

Applying the concept of Thai nutrient profiling as a model for the Thai school lunch planner

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ABSTRACT

This study aimed to develop the Thai school lunch planning program using nutrient profiling (NP). The intention was to create a user-friendly tool that aids teachers in preparing nutritionally balanced school lunch menus. The Thai school lunch planner was developed by gathering 53 popular lunch menus from a school lunch outsourcing company in Bangkok. Menus were grouped into ten categories based on food characteristics and cooking methods. Then, menus were graded according to their energy and 13 nutrients using NP criteria as 'grade A' (score >16), 'grade B' (scores 12-16), and 'grade C' (score <12), and menu category codes were created. Lunch sets were matched across the menu category codes and based on the two formats of school lunch standards. Finally, lunch sets were graded based on energy and 13 nutrient contents using NP criteria, with cut-off macronutrients set at 30% of Thai DRI 2020. Regarding the two formats of school lunch standards, this study found 63 uniquely matched patterns, with the possibility of forming 5,160 lunch sets. Lunch pattern format 1 had 57 patterns and 5,085 menu sets, of which 2,706 menu sets met 30% of the Thai DRI macronutrient requirement. The lunch pattern format 2 could create up to 75 sets from six patterns. Thirty-seven menu sets (49.3%) met the 30% Thai DRI macronutrient requirement. NP could be a valuable alternative for planning school lunch sets to guarantee high-quality and nutritious meals. This technique can be combined with the existing school food menu guidelines. Teachers, with or without basic nutrition knowledge, can find this strategy relatively user-friendly. Even though this technique is suitable for primary schools that serve two side dishes, schools serving one side dish can apply it by increasing the portion of the side dish.

Key words:

Thai school lunch program, Nutrient profiling, lunch patterns, lunch set, menu

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INTRODUCTION

Childhood is a critical period for physiological, brain, behavioral, and socio-emotional/psychosocial development.¹ Healthy eating practices benefit health, growth, learning ability, and academic performance.² The government recognizes and emphasizes the importance of promoting optimal health among Thai children age-appropriately and fostering robust intellectual development. By consistently assisting and supporting the lunch budget in all jurisdictions, the school lunch program for public primary schools has been in place since 1992. In Bangkok Metropolitan Administration (BMA), a special administrative region, the government allocates a budget of 21 baht for school lunches, and BMA contributes an additional 4 baht. Therefore, schools receive a daily stipend of 25 Baht per student.³

According to the public health activity report Fiscal year 2021-2022, Health Promotion Division, Health Department, BMA, it was found that primary school students were 15.3 and 18.2 % overweight (weight for height $>+2$ SD), with a tendency to increase and exceed the target value (< 10 %). Stunting (height for age <-2 SD) was reported at 3.5 and 4.8 %, and wasting (weight for height <-2 SD) was at 3.8 % and 5.3 %, with a tendency to increase and exceed the target of lower than 5 % set by the MOPH.^{4,5} This is a problem where the double burden of malnutrition is inherently linked to childhood nutrition, variety of food, environments, and socioeconomic factors.⁶ Many children grow up without learning the fundamentals of consuming a healthy diet. In this regard, school lunch helps establish healthy eating practices in young children that can prevent or reverse the health effects of being overweight, poor eating habits, and the

occurrence of chronic diseases in the future.⁷

The Thai School Lunch Program website for BMA was created in 2020 to monitor school lunch quality. The adequacy of energy and the contribution to energy values of different nutrients according to different age groups are evaluated through a scoring system based on the dietary reference intake for Thais in 2003 (Thai DRI). Ten types of nutrients are used to calculate the scoring criteria, divided into three main nutrients: energy (kcal), protein (g), and fat (g), and the scoring criteria are divided into five levels. Seven types of micronutrients are dietary fiber (g), vitamin A (RAE), vitamin B1 (mg), vitamin B2 (mg), vitamin C (mg), iron (mg), and calcium (mg), and the scoring criteria are divided into four levels. School directors generally appoint a teacher to oversee the lunch program and plan the lunch sets. However, most teachers lack nutrition knowledge and related nutritional principles.⁸ The criteria for evaluating the quality of school lunch sets are difficult for teachers to comprehend within the existing scoring system. Therefore, another user-friendly approach is required.

Nutrient profiling (NP) is a model used to evaluate the nutritional quality of individual foods based on their energy content and nutrient composition. This is achieved by assigning lower ratings to foods with excessive calories, fat, sugar, and salt.⁹ World Health Organization Member States and Regions could adopt the concept of NP in developing the marketing of foods to children, health and nutrition claims, product labeling, and logos.¹⁰ In 2015, Thailand introduced food classification criteria called Thai NP using a rating system with grades A, B, and C. This system incorporates the Thai Recommended Daily Intakes (Thai RDIs) for calculation, aiming to identify food

properties linked to the risk of obesity and non-communicable diseases (NCDs).¹¹ This study aims to develop the Thai school lunch planning program using NP. This approach involves applying a food grading system for evaluating school food menus. The intention is to create a user-friendly tool that aids teachers in preparing nutritionally balanced school lunch menus.

METHODS

Study design

The design of this study was the development of a school lunch planner based on Thai school lunch standards. The data collection and analysis were performed between January and July of 2023. Figure 1 depicts the five stages of an algorithm for lunch set planning, all of which were conducted manually.

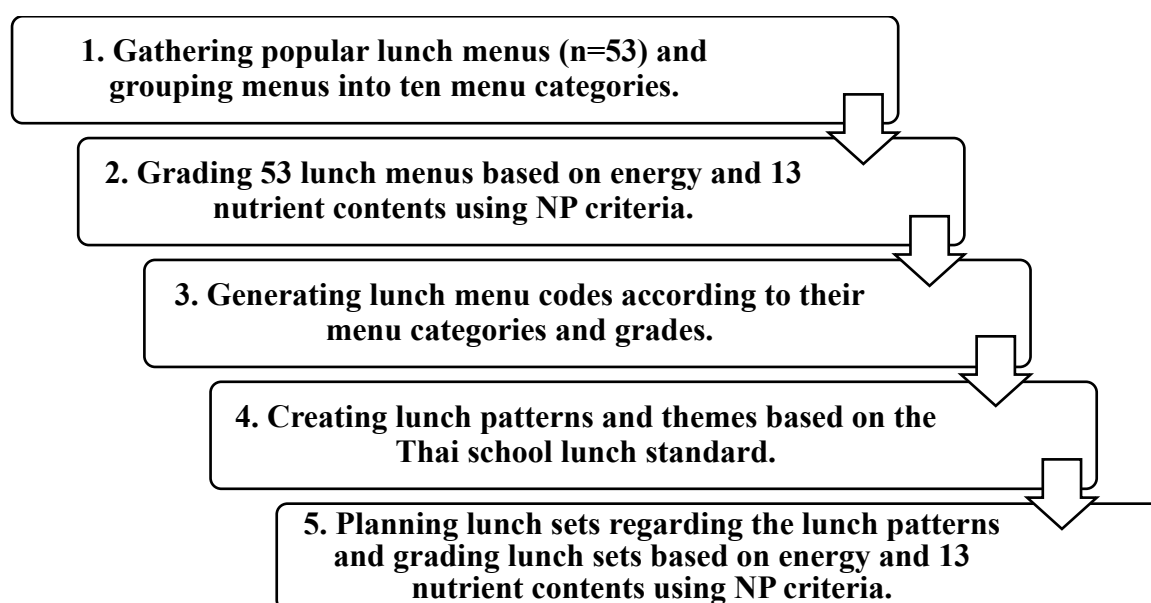


Figure 1. Five stages of an algorithm for lunch set planning.

Lunch planner development

First, this cross-sectional study included 53 popular school lunch menus provided by a school lunch management company for primary schools in Bangkok, the capital city of Thailand. Menus were determined by portion sizes for primary students and classified by food characteristics and cooking methods. Then, all menus were grouped into ten categories: single dish, clear soup, curry/soup with coconut milk, stir-fried foods, deep-fried foods, spicy salad, steamed food, fruits, and Thai desserts.

Second, 53 lunch menus were graded for their healthiness based on energy (kcal) and 13 nutrient contents: protein (g),

fat (g), total saturated fatty acid (g), cholesterol (mg), calcium (mg), iron (mg), vitamin A (RAE), vitamin B1 (mg), vitamin B2 (mg), vitamin C (mg), dietary fiber (g), sodium (mg), and sugars (g), using the Thai food composition software (INMUCAL-Nutrients Version 4.0)¹². The Thai NP criteria, which are 'grade A' (score >16, most healthy), 'grade B' (12-16, moderate healthy), and 'grade C' (score <12, least healthy), were applied for the grading method,¹¹ as shown in Table 1. At this stage, none of the menus qualified for 'grade A'. Forty-five menus were accepted for 'grade B', while eight were assigned for 'grade C', as shown in Table 2.

Table 1. Menu name for each menu category.

Category number	Category name	Menu name	Menu category code	Grade
1	Rice	Steamed white rice (a staple food)	B1	B
2	Single dish	Steamed rice topped with chicken (Khao Man Gai) + wax gourd soup	B2	B
		Rice vermicelli noodle soup with pork and pork liver		B
		Wide rice noodles gravy with chicken (Rad Na Gai)		B
		Steamed rice topped with roasted red pork (Khao Moo Dang) + 1/2 boiled eggs + wax gourd soup	C2	C
		Fermented rice noodles in snakehead fish coconut milk curry (Kanom Jeen Namya) + 1/2 boiled eggs		C
3	Clear soup	Mixed vegetables stew with pork (Tom Jab Chai)	B3	B
		Mixed vegetables spicy soup with pork (Kaeng Liang)		B
		Radish clear soup with chicken		B
		Wax gourd clear soup with minced chicken		B
		Cabbage clear soup with minced pork		B
		Glass noodles clear soup with minced chicken		B
		Mixed vegetables sour soup with shrimp (Kaeng Som)		B
		Mixed tom yum soup with mushroom		B
		Egg tofu clear soup with minced pork and blood curd		B
		Five spice egg stew with pork and pork blood curd (Kai Pa-lo)		B
4	Curry/soup with coconut milk	Chicken and galangal in coconut milk soup with blood curd (Tom Kha Gai)	B4	B
		Green curry with fish balls (Kaeng Keaw Wan)		B
		Red curry with pork and thai morning glory (Kaeng Tay Po)		B
		Red curry with pork and pumpkin		B
		Pha-naeng curry with chicken		B
		Red curry with chicken and bamboo shoots		B
5	Stir-fried foods	Stir-fried basil with pork and pork liver (Pad kra pao)	B5	B
		Stir-fried cabbage with carrot and minced pork		B
		Stir-fried mixed vegetables with chicken and chicken liver		B
		Stir-fried kale with pork		B
		Stir-fried chili pastes with pork		B
		Stir-fried thai morning glory with pork		B
		Stir-fried glass noodles with minced pork		B
		Stir-fried cucumber with chicken liver and egg		B
6	Deep-fried foods	Omelet with minced pork	B6	B
		Fried pork with garlic + cucumber and blanched carrot		B
		Crispy fried small fish		B
		Chicken wings red sauce	C6	C
7	Spicy salad	Spicy minced pork salad with pork liver (Lab Moo) + cucumber, yard long bean and cabbage	B7	B
		Spicy mixed salad (Yum)		B
		Spicy omelet salad with cucumber		B

Category number	Category name	Menu name	Menu category code	Grade
8	Steamed food	Steamed egg with pork	B8	B
9	Fruits	Guava	B9	B
		Tangerine		B
		Watermelon		B
		Banana		B
		Apple		B
		Mango		B
		Rambutan		B
		Rose apple		B
		Cantaloupe		B
		Grapes		B
10	Thai desserts	Green beans in syrup	B10	B
		Lod-Chong in coconut milk syrup with corn and red bean	C10	C
		Grass jelly in syrup with corn and red bean		C
		Pumpkin in coconut milk		C
		Assorted bean and barley in syrup (Tao Thueng)		C

Third, menu category codes were generated according to the categories and grades. For example, B2 is a menu in category 2 with a 'grade B'. All menu

category codes B1-B7, B9-B10, C2, C6, C8, and C10 are shown in Table 2. This step is important for finding the number of possible lunch patterns.

Table 2. Menu grade numbers and menu category codes for each menu category.

Category number	Category name	n	Grade			Menu category code	
			A	B	C		
1	Rice (a staple food)	1	-	1	-	B1	-
2	Single dish	5	-	3	2	B2	C2
3	Clear soup	10	-	10	-	B3	-
4	Curry/soup with coconut milk	6	-	6	-	B4	-
5	Stir-fried foods	8	-	8	-	B5	-
6	Deep-fried foods	4	-	3	1	B6	C6
7	Spicy salad	3	-	3	-	B7	-
8	Steamed eggs	1	-	-	1	-	C8
9	Fruits	10	-	10	-	B9	-
10	Thai desserts	5	-	1	4	B10	C10
Total (N)		53	0	45	8		

Fourth, matching menu category codes produced patterns and themes for lunch. The lunch patterns were formed based on the Thai school lunch standard, which has two whole meal formats as follows:

Format 1: The whole meal includes rice (category 1), two side dishes (food groups 3-8), and fruits or Thai desserts (food groups 9-10). The principles for creating lunch patterns are that menus from the same group should not be paired; for example, pairing stir-fried foods and other

stir-fried foods should be avoided, and soups should not be paired; for instance, clear soup should not be paired with curry/soup with coconut milk.

Format 2: The whole meal comprises a single dish (category 2) with fruits or Thai desserts (categories 9 and 10).

Seasonal fruits were the main dessert for both formats, and a sweet dessert can be replaced occasionally.

Fifth, the lunch sets were planned according to the patterns and themes. The energy and nutrient contents of each lunch set were calculated and then graded based on Thai NP criteria similar to the second stage. This stage is crucial for determining

nutritional adequacy for each age group, ranging from 6 to 12 years old. A cut-off of 30% of Thai DRI 2020¹³ was applied to classify the proportion that should be received at lunch (Table 3). The values of three macronutrients, including energy (kcal), protein (g), and fat (g), must fall within a range between 75% and 133% of the 30% Thai DRI¹⁴, indicating that the lunch sets met the criteria. Apart from quantitative evaluation, this stage also considered the qualitative evaluation of factors, such as food variety, cooking methods, and seasonality. All lunch set costs were within the budget of 25 THB per meal.

Table 3. The nutrient criteria for the lunch set of primary students.

Nutrient	6-12 years old
Energy (kcal)	473
Protein (g)	14.2
Fat (g)	14.2
Total Saturated Fatty acid (g)*	<5.3
Cholesterol (mg)**	< 90
Calcium (mg)	274
Iron (mg)	3.30
Vitamin A (RAE)	139
Vitamin B1 (mg)	0.24
Vitamin B2 (mg)	0.24
Vitamin C (mg)	15.3
Dietary fiber (g)***	4.2
Sodium (mg)	106-317
Sugars (g)****	5.91

* Recommendations of Thai DRI, not more than 10% of the total energy per day.

** Recommendations of Thai RDIs, not more than 30% of the total recommended value of 300 mg per day¹⁵.

*** Recommendations of Thai DRI, number of ages (years) +5 equals grams of dietary fiber per day.

**** Recommendations of Thai DRI, not more than 5% of the total energy per day.

Data analysis

This study was conducted manually using Microsoft Excel 2021. Descriptive results were presented in numbers and percentages.

RESULT

Regarding the two whole meal formats of school lunch standards, this study found 63 uniquely matched patterns, with the possibility of creating 5,160 lunch sets.

Format 1

For format 1, lunch patterns consisted of rice, two side dishes, and either fruits or Thai desserts. There were 57 patterns available, and 5,085 lunch sets could be organized. In each lunch set, there are four components, so the lunch patterns had four menu category codes that could be

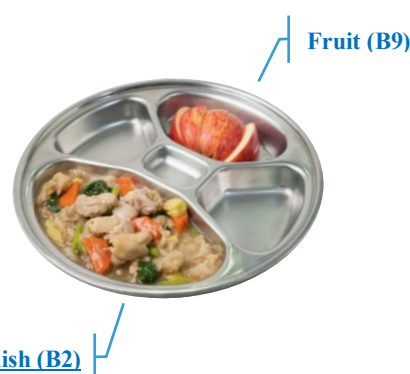
divided into four themes: 4 B (all 4 components received B grades), 3 B1 C (B grade for 3 components + C grade for 1 component), 2 B2 C (B grade for 2 components + C grade for 2 components), and 1 B3 C (B grade for 1 component + C grade for 3 components), as shown in figure 2A.



Theme 4B, pattern B1B3B5B9

Figure 2A. Lunch sets for format 1.

Of the 5,085 lunch sets that were tested, 2,706 met 30% of the Thai DRI macronutrient requirements, as shown in Table 4. Of the themes where lunch sets could have met the criteria, 65.4% belonged to theme 4B, 38.1% to theme 3B1C, and 6.7% to theme 2B2C. However, all lunch



Theme 2B, pattern B2B9

Figure 2B. Lunch sets for format 2.

sets in theme 1B3C did not meet 30% of the Thai DRI macronutrient requirements. Therefore, the number of lunch sets consisting of menu category code grade B met the criteria of NP more than those of grade C.

Table 4. The grade of the lunch sets for each pattern consists of rice, two side dishes, and fruits/Thai desserts that pass 30% Thai DRI macronutrient requirement.

No.	Pattern*	Lunch set grade, n (%)			total	Lunch set grade pass 30% Thai DRI, n (%)			
		A	B	C		A	B	C	total
Theme 4B (all 4 components received B grades)									
1	B1B3B5B10	18 (22.5)	49 (61.3)	13 (16.3)	80 (100)	2 (11.1)	19 (38.8)	3 (23.1)	24 (30)
2	B1B3B6B10	9 (30)	14 (46.7)	7 (23.3)	30 (100)	0 (0)	0 (0)	2 (28.6)	2 (6.7)
3	B1B3B5B9	296 (37)	433 (54.1)	71 (8.9)	800 (100)	236 (79.7)	366 (84.5)	49 (69)	651 (81.4)
4	B1B3B6B9	108 (36)	149 (49.7)	43 (14.3)	300 (100)	29 (26.9)	90 (60.4)	17 (39.5)	136 (45.3)
5	B1B3B7B9	106 (35.3)	155 (51.7)	39 (13)	300 (100)	16 (15.1)	57 (36.8)	27 (69.2)	100 (33.3)
6	B1B4B5B10	0 (0)	13 (27.1)	35 (72.9)	48 (100)	0 (0)	1 (7.7)	8 (22.9)	9 (18.8)
7	B1B4B5B9	4 (0.8)	278 (57.9)	198 (41.3)	480 (100)	4 (100)	267 (96)	189 (95.5)	460 (95.8)
8	B1B4B6B10	0 (0)	12 (66.7)	6 (33.3)	18 (100)	0 (0)	0 (0)	0 (0)	0 (0)
9	B1B4B6B9	7 (3.9)	116 (64.4)	57 (31.7)	180 (100)	7 (100)	59 (50.9)	11 (19.3)	77 (42.8)
10	B1B4B7B10	0 (0)	9 (50)	9 (50)	18 (100)	0 (0)	0 (0)	4 (44.4)	4 (22.2)
11	B1B4B7B9	18 (10)	84 (46.7)	78 (43.3)	180 (100)	11 (61.1)	61 (72.6)	78 (100)	150 (83.3)
12	B1B5B6B10	2 (8.3)	13 (54.2)	9 (37.5)	24 (100)	1 (50)	1 (7.7)	0 (0)	2 (8.3)
13	B1B5B6B9	75 (31.3)	100 (41.7)	65 (27.1)	240 (100)	70 (93.3)	55 (55)	0 (0)	125 (52.1)
14	B1B5B7B10	5 (20.8)	18 (75)	1 (4.2)	24 (100)	0 (0)	8 (44.4)	0 (0)	8 (33.3)
15	B1B5B7B9	83 (34.6)	155 (64.6)	2 (0.8)	240 (100)	63 (75.9)	155 (100)	2 (100)	220 (91.7)
16	B1B6B7B10	3 (33.3)	3 (33.3)	3 (33.3)	9 (100)	0 (0)	1 (33.3)	0 (0)	1 (11.1)
17	B1B6B7B9	36 (40)	41 (45.6)	13 (14.4)	90 (100)	12 (33.3)	35 (85.4)	3 (23.1)	50 (55.6)
18	B1B3B7B10	6 (20)	19 (63.3)	5 (16.7)	30 (100)	0 (0)	2 (10.5)	2 (40)	4 (13.3)
total		776 (25.1)	1661 (53.7)	654 (21.2)	3091 (100)	451 (58.1)	1177 (70.9)	395 (60.4)	2023 (65.4)
Theme 3B1C (3 components received B grades + 1 component received C grade)									
19	B1B3B5C10	35 (10.9)	96 (30)	189 (59.1)	320 (100)	18 (51.4)	54 (56.3)	122 (64.6)	194 (60.6)
20	B1B3B6C10	9 (7.5)	39 (32.5)	72 (60)	120 (100)	0 (0)	6 (15.4)	21 (29.2)	27 (22.5)
21	B1B3B7C10	18 (15)	45 (37.5)	57 (47.5)	120 (100)	0 (0)	12 (26.7)	39 (68.4)	51 (42.5)
22	B1B4B5C10	0 (0)	34 (17.7)	158 (82.3)	192 (100)	0 (0)	20 (58.8)	34 (21.5)	54 (28.1)
23	B1B4B6C10	0 (0)	18 (25)	54 (75)	72 (100)	0 (0)	7 (38.9)	4 (7.4)	11 (15.3)
24	B1B4B7C10	0 (0)	20 (27.8)	52 (72.2)	72 (100)	0 (0)	3 (15)	20 (38.5)	23 (31.9)
25	B1B5B6C10	1 (1)	23 (24)	72 (75)	96 (100)	1 (100)	12 (52.2)	1 (1.4)	14 (14.6)
26	B1B5B7C10	8 (8.3)	41 (42.7)	47 (49)	96 (100)	0 (0)	28 (68.3)	12 (25.5)	40 (41.7)
27	B1B6B7C10	4 (11.1)	9 (25)	23 (63.9)	36 (100)	1 (25)	3 (33.3)	4 (17.4)	8 (22.2)
28	B1B3C6B10	0 (0)	0 (0)	10 (100)	10 (100)	0 (0)	0 (0)	0 (0)	0 (0)
29	B1B3C6B9	0 (0)	3 (3)	97 (97)	100 (100)	0 (0)	2 (66.7)	60 (61.9)	62 (62)
30	B1B3C8B10	0 (0)	8 (80)	2 (20)	10 (100)	0 (0)	0 (0)	0 (0)	0 (0)
31	B1B3C8B9	8 (8)	74 (74)	18 (18)	100 (100)	1 (12.5)	13 (17.6)	0 (0)	14 (14)
32	B1B4C6B10	0 (0)	0 (0)	6 (100)	6 (100)	0 (0)	0 (0)	0 (0)	0 (0)
33	B1B4C6B9	0 (0)	0 (0)	60 (100)	60 (100)	0 (0)	0 (0)	0 (0)	0 (0)
34	B1B4C8B10	0 (0)	0 (0)	6 (100)	6 (100)	0 (0)	0 (0)	0 (0)	0 (0)
35	B1B4C8B9	0 (0)	51 (85)	9 (15)	60 (100)	0 (0)	42 (82.4)	9 (100)	51 (85)
36	B1B5C6B10	0 (0)	0 (0)	8 (100)	8 (100)	0 (0)	0 (0)	0 (0)	0 (0)
37	B1B5C6B9	0 (0)	0 (0)	80 (100)	80 (100)	0 (0)	0 (0)	0 (0)	0 (0)
38	B1B5C8B10	0 (0)	8 (100)	0 (0)	8 (100)	0 (0)	0 (0)	0 (0)	0 (0)
39	B1B5C8B9	8 (10)	72 (90)	0 (0)	80 (100)	8 (100)	71 (98.6)	0 (0)	79 (98.8)
40	B1B6C8B10	0 (0)	2 (66.7)	1 (33.3)	3 (100)	0 (0)	0 (0)	0 (0)	0 (0)
41	B1B6C8B9	2 (6.7)	28 (93.3)	0 (0)	30 (100)	1 (50)	19 (67.9)	0 (0)	20 (66.7)
42	B1B7C8B10	0 (0)	3 (100)	0 (0)	3 (100)	0 (0)	0 (0)	0 (0)	0 (0)
43	B1B7C8B9	4 (13.3)	26 (86.7)	0 (0)	30 (100)	3 (75)	16 (61.5)	0 (0)	19 (63.3)
44	B1C6B7B10	0 (0)	0 (0)	3 (100)	3 (100)	0 (0)	0 (0)	0 (0)	0 (0)
45	B1C6B7B9	0 (0)	1 (3.3)	29 (96.7)	30 (100)	0 (0)	0 (0)	0 (0)	0 (0)
total		97 (5.5)	601 (34.3)	1053 (60.1)	1751 (100)	33 (34)	308 (51.2)	326 (31)	667 (38.1)
Theme 2B2C (2 components received B grades + 2 components received C grades)									
46	B1B3C6C10	0 (0)	0 (0)	40 (100)	40 (100)	0 (0)	0 (0)	1 (2.5)	1 (2.5)
47	B1B3C8C10	0 (0)	15 (37.5)	25 (62.5)	40 (100)	0 (0)	0 (0)	6 (24)	6 (15)
48	B1B4C6C10	0 (0)	0 (0)	24 (100)	24 (100)	0 (0)	0 (0)	0 (0)	0 (0)
49	B1B4C8C10	0 (0)	0 (0)	24 (100)	24 (100)	0 (0)	0 (0)	2 (8.3)	2 (8.3)
50	B1B5C6C10	0 (0)	0 (0)	32 (100)	32 (100)	0 (0)	0 (0)	0 (0)	0 (0)
51	B1B5C8C10	0 (0)	15 (46.9)	17 (53.1)	32 (100)	0 (0)	0 (0)	7 (41.2)	7 (21.9)
52	B1B6C8C10	0 (0)	3 (25)	9 (75)	12 (100)	0 (0)	0 (0)	0 (0)	0 (0)
53	B1B7C8C10	0 (0)	6 (50)	6 (50)	12 (100)	0 (0)	0 (0)	0 (0)	0 (0)
54	B1C6B7C10	0 (0)	0 (0)	12 (100)	12 (100)	0 (0)	0 (0)	0 (0)	0 (0)
55	B1C6C8B10	0 (0)	0 (0)	1 (100)	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)
56	B1C6C8B9	0 (0)	0 (0)	10 (100)	10 (100)	0 (0)	0 (0)	0 (0)	0 (0)
total		0 (0)	39 (16.3)	200 (83.7)	239 (100)	0 (0)	0 (0)	16 (8)	16 (6.7)
Theme 1B3C (1 component received B grade + 3 components received C grades)									
57	B1C6C8C10	0 (0)	0 (0)	4 (100)	4 (100)	0 (0)	0 (0)	0 (0)	0 (0)
total		0 (0)	0 (0)	4 (100)	4 (100)	0 (0)	0 (0)	0 (0)	0 (0)
Total		873 (17.2)	2301 (45.3)	1911 (37.6)	5085 (100)	484 (55.4)	1485 (64.5)	737 (38.6)	2706 (53.2)

*Pattern: A, B and C are menu grade in categories, followed by category numbers (1-10).

Format 2

For format 2, the lunch patterns of lunch sets consisted of a single dish paired with fruits/Thai desserts. In one lunch set, there were two components, so lunch patterns had two menu category codes that could be divided into three themes: 2B (all two components received B grades), 1B1C (B grade for 1 component + C grade for 1 component), and 2C (all 2 components received C grades), as shown in figure 2B.

In Table 5, it was found that up to 75 lunch sets could be created from six

patterns. Thirty-seven lunch sets (49.3%) met the criteria of 30% Thai DRI for macronutrients.

Theme 2C showed the highest percentage (62.5%) of lunch sets that met the criteria, followed by theme 1B1C at 52.9% and theme 2B at 42.4%. The results differed from format 1 because lunch sets consisting of menu category code grade C met more criteria than those consisting of menu category code grade B.

Table 5. The grade of the lunch sets for each pattern consists of a single dish with fruits/Thai desserts that pass 30% Thai DRI macronutrient requirement.

No.	Pattern*	Lunch set grade, n (%)				Lunch set grade pass 30% Thai DRI, n (%)			
		A	B	C	total	A	B	C	total
Theme 2B (all 2 components received B grades)									
1	B2B9	1 (3.3)	29 (96.7)	0 (0)	30 (100)	0 (0)	12 (41.4)	0 (0)	12 (40)
2	B2B10	0 (0)	3 (100)	0 (0)	3 (100)	0 (0)	2 (66.7)	0 (0)	2 (66.7)
total		1 (3)	32 (97)	0 (0)	33 (100)	0 (0)	14 (43.8)	0 (0)	14 (42.4)
Theme 1B1C (1 component received B grade + 1 component received C grade)									
3	B2C10	0 (0)	5 (41.7)	7 (58.3)	12 (100)	0 (0)	3 (60)	5 (71.4)	8 (66.7)
4	C2B9	0 (0)	0 (0)	20 (100)	20 (100)	0 (0)	0 (0)	10 (50)	10 (50)
5	C2B10	0 (0)	0 (0)	2 (100)	2 (100)	0 (0)	0 (0)	0 (0)	0 (0)
total		0 (0)	5 (14.7)	29 (85.3)	34 (100)	0 (0)	3 (60)	15 (51.7)	18 (52.9)
Theme 2C (all 2 components received C grades)									
6	C2C10	0 (0)	0 (0)	8 (100)	8 (100)	0 (0)	0 (0)	5 (62.5)	5 (62.5)
total		0 (0)	0 (0)	8 (100)	8 (100)	0 (0)	0 (0)	5 (62.5)	5 (62.5)
Total		1 (1.3)	37 (49.3)	37 (49.3)	75 (100)	0 (0)	17 (45.9)	20 (54.1)	37 (49.3)

*Pattern: B and C are menu grade in categories, followed by category numbers (1-10).

DISCUSSION

The findings have provided the possibility of developing a teacher-friendly school lunch planner using the Thai NP principle. It is practical for teachers to choose menus according to the school context and independently adjust the food menu to improve the nutritional value of the school lunches that meet the student's nutrition requirements.

Forming patterns of a lunch set consisting of rice, two side dishes, and fruits/Thai desserts by pairing good-grade dishes can result in a good-quality meal. However, when creating a menu set for optimal quality, various factors beyond

selecting a lunch set with good-grade dishes must also be considered.

Theme 4B had more lunch sets that met the criteria than other themes. However, when considering each pattern, the lunch patterns that met the criteria with less than 10% were pattern 2 (B1B3B6B10), pattern 8 (B1B4B6B10), and pattern 12 (B1B5B6B10). This is a problem regarding macronutrient requirements, in which the levels of protein and fat are higher than the acceptable range. Also, in other themes, problems may arise, which are likely due to improper side dish pairing. Therefore, to create lunch patterns, one should avoid pairing side dishes containing oil or coconut milk within lunch sets, such as the combination of curry/soup

with coconut milk, stir-fried foods, and deep-fried foods within lunch sets, because these side dishes are relatively high in fat while curry/soup with coconut milk and deep-fried foods main ingredient is meat, resulting in high protein content. If the first side dishes are in groups 4, 5, and 6, the second should be in groups 3, 7, and 8, but not with the same soup menu.

In contrast, when forming a pattern of lunch sets consisting of single dishes paired with fruits/Thai desserts, it was found that a poor-grade theme (2C) met more criteria than good-grade themes (1B1C, 2B). Single dishes were mainly meat-based, so the protein content passed a certain threshold. However, fat content was relatively different among single dishes, with some being low in fat, and others high in fat. There were some single dishes in theme 2B in pattern 1 (B2B9) and theme 1B1C in pattern 4 (C2B9) with less fat when paired with fruit, resulting in the fat content not meeting the requirement. On the other hand, theme 2C, when paired with Thai desserts, met the fat requirement. Another concern is that single dishes had few vegetables, so most did not meet the dietary fiber requirement. Therefore, it is recommended to create a lunch set of single dishes as follows:

- If the single dish is relatively low in fat, it should be paired with Thai desserts that contain coconut milk and are high in fiber, such as noodle soup with pork and pork liver paired with black beans boiled in coconut milk.
- If the single dish is high in fat, it should be paired with fruit or Thai desserts that are high in fiber but must not contain coconut milk, such as steamed rice topped with chicken (Khao Man Gai) or noodles in gravy with chicken (Rad Na Gai) paired with green beans in syrup.

Creating lunch sets for children is not only about providing nutrients that meet their daily requirements. Looking at weekly nutrient values will help better visualize excess or deficiency of nutrients¹⁶. There should be lunch sets for all five weekdays to evaluate weekly nutrient profiles. Providing nutritionally standardized school lunches could be a reliable way to reduce childhood overweight and obesity¹⁷. A variety of food preferences and dietary habits are established in early childhood. Therefore, nutrition education about the relationship between nutrition and disease prevention is a good attitude toward shaping eating behaviors and modifying existing dietary habits¹⁸. For students to maintain good health, it may require cooperation from many sectors, whether it is teachers in charge of the lunch program who provide nutritional meals, dietitians or other health care practitioners playing a role in helping to accurately assess energy intake and promote a dietary lifestyle among children by educating them about good food choices¹⁶. If there is a need for a driving force for better quality school nutrition work, it should be additional nutrition education for teachers.

Nutrient profiling is a behavioral nutrition approach that does not dictate to people what they should be eating or not eating. Instead, it is about educating users about the general nutritional value of foods and helping them make dietary choices. Nutritional profiling is the evaluation of foods based on their nutritional content, as it focuses on the quality of food rather than its quantity. This idea has led to the development of several nutritional assessment systems. Examples of these systems are NuVal¹⁹ and ANDI²⁰. Additionally, Leonard H. Epstein and his colleagues developed the Traffic Light Diet in the 1970s. With this nutritional approach, Epstein used his three-color palette to create diets that were easy to follow for

overweight children²¹. The concept of the traffic light diet has inspired two decades of new research due to its groundbreaking nature. The traffic light diet is a systematic eating plan that categorizes foods according to the colors of traffic lights. Green represents low-calorie foods that can be eaten anytime (go), orange (caution) signifies low-calorie foods that can be eaten once in a while, and red (stop) denotes high-calorie foods that should be consumed rarely.

This research contributes to the body of knowledge on two different levels: to society and to science. The first level of contribution is presented to the society as a nutrition-based dietary tool that offers the nutritional content of different recipes by nutrient profiling concept. The nutritional information is more useful when presented in a practical, easy to follow and easy to understand manner tailored to the target population group (e.g., teachers). The second and more important level of contribution is presented to the science as a new method for nutrition education. This is used to rank recipes based on their nutritional quality. Nutrition education is a key component when it comes to the Thai school lunch planner. This study can add to the evidence base that nutritional behavior strategies may be a modern adjunct for addressing child overweight or obesity problems and (or any other diet-related chronic conditions) dietary management. Our study suggests that the tool may have some beneficial effects to improve the dietary behavior of students.

Considering the nutrition management used in the school lunch programs in other countries that have set nutrient standards, such as Japan, the United States, the United Kingdom, and South Korea, distinct approaches are evident²². In Japan, lunch menus are created and prepared in each school or central school kitchen under the supervision of nutritionists¹⁷. Nevertheless, in Thailand, the creators of lunch sets are the teachers in

charge of the lunch program, whether or not they have received nutrition training. Thus, the lunch planner model developed in this study may be useful to teachers for planning school lunches.

This model of lunch planner is suitable for schools that provide rice with two side dishes, as it provides food menu details for various grades in Table 1. However, for some schools that only serve rice with one side dish, this principle can also be applied by increasing the portion of the side dish. Public primary schools in Thailand follow the same school lunch standard. Even though lunch menus were designed for Bangkok, schools in other areas can adopt this planner.

This lunch planner model can be scaled up by scheduling lunch sets for weeks or months concerning food and nutrient standards. Schools in other regions can apply this model as they follow the same lunch standards, and ingredients can be modified based on the school context.

This study was limited in the quantity of recipes covered for all regions of Thailand. It includes some nutrients from the Thai food composition database that might be relevant for further study.

CONCLUSION

This lunch planner can be combined with the existing school food menu guidelines, and nutrient profiling could be a useful alternative for planning school lunch sets to guarantee that they have high-quality and optimal nutritional value. Teachers with or without basic nutrition knowledge may find this strategy user-friendly. Schools should create weekly or monthly lunch sets to ensure that children receive complete nutrition and prevent them from losing their appetite.

RECOMMENDATION

Thai NP criteria used in this study are applicable for people aged 6 years and older, which is a criterion that is quite wide. In the future, the Thai NP criteria may need to be developed to suit the nutrient needs of children in each age group. Also, this criterion is per serving or meal, which may not be suitable for grading food dishes. Therefore, a Thai NP criterion should be used to grade each type of food, such as side dishes, fruits, and Thai desserts, to indicate that a good-quality food dish, when paired with other food types, will also result in a good-quality lunch set.

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