Short Communication

Dietary patterns and food choices of a population sample of adults on Guam

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This study examined dietary patterns of adults on Guam. Four hundred subjects were selected via a multistage procedure to represent the island's population. A 24-hour dietary recall was administered via telephone in 1995 to 1996. Diets were computer analyzed. There were 4,913 food items reported, representing 1,042 individual foods. Most respondents, 51.3%, had a "more-frequent" eating pattern, 36.9% had "regular" and 11.8% had "less-frequent." Energy consumption increased ($p < 0.05$) with eating frequency. Highest levels of all nutrients ($p < 0.05$) were at the evening meal. The sexes did not differ in nutrient proportions by meal. Grains, meats, and beverages were eaten most frequently. Meat/fish, mixed dishes, and grains supplied 68% of the energy and 47% to 91% of the micronutrients. Twenty five percent of the carbohydrate was from sweetened drinks and desserts. Rice was the most frequently consumed food. More than half of the subjects had no fruit, a third had no vegetables, and only 38.5% had dairy foods. Calcium came from multiple sources: dairy (27.6%), mixed dishes (23.8%), fish (12.6%), desserts (8.5%) and vegetables (6.6%). Most people, 91.8%, had fiesta meals with median consumption at 6 meals per year (range: 0 to 200). Betel nut was used by 12.3% of the sample with median consumption 0 whole nuts per day (range: 0 to 25). Ethnic differences ($p < 0.01$) were observed in both fiesta meal and betel nut consumption. The Guamanian diet includes limited use of traditional foods and dietary patterns associated with increased risk for chronic disease.

Key Words: dietary patterns, food, Guam, calcium, Chamorro

INTRODUCTION

Food and meal patterns are markers for nutrient intakes and diet quality.[1] Nutrient intake has a direct impact on the development of a number of the chronic diseases. Meal patterns affect resting energy expenditure, body fat,[2-4] bone density,[4] serum cholesterol, and glucose tolerance.[5] Dietary patterns have undergone tremendous changes from the pre-Spanish days on the Pacific island of Guam which undoubtedly contributes to the current high rates of chronic disease and obesity.[6-9]

At the time of the first European contact with the Pacific Islands, food was in such abundance in island life and described as "subsistence affluence".[10] On Guam, the diet was predominantly vegetarian including taro, breadfruit, yams, rice, coconut, banana, sugar cane, and seafood. The European influences added sweet potatoes, corn, cassava, leguminous pods and seeds and several species of *Curcurbitaceae* (fruits and vegetables such as watermelons and eggplants). By the early 1900s, fish of various kinds, venison, pork, and chicken were common.[7] Neurotoxic foods, including cycad flour, flying foxes, and other feral or wild animals were components of the Chamorro traditional diet as well.[11] World War II brought a shift to imported foods. In the late 1950's local food production accounted for only 15% of the populations requirement and the diet consisted predominately of rice, flour, sugar, and meats, with fruits and vegetables consumed in small amounts.[12] Similar food choices were noted more recently in Guamanian children.[13] Nutrient analysis of the diet of adults[14] and adolescents[15] on Guam documented excessive levels of saturated fat, cholesterol, and sodium but low levels of fiber, vitamin A, vitamin C, vitamin E, folate, calcium, magnesium, and potassium.

Cultural traditions such as fiestas and betel nut use can also affect nutritional status. The fiestas on Guam, celebrated to give recognition to the patron saint of each village, are more common than that in many communities. The fiesta meal generally includes several main courses, many side dishes, and a wide range of desserts.[12] It is not unusual for people to consume large amounts of food during a fiesta. The practice of using betel nut on Guam is ancient but the prevalence data have not been examined systematically.[16] Betel nut (Areca catechu) is the fourth most commonly used drug with well known carcinogenic effects.[17] Recent research suggests an independent and positive association of betel nut use with metabolic

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syndrome in adults, specifically a dose response increase in abdominal obesity, hypertriacylglycerolemia, and high blood pressure.[18]

The purpose of this study was to examine the dietary patterns and food choices of adults on Guam. This information will broaden our understanding of a Pacific Islander group which is greatly underrepresented in health research.[8] A very limited amount of nutrition research about the population on Guam is available in scientific literature. This investigation can help focus public health efforts on the island and provide reference for dietary changes over time.

METHODS

Local researchers interviewed a representative sample of the population of Guam with regard to diet and health, via telephone, from 1995 to 1996.[14] The survey consisted of a multiple-pass 24-hour dietary recall, as well as demographic, and health questions. Experts from the Guam Cooperative Extension Service assessed the survey for content validity and cultural sensitivity. Interviews were conducted in English, Chamorro, Tagalog, or Palauan according to the preference of the participants. Human subjects committees at two universities approved this study. Participants gave informed consent orally.

Subjects

The subjects, 211 men and 189 women, were chosen by a multistage procedure to reflect the population distribution of the island residents based on ethnicity and gender. First, households were selected from the Guam Telephone Book using systematic sampling, and secondly, subjects were randomly selected from within the household[19] until 400 subjects were enrolled. The sample ethnic distribution was Chamorro (37.2%), Palauan (2.5%), Pohnpeian (0.5%), Other Pacific Islander (2.2%), Chinese (1.2%), Filipino (23.0%), Japanese (1.8%), Korean (2.8%), Other Asian (1.2%), White (13.8%), African American (1.8%), Other Single Ethnic (2.0%), Chamorro and Other (5.0%), and Asian and Other (5.0%). The smaller groups were combined for analysis. The average (± SD) age for the sample was 38.5 ± 14.9 years ranging from 18 to 83 years. The average length of residence on Guam was 21.1 ± 17.4 years ranging from one month to 83 years.

Data Collection

The question about fiesta meal participation was worded, "How many fiesta and fiesta type meals have you gone to in the last month/year?" The question about betel nut was phrased as, "Did you chew betel nut yesterday?" Body Mass Index (BMI) was calculated by using weight in kilograms divided by height in meters squared.

The diet recalls were analyzed for nutrient content using the Food Intake Analysis System version 3.0 (The University of Texas-Houston and the United States (U.S.) Department of Agriculture, 1996, Houston, Texas). Foods were grouped into aggregates according to type and nutrient content.[20] The nutrient contribution made by the food aggregates was obtained by taking the target nutrient contributed by a *specific food grouping* for all individuals divided by the target nutrient contributed by *all foods* in the sample.

If the subjects did not identify a meal by name (e.g. breakfast), meal designations were based on the time of day. Foods consumed between breakfast and lunch were designated as mid-morning snacks, between lunch and dinner were late afternoon snacks, and after dinner were bed-time snacks. Snacks were generally smaller than meals. Subjects were then categorized as "less- frequent", "regular" or "more-frequent" meal consumers. The "less-frequent" pattern was two meals with no snacks, one meal with three or fewer snacks, or three or fewer snacks with no meals. The "regular" meal pattern was three meals, or two meals with one or two snacks. The "more-frequent" pattern was two meals with three snacks, or three meals with one or more snacks. Two subjects were not included in this analysis because of missing data about meal timing.

Statistical analysis

Statistical analysis was performed using the Statistical Analysis System (SAS) (SAS Institute, version 6.09, 1993, Cary, NC). Descriptive statistics were used for demographic characteristics and nutrient summaries. Frequency tables were used to determine the number and percentages of subjects who consumed each of the food groupings. Analysis of variance followed by Tukey's multiple comparison procedure was used to determine differences between the meal patterns, nutrients, gender, ethnicity, and BMI. The level of significance used for these tests was $p < 0.05$. The Kruskal-Wallis test followed by the Dunn procedure with a Bonferroni adjustment was used to determine significance among ethnic groups for betel nut and fiesta meal consumption.

RESULTS

Meal Patterns

Most of the subjects, 51.3%, had a "more-frequent" eating pattern, 36.9% had a "regular" pattern, and 11.8% had a "less-frequent" pattern. The average intake of meals and snacks was 3.6 daily with 8.6 foods per person at each meal and 1.8 at each snack. Energy consumption increased ($p < 0.001$) from 1,416 to 1,986 to 2,274 calories per day with eating frequency. Approximately 5% of meals had fewer than 40 calories for each meal pattern. Mean BMI declined in a pattern that approached significance ($p = 0.06$) from 26.9 to 26.2 to 25.1 for "less-frequent", "regular", and "more-frequent" eating patterns, respectively. BMI values for all eating patterns were in the "overweight" category.[21]

Nutrient composition differed significantly ($p < 0.001$) for all nutrients by meal when comparing breakfast, lunch, dinner, and total snacks (data not shown). The dinner meal had the highest intake of nutrients and breakfast had the lowest. For snacks, morning was most common (52.8% of snacks) followed by afternoon (30.3%) and evening (21%). There were no statistical differences between men and women when nutrients were considered as a proportion of total intake by meal and snack.

Food Choices

There were 4,913 food items reported by all subjects which represented 1,042 individual food (e.g., fresh green beans and canned green beans were two food items that were categorized as the individual food "green beans")

Table 1. Food choices of Guamanian adults

Food	Times reported	% of total food items	Subjects reporting foods n†	% ‡	Food items per person§ (mean)	% of total food weight	Main foods in group (number of times reported)
Grains	829	16.9	360	90.0	2.3	14.7	Rice (488), bread (178), cereal (85), noodles (30), pancakes/biscuits (25), crackers (25)
Meat/fish	778	15.8	339	84.8	2.3	11.6	Chicken (159), beef (148), fish (141), eggs (75), sausage/bacon/hot dogs (65), pork, ham (60), canned meat (42), legumes (40), shrimp (30), lamb (1)
Drinks	720	14.7	336	84.0	2.1	32.2	Soft drink (240), coffee (223), tea (183), fruit flavored drink (74)
Condiments	626	12.7	261	65.3	2.4	1.2	Sugar, syrup (208), creamer (106), butter (100), salad dressing (71), soy sauce (58), mustard (22), pickles/olives (19), catsup (18), vinegar (8), gravy (6).
Vegetable	604	12.3	251	62.8	2.4	5.7	Lettuce (75), potato (69), cabbage (67), onion (54), tomatoes (48), carrot (46), mixed vegetables (37), cucumber (35), broccoli (34), bean (30), corn (23), peas (14), celery (11), peppers (11), taro (10), mushroom (6), seaweed (5), squash (5), cauliflower (5), daikon (4), breadfruit (2), cassava (2), tamarind (2), other (4).
Mixed Dishes	507	10.3	310	77.5	1.6	15.2	Fried rice (87), beef w/vegetable (84), hamburger (82), noodle soup (71), sandwiches (65), canned soup (60), chicken dishes (i.e., adobo) (44), pizza (24).
Fruit	345	7.0	178	44.5	1.9	8.0	Fruit juice (102), banana (50), citrus fruit (50), apple (40), melon (29), mango (21), grapes (20), pear (17), fruit canned in syrup (7), other (9).
Desserts, snacks	253	5.1	169	42.3	1.5	2.9	Cookies (45), salty snacks (43), sweet roll (41), ice cream (32), cake (24), chocolate candy (24) other candy (17), buchi-buchi (sticky rice filled with mongo beans) (14) pie (13).
Dairy	220	4.5	154	38.5	1.4	4.7	Low-fat milk, (84), whole milk (52), cheese (31), chocolate milk (22), skim milk, (12), evaporated milk (10), yogurt (9).
Alcohol	31	0.6	22	5.5	1.4	3.7	Beer (26), wine (4), liqueur (1).
Total¶	4913	99.99					

† the number of individuals eating foods from each group.; ‡ the number of individuals eating foods from each group ÷ total sample.; § the number of times a food was reported divided by the number of people reporting this item.; ¶ Total does not equal 100 due to rounding.

which were consolidated into nine major food groups (Table 1). The foods eaten most frequently were from the grain, meat, and beverage groups while dairy foods were consumed the least. Rice was the single most frequently consumed food item. Canned and processed meats were 21% of the meat group. When fish was combined with fish-based mixed dishes, approximately 3.5% of the total foods were fish, 47% of that fish was fresh, and the rest was canned or dried. Beverages, excluding milk, were reported by 84% of the sample and nearly all of these drinks were sweetened.

Vegetables were eaten twice as often as fruits. Iceberg lettuce, fried potatoes, and cabbage were the most frequently consumed vegetables. Approximately 30% of the fruits were in the form of juice. Western foods such as hamburgers, sandwiches, canned soups, and pizza made up a third of the mixed dishes. Sweet snacks were more prevalent than salty snacks such as chips. Thirty eight percent of the sample consumed dairy products.

Meat/fish, mixed dishes, and grains accounted for 68% of the energy, and from 47 - 91% of the micronutrient content of the diet (Table 2). Seventy-nine percent of the protein, 68% of the fat, and 88% of the cholesterol were from meat and mixed dishes, although a sizable portion of the fat was from condiments (7.5%) and desserts (10%) as well. A fourth of the carbohydrate was from drinks and desserts/snacks. Sixty-five percent of the Vitamin A was found in vegetables, mixed dishes, and meat/fish. Calcium came from multiple sources: 27.6% from dairy foods, 23.8% from cheeseburgers, pizzas and other mixed dishes, 12.6% from fish, 8.5% from desserts (mainly ice cream), and 6.6% from vegetables. Seventy-eight percent of the sample had mixed dishes (1.6 times per day) which provided 19% to 35% of the fiber, vitamins, and minerals in the diet with slightly lower amounts of vitamin C.

Fiesta Meals, Betel Nut, and BMI

Most of the participants, 91.8%, reported consuming at least one fiesta meal a year (Table 3). Although nearly everyone participated, there was considerable variability in this practice. Fiesta meal participation by age and sex indicated that those from 75 to 84 years old participated in fiesta meals more ($p < 0.05$) than any other age group but no differences were found between men and women. The Kruskal-Wallis test showed significant differences among groups, with Chamorros different from Other Asians ($p < 0.01$) and Whites ($p < 0.01$), for fiesta meals per year.

Only 49 subjects, 12.3% of the sample, reported using betel nut (Table 3). For these individuals, the average number of betel nuts consumed was 3.4 ± 7.6 and ranged from 0.1 to 50 whole nuts daily. The Kruskal-Wallis test

Table 2. Food sources of nutrients among Guamanians as a percent contribution to total diet.

Nutrient	Grains	Meat/ fish	Drinks	Condi-ments	Vege-tables	Mixed Dishes	Fruits	Desserts/ snacks	Dairy	Alcohol	Total[†]
Energy	19.4	26.8	6.6	4	4.2	21.4	4.4	8.5	3.3	1.4	100
Carbohydrate	34.2	2.8	15	3	5.4	15.8	9.6	10.3	2.8	1.1	100
Protein	9.8	52.4	0.3	0.3	2.3	26.2	1	3.1	4.3	0.2	99.9
Fat, total	5.9	42.1	0.1	7.5	4.6	25.9	0.7	9.8	3.4	0	100
Fat, saturated		42.4	0.2	5.5	3.6	24.7	0.5	10.6	7.3	0	99.9
Fat, mono-unsaturated	5.7	47	0	5.1	4.7	25	0.6	9.9	2.1	0	100.1
Fat, poly-unsaturated	7.6	30.1	0.1	15.7	6.4	29.3	0.7	9.5	0.6	0	100
Cholesterol	2.6	61.6	0	0.6	1.3	26.2	0	5.3	2.3	0	99.9
Fiber	30.7	5.8	0.5	0.7	18	22.6	11.6	7.1	0.8	2.2	100
Vitamin A	9	16	4.8	1.9	23.8	25.6	7.4	5.2	6.4	0	100.1
Thiamin	25	29.7	0.8	0.2	6.1	23.1	5.6	4.8	4.5	0.3	100.1
Riboflavin	17.4	30.8	2.8	0.5	4.3	22.7	3.3	6.6	10.4	1.2	100
Niacin	16.3	42.8	1.8	0.4	3.8	26.6	2	2.9	2.1	1.2	99.9
Vitamin B_6	14.9	37.7	0.5	0.7	7.9	20.3	9.8	2.3	4.1	1.8	100
Folate	20.7	12.8	7.9	0.5	15.2	19.1	13.3	3.8	4.7	1.8	99.8
Vitamin B_{12}	4.5	63.9	0	0.2	0.2	22.8	0	1.6	6.6	0.2	100
Vitamin C	1.7	7.4	18.3	1	19.5	13.5	36.1	0.6	1.8	0	99.9
Vitamin E	11.2	25.8	0.1	8	8.1	25.2	5.6	10.7	5.3	0	100
Calcium	11	12.6	4.4	0.7	6.6	23.8	4	8.5	27.6	0.7	99.9
Phosphorous	11.8	37.9	2.6	0.8	4.5	24.1	1.8	5.8	9.8	0.8	99.9
Magnesium	16.4	24.9	6.4	0.7	9	20.2	7.1	6.1	7.5	1.7	100
Iron	26.5	26.7	2.4	0.8	5.7	26	2.9	5.2	3.5	0.2	99.9
Zinc	14.8	44.9	1.8	0.7	2.8	24.9	1.1	3.3	5.7	0.1	100.1
Copper	18.6	23.2	6.1	1.2	9.2	22.3	8	6.2	4.5	0.7	100
Sodium	14	29.5	1	5.4	7.5	35.6	0.1	4.3	2.5	0.1	100
Potassium	6.1	27.8	6.4	1.1	12.8	20.9	12.8	4.3	6.9	0.8	99.9

[†] Totals not always equal to 100 due to rounding.

Table 3. Betel nut use, fiesta meal participation, and body mass index (BMI) of Guamanian adults.

Ethnicity	Participants		Betel nut use		Nuts per day	Fiesta meals yearly	BMI Wt (kg)/ht $(m)^2$
	number	%	number	%	median (range)	median (range)	mean ± SD
Chamorro	149	37.3	9*	18.1	0 (0 – 25)*	6 (0 – 200)**	27.0 ± 5.8 [a]
Chamorro/Asian[†]	40	10.0	9	17.5	0 (0 – 0.5)	7 (0 – 50)	26.6 ± 4.0 [ab]
Filipino	92	23.0	2	3.3	0 (0 – 10)	6 (0 – 120)	24.0 ± 4.4 [bc]
Other Asians[‡]	28	7.0	0	0	0 (0 – 0)	4 (0 – 52)**	22.5 ± 3.0 [c]
Other Pacific Islander[§]	21	5.3	26	52.4	0.1 (0 – 10)*	3 (0 – 40)	26.0 ± 5.3 [abc]
Other Single Ethnic Group[¶]	15	3.8	3	6.7	0 (0 – 0.5)	3 (0 – 50)	25.5 ± 2.8 [abc]
White	55	13.8	0	0	0 (0 – 0)*	5 (0 – 24)**	26.0 ± 8.8 [abc]
Total	400		49	12.3	0 (0 – 25)	6 (0 – 200)	25.7 ± 5.8

[*] The Kruskal-Wallis test showed significant differences among groups at $p < 0.001$ with Chamorros different from Other Pacific Islanders and Whites for betel nuts used per day.; [**] Kruskal-Wallis test showed significant differences among groups at $p<0.01$ with Chamorros different from Other Asians and Whites for fiesta meals per year.; [a,b,c] Means with the different superscript in a column are significantly different at $p < 0.05$.; [†] Chamorro/Asian are primarily mixed Chamorro and Filipino.; [‡] Other Asians includes Chinese, Japanese, Korean, Indian, and Vietnamese.; [§] Other Pacific Islander includes Palauan, Pohnpeian, and Chuukese.; [¶] Other Single Ethnic Group includes Black and Hispanic.

showed significant differences among groups, with Chamorros different from Filipinos ($p < 0.001$), Other Pacific Islanders ($p < 0.001$), and Whites ($p < 0.001$), for betel nuts per day.

Mean BMI (± SD) for the full sample was 25.7 ± 5.8 kg/m^2 (Table 3). Median BMI was 24.9 and ranged from 16 to 83.4. There were significant differences in BMI by ethnicity ($p < 0.5$).

DISCUSSION

The food patterns observed in the Guamanian sample are similar to those found in the United States[1], where frequent meals and snacks are the norm. More frequent eating resulted in significantly higher energy intakes, yet also a trend towards lower Body Mass Index (BMI) levels. Several research studies show favorable metabolic results with more frequent meals including decreased overweight,[3] fat mass,[3,4] total cholesterol, low density lipoproteins,[5] late evening leptin concentration,[4] blood glucose, and serum insulin.[22] Thus, as the frequency of meals increases the tendency for overweight and health problems can decline.

In practice, increasing the number of eating occasions without increasing energy intake and risk for obesity may

be difficult in light of large portion sizes and the easy availability of foods with high energy density.[23] In particular, snacks can alter the diet because of their high-energy density, low-nutrient content and lack of satiety.[24] The fact that the average BMI for all meal patterns and most of the cultural groups on Guam exceeds the level for healthful weight, indicates a need for dietary modifications. The frequent participation in fiestas on Guam presents a further challenge as fiesta meals are an important part of the culture and there are many sociological benefits to this tradition.[25]

The predominant foods in the Guamanian diet are refined grains, meats, and sweets. Rice remains a dietary staple.[6,7,10] Frequent consumption of sweets with low fruit and vegetable intake was observed in children[13] and adolescents[26]. These food choices result in poor dietary quality,[14] and are unfortunate in a population prone to obesity and chronic disease. Limitations to food selection on Guam are: the scarce amount of land available for agriculture, frequent typhoons, recurrent power outages, and the expense related to imported foods. In contrast to earlier years, fish is now a relatively small part of the diet despite many health benefits, such as reduced atherogenesis[27] and lower plasma leptin.[28] Unfortunately, the fishing industry in the Pacific has become strongly export-oriented despite the fact that fish is a food resource.[29]

Dairy foods are not a traditional part of the island diet.[6,7,10] Dairy consumption in adults on Guam is lower than that reported for Guamanian children.[13] The difference could result form the additional milk provided for the children through the school lunch program and the later onset of lactose intolerance. Avoidance of dairy foods, whether for true or perceived allergies or intolerances, often carries negative consequences.[30] We note in this study that calcium came from multiple sources, which along with other traditional foods can be used to improve the calcium content of the diet. Over ninety percent of Guamanians do not meet calcium recommendations.[14]

No participant reported consumption of flying foxes or cycad flour. Flying fox consumption is a highly valued traditional aspect of the Chamorro culture but there has been a rapid decline in the population in the 20th century due to deforestation, brown tree snakes, and hunting. These animals are imported and are still consumed, but more as a specialty food. Consumption of the flying fox is thought to inadvertently contribute to the consumption of a neurotoxin present in cycad.[11]

There are ethnic differences in betel nut use on Guam, as previously observed in women.[31] Those on Guam who use betel nut consume amounts similar to the approximately 3-4 nuts per day in India, but much lower than the average Taiwanese use of 44 per day.[16] The dietary impact of betel nut is modest as each nut has approximately seven calories and one-tenth of a gram of protein.[32] The metabolic effects of betel nut are more complex. Betel-quid use appears to modulate metabolic signals regulating human appetite for food in both the fed and fasted states,[33] and is associated with obesity and the metabolic syndrome.[18] Those who chew betel nut should become aware of the metabolic ramifications of the practice.

Limitations of this study are that only one day of dietary intake was collected which may not represent usual intake,[34] subjects may have misreported food intake,[35] meal pattern definitions were not standardized,[1,2] and under-estimation of overweight based on self-reported height and weight is possible.[36] Also, we were not able to validate self-reports of betel nut consumption, but there is no stigma to using betel nut on the island. Strengths include selecting a sample that is representative of the population, using culturally sensitive interviewing techniques, and being the first to assess systematically the food intake, meal patterns, and betel nut use of adults on Guam.

Results of this study confirm suggestions that the diet on Guam is more westernized in both food choices and meal patterns. Choosing mixed dishes modified to increase vegetable and decrease fat content, eating fruit rather than sweets for desserts and snacks, choosing whole grains, including foods with calcium in meals, and limiting the intake of fats and sweetened beverages can be healthful nutrition goals for most island residents. A regular eating pattern with energy balance is also recommended. Issues related to costs, availability, marketing, and the environment also play a role in food choices, so efforts to improve diet on Guam should be pursued at many levels.[37]

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AUTHOR DISCLOSURES

Rebecca S Pobocik, Alison Trager and Lora Morrell Monson, no conflicts of interest.

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Short Communication

Dietary patterns and food choices of a population sample of adults on Guam

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關島成年族群樣本的膳食型態及食物選擇

本研究調查關島成年族群的膳食型態。以多段抽樣方式，選取 400 名研究對象代表島上族群。在 1995-1996 年間，透過電話實施 24 小時飲食回憶。膳食資料經由電腦分析。共有 4913 項次食品被報告，代表 1042 種食品物。大部份應答者，51.3%為“頻繁”的膳食模式、36.9%為“經常”及 11.8%為“偶爾”。熱量消耗隨著進食頻率而增加(p<0.05)。所有營養素在晚餐有最高的攝取量(p<0.05)。每餐的營養素百分比，在性別上並沒有差異。穀類、肉類及飲料攝取頻率最高。肉/魚、混合菜和穀類提供 68%的熱量和 47%-91%的微量營養素。25%的醣類來自含糖飲料及甜點。米飯是攝取頻率最高的食物。超過一半的個案沒有吃水果，三分之一沒有吃蔬菜以及只有 38.5%有攝取乳製品。鈣質來自多種來源：乳類(27.6%)、混合菜餚(23.8%)、魚(12.6%)、甜點(8.5%)及蔬菜(6.6%)。大部分的人，91.8%有節慶飲食，中位數為每年 6 餐 (範圍 0-200)。12.3%嚼食檳榔，中位數為每天攝取 0 顆(範圍 0-25)。節慶飲食與檳榔使用在種族之間具有差異(p<0.01)。關島飲食包括使用有限的傳統食物及膳食型態與上升的慢性疾病危險性有關。

關鍵字：膳食模式、食品、關島、鈣質、查摩洛人。