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FOOD CONSUMPTION PATTERNS AND DIETARY ADEQUACY OF HIGHLAND KAREN OF NORTHWEST THAILAND

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ABSTRACT

This research examined differences in dietary patterns and adequacy of mothers and their weaned children between the less modernized Pwo animist and the more modernized Sgaw Christian highland Karen of northwest Thailand. 24-hour dietary recalls and food frequency questionnaires revealed that Pwo mothers and their weaned children consumed overall fewer food items and had less dietary diversity than Sgaw mothers and their weaned children in all three seasons (post-harvest, pre-harvest and harvest). There were particular differences in the consumption of fruits, vegetables, marine foods and eggs in all seasons between the two groups. Dietary adequacy was lower among both Pwo mothers and their weaned children than among Sgaw mothers and their weaned children. Seasonal variations in percentages of RDIs were found for all groups. However, both Pwo and Sgaw weaned children had a greater seasonal fluctuation in dietary adequacy than their mothers.

KEY WORDS

food patterns, dietary adequacy, Karen, Thailand

INTRODUCTION

Different ethnic groups, religious affiliations and modernization processes contribute to differences in food beliefs and dietary patterns and adequacy in traditional societies[1]. A few researchers[2-4] have found that the adoption of Christianity tends to be associated with modernization in traditional societies, including Southeast Asia. Both Christianity and modernization promote new rational ideas, knowledge and practices in traditional societies[5-7], including dietary behavioral changes[8] and increases in dietary diversity[9].

The Karen tribes of Thailand provide an example of one such traditional society which is now facing increasing exposure to modernization. The highland Pwo and Sgaw Karen of northwest Thailand reside in fairly geographically isolated villages ; both groups share the same ecosystem and utilize similar food production methods. Despite the geographical similarities, however, there are some historical differences between the two groups : long periods of western Christian missionary activity, primarily focused among the Sgaw[10-12] have influenced differential patterns of modernization between the two ethnic groups[13, 14]. The earlier and greater Christian missionary activity itself, as well as the development by the missionaries of a Sgaw Karen script, have resulted in the Sgaw tending to have greater contact than the Pwo with the outside world[10-12]. In addition, a preliminary health and nutritional study showed that Sgaw preschool children

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tend to be healthier and experience better growth than Pwo preschool children among the highland Karen[15], despite the fact that the two groups share the same ecosystem. Therefore, a follow-up study was conducted in order to determine the specific relative factors accounting for differences in growth and health status between the two groups. This article presents the results of one part of that study, examining dietary patterns and dietary adequacy of weaned children and their mothers among the more modernized Sgaw Christian and less modernized Pwo animist households of the highland Karen in northwest Thailand.

STUDY POPULATION

The Karen are the largest tribal population in Thailand. As of 1990, there were approximately 276,000 people, making up about 50% of the total Thai hill tribal population[16]. Most Thai Karen belong either to the Sgaw or the Pwo ethnic group. The Sgaw is the larger of the two groups, accounting for 80% of all Thai Karen[17]. The majority of Karen have now migrated to the lowlands as a result of rapid population increases in recent decades[11, 13], but a significant number (about 28% of the Karen in the area of the study population) still live in fairly isolated highland villages[18]. While the Pwo and Sgaw have distinct, mutually unintelligible languages and often have different religions, both groups nevertheless identify themselves as Karen and thus share many societal commonalities[11, 19].

In 1990, about 55% of all Karen (mainly in the lowlands) claimed Buddhism as their primary religion while 28% (mainly in the highlands) stated they followed an indigenous animistic religion and 17% (highland and lowland combined) claimed they were Christians[16]. Western Christian missionaries began working primarily among the Sgaw at the end of World War II[10, 11, 17]. As a result, although animism and Christianity are found among both the highland Pwo and Sgaw, highland Sgaw are more likely to be Christians than are highland Pwo[10]. In the preliminary study[15], for example, 87.0% of the Sgaw, as opposed to only 14.0% of the Pwo, stated that they were Christians, a difference which is highly significant ($p < .01$). This distinction is important because the adoption of Christianity is frequently associated with substantial sociocultural and behavioral changes[3]. The activity of western Christian missionaries mainly among the Sgaw over long periods of time may be associated with higher degrees of exposure to the outside world and the promotion of more rational ideas, knowledge and practices even among the more isolated highland Karen.

METHODS

The research design for the present study involved comparisons between the Sgaw Christians as the most exposed to a modern way of life and the Pwo animists as the least exposed among the highland Karen. Although not all Sgaw are Christians and not all Pwo are animists, that was the case in the present study. Therefore, for the sake of simplicity, Sgaw is used interchangeably with Christian and Pwo with animist in the following sections.

The study was conducted in four highland Sgaw and four highland Pwo villages in the Mae Sariang district of Mae Hong Son province from January through December 1995. The Pwo villages contained 20 to 49 households and the Sgaw villages consisted of 18 to 37 households. Observations were made during three major farming seasons : Post-harvest (January-March), pre-harvest (June-September), and harvest (October-early December). All of these villages were isolated, with the closest road (which was not always accessible to vehicles) being 5 to 12 hours walk from each village. Access to the study villages was obtained through a mobile clinic associated with the Mae Sariang hospital. Since 1979 the mobile clinic has provided health care to highland villages which are sufficiently isolated that the Thai government has not yet established a health clinic in that village or in a nearby

village. The team visited each village only a few times a year because of the difficulty of access caused by weather and lack of transportation. Villagers were under no obligation to accept treatment or health care.

Data were collected on individuals from 77 Pwo animist and 71 Sgaw Christian households in the study villages. All households with preschool children (55% of the total households among the Sgaw and 75% of the total households among the Pwo) participated in the study. The primary subjects within each family were the mother and those of her preschool children whose diet she had begun to supplement, meaning they were not exclusively breastfed. The ages of most Sgaw children and adults and some Pwo children and adults were obtained from the records of the mobile clinic, which on each visit records the date of birth of clinic attendant infants who were born since the clinic's last visit. When the age of an individual was not available from the records of the mobile clinic, age was determined through intensive questioning of the parents and other villagers about events of known date which occurred at the time of birth. Nude weight of the preschoolers was measured to the nearest 0.1 kg on a portable Salter Spring balance with a 25 kg capacity. Mothers were measured to the nearest 250 gr on a pressure scale with a 120 kg capacity. All mothers wore light clothing and no footwear. A correction for clothing was applied in order to estimate nude weight. Scale calibration was checked each day.

The dietary intake and food patterns of both mothers and preschoolers were evaluated with 24-hour dietary recalls and food frequency interviews, collected during each of the three seasons. Recalls were collected on three consecutive days during each season for both mothers and preschoolers. Since it was impossible to measure the intake of breast milk in nursing children, only the data on weaned children were utilized for these analyses. The study also excluded children and mothers who had mild to severe illnesses such as high fever, diarrhea and/or severe abdominal pain at the time of the visit since such conditions are associated with a loss of appetite[20-26]. The results of the recalls were verified for at least one meal on each of the three day measurement period by comparing the results of the recall with the amounts recorded by an observer. The food frequency interview was collected initially during the first study season and then re-evaluated for accuracy and completeness each succeeding season. The pretest (December, 1994) determined that there were no differences in food patterns or food frequencies within families between the sexes or between age categories. Since an entire family eats out of the same pot, this is not surprising. Therefore, a single food pattern for each family was constructed. The dietary recall information was converted into the daily nutrient intakes and percent of the FAO/WHO recommended daily intakes (RDI), mainly using Thai food composition tables, based on the average of the three days for each season. Due to the difficulty of measuring and quantifying physical activity, the RDI's did not take into account the effect of physical activity on nutrient requirments for the study.

All statistical analyses were performed with SPSS/PC+, Version 6.0.

RESULTS

Meal Patterns

Approximately 67% of Pwo mothers and 3.5% of their weaned children during the post-harvest season, 71.9% of Pwo mothers and 5.3% of weaned children during the pre-harvest season, and 74.6% of Pwo mothers and 5.3% of weaned children during the harvest season ate only two main meals, generally morning and evening meals, as part of their daily routine. On the other hand, 94.2% of Sgaw mothers and all their weaned children during the post-harvest season, 93.8% of Sgaw mothers and all their weaned children during the pre-harvest season, and 90.8% of Sgaw mothers and all their weaned children during the harvest

season ate three meals (morning, midday and evening) as the general rule.

For both the Pwo and Sgaw, the morning meal was usually between 6 and 7 A.M., except during the harvest season, when the morning meal was usually between 5 to 6 A.M. The whole family usually ate together. All Pwo and Sgaw mothers reported a morning meal of rice and chili peppers and salt during all seasons. In addition, most of the Sgaw mothers (over 90%) and approximately 78% of the Pwo mothers consumed vegetables, meat, small fish and/or roots and tubers flavored with either shrimp, fish or bean paste during all seasons as part of the morning meal.

The midday meal was usually between noon and 1 P.M. Cold rice and leftover dishes from the morning meal with chili and salt paste were used, since mothers seldom cooked for lunch ; only approximately 38% of Sgaw mothers in this study cooked food for lunch. Many Sgaw mothers (approximately 75%) and some Pwo mothers (approximately 25%) wrapped up rice with chili peppers and salt, and sometimes dried fish in a big leaf (usually banana) to take to the field during the pre-harvest and the harvest season. The evening meal was usually consumed between 4 : 30 and 5 : 30 P.M. and followed a pattern similar to the morning meal.

The Karen usually did not drink any beverage with meals. After a meal was finished, individuals drank water from a bamboo vessel. During the study period, approximately 59% of the Sgaw mothers drank weak tea several times a week, as opposed to only 8% of the Pwo mothers.

The dietary patterns of weaned children were fairly similar to those of their mothers. However, there were three important differences between mothers and children. First, many Pwo mothers did not eat a midday meal but most weaned children ate lunch in their homes or fields, even though they often ate only cold rice for lunch. Second, weaned children usually consumed smaller amounts of food than their mothers (for example, mothers generally ate two to three whole plates of cooked rice at each meal, but children ate half to one plate of rice). Third, children consumed foods between meals more frequently than their mothers. In-between meal foods generally consisted of rice, a piece of roasted meat, fruits, roots or tubers, jaggery, sugarcane, nuts and seeds. The study population did not have a specific or regular time for snacking, such as midmorning or afternoon. Snacks were consumed at the onset of hunger and taken from available foods, such as from the cooking pot. If food was not readily available, nothing was consumed. Approximately 12% of Pwo mothers and 16% of weaned children, and approximately 27% of Sgaw mothers and 31% of weaned children ate some kind of foods between meals during the study periods.

The Karen observed in this study generally preferred to boil their food stuffs, so most meals consisted of soup. Even after they roasted meats, they boiled the sliced meats and/or vegetables with water, salt, chili peppers, dried garlic or onion and shrimp, fish, or soybean paste and ajinomoto (monosodium glutamate) if available. In addition, Sgaw mothers often used lard to saute vegetables and/or meat with salt, chili pepper, and dried garlic or onion, sometimes adding shrimp, fish, or soybean paste. On the other hand, Pwo mothers did not use the sauteing method of cooking as often as the Sgaw.

Food Patterns

A total of 143 different food items were used by both ethnic groups during all three seasons of the study period. The median and range of total daily food items by Pwo and Sgaw mothers and weaned children in each season are described below. In the post-harvest season, there was a median of 6.4 (range : 4-13) for Pwo mothers and 8.7 (5-17) for Sgaw mothers ($p < .001$) ; 6.2 (3-12) for Pwo weaned children and 8.6 (5-15) for Sgaw weaned children ($p < .001$). In the pre-harvest season, 5.9 (4-12) for Pwo mothers and 8.5 (5-18) for Sgaw mothers ($p <$

.001) ; 5.8 (3-11) for Pwo weaned children and 8.2 (5-15) for Sgaw weaned children ($p < .001$). In the harvest season, 6.2 (4-11) for Pwo mothers and 8.1 (5-14) for Sgaw mothers ($p < .001$) ; 5.8 (4-10) for Pwo weaned children and 7.9 (4-13) for Sgaw weaned children ($p < .01$). In all, Pwo mothers and weaned children tended to both consume fewer food items and have less dietary diversity than Sgaw mothers and weaned children in all three seasons. However, there were no significant differences between mothers and their weaned children in either the Pwo or Sgaw Karen in any of the seasons ($p > .05$).

Since Sgaw mothers and weaned children tended to consume more food items than their Pwo counterparts, it is not surprising that there were also significant differences in specific food groups in all three seasons ($p < .05$). Sgaw mothers consumed significantly more items than Pwo mothers within the following food groups : grains, vegetables, fruits, marine foods, fats and miscellaneous during the Post-harvest season ; vegetables, fruits, marine foods, fats and miscellaneous during the pre-harvest season ; and roots and tubers, vegetables, fruits, marine foods, condiments and miscellaneous foods during the harvest season. Sgaw weaned children also consumed significantly more items than Pwo weaned children within the following food groups : grains, vegetables, fruits, marine foods, eggs, fats and sugars during the post-harvest season ; legumes, fruits, marine foods, eggs, fats and sugars during the pre-harvest season ; and roots and tubers, fruits, marine foods, eggs, sugars and condiments during the harvest season.

In order to identify the specific sources of these different dietary patterns, foods in each food group which had markedly different rates of consumption between the two ethnic groups for mothers and weaned children were identified (tables 1 and 2). The food items indicated in these tables are good sources of nutrients such as calories, protein, calcium, iron, vitamin A, thiamin, riboflavin, niacin and vitamin C. These tables thus compare the contributions of nutrient rich food items in the diets of both Pwo and Sgaw mothers and weaned children, using information obtained from the 24-hour dietary recalls. The differences in consumption rates of these food items between the Pwo and Sgaw diets primarily account for the differences in the percent RDIs between the groups for the above named nutrients, as will be described shortly.

Sgaw mothers and weaned children also consumed significantly more condiments (crude salt, dried ginger root and dried bulbs of garlic) than Pwo mothers and weaned children during the harvest season ($p < .05$). Pwo mothers consumed significantly more betal leaves and betal nuts than Sgaw mothers during all three seasons ($p < .05$). However, these were not included in tables 1 and 2 since the condiments generally were used in very small amounts as spices in soups or chili paste ; none of these commonly used condiments contained key nutrients. Thus, condiments do not have much influence as major components of the nutrient differences among both Pwo and Sgaw Karen. Similarly, betal leaves and betal nuts were used as chewing nuts, especially among the Pwo Karen. A piece of a betal leaf and a small betal nut, including a small amount of lime and bark usually are chewed and spit out a few times a day. Since nutrients derived from lime, bark, betal leaf and nut chewing are not available in the literature, and little if any of the nuts, leaves, lime and bark are actually consumed, nutritional information was not included in this study.

As indicated in tables 1 and 2, glutinous rice consumption in the post-harvest season was reported by approximately 29% of Pwo mothers and 24% of weaned children and approximately 40% of both Sgaw mothers and weaned children. Pwo mothers and weaned children also generally consumed vegetables less frequently in the post-harvest season than Sgaw mothers and weaned children. For example, eggplant, high in vitamin A, was consumed by 24.2% of

Pwo mothers and 22.4% of weaned children and 43.5% of Sgaw mothers and 40.7% of weaned children. Consumption of squash, another good source of vitamin A, was reported by 47.1% of Pwo mothers and 46.6% of weaned children but by 65.2% of Sgaw mothers and 61.7% of weaned children.

All Pwo and Sgaw mothers reported gathering wild vegetables. However, Pwo mothers did so less frequently (median 5 times per month ; range 1 - 15 times) than Sgaw mothers (median 6 times per month ; range 2 - 20 times). In addition, approximately 48% of the Pwo planted vegetables, including eggplant, coriander (high in vitamin A, thiamin, riboflavin and vitamin C) and squash in their fields, while approximately 70% of Sgaw households planted vegetables in their fields. Only 7.6% of Pwo mothers and 6.9% of weaned children consumed papaya (high in vitamins A and C) in contrast to 43.5% of Sgaw mothers and 40.7% of weaned children. Pomelo (high in vitamin C) consumption was

Table 1 Description of significant daily food consumption patterns among all Pwo and Sgaw mothers reporting in each season($p<0.05$)

	Post-harvest		Pre-harvest		Harvest	
Food	Pwo (n=66) %	Sgaw (n=69) %	Pwo (n=64) %	Sgaw (n=65) %	Pwo (n=63) %	Sgaw (n=65) %
Grains:						
Glutinous rice	28.8	39.1	--	--	--	--
Roots & Tubers:						
Cassava	--	--	--	--	27.1	38.5
Vegetables:						
Eggplant	24.2	43.5	15.2	47.8	--	--
Coriander	22.7	58.0	0.0	24.6	--	--
Squash	47.1	65.2	--	--	30.2	46.2
Paracress leaves	13.6	23.2	--	--	--	--
Holy basil	--	--	0.0	20.3	--	--
Mustard greens	--	--	16.7	58.1	--	--
Tomato	--	--	--	--	1.6	20.0
Cucumber	--	--	--	--	23.8	35.4
Yard long bean	--	--	--	--	9.5	29.2
Fruits:						
Papaya	7.6	43.5	0.0	33.8	0.0	26.2
Pomelo	9.1	29.1	--	--	3.2	30.8
Mango	--	--	1.6	27.7	--	--
Marine foods:						
Shrimp/Fish paste	24.2	56.5	26.6	50.8	28.6	46.2
Small fish/Tadpole	28.8	40.6	23.4	36.9	11.1	36.9
Small crab	30.3	43.5	--	--	--	--
Fats:						
Lard	13.6	23.2	15.6	30.8	--	--

reported by less than 10% of both Pwo mothers and weaned children but by approximately 30% of both Sgaw mothers and weaned children. Approximately 8.0% of Pwo and 33.8% of Sgaw households had papaya trees, and 10.4% of Pwo and 26.8% of Sgaw households had pomelo trees in their backyard. Shrimp and fish pastes (high in protein, calcium, thiamin, riboflavin and iron) were used primarily in soups. Both Karen groups usually bought these pastes in the nearest town and kept them at least a few months in their homes. Small fish, tadpoles, and small crabs (all nutritionally similar to shrimp or fish paste) were consumed by approximately 30% of Pwo mothers and weaned children and approximately 40% of Sgaw moth-

Table 2 Description of significant daily consumption patterns among Pwo and Sgaw weaned children derived from all Pwo and Sgaw mothers reporting in each season($p<0.05$)

	Post-harvest		Pre-harvest		Harvest	
Food	Pwo (n=58) %	Sgaw (n=81) %	Pwo (n=57) %	Sgaw (n=74) %	Pwo (n=55) %	Sgaw (n=76) %
Grains:						
Glutinous rice	24.1	39.5	--	--	--	--
Roots & Tubers:						
Cassava	--	--	--	--	25.5	40.5
Legumes:						
Soybean paste	--	--	28.1	39.2	--	--
Peanut	--	--	3.5	12.2	--	--
Vegetables:						
Eggplant	22.4	40.7	--	--	--	--
Coriander	20.7	55.6	--	--	--	--
Squash	46.6	61.7	--	--	--	--
Paracress leaves	12.1	19.8	--	--	--	--
Fruits:						
Papaya	6.9	40.7	0.0	36.5	0.0	26.3
Pomelo	8.6	29.6	--	--	3.5	36.5
Mango	--	--	1.8	31.1	--	--
Marine foods:						
Shrimp/Fish paste	27.6	49.4	24.6	51.4	27.3	47.4
Small fish/Tadpole	29.3	40.7	21.1	37.8	10.9	36.8
Small crab	31.0	48.1	--	--	--	--
Eggs:						
Chicken	0.0	29.6	0.0	28.4	0.0	17.1
Fats:						
Lard	12.1	24.7	12.2	32.4	--	--
Sugars:						
Jaggery	13.8	22.2	0.0	16.2	9.1	17.1

ers and weaned children.

Approximately 80% of Pwo and Sgaw households kept lard made from pig fat (a good source of calories) in their homes. However, the Sgaw generally reported using lard in cooking on a weekly or monthly basis while most Pwo reported using it only on a monthly basis. In fact, only approximately 13% of Pwo mothers and weaned children and approximately 24% of Sgaw mothers and weaned children reported actually consuming lard in the 24-hour recalls. The small lard consumption is not surprising because the Karen, as discussed earlier, generally preferred to boil their food stuffs, rather than sauteing or frying them. There were significant differences between Pwo and Sgaw weaned children in the consumption of eggs (high in protein, vitamin A, thiamin and riboflavin) and sugars ($p < .05$). None of the Pwo weaned children consumed chicken eggs, while 29.6% of Sgaw weaned children consumed them. Jaggery (high in calories, calcium, iron and vitamin A) was consumed by 13.8% of Pwo weaned children and 22.2% of Sgaw weaned children. Both Pwo and Sgaw parents usually bought jaggery, made from sugarcane, in the nearest town.

In the pre-harvest season, there were marked differences in the consumption of vegetables between Pwo and Sgaw mothers, though not among Pwo and Sgaw children. Differences in the consumption of legumes (high in protein, iron and riboflavin), chicken eggs, and jaggery were only apparent between Pwo and Sgaw weaned children. Differences in the consumption of fruits, marine foods and fats occurred between Pwo and Sgaw mothers and Pwo and Sgaw weaned children. For example, approximately 28% of Pwo weaned children and 39% of Sgaw weaned children consumed soybean paste, bought in the nearest town and used primarily in soups and sometimes for mixing with rice. Peanuts were consumed by 3.5% of Pwo and 12.2% of Sgaw weaned children. Only five Sgaw households planted peanuts in their fields ; other families bought peanuts in the nearest town. Approximately 30% of Sgaw mothers and weaned children consumed mango and papaya but less than 2% of Pwo mothers and weaned children consumed them. Only one Pwo household had mango trees but thirteen Sgaw households had mango trees in their backyards and they usually shared them with neighbors. As described above, 7.8% of Pwo and 33.8% of Sgaw households had papaya trees in their backyards.

In the harvest season, the major differences in the consumption of foods were among roots and tubers, fruits, and marine foods between Pwo and Sgaw mothers and Pwo and Sgaw weaned children. Differences in vegetable consumption occurred between Pwo and Sgaw mothers only. Differences in egg and sugar consumption were only apparent between weaned children. As in all other seasons, Pwo mothers and weaned children consumed much less food and also fewer types of food than Sgaw mothers and weaned children. Cassava (high in vitamin C) consumption, for example, was reported by 27.1% of Pwo and 38.5% of Sgaw mothers and 25.5% of Pwo and 40.5% of Sgaw weaned children. The most common use for cassava was in soups and sometimes roasting. The consumption of vegetables was about the same as in other seasons, with Pwo mothers consuming fewer than Sgaw mothers. Consumption of fruits and marine foods was also much lower among Pwo mothers and weaned children than among Sgaw mothers and weaned children.

The food frequency questionnaires were also used to gather information on food consumption since a number of studies suggested that the food frequency questionnaire generally gives a better usual food intake measurement than the 24-hour recalls[27-29]. Such data therefore provide a way of verifying the 24-hour recall data. Use of rice, chili peppers and crude salt was reported by all on a daily basis in all seasons. There was some seasonality of some foods due to different harvest times, especially for vegetables, fruits, roots and tubers. Milk

and milk products were not consumed with any degree of frequency by any of the subjects.

The Sgaw had a generally greater dietary diversity than the Pwo. For example, the Sgaw mothers reported using chicken eggs on a weekly (21.7%), monthly (69.6%) and occasional (8.7%) basis during the post-harvest season ; weekly (23.2%), monthly (71.0%), and occasionally (5.8%) during the pre-harvest season ; and weekly (2.9%), monthly (78.3%), and occasionally (18.8%) during the harvest season. On the other hand, Pwo mothers reported using chicken eggs on an occasional (32.4%) basis and 67.6% of Pwo mothers had never used chicken eggs for consumption in any season.

Frog, bird and rat were the most frequently consumed meats among both the Pwo and Sgaw. These were used on a weekly basis by 30 to 50% of Pwo and Sgaw in all three seasons. These animals are usually numerous, so they can be caught much more easily than other wild animals. Eighty-three percent of Pwo and 98.6% of Sgaw hunted on a regular basis. In addition, the Pwo (median 2 times per month, the range 1 - 8) hunted less frequently than the Sgaw (median 4 times per month, the range 2 - 13). However, it was difficult to hunt wild animals such as deer, wild cats, and monkeys because there were fewer of these animals than there were of rats and birds, with the numbers of the former decreasing each year[30]. The Pwo generally only consume domesticated animals such as chickens, pigs and goats following a ceremonial sacrifice.

The frequency of consumption on a weekly basis of six marine foods varied from 20.6% to 41.2% of Pwo families and 14.5% to 63.8% of Sgaw families during the post-harvest season, by 17.6% to 41.2% of Pwo and 5.8% to 66.7% of Sgaw during the pre-harvest season, and by 1.5% to 35.3% of Pwo and 2.9% to 52.2% of Sgaw during the harvest season. They usually bought shrimp, fish paste, dried fish, and canned fish in the nearest town. Other marine foods such as small fish, tadpole, river prawn, and small crab were caught in rivers, streams and/or ponds.

Soybean paste was the most frequently consumed legume in all seasons. Twenty five percent of Pwo mothers used soybean paste on a weekly basis in all seasons, while 30% of Sgaw mothers used it on a weekly basis during the post-harvest and harvest seasons and 67% used it during the pre-harvest season. Nine Sgaw families raised sesame seeds and/or peanuts in their own fields but none of the Pwo families raised any kind of legume.

All mothers reported using yam either weekly (48.5% of Pwo and 46.4% of Sgaw) or monthly (51.5% of Pwo and 53.6% of Sgaw) during the post-harvest season only. Other seasons had lower yam consumption. Roots and tubers (yam, taro and cassava) had quite similar levels of consumption between the Pwo and Sgaw, excepting cassava during the harvest season (35.3% of Pwo and 53.6% of Sgaw on weekly basis).

Chili pepper, small onion, squash, golkakra, eggplant, coriander and chinese cabbage were the most frequently consumed vegetables during the post-harvest season ; chili pepper, small onion, and bamboo shoots were most frequently consumed during the pre-harvest season ; and chili pepper, small onion, bamboo shoots, eggplant, and squash were most frequently consumed during the harvest season among both the Pwo and Sgaw. However, the Sgaw were more likely to use vegetables on a daily or weekly basis than the Pwo.

Seven kinds of fruits were mentioned in the responses to the food frequency questionnaire. However, three fruits (jackfruit, melon and pineapple) were consumed much less frequently than other fruits such as banana, papaya and pomelo in all seasons. Over 75% of Pwo mothers reported consuming jackfruit, melon and pineapple only on an occasional basis or never at all. On the other hand, approximately 50% of Sgaw mothers consumed jackfruit, melon and pineapple on a monthly or occasional basis in all seasons. The most frequently consumed fruit was banana in all seasons. Approximately

70% of Pwo and 98% of Sgaw mothers reported consuming banana on a weekly or monthly basis in all seasons. Approximately 50% of the Pwo used papaya and pomelo on a weekly or monthly basis in all seasons while approximately 90% of the Sgaw used papaya and pomelo on a weekly or monthly basis in all seasons.

Consumption of sugars was not great among either Karen group. However, the Sgaw did use sugars, including sugar, jaggery and sugarcane, more frequently than the Pwo. Approximately 46% of Pwo reported that they had never used sugars in any season, while only approximately 16% of Sgaw reported never having used sugars.

Dietary Adequacy

Two-way analyses of covariance of percent of RDIs by sex and ethnic group, while controlling for age, were used to test for significant sex differences. There were no significant differences between males and females for any of the seasons ($p > .05$) ; therefore, sexes were combined for further analyses.

The results of a comparison of the mean percent RDIs of nine nutrients between Pwo and Sgaw weaned children in each season, after controlling for age, are all shown in table 3. It was not necessary to control for weight since weight is taken into consideration in the calculation of the RDI's. Percent RDIs for all nine nutrients were significantly lower among Pwo

Table 3 Results of one-way analyses of covariance of percent of RDI for weaned children by ethnic group, while controlling for age during three seasons

	Post-harvest			Pre-harvest			Harvest		
	Age-adjusted means			Age-adjusted means			Age-adjusted means		
	Pwo (n=58)	Sgaw (n=81)	F	Pwo (n=57)	Sgaw (n=74)	F	Pwo (n=55)	Sgaw (n=76)	F
Calories	86.3	91.5	43.6***	83.6	89.7	60.0***	80.0	86.4	63.7***
Protein	132.6	166.1	100.6***	129.8	154.1	50.3***	125.3	146.1	63.9***
Calcium	12.5	31.8	99.9***	12.7	26.2	54.8***	13.1	25.6	53.8***
Iron	16.3	34.6	78.2***	18.2	35.1	72.4***	18.5	28.0	29.5***
Vitamin A	27.7	56.7	35.2***	29.3	55.9	22.6***	42.9	61.4	18.5***
Thiamin	47.4	57.9	57.0***	48.3	59.4	56.9***	48.3	57.3	36.3***
Riboflavin	13.9	27.4	65.9***	13.2	26.3	122.3***	15.2	20.8	33.5***
Niacin	70.6	90.1	99.6***	69.9	84.8	58.5***	68.4	80.6	41.7***
Vitamin C	36.7	112.6	51.7***	26.4	85.8	52.6***	41.3	111.2	43.1***

***Significant effect, $p < .001$

than among Sgaw weaned children in all seasons ($p < .001$).

Table 4 provides age-adjusted means for the percent RDIs of nine nutrients in Pwo and Sgaw mothers in each season. All percent RDIs, excepting iron during the harvest season, were significantly lower among Pwo than among Sgaw mothers in all seasons ($p < .001$).

Analyses of seasonal variations in the percent of RDIs found different seasonal patterns in Pwo and Sgaw weaned children (tables 5 and 6). Seasonal variations also were found for mothers in both ethnic groups (tables 7 and 8). Both Pwo and Sgaw weaned children had greater seasonal fluctuations in dietary adequacy than their mothers. In particular, the age-adjusted means for calories and protein percent of RDIs showed significant seasonal differences in both Pwo and Sgaw weaned children ($p < .01$) but not in their mothers ($p > .05$). The highest percent of RDIs for children in both ethnic groups occurred in the post-harvest season and declined each succeeding season, with the lowest percent of RDIs during the harvest season.

Age and energy-adjusted means for the percentage of vitamin C RDIs (tables 5 - 8) revealed significant seasonal differences among all groups ($p < .05$). Adequacy of vitamin C intake for the post-harvest and harvest seasons was better than during the pre-harvest season in all samples. The main sources of vitamin C for both the Pwo and Sgaw Karen are banana, guava, papaya, mango, pomelo, gourd and cas-

Table 4 Results of one-way analyses of covariance of percent of RDI for mothers by ethnic group, while controlling for age during three seasons

	Post-harvest			Pre-harvest			Harvest		
	Age-adjusted means			Age-adjusted means			Age-adjusted means		
	Pwo (n=66)	Sgaw (n=69)	F	Pwo (n=64)	Sgaw (n=65)	F	Pwo (n=63)	Sgaw (n=65)	F
Calories	80.1	89.8	68.0***	79.3	89.2	81.4***	78.8	88.8	88.2***
Protein	90.0	117.0	89.3***	88.0	110.2	62.5***	89.8	108.6	39.2***
Calcium	14.1	40.8	79.6***	14.3	34.6	53.0***	14.8	35.0	49.0***
Iron	17.9	28.4	21.3***	18.9	27.0	16.8***	20.5	21.5	0.3
Vitamin A	55.2	100.1	28.3***	63.9	90.0	16.2***	76.9	112.1	37.5***
Thiamin	60.3	71.2	48.9***	63.5	75.1	51.7***	65.4	73.9	32.6***
Riboflavin	15.2	27.6	118.5***	16.4	27.1	80.1***	18.8	22.1	15.2***
Niacin	86.7	108.5	104.9***	87.3	102.7	68.5***	89.9	99.9	26.5***
Vitamin C	41.6	132.1	41.9***	39.4	91.4	48.9***	51.0	100.1	47.2***

***Significant effect, $p < .001$

sava. These foods are easier to collect during the post-harvest and harvest season, because of optimal ripeness, than during the pre-harvest season.

Pwo-weaned children and their mothers, but not their Sgaw counterparts, showed significant seasonal variations in vitamin A percent of RDIs ($p < .001$). Age-adjusted means for riboflavin and niacin percent RDIs showed seasonal fluctuations among both Sgaw weaned children and their mothers ($p < .001$). The same variations appeared in the age-adjusted means for percent of RDIs of iron for Sgaw mothers ($p < .05$) and iron and calcium for weaned children ($p < .01$). On the other hand, age-adjusted means for thiamin and riboflavin percent RDIs for Pwo mothers showed significant seasonal variations ($p < .001$) and significant differences were found in age and energy-adjusted means of iron, riboflavin, and thiamin RDIs ($p < .01$) for Pwo weaned children.

DISCUSSION

This article examined the food patterns and adequacy of weaned children and their mothers between the less modernized Pwo animist and the more modernized Sgaw Christian highland Karen of northwest Thailand. Although both groups are geographically isolated, reside in the same ecosystem, utilize similar food production methods and were visited by mobile health clinics at roughly equal rates, there were a few similarities but mainly clear differences in the food patterns and adequacy between two groups.

Table 5 Results of one-way analyses of covariance of percent of RDI for Pwo weaned children by season, while controlling for age

	Post-harvest	Pre-harvest	Harvest	
	n=58	n=57	n=55	F
Calories	87.4	83.8	79.4	38.0***
Protein	134.7	130.2	124.4	5.7**
Calcium	12.8	12.7	12.9	0.0
Iron	16.7	18.3	18.2	1.5
Vitamin A	28.7	29.6	42.2	11.1***
Thiamin	47.9	48.5	47.9	0.1
Riboflavin	14.1	13.3	15.0	2.2
Niacin	71.4	70.1	67.8	2.0
Vitamin C	38.3	26.8	40.4	6.3**

**Significant effect, $p < .01$

***Significant effect, $p < .001$

The Karen usually refer to having meals as "*Oh Mè*" (eating rice). Rice is the most important staple core food among both Karen groups. Other foods, such as meats or vegetables, are primarily supplements to the main diet of rice. However, Pwo mothers and children had a much more monotonous diet, ate a midday meal with less frequency, and had less dietary diversity than Sgaw mothers and children. There were marked differences, especially in the consumption of vegetables, fruits, marine foods and eggs, in all seasons between Pwo and Sgaw mothers and children in those foods which are good sources of vitamins A, B and C, protein, iron and calcium. The major components of the difference in dietary adequacy between the Pwo and Sgaw was a consequence of these differences in consumption.

These differences involved the tendency for Pwo animist Karen to be more isolated and less modernized than Sgaw Christian Karen. This tendency is at least partially the result of a historical pattern of earlier and greater western Christian missionary activity among the Sgaw[10-12]. Acceptance of Christianity among the Sgaw Karen has promoted new knowledge, rational ideas and practices, and appears to have led to behavioral changes in relation to food related beliefs and practices leading to increased dietary diversity and adequacy. The study also found that the Pwo animists held many more food related beliefs and practices

Table 6 Results of one-way analyses of covariance of percent of RDI for Sgaw weaned children by season, while controlling for age

	Post-harvest	Pre-harvest	Harvest	
	n=81	n=74	n=76	F
Calories	91.5	89.8	85.7	43.5***
Protein	166.5	154.5	146.9	21.3***
Calcium	32.1	26.2	25.3	5.9**
Iron	34.8	35.1	27.6	7.1**
Vitamin A	57.4	55.7	60.2	0.3
Thiamin	58.0	59.3	57.1	1.2
Riboflavin	27.4	26.3	20.8	11.6***
Niacin	90.4	84.6	79.9	15.4***
Vitamin C	115.2	85.6	109.3	3.6*

*Significant effect, $p < .05$

**Significant effect, $p < .01$

***Significant effect, $p < .001$

than the Sgaw Christians. Some Sgaw mothers who had been raised animist could still recall these beliefs, though they no longer practiced them. The Pwo in this study were also significantly less interested in planting new or different crops. In addition, Pwo mothers in the study also had less interest in or knowledge of nutrition than their Sgaw counterparts, and mainly believed that as long as an individual was full there were no other nutritional concerns. Pwo mothers also gathered wild vegetables less frequently, planted fewer vegetables or fruits, and hunted less frequently than Sgaw mothers. Many Pwo households, but no Sgaw households, reported a strong belief in spiritual forces which cause illness and even death. Apparently as a result of these beliefs, Pwo households hunted less frequently than Sgaw households because most Pwo reported believing that jungle spirits may attack people and cause illness, such as malaria. The Pwo generally only consumed domesticated animals following a ceremonial sacrifice. None of the Pwo consumed chicken eggs because of their belief that eggs make children sick and because of their practice of using eggs as a spiritual messenger for ritual ceremonies.

The percent RDIs for weaned children were all less than 100% of the RDIs, with two exceptions. Protein RDIs in both ethnic groups in all seasons and vitamin C RDIs of Sgaw weaned children during the post-harvest and harvest seasons were met. In addition, Pwo mothers also had less than 100% of the RDIs for all nutrients in all seasons. On the other hand, Sgaw mothers had adequate intakes of

Table 7 Results of one-way analyses of covariance of percent of RDI for Pwo mothers by season, while controlling for age

	Post-harvest	Pre-harvest	Harvest	
	n=66	n=64	n=63	F
Calories	80.3	79.8	80.2	0.1
Protein	90.1	88.3	91.9	1.3
Calcium	14.3	14.5	15.0	0.2
Iron	17.9	18.9	20.5	1.6
Vitamin A	56.5	64.3	78.2	12.7***
Thiamin	60.5	63.6	65.7	7.9***
Riboflavin	15.3	16.4	18.9	12.3***
Niacin	86.8	87.5	90.1	2.0
Vitamin C	43.7	40.3	52.1	4.1*

*Significant effect, $p < .05$

***Significant effect, $p < .001$

protein and niacin in all seasons and adequate intakes of vitamin A and vitamin C in the post-harvest and harvest seasons. FAO/WHO[31] has recommended high quality proteins or high biological value proteins, including eggs, milk and legumes. The quality of protein is usually measured by the essential amino acid content of proteins. However, the Karen's daily diet was mainly rice, with a low or nonexistent intake of eggs, fresh meat and fish, and legumes, especially among the Pwo, and milk and milk products among both ethnic groups. A diet of rice does not contain all of the essential amino acids. Therefore, although their protein quantity appears adequate, the quality of protein consumed may not actually be satisfactory in all groups. Additionally, even though protein RDI's were met, calorie RDIs were inadequate in both ethnic groups in all seasons. Thus, the protein intakes might not be satisfactory, since some protein is used for energy[32]. However, the data needed to test these hypotheses are not available.

Seasonal variations in nutrient intake were found for both weaned children and mothers in both ethnic groups. However, both Pwo and Sgaw weaned children had a greater seasonal fluctuation in dietary adequacy than their mothers. The highest percent of RDIs for children in both ethnic groups occurred in the post-harvest season and declined each succeeding season, with the lowest percent of RDIs during the harvest season. The harvest season, which falls between October and the beginning

Table 8 Results of one-way analyses of covariance of percent of RDI for Sgaw mothers by season, while controlling for age

	Post-harvest	Pre-harvest	Harvest	
	n=69	n=65	n=65	F
Calories	89.8	89.2	89.0	0.3
Protein	116.8	110.2	111.5	2.0
Calcium	40.5	34.4	34.7	1.6
Iron	28.3	27.1	21.5	4.3*
Vitamin A	98.9	89.6	110.8	2.9
Thiamin	71.0	75.0	73.6	2.7
Riboflavin	27.4	27.0	22.1	10.4***
Niacin	108.4	102.6	99.7	8.4***
Vitamin C	129.9	90.5	99.1	4.9**

*Significant effect, $p < .05$

**Significant effect, $p < .01$

***Significant effect, $p < .001$

of December, is the most active period of the agricultural cycle. Many men, women, older boys and girls, and even sometimes the whole family, camp near their fields for the harvest, since fields are usually 1.5 to 3 hours walk away. The rice stalks are cut with reaping knives or small hand sickles, dried for a month, and threshed in the field. Most villagers usually have more free time than usual for a few months after they have finished carrying the rice on their backs to their granaries in the village from the paddy fields after harvest. These findings are interesting because dietary adequacy of Thai lowland tribal groups, who mainly participate in the wage labor economy, was at its best during the harvest season, when food is most plentiful[33]. These results suggested that the mothers' work load might influence their children's dietary intakes. Their intensive farming labor was needed during the rice growing season, especially during the harvest season, and not as much attention could be given to their children. Dietary adequacy in children also could depend to a certain extent on who is left as caretaker when the mother is away. In addition, physical activity in both mothers and children might be taken into account in examining seasonal differences in nutrient intake, but this study did not examine these particular questions.

The percentages of RDIs for weaned children in both groups were greater than those of their mothers for protein but lower for vitamins, on average. These results suggest that children receive more meat or fish, but fewer vegetables and vegetable products, than their mothers. Preschool children usually prefer animal products over vegetable products. Karen mothers usually followed their children's preferences and did not push their children to eat anything they viewed with distaste, such as green vegetables.

Assuming that food consumption patterns and nutritional adequacy are positively influenced by differential levels of modernization among the highland Karen, the Thai government and non-government groups have initiated many programs aimed at improving agricultural productivity, transportation networks, schools, water supplies, health facilities, and the wage labor economy over the last several decades[13, 17]. Thus, Pwo animist Karen should experience increased dietary diversity and improved nutritional adequacy as they become increasingly assimilated into Thai society. Sgaw Christian Karen also should continue to change under the impact of modernization, with greater intake of a larger variety of foods and an increase in cash crops and products, including milk and milk products which are still not consumed by the highland Karen.

However, the effects of increased exposure to modernization are not entirely positive. For example, as a result of population pressure, fallow cycles have been shortened in highland Karen villages, resulting in a decrease in soil fertility and ultimately in substantial reductions in agricultural productivity[34-36]. Hamilton (1976) stated that fallow cycles must be maintained for a minimum of 7 to 8 years to ensure good soil fertility but should be maintained for even longer periods for the greatest productivity. Many Pwo households (63.6%) and 43.8% of Sgaw households had minimum fallow cycles of less than 7 years and 29.9% of Pwo households and 37.5% of Sgaw households had maximum fallow cycles of less than 7 years, an insufficient period of time to restore the soil to a high level of productivity. Only minimum fallow cycles were significantly longer among Sgaw households than among Pwo households ($p < .01$). Furthermore, the increasing encroachment of modernization in the highlands also is resulting in decreasing numbers of wild animals[30] ; both Karen groups hunted infrequently during the study period, and frequency of hunting will most probably decrease further as the number of wild animals decrease.

Therefore, this evidence suggests that there will be greater complexity of dietary diversity and nutritional adequacy for the highland

Karen in a near or far future. This study shows that, up to this point, modernization has had a positive impact on the health and nutritional status of the Sgaw Karen. The positive impact of modernization on health and nutritional status also is dependent, however, on how the positive effects of modernization weigh against the negative effects in this particular situation, with this particular group. The process of modernization, including improved agricultural productivity, increased participation in the wage labor economy, and the institution of other government or non-government programs among highland Karen, is not inherently positive or negative. The situation of the highland Karen, with modernization only just beginning to make inroads into traditional cultures, provides a good basis for future research on the effects of modernization.

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タイ北西部の高地山岳民族カレンの食事摂取パターンと栄養充足度

大森絹子

要旨

タイ北西部の高地山岳民族で，近代化の遅れたポーカレンアニミストと近代化の進んだスゴーカレンクリスチャンの2グループを対象に，完全離乳後の幼児とその母親の食事パターンと栄養充足度の比較研究を行った。1日（24時間）の食事のリコールと食物摂取頻度の聞き取り調査により，ポーカレンの母親とその子どもは，スゴーカレンの母親とその子どもに比べて，全体的に3シーズン（収穫期後，収穫期前，収穫期）とも食物摂取の種類が少なく，食物の多様性にも乏しいことが判明した。特に，果物，野菜，海鮮物，卵の摂取に違いがあった。栄養充足度は，ポーカレンの母親とその子どもはスゴーカレンの母親とその子どもよりも低かった。栄養摂取率には2グループとも季節の変化が見られた。しかしながら，2グループとも幼児の季節の変動は母親に比べて大きかった。