0.71
Mood and emotion	3.98 ± 0.81
Lifestyle	3.65 ± 1.36
Knowledge	2.03 ± 0.82

TABLE 3. Coefficients of the MLR model Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	*p*	95% CI
	β	SD	β		
(Constant)	0.941	0.209		0.000	0.530 – 1.352
Income	0.047	0.021	0.048	0.027	0.005 – 0.089
Education	−0.062	0.015	−0.089	0.000	−0.092 – −0.032
Healthy awareness	−0.111	0.019	−0.133	0.000	−0.148 – −0.074
Goods price	0.167	0.027	0.146	0.000	0.114 – 0.220
Family/reference person	−0.170	0.053	−0.058	0.002	−0.275 – −0.065
Approach	0.464	0.031	0.347	0.000	0.403 – 0.526
Promotion	0.135	0.022	0.121	0.000	0.092 – 0.178
Mood/emotion	0.095	0.018	0.098	0.000	0.059 – 0.131
Lifestyle	0.038	0.011	0.066	0.000	0.017 – 0.060
Knowledge	−0.247	0.019	−0.257	0.000	−0.285 – −0.210

[a]Dependent variable: unhealthy food choice score; the significance of the associated *p*-value at a 95% confidence level ($p < 0.05$)

by doing activities to make them aware and learn. From this point, I found that there is a practical way to make it." As noted by one agricultural specialist, "We can make it like tutorials in school to guide the children and let them tell their parents and also guide grandparents to be more aware of consumption."

Educating and supporting members of the new-generation media, whose role includes being social influencers to help advocate accurate information and knowledge on NCDs and healthy diet consumption. As mentioned by a few of the key informants, "Supporting the role of mass media or influencers of each target group in knowledge communicating on NCDs, is very important and if they have the appropriate NCDs' knowledge, so they will be able to create new correct and appropriate contents that can reach by general people too."

Meanwhile, a local administration specialist opined, "For example, in the Muslim community, they mostly obey the leader. We can reach the leaders and let them help us in communication with the local people. But there is one thing we need to consider—how accurately do the leaders understand the principles of academic knowledge that we want them to represent for us?"

Creating a public food database that is easily accessible. A commerce specialist mentioned, "The government should make a platform or infrastructure with research funds to create an information data list, but we wouldn't follow what other countries do because our resources are not the same." Similarly, a food and agro-product standard specialist said, "Another tool that the government should do is a data platform or an application to scan and calculate what we eat, where we can scan a QR code on the side of the pack to see how much of the nutrients we have and how much quota is left for today's consumption."

Designating consumer-friendly front-of-package labels (FoPL): the form of FoPL that received the highest votes was the Health Star Rating (HSR) System label. As 56 years old bus fare collector opined "…*I sometimes eat snacks and never see the label on them because I never understand it and no need to know how much of it has. Besides, its font size is very small so I can't read it. It would be nice if there are pictures like a symbol*…"

A grade 6 student said "…*Is Monosodium Glutamate is MSG or not? I'm not sure. And I need it to be more simple and bigger* …"

45 years old factory worker opined "…*I can read it but I don't understand. I'm not scientist, not dietitian. What is sodium, what is energy? Also, this label says 0 for Sugar, what does it mean? If it doesn't contain sugar, why is written here? It will be easier if they print only what it has. And how could I understand the percent sign (%)? Come back to sodium, what is it?*…"

A taxi service owner, 72 years old said "…*I am just an ordinary guy and don't know about nutrition. "FAT 3%" or "Sodium 21%" I can't get them* …"

As a group of general people opined, "It doesn't mean the nutrition labels are not important for me but I need them to be more simple and bigger. And I am just an ordinary guy and I don't know about nutrition. 'FAT 3%' or 'Sodium 21%' I can't get them." Many the key informants stated, "We should have a common symbol in which everyone knows the meaning. For example, the symbol of it is [Thai Industrial Standards] which means Energy Efficiency No.5 rating star label in electronic devices. So this kind of symbol, it does not need any calculation. Everyone can recognize that 1 star is poor and 5 star is great."

DISCUSSION

The results of this study revealed that the four factors inhibiting unhealthy diet consumption behavior, namely, knowledge, family and reference person, health awareness, and education, were all related to HL. Thus, if

the HL status of adults can be improved to a satisfactory level, the prevalence of NCD risk behaviors in these adults would be reduced.[51] Currently, under the 5-year action plan for national NCD prevention and control (2023–2027), the Ministry of Public Health and related networks jointly implemented policies to drive HL with activities that are consistent with such policies, including (1) training to develop the skills and potential of personnel of agencies under the Department of Medical Services on HL and (2) activities for creating media for communicating HL. In addition, the relevant agencies in each area will create and implement projects that are appropriate and meet the needs of people in each area, such as strengthening the potential of leaders and officials to become HL coaches, promoting knowledge about food and health (HL), development of HL media for an online platform (i.e., knowledge communication and public relations to create HL), creating HL to change the health behaviors in individuals with suspected NCDs and patients with diabetes and hypertension, and so forth.[52] Because project approval must be requested each year, the weakness of these projects is the lack of continuity; however, the creation of HL for the population requires continuous reinforcement of knowledge to change inappropriate health behaviors and cultivate good health behaviors.[53] In addition, the development of HL requires underpinning local and national policy, laws, and regulations to create enabling environments that reduce NCD risk factors,[51] which, even if treated, are often poorly controlled. Therefore, for health sustainability, we should identify policy instruments that inhibit NCD risk factors by supporting and changing individuals' lifestyles to include proper dietary habits.[54] In Thailand, the appropriate proactive policies that can sustainably strengthen HL and support the proper dietary habits of the population, if implemented at the national level, consist of the following four proposals.

The results of a study about the effectiveness of the health promotion curriculum in enhancing NCD HL in Indian youth revealed that a theory-driven skills-focused curriculum is a tool for enhancing NCD HL.[55] However, because they involve many factors, such reforms to the national curricula can be complicated and time-consuming.[56] Therefore, a more feasible and immediate approach is not reforming the curricula but rather using the existing curricula together with providing encouragement and support to all schools to add certain activities or projects for children regularly. This is to help children build the skills and abilities necessary for connecting academic knowledge learned in the classroom with practice in daily life, resulting in children and adolescents having HL and, ultimately, healthy consumption behavior. The findings of relative research indicated that teaching nutrition in elementary schools by properly educated teachers is essential to fostering appropriate knowledge and healthy consumption behavior in children.[57] Moreover, children who participated in a nutrition education program showed improvement with a significantly increased frequency of daily fruit and vegetable consumption.[58]

Several studies have found that social influencers can have an effect on significant increases in positive beliefs and positive changes in health behaviors.[59,60] One study found that social media–disseminated public health messages reached more than 23% of the Northern Ireland population. A Web-based survey suggested that the campaign might have contributed to improved knowledge among the target population.[61] Therefore, governments should place greater importance on NCD education and healthy consumption behavior. Because social influencers can influence individuals' consumption of healthy foods, it is also necessary to identify channels and forms of communication in addition to traditional methods to achieve greater communication efficiency and suitability for people in different groups or age groups.[62] In addition, because social influencers may have inappropriate knowledge and understanding that results in the dissemination or sharing of false nutritional information or information not supported by scientific evidence, the government must rigorously examine information published on social media platforms and should support social influencers' appropriate knowledge and understanding of NCDs and healthy consumption behavior. Ultimately, it can lead to misunderstandings that may adversely affect people's health and consumption behavior and health.[62]

Research results have shown that Thailand lacks adequate data collection and database management for information on food and NCDs. A government database is an indicator of infrastructure support; although these databases may not have a direct effect on or influence consumers to develop good food consumption behavior, it must be acknowledged that a database system for food and NCDs will be useful in facilitating and support a wide variety of projects or activities related to healthy food consumption and NCDs to improve the food environment.[63] In the Netherlands, for example, food composition databases play an essential role in public health nutrition, both in the monitoring of food reformulation and in nutrition epidemiology, as diet–disease relationships are often multicausal.[64] In the case of South Korea, which developed a processed foods database for the estimation of processed food intake in the Korean population, a study found that this newly developed nutrient foods database for processed foods contributed to the accurate estimation of nutrient intakes in the Korean population.[65] This empirical evidence shows that the development of a public food database is necessary because it might help facilitate and encourage the public sector or consumers to more easily and efficiently develop healthy consumption behavior.

According to the research data, the current guideline daily amounts (GDA) on FoPL are still not as consumer-friendly

as they should be because they are difficult to understand and time-consuming to read; they also require some nutritional knowledge to read and interpret.[66,67] The phrase *not understanding* might be due to the format of the label, which requires nutritional calculations,[66] use of specific academic terms, lack of nutritional knowledge,[68] use of foreign languages,[69] font size and color,[70] and so forth. Moreover, in this study, the in-depth interviews revealed that most of the informants preferred the HSR System label. Its popularity might be due to the shared appearance with the current GDA and inclusion of a scale similar to the "Energy Efficiency No.5 Label," a label used frequently on electronic appliances and that is familiar to the Thai population. With its semigraphic nature, this scale allows for immediate recognition and understanding, and it can assist consumers in choosing a healthy meal.[71] A study on the cost-effectiveness of product reformulation in response to the HSR Food Labeling System in Australia revealed that the HSR-attributable reformulation led to changes in the mean population energy intake, mean body weight, and health-adjusted life-years gained.[72] In addition, researchers found that almost two-thirds of Australian household grocery shoppers were willing to pay more for a product with the HSR, on average up to an additional 3.7% of the price of the product.[73]

This study had some limitations, and caution must be taken in making generalizations based on the results. This study had characteristics of a cross-sectional study, in that we analyzed unhealthy diet consumption in a population at a single point in time to understand the determinants of health and described the features of the population.[74] For this reason, the study had the following limitations. First, this study may be subject to selection bias, as we surveyed and collected data from patients with NCDs at an early stage who were able to live normally. Therefore, to screen only sample groups with NCDs that were truly connected to diet or consumption behavior and to reduce bias, we defined the inclusion criteria as patients with NCDs with an early stage of diabetes,[36] obesity, or hypertension[37] and exclusion criteria as patients with congenital diabetes (type 1), patients with NCDs who had complications for which the symptoms could not be determined as caused by NCDs, inpatients or those with severe illness, individuals without NCDs, and informants who felt uncomfortable or did not want to provide information to this study. The second limitation was sampling bias. The we selected the sample population using quota sampling from different regions based on the highest numbers of deaths from NCDs in five regions of Thailand. The way to reduce bias in this case was to increase the sample size by three replications to improve statistical reliability.[40,41] This includes using the quantitative results to inform the qualitative study questions in the interview of informants regarding their opinions on the consistency of the quantitative study results with the actual situation and the social context from experts, stakeholders, and the general population. The third limitation was information bias. For the quantitative study, we tested the questionnaire for validity by evaluating the IOC, and we tested reliability using the alpha coefficient method.[46] For the qualitative study, we tested the semi-structured interview form for validity by testing the IOC. In addition, we analyzed information through data triangulation from three different informant groups. Moreover, we explained to the responders in the quantitative study and informants in the qualitative study about the purpose/method of analysis and assured them the presentation of the results would be an overall perspective reported anonymously and not separated by the individual. Thus, the answers and opinions of each responder or informant would not be known. Therefore, both respondents and informants could be confident that no negative impact would occur from answering truthfully.

However, we cannot deny that further analysis using more comprehensive and larger samples is crucial. Future studies that consider these shortcomings will certainly contribute to better characterizing the predictors of the unhealthy food choice equation. There is also a need for future studies on the effective means and styles of increasing NCD knowledge in each population group, such as children, influencers, and the general population. Moreover, quantitative studies are required to identify a pattern of FoPL that is efficient and consumer-friendly. These efforts will provide strong support to the findings of this study and assist in their actual implementation.

CONCLUSIONS

We synthesized the results of this study through a quantitative analysis to identify the factors influencing unhealthy dietary consumption, followed by a qualitative analysis to propose proactive policies. Stakeholders across all three sectors unanimously agreed that such proactive policies are essential for enhancing knowledge and health awareness, ultimately fostering HL among the populace. Moreover, in examining the underlying choices regarding unhealthy food consumption, it became evident that in addition to factors that impede harmful dietary consumption, there are also those that encourage it. Furthermore, the data indicate that the implementation of health policy is pertinent to numerous industries. Consequently, governments that incorporate health impacts into every policy, referred to as "Health in All Policies," can enhance the implementation of health policies, making them more interconnected, coherent, and efficient, ultimately promoting sustainability in public health care.

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CONFLICT OF INTEREST

No conflicts are declared.

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