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Comparison of the Block Kid's Food Frequency Questionnaire with a 24 h dietary recall methodology among Hmong-American children, 9–18 years of age

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Abstract

Hmong are one of the immigrant Asian subgroups with increasing rates of obesity, type 2 diabetes and CVD. Despite their population growth in the USA and declining health status, no research has investigated the appropriateness of dietary assessment measures, including FFQ and 24 h dietary recalls among Hmong. The present study compared the nutrient information obtained through a 24 h dietary recall method with that collected using the Block Kid's Food Frequency Questionnaire (Block FFQ) among Hmong-American children (n 335) of 9–18 years of age. For this purpose, two 24 h dietary recalls were collected during non-consecutive days and averaged for comparison. The Block FFQ was administered on the day of the second 24 h recall and the two methodologies were also compared using t tests. Among all children, Block FFQ nutrient estimates for vitamin A, vitamin C and food group servings for vegetables and fruits were significantly higher than those assessed through the 24 h dietary recalls ($P<0{\cdot}001$). Nutrient estimates for protein and food group servings for grains and meat and beans were significantly higher among all participants when assessed through the 24 h dietary recalls than through the Block FFQ ($P<0{\cdot}05$). The results suggest that the Block FFQ does not appear to be a good measure of protein, grain, and meat and bean intake among Hmong children of 9–18 years of age, and the 24 h dietary recall offers a better account of the Hmong diet and is inclusive of ethnic food options otherwise missed in the Block FFQ. We recommend the modification of the current Block FFQ to appropriately reflect cultural food/beverage items of the population in interest.

Key words: Asian Americans: Hmong: Dietary assessments: FFQ: 24 h dietary recalls: Minority health

The Asian population has seen steady increases globally. It is estimated that approximately 16 million Asians live in the USA, while over 2 million British Asians live in the UK[1,2]. Hmong, one of the many Asian subgroups, live in many areas of the world including Asia (China, Laos and Thailand), Europe (France and Germany), North America (Canada and USA), South America (Argentina and French Guiana) and Australia[3,4]. During the Vietnam Conflict (1954–75), Hmong secretly assisted the US military and Central Intelligence Agency, and consequently suffered persecution and oppression from communists including genocide, poverty, food insecurity and starvation[4–7]. Soon after, Hmong migrated to refugee camps in Thailand and many other countries, including the USA[7]. The Hmong population in the USA has increased considerably since the group first immigrated in 1975, and it is estimated that more than 200 000 Hmong currently reside in the USA and that the number is expected to increase because they represent the youngest Asian subgroup with a mean age of 13 years[8,9].

Post-migration, rates of obesity and related conditions including type 2 diabetes, hypertension, stroke and CVD have increased among Hmong adults and children[3,6,10–12]. Western food environmental influences including easy availability and accessibility of foods, increased consumption of processed, refined and sugary foods, and a decrease in physical activity levels are some of the reasons that might explain this group's declining health status[10–17]. Traditionally, Hmong consumed diets high in complex carbohydrates, boiled vegetables and small amounts of meat boiled with vegetables to make soups[6,18]. Meats were used sparingly and hunting and fishing provided supplemental protein sources to meats purchased at the grocery store[6]. An increased consumption of saturated fats, sugars, refined grains and salt has been noted among the Hmong after their migration to the USA[6,18].

Childhood obesity is now a global health issue, and about 110 million children worldwide are classified as either overweight or obese[19]. Data suggest that the prevalence of overweight and obesity is disproportionately higher among children and

Abbreviation: Block FFQ, Block Kid's Food Frequency Questionnaire.

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adolescence from ethnic minorities, including Hmong[10–21]. Obesity during childhood and adolescent years is predictive of serious consequences including adult-onset cardiovascular, renal and neurological diseases, diabetes, and impaired psychosocial functioning, all of which can lead to premature death[12,19,22]. Despite a higher prevalence of overweight/obesity and increases in population numbers, data on dietary consumption patterns and on the usage of appropriate dietary assessment methodologies including 24 h dietary recalls and FFQ are limited among Hmong adults and children specifically, and Asian subgroups in general.

FFQ and 24 h dietary recalls are commonly used dietary assessment measures. FFQ collect descriptive data on usual intakes of foods consumed over a longer time period; the method is easy to administer and takes a shorter time for completion[23–25]. However, frequencies and portion sizes listed in the FFQ do not necessarily measure the amount of the food typically consumed by the participant, and the differences between nutrient *v.* energy-dense foods are not captured[23,25]. Also, studies investigating the absolute validity of FFQ are limited too, casting doubt on the adequacy of this measure[25]. The 24 h dietary recall, on the other hand, collects individual dietary intake over the past 24 h period, and it is easy to administer with low participant burden; however, the method is expensive to incorporate in research designs and relies on participant memory, and a single 24 h dietary recall is likely to omit foods consumed infrequently, necessitating multiple recalls in order to assess usual dietary intake[23]. Relative validity studies involving the 24 h recall methodology have shown this measure to be reflective of mean energy intakes[23,26].

Research has suggested that the appropriateness of a specific dietary measure may vary between multi-ethnic groups, as choices in food groups and/or beverages differ with cultural eating and diet-related practices. For example, Smith & Fila[27] compared the 24 h dietary recall with the Block Kid's Food Frequency Questionnaire (Block FFQ) among Native American youth (9–13 years of age), and found the FFQ to be a less reliable measure, because the instrument did not capture appropriate portion sizes and did not list specific food items pertinent to the Native American culture including fry bread, Indian tacos and wild rice hot dishes.

To date, Block FFQ are not designed to be culture-specific and most of them list food options reflecting the usual white American dietary practices including fast foods, refined grains and other processed food choices. In contrast, the traditional Hmong diet tended to be rich in complex carbohydrates, and included a variety of vegetables, organ and hunted meats, and a variety of tropical fruits consumed in limited quantities[6,18]. To our knowledge, no study has investigated the usefulness of dietary assessment instruments including the Block FFQ with the Hmong population. Therefore, the purpose of the present study was to compare nutrient information obtained through a 24 h dietary recall method with that collected using the Block FFQ among first- and second-generation Hmong-American children (*n* 335) of 9–18 years of age. The results of the present investigation will help future researchers to incorporate the appropriate dietary methodology to assess dietary status and plan epidemiological, clinical and/or community-based interventions among Hmong children.

Experimental methods

Participants

A total of 335 Hmong children, aged 9–18 years, participated in the present study. Minnesota is the state with the largest Hmong population within the Midwestern region of the USA, and Minneapolis/St Paul (our primary data collection site) is the home to 97·3 % of Minnesota's Hmong population[9], making this location ideal for data collection.

Some children were born and/or raised in the USA and included 9–13-year-olds (*n* 144) and 14–18-year-olds (*n* 156). Others were born and/or raised in Thailand/Laos who had been living in the USA for ≤5 years and were either 9–13 years old (*n* 21) or 14–18 years old (*n* 14). Children were recruited at seventeen different sites, including Hmong-based organisations (54 %), schools (26 %), churches (12 %) and through advertisements in the Hmong newspaper (8 %), and Hmong key informants and community leaders helped with the recruitment process. Those who wished to participate contacted researchers or organisation leaders to sign up for an enrolment time and both parental consent and child assent were obtained in advance. The present study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by the Institutional Review Board at the University of Minnesota (study no. 0610S93551). Written informed consent was obtained from all parents of the subjects and the child subjects gave written assent.

24 h dietary recalls

In the present study, two 24 h dietary recalls were collected during non-consecutive days by researchers trained in this measure, 30 % of the recalls included a weekend day. A four-stage, multiple-pass interview technique was used[23]. Stage 1 involved collecting the full list of foods and beverages consumed by the child and during stage 2, a detailed description of each item consumed was recorded. The child was asked specific food brands and cooking methods during stage 3, and stage 4 involved dietary supplement information followed by a review of the recall by the researcher. Measuring cups, spoons and colourful plastic food models and pictures of both Hmong and American foods (for example, rice, papaya, yam, bread, pizza, cereal) were presented to children to aid with portion size estimation. Interview time was about 15–30 min per child and a Hmong interpreter assisted the researchers with translation for a small number of newly immigrated or non-English-speaking participants.

Block Kid's Food Frequency Questionnaire

The standard Block FFQ[28] was used to assess the frequency/portion of foods consumed during the past week. The instrument used in the present study included seventy-seven food and beverage options with coding schemes for frequency (ranging from foods not eaten in the past week to foods eaten everyday in the past week) and serving sizes (for example, 1/4 cup, 1/2 cup, one cup or two cups) for the amount of

food/beverage consumed in 1 d. Certain items such as cereals, milk, tacos and burgers included specific response categories. For example, tacos included response options asking whether it was with or without meat/chicken; question on burgers asked the type of burger consumed (cheeseburger or hamburger). An additional question addressed vitamin consumption and the number of days the supplement was consumed during the last week. A separate sheet with pictures of cups of food (1/4 cup to two cups) was presented to aid with portion size estimations. The food list for the questionnaire was developed from the National Health and Nutrition Examination Survey (1999–2) dietary recall data and the nutrient database was developed from the USDA Nutrient Database for Dietary Studies (version 1.0)[28]. The questionnaire was administered on the day of the second 24 h dietary recall and depending on age and reading ability, children took an average of 10–20 min for completion.

Frequency tool

A culturally specific food-frequency tool was created by Franzen & Smith[6,11,13] to investigate the consumption of Hmong and/or American food sources among adults and children. This instrument was used in conjunction with the 24 h dietary recall and the Block FFQ during the study. Once we noted that meat intake was low with our two comparison methods, we examined the protein food sources captured from the culturally specific food-frequency tool developed for Hmong. We will only discuss the results pertinent to protein food sources in the present study because it helps explain gaps found in the Block FFQ. Children were asked the frequency of consumption of protein food sources including bacon, beef, squirrel, pheasant, organ meat and venison. Possible response options included 'never', 'holidays only', '2–3 times per month', 'one time per week', '2–3 times per week' and 'daily'.

Anthropometric measures

Heights and weights were measured using standard procedures[29]. BMI was calculated as weight (kg)/height $(m)^2$ and plotted on the Centers for Disease Control and Prevention BMI-for-age sex-specific growth charts to obtain a percentile, which ranks underweight children as <5th percentile, healthy weight ≥5th to <85th percentile, overweight ≥85th to <95th percentile and obese children ≥95th percentile[30]. Height-for-age was ranked as <5th percentile for short participants, ≥5th to <85th percentile for average statured participants and ≥85th percentile for tall participants.

Statistical analysis

Data were checked for normality and analysed using Predictive Analytics SoftWare (PASW version 17; 2009; WinWrap Basic). Means, standard deviations and frequencies were calculated using descriptive statistics. ESHA Food Processor® Software (version 10.4.0; 2009; ESHA Research) was used to analyse 24 h dietary recall data. The results were then imported into PASW for further analysis. Block FFQ data were analysed through NutritionQuest (2009). Independent and paired-samples *t* tests were used to compare differences in nutrients and food group intake between the 24 h recall and Block FFQ data. The significance level was set at $P<0{\cdot}05$.

Results

Sample characteristics

Table 1 presents the sample characteristics of Hmong children in the present study. About 45 % of the sample was boys and 55 % girls. Children were divided into two groups, 9–13 years old (49 %) and 14–18 years old (51 %) (Table 1). About 16·1 % of the sample was overweight (BMI-for-age ≥85th to <95th percentile) while 30·4 % obese (BMI-for-age ≥95th percentile) using the US norms established by the Centers for Disease Control and Prevention[30]. About 23·3 % of our sample was short-statured (height-for-age <5th percentile) and 4·5 % was tall (height-for-age ≥85th percentile) (Table 1). US-born children were significantly heavier and taller compared with Thailand/Laos-born children (mean weight: 55·8 (SD 18·1) *v.* 44·2 (SD 11·2) kg, mean height: 151·3 (SD 10·9) *v.* 146·9 (SD 11·1) cm; $P<0{\cdot}05$).

9–13-year-olds

Compared with the Block FFQ, the 24 h dietary recall values (both the average 24 h recall and the second 24 h recall) were significantly higher for protein, vitamin D and Ca, and for food groups, grains, milk, and meat and beans. Nutrient values for vitamin A, vitamin C and Na, and food group values for vegetables and fruits were significantly higher for the Block FFQ than for the 24 h recall. No differences were observed between the two methodologies for total energy intake, carbohydrates, fat, saturated fat, B-vitamins (except niacin), Fe and P (Table 2). Compared with females, significant differences between the two methodologies were observed for half of the nutrients and all food groups (except milk) among males.

14–18-year-olds

Among older children, the 24 h dietary recall values were significantly higher for energy, protein, fat, cholesterol, thiamin, niacin and Fe, and for food groups, grains, and meat and beans. The Block FFQ values were significantly higher for vitamin A and vitamin C, and for food group servings, vegetables and fruits. Additionally, nutrient values for carbohydrates, saturated fat, vitamin D, riboflavin, vitamin B_6, folate, vitamin B_{12}, P and Na were not significantly different between the two measures (Table 2). No sex differences in nutrient values and food group serving consumption were observed for this age group.

Frequency tool

The results from the frequency tool are presented in Table 3. On a daily basis, about 27 % of the children reported consuming beef, 23 % boiled chicken and 29 % pork (Table 3). Of all children, about 17 % reported eating bacon, 39 % eggs, 19 % fish and

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Table 1. Sample characteristics of Hmong-American children (*n* 335)

(Mean values and standard deviations; number of children and percentages)

	Males				Females			
	9–13 years (*n* 82)		14–18 years (*n* 68)		9–13 years (*n* 83)		14–18 years (*n* 102)	
	n	%	*n*	%	*n*	%	*n*	%
Age (years)								
Mean	11·4		15·7		11·2		15·8	
SD	1·3		1·4		1·3		1·2	
Grade level								
Middle school	50	61	8	12	46	55	9	9
High school	–		59	87	–		92	90
Post-secondary	–		1	1	–		1	1
Birth location								
USA	73	89	60	88	71	85	96	94
Thailand or Laos*	9	11	8	12	12	14	6	6
Height-for-age percentiles								
< 5th percentile (short)	5	6	20	29	9	11	44	43
≥ 5th to <85th percentile (average)	69	84	47	69	68	82	58	57
≥ 85th percentile (tall)	8	10	1	1	6	7	0	
BMI percentiles								
≥ 5th to <85th percentile (healthy)	40	49	31	46	51	61	57	56
≥ 85th to <95th percentile (overweight)	12	15	10	15	14	17	18	18
≥ 95th percentile (obese)	31	38	26	38	18	22	27	26

* Children who were born in Thailand or Laos were living in the USA for ≤5 years.

Table 2. Comparisons between the 24 h dietary recall and the Block Kid's Food Frequency Questionnaire (Block FFQ) among Hmong-American children by age groups, 9–13 years and 14–18 years

(Mean values and standard deviations)

	9–13 years				14–18 years			
	Block FFQ		Average 24 h dietary recall		Block FFQ		Average 24 h dietary recall	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Energy (kcal/d)	1481·3	1355·0	1594·6	522·4	1607·4	1173·7	1873·7*	770·7
Energy (kJ/d)	6221·4	5691·1	6697·3	2194·1	6750·9	4929·4	7869·5*	3236·8
Carbohydrates (g/d)	197·7	176·6	203·5	70·7	222·9	160·2	240·7	99·9
Protein (g/d)	55·1	52·1	72·8***	28·1	59·5	41·9	81·9***	40·2
Fat (g/d)	54·7	25·1	54·8	25·1	55·4	45·3	64·5*	35·1
Saturated fat (g/d)	18·1	16·8	18·9	9·1	18·7	14·4	21·1	11·6
Cholesterol (mg/d)	198·2	189·9	250·6	181·9	203·6	150·3	266·5***	190·6
Fibre (g/d)	12·3	11·2	9·7	4·5	12·6	9·1	11·0*	6·2
Vitamin A (μg/d)	418·1	372·9	306·5***	192·4	466·7	287·5	315·8***	248·3
Vitamin C (mg/d)	116·2	117·4	68·8***	56·6	138·0	117·8	85·0***	94·3
Vitamin D (μg/d)	3·2	2·4	3·9*	3·0	3·4	2·1	3·6	2·6
Thiamin (mg/d)	1·2	1·0	1·2	0·6	1·3	0·9	1·5*	0·8
Riboflavin (mg/d)	1·4	1·1	1·3	0·6	1·5	1·0	1·4	0·9
Niacin (mg/d)	14·8	13·7	18·1	9·8	16·4	11·9	21·1***	12·7
Vitamin B_6 (mg/d)	1·4	1·1	1·3	0·6	1·5	1·0	1·5	1·0
Folate (μg/d)	291·2	243·3	274·6	133·8	328·7	216·2	320·0	194·5
Vitamin B_{12} (μg/d)	3·4	3·0	3·9	3·9	3·8	2·7	4·1	3·3
Ca (mg/d)	606·7	518·9	673·7*	311·5	569·0	447·3	609·5	344·7
Fe (mg/d)	10·3	9·2	12·1	5·4	11·5	8·3	13·8	7·3*
P (mg/d)	896·5	787·8	809·9	295·4	961·6	637·9	906·1	419·0
Na (mg/d)	2403·1	2155·2	2037·5*	1048·2	2629	1730·9	2500·2	1325·0
Grains (ounce equivalents)	3·3	2·9	6·5***	3·1	3·9	2·7	7·4***	4·4
Vegetables (cups)	1·4	1·7	0·6***	0·8	1·4	1·2	0·9***	0·8
Fruits (cups)	1·6	1·3	1·1***	0·8	1·6	1·1	0·9***	1·0
Milk (cups)	1·0	0·9	1·5***	0·8	1·2	0·8	1·2	1·0
Meat and beans (ounce equivalents)	1·8	2·0	5·1***	3·2	1·8	1·6	5·9***	4·9

Mean values were significantly different between the 24 h dietary recall and the Block FFQ within an age group for a specific nutrient or food group: * $P < 0·05$, *** $P < 0·001$.

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22% ate cheese 2–3 times per week. Pheasant and organ meat were consumed at least once per week by 10 and 8·4% of the children, respectively (Table 3). About 21% of the children reported eating squirrel and 22% reported eating venison 2–3 times per month.

Discussion

The present study is the first one to investigate the usefulness of the Block FFQ as a dietary assessment methodology among Hmong-American children. The present results indicate that the Block FFQ and 24 h dietary recall values (average 24 h recall or second 24 h recall) were not comparable for up to nine nutrients and all the food groups among 9–13-year-olds and ten nutrients and four food groups among 14–18-year-old children. Among all children, nutrient estimates for protein, vitamin A and vitamin C, and food group servings for grains, vegetables, fruits, and meat and beans were significantly different between the two methodologies, while no significant differences were found for carbohydrate, saturated fat, riboflavin, vitamin B_6, folate, vitamin B_{12} and P intake.

Compared with the 24 h dietary recall analysis, protein and meat and bean intake were significantly underestimated through the Block FFQ (Table 2). Although the Block FFQ offers protein-rich food options such as bacon, ham, roast beef, steak and ribs, such protein sources do not capture the protein food sources commonly consumed in the Hmong culture including venison, squirrel, pheasant and organ meat, which are not included in the Block FFQ. The Block FFQ was designed using the National Health and Nutrition Examination Survey (1999–2) data involving whites, African American and Hispanic populations and does not include culturally specific food items for the Asian and/or Hmong population[28]. Our food-frequency tool targeted cultural protein-rich foods and the results indicate that children ate pheasant, organ meat, squirrel and venison frequently. Earlier, Franzen & Smith[6] conducted focus groups with Hmong adults and reported that Asian grocery stores sold a variety of cultural food items including papaya, yams, taro, mushrooms and organ meat; additionally, squirrel and venison were commonly hunted and consumed. These results suggest that unless a culturally appropriate FFQ for Hmong is available, the 24 h dietary recall method is a better choice to assess this population's food consumption patterns.

Another important difference between the two methods was observed in the estimates for Ca, vitamin D and milk among the 9–13-year-old children (while no differences were noted among older children), and the 24 h values for these nutrients were significantly higher than the Block FFQ values. One possible explanation could be insufficient and/or culturally inappropriate Ca- and vitamin D-containing foods listed in the Block FFQ. Jensen *et al.*[31] estimated Ca intake among Asian, Hispanic and white youth through a unique FFQ which included Ca food sources commonly consumed by these groups, including tofu, natto, seafood, pizza, atole and tamales, some of these items are lacking in the Block FFQ.

Another explanation for Ca and vitamin D underestimations might be the incomplete or poorly worded portion size estimation questions for certain food items listed in the Block FFQ. For example, the question on cereals asked 'How often (in days) do you have milk on cereal?', without prompting for the quantity of milk that was added on the cereal. Also, the question on milk consumption asked about the number of glasses or cartons of milk consumed (ranging from half to three glasses/cartons), with no visual photography on the size of a glass or carton. Further, the question on supplementation inquired how many days were vitamin pills consumed, and did not ask the number of pills consumed. Such incomplete questions and/or prompts could have possibly resulted in incorrect responses by younger children, who have limited knowledge and/or memory on portion size estimations, leading to error in nutrient estimates. Although Molag *et al.*[32] indicated that portion size questions do not always improve the performance of the FFQ, they too suggested that methods to estimate portion sizes need improvement to avoid measurement errors in dietary assessments.

Among all children, compared with the 24 h dietary recall values, fruit and vegetable servings were reported higher for the Block FFQ. While comparing Block FFQ results with 24 h dietary recalls among 10–17-year-old Hispanic, African American and white youth, Cullen *et al.*[24] also found a higher mean vegetable intake through the Block FFQ, possibly suggesting a link between child food preferences and items remembered during the 24 h recalls. Previous research has indicated that multiple factors influence children's dietary recall, including the kinds of foods recalled (entrée and main dishes are recalled better than side dishes, familiar items are recalled easily), food likeability and

Table 3. Frequency in the consumption of protein-rich foods among Hmong-American children

	Never	Holidays only	2–3 times/month	1 time/week	2–3 times/week	Daily
Bacon	21·0	7·1	31·0	15·5	16·7	8·7
Beef	4·8	2·1	10·7	16·4	39·4	26·6
Boiled chicken	5·1	2·1	12·8	20·3	36·4	23·3
Eggs	2·4	0·3	11·6	20·6	39·1	26·0
Fish	13·1	5·1	31·3	23·6	18·5	8·4
Pheasant	59·7	6·9	14·3	9·6	5·7	3·8
Pork	7·8	1·8	14·4	15·3	32·0	28·7
Organ meat	58·2	9·6	11·3	8·4	7·5	5·0
Squirrel	52·5	11·6	20·9	5·7	5·4	3·9
Venison	48·1	16·4	21·8	6·3	4·2	3·2
Hotdog	12·8	3·3	36·4	22·7	17·9	6·9
Cheese	19·5	5·1	21·3	22·5	21·9	9·7
Soya milk	40·6	9·9	20·3	12·2	10·7	6·3

cognitive processes (attention, memory organisation, retention, retrieval and response)[33–36]. A possible explanation for over-reporting fruits with the Block FFQ could be that children believed they ate more fruit than they actually did. Children see a variety of fruits and vegetables in the school and having a list of these items in the Block FFQ as a prompt might have led some children to falsely over-report their fruit and vegetable consumption.

Compared with the 24 h dietary recall, the Block FFQ reported higher Na consumption among the 9–13-year-olds. A plausible explanation for higher Block FFQ Na estimation could be that this questionnaire lists specific high-Na food items including ketchup, salsa, sauces and processed foods which might act as memory prompts for younger children. Also, because the Block FFQ assessed Na consumption over the prior week, it might have provided more variety in food options compared with recalling foods eaten over the past day. Research has also suggested that young children have trouble remembering condiments during recalls[33,36], which might include added salt, sauces, salad dressings and ketchup, possibly explaining the underestimation of Na intake by younger children in the present study as assessed through the 24 h dietary recall method.

Limitations and conclusion

Although the present study assessed the usefulness of the Block FFQ in a growing but understudied Hmong-American population, there are certain limitations to address. First, self-reported data (either the 24 h dietary recall or the FFQ) are subject to measurement error including participant bias (misreporting, under-reporting or over-reporting because of social desirability or body image issues), memory lapses leading to missed/incorrect information and mistakes in assessing mixed dishes[23]. Further, incorrect estimation of portion sizes by children is not uncommon, and could be because of a lack of motivation to report their intake, low literacy levels or memory retention issues[34–36]. However, research has also suggested that the ability of children to self-report their dietary intake improves after 8 years of age[35], suggesting that our sample were more likely to report their intake to the best of their knowledge. Second, although the present study found the 24 h dietary recall methodology to be a reliable dietary assessment measure when compared with the Block FFQ, more research is needed to investigate the absolute validity of the 24 h dietary recall measure by incorporating methods including weighing or observing food items, videotaping participants, and assessing nutritional biomarkers such as doubly labelled water to assess energy intake and urinary urea N as a marker of dietary protein[23]. Third, the present results provide important information for future researchers and intervention studies; these results are hard to generalise among the Hmong-American population living in other areas within the USA or other global regions, and more research is needed to examine nutrient assessment especially with minority populations.

The present results indicate that although the Block FFQ can be easily administered by the researcher, this instrument does not appear to be appropriate for Hmong children and should be tested with other Asian-American children in general before use. Specifically, the Block FFQ does not appear to be a good measure for nutrients including for protein, vitamin A and vitamin C, and food group servings for grains, vegetables, fruits, and meat and beans among the 9–18-year-old Hmong children. Therefore, we believe that at this point in time, the 24 h dietary recall (collected through the multiple-pass method on two or more days) offers a better account of the participant's diet. Specifically, dietary recalls are more inclusive of ethnic food choices which are missed in FFQ not designed for the population of interest. It is possible for a FFQ to be developed for use with Asian Americans but it would need to include common foods consumed among Chinese, Japanese, Vietnamese, Hmong and Indian populations, and such an instrument would also require validation studies to support its use. Based on the present findings, we suggest that the developers of the Block FFQ consider modifying their FFQ to incorporate a selection of Asian foods to better reflect the dietary choices of this and other Asian ethnic groups. Specifically, they should consider adding organ meats such as heart, liver and tongue, and hunted meats such as venison, pheasant and squirrel. Smith & Miller[37] recently reported that both urban and rural residents in Minnesota were consuming hunted meats, freshly caught fish and produce from gardens obtained either by themselves or through an informal sharing system. Other researchers have also reported similar findings. Burger & Gochfeld[38] documented that while some South Carolinians in the USA did not hunt themselves, they consumed venison year-round, courtesy of their family and friends. Smith & Miller[37] also suggested the importance of nutritionists asking about food obtained through hunting and fishing because they potentially provide valuable macro- and micronutrients to the diet such as protein, vitamins and minerals that may not be captured through food-frequency intake instruments. Subsequent research would then need to validate such an instrument's appropriateness in follow-up studies. Until such an instrument is designed and validated for Hmong, the present study suggests that the 24 h dietary recall is a more appropriate dietary assessment methodology to use among Hmong-American children, 9–18 years of age.

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