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Areca (Betel) Nut Chewing Practices in Micronesian Populations

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Abstract

Objective—To describe the areca nut/betel quid chewing practices of Micronesian chewers living in Guam.

Design—Two studies were conducted using qualitative data from focus groups and quantitative cross-sectional data from the 2007 Guam Behavioral Risk Factor Surveillance System (BRFSS). Ten focus groups included 49 men and women aged 18–60 years living in Guam in 2007. Participants were areca nut/betel quid chewers selected to reflect Guam's age and ethnic group (Chamorro, Chuukese, Palauan, and Yapese) distributions. Salient themes were extracted from transcripts of the sessions by three expert reviewers. A second method, latent class analysis, was used to identify unique groups of chewers. The groups were then compared on demographics and chewing-related behaviors.

Results—Areca nut and betel quid recipes collected from the focus groups showed that Chamorros had a preference for the ripe nut and swallowed the nut, whereas, the Chuukese, Palauan, and Yapese groups preferred the unripe nut and did not swallow it. Similarly, latent class analysis resulted in the identification of two groups of areca nut/betel quid chewers. Group 1 was all Chamorros. Compared to Group 2, the chewers in Group 1 preferred red and ripe nuts, did not add slake lime (calcium hydroxide) or tobacco, and swallowed the masticated areca nut (with or without Piper betle leaf).

Conclusion—The quantitative analysis confirmed the qualitative exploration of areca nut/betel quid chewers in Guam, thus providing evidence that chewing practices vary among Micronesian populations.

Implication—If future research should include an intervention, the differences in chewing practices among Micronesian populations should be taken into consideration to ensure programmatic success.

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Introduction

Approximately 600 million people worldwide¹ chew areca nut from the *Areca catechu* palm tree. The proper terms are “areca fruit” in reference to the fibrous drupe containing the seed, “areca nut” in reference to the seed only, and “betel quid” in reference to the areca fruit or areca nut combined with the *Piper betle* leaf and other additives. The two major chemical components of areca nut are polyphenols, which contribute to the nut's astringency and bitterness, and alkaloids, which are biologically the most important chemicals present in the nut.² Arecoline, the main alkaloid produces both cholinergic effects (enhanced effects of the parasympathetic nervous system) and anthelmintic effects (expulsion of parasitic worms) in the body.³ The nut is also chewed for cultural reasons among populations in regions where the practice is endemic, such as the Indian Subcontinent, East and Southeast Asia, and the Pacific Islands.

Betel quid chewing is common in places such as India, Taiwan, and Melanesia. Epidemiologic studies on betel quid chewing have been conducted extensively in these places, and have shown consumption of betel quid to be associated with an increased risk for various chronic diseases⁴⁻⁷ and overall mortality.⁸ In particular, areca nut and betel quid have been classified as Group 1 human carcinogens by the World Health Organization.² However, evidence suggests that slake lime and betel leaf (two components of betel quid) are not carcinogenic.²

Areca nut and betel quid chewing is common in Micronesia, a group of islands where documentation on chewing practices is limited. The common term used in this region is “betel nut”, regardless of its reference to the areca nut or betel quid. Micronesia is located in the Western Pacific and is comprised of the following islands: five island nations (including the Federated States of Micronesia, Kiribati, Nauru, Republic of Palau, and Republic of the Marshall Islands), two territories of the United States (Guam and Wake Island), and the Commonwealth of the Northern Mariana Islands. The Federated States of Micronesia is home to the natives of Chuuk, Kosrae, Pohnpei, and Yap. Guam is home to the native Chamorros, and the Commonwealth of the Northern Mariana Islands is home to native Chamorros and Carolinians. It has been noted elsewhere that Chamorros and Non-Chamorro Micronesians have different preferences for areca nut varieties and maturities.⁹

Guam, the island in Micronesia with the largest population, is diversely inhabited with different Micronesian ethnic subgroups. As of 2000, the Micronesian ethnic subgroups living in Guam (and their populations) were: Chamorros [57,297, 84.2%], Chuukese [6,229, 9.2%], Palauans [2,141, 3.1%], Pohnpeiians [1,366, 2.0%], Yapese [686, 1.0%], and Kosraean [292, 0.4%].¹⁰ A recent survey has shown a large increase in the Non-Chamorro Micronesian population in Guam, from 9,831 migrants in 2003¹¹ to 18,305 migrants in 2008.¹² The prevalence of areca nut/betel quid chewing may increase as the numbers of migrants from other Micronesian islands continue to increase, and so will the need to understand the chewing practices in order to monitor trends. Therefore, the objectives of this study were to 1) describe the areca nut/betel quid chewing practices of selected Micronesian populations living in Guam and 2) test the differences in chewing preferences.

Methods

This report is derived from a qualitative exploration of areca nut/betel quid chewing practices combined with quantitative analysis of patterns of areca nut/betel quid chewing in Micronesian populations in Guam. Ethical approval for this study was obtained from the Human Subjects Committee of the University of Guam and the University of Hawaii. The methods for this study are described in detail elsewhere.¹³

Focus group study

Participants—Adult areca nut/betel quid chewers, 18 years and older, participated in ten focus groups designed to examine the chewing practices among selected Micronesian populations living in Guam. Participants were recruited from the community using the judgment (or purposive) sampling technique, which is similar to quota sampling but without a sampling frame.¹⁴ Since the purpose of the focus groups was known prior to sampling, the use of judgment sampling was appropriate.

Prior to recruitment, a meeting was held with outreach employees and researchers from the University of Guam and the Cancer Research Center of Hawaii to discuss appropriate target groups. The consensus was that the Chamorros, Palauans, and Yapese were the predominant areca nut/betel quid chewers; Chuukese were also included because they were the most populous Non-Chamorro Micronesian group on Guam.

Selected participants included those who responded to announcements that were advertised in local newspapers, radio talk shows, and flyers posted in the community. Interested participants were recruited if they: 1) chewed areca nut or betel quid within the past year (Summer 2006 to Summer 2007); 2) identified as Chamorro, Chuukese, Palauan, or Yapese; and 3) were at least 18 years old during the study period. Forty-nine areca nut/betel quid chewers participated. They included eighteen (36.7%) Chamorros, eleven (22.5%) Chuukese, nine (18.3%) Palauans, and eleven (22.5%) Yapese. These groups were targeted based on chewing practices and adequate population size on Guam.

Focus group methods—The focus group script was pilot-tested with a group of university students to train the facilitator. Pilot data were used to improve the focus group methodology. For example, the last of ten questions in the practice focus group script asked about “other family members who chew betel nut.” The answer to the question was consistently discussed with the second question on “first experience chewing betel nut,” since most of the students described learning from family members. These two questions were consequently placed together in the final focus group script.

Ten focus groups were conducted throughout June and July of 2007 at the Cancer Research Center of Guam using the methodology described by Krueger.¹⁵ Separate focus groups were conducted for males and females, and for each of the four ethnic groups. A male facilitator led the male focus groups and a female facilitator led the female focus groups to alleviate any gender-related cultural issues that may exist among the ethnic groups. The Chamorro and Palauan focus groups were conducted in English. The Chuukese and Yapese focus groups were facilitated by a bilingual male or female, and conducted in the appropriate

language of the participants. Group discussions, which ranged from forty-five minutes to more than two hours, were tape recorded with hand-written notes by an assistant. Subsequently, a translator transcribed the tapes from the Chuukese and Yapese groups into English.

The focus group questions examined cultural beliefs about areca nut/betel quid chewing, past and current chewing practices and recipes, chewing etiquette, and reasons for chewing and continuing to chew. Some of the questions that were used as probes are listed on Table 1. Written areca nut/betel quid recipes were voluntarily submitted by focus group members following open-ended discussions.

Behavioral Risk Factor Surveillance System Study

Participants—Areca nut and betel quid chewers who participated in the 2007 Guam Behavioral Risk Factor Surveillance System (BRFSS) survey were included in the quantitative analysis. The BRFSS is a national health survey administered annually by the Centers for Disease Control and Prevention (CDC)¹⁶. Participants were selected by a complex sampling method, which is described in detail elsewhere.¹⁶ There were 657 Guam residents who participated in the 2007 Guam BRFSS, which represented approximately 1% of its adult population. Of 362 (55.1%) participants who answered the areca nut-related questions, 132 (37 ± 3 %) reported ever chewing areca nut/betel quid in their life. Detailed information on chewing practices was available only for current chewers; 43 (12 ± 2 %) were current chewers. Former chewers were excluded from the analysis.

Survey—The 2007 Guam BRFSS was comprised of three components: a core component, an optional module, and state-added questions. Demographic data, alcohol consumption, and smoking status were gathered from the core component. Areca nut and betel quid use was gathered from the state-added questions (Table 1). An ethnicity questionnaire was included as a state-added option, and allowed for the categorization of areca nut/betel quid chewers into Micronesian subgroups. The optional component provided information on diabetes, and does not pertain to this study.

Analysis

Focus groups—Focus group sessions were transcribed immediately after each session. Detailed notes taken by an assistant were used to fill in sections that were difficult to understand. The sessions were transcribed and analyzed using elements of the grounded theory, developed by Glaser and Strauss¹⁷, to identify themes. A modified version of the technique outlined by Bernard¹⁴ was used. The number of focus groups was small enough for the transcriptions to be reviewed by expert reviewers. Three qualitative research professionals with training and experience in anthropology, public health, and nutritional epidemiology were invited to review the focus group transcripts. Each reviewer was given a packet containing the transcriptions and instructions for a systematic approach.¹⁵ The instructions asked the reviewers to read the transcripts and recipes (one focus group at a time); look for emerging themes (by question, and then overall); develop, code, and sort the themes; diagram the analysis; and consider revisions. All three reviewers were Non-Micronesian and non-chewers; however, all have worked with Micronesians. Only themes

reported by two of the three expert reviewers were summarized, categorized into appropriate overlapping themes, and presented in a conceptual model.

Latent class analysis—Latent class analysis was used to analyze data from the 2007 Guam BRFSS. Latent class analysis is a statistical modeling method used to evaluate the relationship in categorical data where latent (unobserved) variables are identified from observed variables.¹⁸ This model uses independent variables (continuous and categorical) to assign membership to a set number k of groups by maximum likelihood, while adjusting for covariates.¹⁹ The Mplus® software (Version 3, Los Angeles, California) was used to perform these analyses. The variables used to identify patterns of areca nut/betel quid chewing among the 43 chewers were (coded yes or no): addition of lime, addition of tobacco, addition of betel leaf, cigarette smoking, and alcohol consumption. These variables were chosen to describe the combinations of ingredients used when chewing a betel quid. The analysis was sex-adjusted. The classes (k) were identified based on conditional probabilities of the selected variables. Results of each subject that was placed into a specific class were exported into a Microsoft Excel spreadsheet, and merged with the original 2007 Guam BRFSS data set. Weighted estimates (for the overall mean and stratified by class) were calculated.

Results

Areca nut and betel quid preferences

Recipes that were collected from the focus groups revealed differences in chewing patterns among ethnic groups (Table 2). The Chamorros preferred to chew the ripe (or hard), red areca nut variety (with betel leaf on occasion), and usually ingested the areca nut. They also distinguished between areca nut varieties of *ugam* (red) and *changnga* (white). The ripe areca nut used by the Chamorros was larger than the areca nut used by the Non-Chamorro Micronesians, and the husk was always removed. One nut could be divided into fourths or eighths, and eaten spaced apart throughout the day.

The Chuukese, Palauan, and Yapese chewers preferred to chew the unripe (or soft) areca nut, which they referred to as “green betel nut” or “Yapese betel nut.” The Chuukese and Palauan preferred the *changnga* variety of areca nuts; the Yapese did not demonstrate a preference for either variety. The entire areca fruit (husk plus the young nut) was chewed as a whole or split into halves. Betel leaf, lime, and tobacco from cigarettes were often added. The tobacco from cigarettes was added as a piece of the cigarette (with the wrapper intact) that was torn to approximate the length of the nut.

The focus groups resulted in seventeen areca nut/betel quid chewing overarching themes that were identified in the analysis by expert reviewers (Figure 1). Some of the positive themes frequently cited were that chewing areca nut/betel quid had energizing, relaxing, and soothing effects:

“It re-energizes me, makes me feel stronger, and keeps me awake at work.”

“I get relief, relaxation, or overcome tension and stress, especially at work.”

“I chew betel nut for stomachache and headache.”

All four ethnic subgroups commented on how chewing brings people together. The Chamorros, Palauans, and Yapese discussed chewing in the context of respect for tradition and social promotion:

“The wisdom is in the betel nut bag... carrying the bag means you are able to make decisions for your whole family.”

“It's part of my ability to keep my culture alive...it helps me speak my language even better.”

“Chewing betel nut initiates that binding we all long for, especially from a small culture.”

The Chuukese men had mixed feelings about the culture of chewing. They described social promotion within the context of family and friends:

“When relatives or close friends call me for a meeting that I don't feel like going to, they mention betel nut. It influences my decision.”

“It helps maintain my friendship and close association with my buddies and co-workers.”

They also noted that the practice was introduced to the Chuukese culture. The habit was considered by some to be culturally unacceptable, but that it served as a mechanism for social adaptation:

“It signifies disobedience to standards.”

“I chew to fit in with everyone.”

The Chuukese women used social promotion, primarily in the context of peer interaction:

“The hardest part to ignore is when I see my friends chewing that I just want to be like them and enjoy chewing together.”

There were positive and negative references to the effect of chewing on teeth. The Chamorros and Yapese discussed how chewing prevents cavities:

“The lime is like a dental filling, so I don't go to the dentist because I don't have cavities.”

The Chamorros who consumed the ripe areca nut noted that biting the nut weakens the teeth over time.

The association of areca nut/betel quid chewing and poor oral health was raised in all the focus groups. All groups admitted to hearing about associations of chewing with oral conditions such as oral cancer, teeth stains, and sensitive gums. However, not all groups, primarily the Chamorro men, agreed with the link to oral cancer:

“If you're going to say that chewing is bad or cancerous...how...if it's just the nut itself?”

“You never hear of our elderly having cancer problems because of chewing betel nut.”

Patterns of areca nut and betel quid chewing

The average age of the areca nut/betel quid chewers included in the BRFSS latent class analysis was 43 years. Two distinct patterns of areca nut/betel quid chewing were identified and their users were grouped into classes for analysis. The first class consisted of 31 chewers and the second class consisted of 12 chewers. Demographic and behavioral characteristics were compared between the two classes (Table 3). More of the chewers in Class 1 had post-secondary education ($41 \pm 11\%$) compared to Class 2 ($11 \pm 10\%$), though this difference was only marginally significant ($p < 0.10$). All the chewers in Class 1 were Chamorros. Most of the chewers in Class 1, compared to Class 2, preferred the ripe areca nut ($93 \pm 7\%$ versus $22 \pm 12\%$) of the red variety ($99 \pm 1\%$ versus $50 \pm 16\%$). Less than half ($35 \pm 10\%$) of the chewers in Class 1 chewed the areca nut with the betel leaf, and the majority of them ($86 \pm 7\%$) ingested the areca nut/betel quid. No one in Class 1 added lime or tobacco with the areca nut compared to Class 2 where $96 \pm 4\%$ added lime and $60 \pm 16\%$ added tobacco. There were no differences in alcohol consumption or cigarette smoking between Class 1 and Class 2.

Discussion and Clinical Implications

Areca nut has not been traditionally grown in Chuuk as it has in Guam, Palau, and Yap. This is evident in the types of products recently exported from each state in the Federated States of Micronesia. In 2007, Yap's major exports were garments and are canut, whereas, Chuuk's major exports were cooked food and reef fish.²² The Chuukese natives typically acquired the betel quid chewing habit as a way of socializing with other groups when they migrated to neighboring islands. The Chuukese in this study explained that young adults adopted the habit when they traveled to other islands in Micronesia to attend school. The Chuukese males in this study found the habit to be unladylike and disrespectful among women. The Chuukese females acknowledge the habit as untraditional and unacceptable, especially among the elders in their community, but continue to chew:

“Back home in Chuuk, when I chewed betel nut, particularly at a funeral site for a relative of mine, it seemed as though everyone was saying, she must have come from somewhere; it (chewing habit) is foreign and belongs to certain places like Yap, Palau, Saipan, etc.”

“Chewing betel nut calls attention. But if you were a Non-Chuukese lady, it is not a big deal and you would not get as much negative attention.”

“Chewing is kind of embarrassing especially in front of your relatives. To me, I would only chew secretly. Gender makes a difference in my culture, as far as chewing betel nut.”

The women continue to chew betel quid to fill boredom and loneliness, and keep energized. It is also encouraged by their peers:

“Lonely times are influential...this is when betel nut chewing comes in.”

“Some people say that I look cool when I chew and that encourages me to keep me chewing. On the contrary, the elders in my community oppose betel nut chewing.”

“People in my age group are affirmatively supporting chewing betel nut. That makes me keep chewing and it is addicting.”

In addition to culture, health issues related to areca nut/betel quid use were raised during the focus group discussions. Areca nut and betel quid chewing may impart different health risks, depending on the combinations of ingredients used. For example, tobacco smoking²³ and betel quid, prepared with²⁴ or without tobacco², have been classified as human carcinogens, and both habits act synergistically on oral cancer.² Kennedy has reported on the oral cancer rates of Pacific Islanders.²⁵ Of all the Pacific Islanders reported, men from Papua New Guinea had the highest oral cancer incidence rate of more than 30 cases per 100,000 people. The second and third highest rates were Yapese (of more than 20 per 100,000) and Palauans (of more than 15 per 100,000), respectively. Chuukese had the lowest rate (of less than 5 cases per 100,000), preceded by Guam Chamorros (of slightly more than 5 cases per 100,000). Higher oral cancer rates in Yap and Palau may be partially explained by the habit of adding other ingredients to the betel quid such as tobacco from cigarette or smokeless tobacco. Lower rates among Chamorros may reflect the possible absence of smokeless tobacco in the Chamorro betel quid. In fact, the Chamorro population in Guam is atypical in their preference for chewing the ripe areca nut by itself. This unique behavior may be useful in understanding the effects of areca nut chewing (by itself) on risk for oral cancer in human populations. Although Chuukese chew betel quid similarly to Yapese and Palauans, their low oral cancer incidence rate is perhaps related to the recent introduction of betel quid chewing to the Chuukese culture.

Beliefs

Culturally, the Chamorros, Palauans, and Yapese in the focus groups were proud to claim their areca nut/betel quid chewing custom, and most were eager to pass it on. They all agreed that chewing promotes socialization. However, some of the chewers shared that they felt stigmatized when chewing areca nut/betel quid while socializing with non-chewers. When asked, “What made you start chewing betel nut?” a Chamorro female and Chuukese male both responded by describing how peer pressure influenced them to chew. Areca nut and betel quid chewing symbolized the “spirit of brotherhood” and a sense of welcoming, even among first-time acquaintances.

Betel quid has been used as a peace-maker and has been known to improve critical thinking processes²⁰, especially during group meetings. According to the Palauan men, when there is tension at a meeting, the chief interrupts the meeting for a betel quid break. Immediately after chewing, the men feel relaxed and ready to continue the meeting. The effects of improved concentration and relaxation have been documented elsewhere²¹, although the exact mechanisms are not fully understood.

Both the Chamorro and Yapese groups believed that betel quid provides a coating on the teeth that prevents cavities. This cultural belief is supported by anthropological evidence^{26,27} and clinical observation²⁸⁻³⁰, where evidence of dental caries was low among areca nut/betel quid chewers; however, a study that controls for other lifestyle practices that

may confound the relationship is warranted. Gerry and colleagues³¹ found that among areca nut/betel quid chewers on Guam, the prevalence of dental caries was less than in non-chewers. It may be that constant mastication of the nut assists in removing foodstuff and other debris from between the teeth. Furthermore, areca nut/betel quid chewers traditionally use the areca nut husk as a toothbrush to help cleanse the mouth after chewing³¹; thus, nuances of chewing practice may also influence risk for dental caries. While areca nut/betel quid may protect against dental caries, the effect on the oral gingiva is less favorable as chewing is associated with periodontal disease^{32, 33}. Furthermore, biting hard areca nuts may weaken the teeth.

The Palauans and Yapese in this study believed that betel quid chewing reduces appetite by suppressing hunger during work hours or until it is convenient to eat. Though areca nut may suppress hunger³⁴, other literature suggests an association between areca nut/betel quid chewing and elevated measures of obesity^{7,35}, possibly due to an increase in appetite.⁷

Practices

Areca nut chewing practice among the Chamorros was distinct from the other Micronesians (Chuukese, Palauan, and Yapese). Most of the Chamorros preferred the *ugam* (ripe red areca nut variety), which is also most prized among Chamorro avid chewers. Some of the Chamorros also chewed the areca nut with betel leaf, and often ingested the masticated wad and juice. The other Micronesians (Chuukese, Palauan, and Yapese) generally preferred the unripe nut with the betel leaf, lime, and tobacco. According to Staples and Bevacqua³⁷, the alkaloid levels are highest in the unripe fruits, and thus they provide a better stimulating effect. The strength of the areca nut may be a contributing factor to its preference among certain ethnic groups. For example, the other Micronesian groups consistently referred to the young areca nut as “Yapese betel nut.” The Yapese women believed that their areca nut is stronger than any other areca nut. The women chewed the young nut, however, preference for a particular variety was not mentioned:

“Yapese betel nut is stronger than any betel nut.”

“Some of the local (Guam) betel nuts taste... kind of sweet, but Yapese, does not.”

A young Chamorro male considered the habit of chewing to be an alternative to smoking.

“I don't like to smoke marijuana or cigarette so I would chew the young one.”

However, the betel quid recipes obtained from the focus groups included harmful ingredients such as tobacco, and recently, alcohol. Those who added alcohol claimed it enhanced the experience. Betel quid chewing can become a habitual practice where tolerance increases with habituation.³⁶ The addition of tobacco and alcohol to betel quid may have resulted from habituation over many years of usage. The Yapese women believed that the addiction to betel quid chewing resulted from the addition of tobacco to the quid:

“I think we get addicted when we start chewing it with cigarette.”

“When it is just betel nut, leaf and the lime, you can quit. But when you chew it with cigarette you get the nicotine from it and you get addicted.”

A few of the Non-Chamorro Micronesians added cardamom, ginger, and vodka to their betel quid. Cardamom and ginger were added primarily because they “make the breath smell good,” though cardamom provided additional sweetness and ginger imparted spiciness. One Chuukese and one Yapese participant had developed a relatively new habit of spiking their ingredients, such as the tobacco or areca nut, with vodka to enhance the euphoric effects. Swallowing was generally not practiced among the other Micronesians, probably due to the complex mixture of ingredients used with the unripe nuts and the physical impossibility of swallowing the large masticated husk.

These chewing differences were supported by quantitative analysis of the 2007 Guam BRFSS data. Two classes of chewers were identified from the latent class analysis. Information gathered from the focus groups and latent class analysis suggests that Chamorros are more likely to chew the ripe, red areca nut; and swallow the masticated wad (and juice) even if the betel leaf is added. The Chuukese, Palauans, and Yapese are more likely to chew the unripe, areca fruit (nut and husk) with betel leaf, lime, tobacco (from cigarette), and other spices; and spit out the juice and betel quid. These behavioral differences and the reasons for such differences should be taken into account when developing interventions targeted to Micronesian communities.

Chewing practices among the Chamorros seems to have evolved over the years. Chamorros are believed to have originated from Southeast Asia^{38,39}, where betel quid chewing is also believed to have originated. If the ancient Chamorros chewed as their Southeast Asian ancestors did, a plausible suggestion based on anthropological evidence of betel stains in the teeth of the remains of ancient Chamorros^{26,27,40}, then the chewing patterns of today reflect hundreds of years of cultural change and adaptation. It would be useful to understand the factors that drive such changes. Effects of Western contact, and whether or not areca nut and betel quid use can be applied as a phenotypic marker for acculturation, are worth exploring. One hypothesis is that as the island adopted more Westernized thoughts, chewing became less attractive, and resulted in decreasing popularity. Modern simplification, or the removal of ingredients from the betel quid, as reflected in the practice of modern day Chamorros who chew only areca nut, may have been for convenience and the desire to be more attractive (less obvious). This may also explain the preference for swallowing. Other Micronesian islands remain less westernized than Guam, and may be less acculturated to Western customs. As Micronesians continue to migrate, they may also bring their practices with them. The effects of such migration on chewing practices and prevalence (in other countries) are areas for further research.

Strengths and Limitations

The strengths of this study were the ethnic diversity of the participants in the focus groups and the use of population-based data from the BRFSS to quantify the areca nut/betel quid chewing patterns that were gathered from the focus groups. This study was limited in the number of areca nut/betel quid chewers who completed the BRFSS areca nut-related questionnaire. A larger number of areca nut/betel quid chewers may have resulted in more than two classes of chewers.

Conclusion

Micronesian areca nut/betel quid chewers on Guam have key ethnic differences in chewing practices. The quantitative analysis confirmed the qualitative exploration of areca nut/betel quid chewing, and has provided further evidence of the variability in chewing practices among Micronesian populations. If future research should include an intervention, the differences in chewing practices should be considered for the intervention to succeed. For example, betel quid chewing cessation may be more successful in the Chuukese community, a relatively new group of chewers, than in the Chamorro, Palauan, and Yapese communities where chewing is culturally embedded.

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References

1. Gupta PC, Warnakulasuriya S. Global epidemiology of areca nut usage. *Addict Biol.* 2002; 7:77–83. [PubMed: 11900626]
2. World Health Organization. Betel-quid and areca-nut chewing and some areca-nut-derived nitrosamines. Lyon: International Agency for Research on Cancer; 2004.
3. Strunz, GM.; Findlay, JA. Pyridine and Piperidine Alkaloids. In: Brossi, A., editor. *The Alkaloids*. New York: Academic Press; 1985. p. 89-183.
4. Yen AMF, Chen LS, Chiu YH, Boucher BJ, Chen THH. A prospective community-population-registry-based cohort study of the association between betel-quid chewing and cardiovascular disease in men in Taiwan (KCIS no.19). *Am J Clin Nutr.* 2008; 87:70–78. [PubMed: 18175739]
5. Guh JY, Chen HC, Tsai JF, Chuang LY. Betel-quid use is associated with heart disease in women. *Am J Clin Nutr.* 2007; 85:1229–35. [PubMed: 17490957]
6. Kang I, Chou C, Tseng Y, Huang C, Ho W, Shih C, et al. Association Between Betel nut Chewing and Chronic Kidney Disease in Adults. *J Occup Environ Med.* 2007; 49:776–79. [PubMed: 17622851]
7. Chang WC, Hsiao CF, Chang HY, Lan TY, Hsiung CA, Shih YT, et al. Betel nut chewing and other risk factors associated with obesity among Taiwanese male adults. *Int J Obes.* 2006; 30:359–63.
8. Lan TY, Chang WC, Tsai YJ, Chuang YL, Lin HS, Tai TY. Areca Nut Chewing and Mortality in an Elderly Cohort Study. *Am J Epidemiol.* 2007; 165:677–83. [PubMed: 17204513]
9. The Guam Website-Hafa Adai. [cited 2009 October 10] Betelnut: Mama'on. Available from <http://ns.gov.gu/pugua.html>
10. United States Census Bureau. [cited 20 January 2011] Census 2000 Data for Guam. updated 2010 June 23 Available from: <http://www.census.gov/census2000/guam.html>
11. Office of the Governor of Guam. 2005 Guam statistical yearbook. Hagatna: Bureau of Statistics and Plans; 2006.
12. Office of the Governor of Guam. 2008 Guam statistical yearbook. Hagatna: Bureau of Statistics and Plans; 2009.
13. Paulino, YC. Describing and measuring variability of Areca catechu (betel nut) chewing in Micronesian populations in Guam. Ann Harbor: UMI Dissertation Publishing; 2010.
14. Bernard, HR. Research methods in anthropology: qualitative and quantitative approaches. 3rd. Walnut Creek: AltaMira Press; 2002.

15. Krueger, RA. Focus groups: A practical guide for applied research. Newbury Park: Sage Publications; 1994.
16. Centers for Disease Control and Prevention. Behavioral risk factor surveillance system operational and user's guide. Atlanta: Centers for Disease Control and Prevention; 2005.
17. Glaser, BG.; Strauss, AL. The discovery of grounded theory: strategies for qualitative research. New York: Aldine Publishing Company; 1967.
18. McCutcheon, AL. Latent class analysis. Newbury Park: Sage Publications; 1987.
19. Muthen, B. Latent variable mixture modeling. In: Marcoulides, GA.; Schumacker, RE., editors. New developments and techniques in structural equation modeling. New Jersey: Lawrence Erlbaum Associates; 2001. p. 1-33.
20. Huyser-Honig J. Community or cash?: betel nut's changing role on Yap. *The World & I*. 2002; 17:200–09.
21. Winstock A. Areca nut-abuse liability, dependence and public health. *Addict Biol*. 2002; 7:133–38. [PubMed: 11900633]
22. The 2007 FSM international trade publication release. Palikir: FSM; 2007. Government of the Federated States of Micronesia.
23. World Health Organization. Tobacco smoke and involuntary smoking. Lyon: International Agency for Research on Cancer; 2004.
24. World Health Organization. Tobacco habits other than smoking; betel-quid and areca-nut chewing; and some related nitrosamines. Lyon: International Agency for Research on Cancer; 1985.
25. Kennedy, D. Review of the use of areca (betel) nut and tobacco in the Pacific: A report from the Secretariat of the World Health Organization (WHO); Pacific Global Health Conference; Honolulu, HI. 2007;
26. Douglas MT, Pietrusewsky M, Ikehara-Quebral RM. Skeletal biology of Apuruguan: A precontact Chamorro site on Guam. *A J Phys Anthropol*. 1997; 104:291–313.
27. Pietrusewsky M, Douglas MT, Ikehara-Quebral RM. An assessment of health and disease in the prehistoric inhabitants of the Mariana Islands. *A J Phys Anthropol*. 1997; 104:315–42.
28. Howden GF. The cariostatic effect of betel nut chewing. *PNG Med J*. 1984; 27:123–31.
29. Moller IJ, Pindborg JJ, Effendi I. The relation between betel chewing and dental caries. *Scand J Dent Res*. 1977; 85:64–70. [PubMed: 265084]
30. Hornung, RS. Observations on the effects of betel-nut chewing. Agana: Guam Recorder; 1972.
31. Gerry RG, Smith ST, Calton ML. The oral characteristics of Guamanians including the effects of betel chewing on the oral tissues: part I. *Oral Surgery*. 1952; 5:762–81.
32. Akhter R, Monsur-Hassan NM, Aida J, Takinami S, Morita M. Relationship between quid additives and established periodontitis among Bangladeshi subjects. *J Clin Periodontol*. 2008; 35:9–15. [PubMed: 18021263]
33. Parmar G, Sangwan P, Vashi P, Kulkarni P, Kumar S. Effects of chewing a mixture of areca nut and tobacco on periodontal tissues and oral hygiene status. *J Oral Sci*. 2008; 50:57–62. [PubMed: 18403885]
34. Strickland SS, Veena GV, Houghton PJ, Stanford SC, Kurpad AV. Areca nut, energy metabolism and hunger in Asian men. *Ann Hum Biol*. 2003; 30:26–52. [PubMed: 12519653]
35. Mannan N, Boucher BJ, Evans SJW. Increased waist size and weight in relation to consumption of Areca catechu (betel-nut); a risk factor for increased glycaemia in Asians in East London. *Brit J Nutr*. 2000; 83:267–75. [PubMed: 10884715]
36. Chu N. Neurological aspects of areca and betel chewing. *Addict Biol*. 2002; 7:111–14. [PubMed: 11900630]
37. Staples, GW.; Bevacqua, RF. Areca catechu (betel nut palm). In: Elevitch, CR., editor. Traditional trees of Pacific Islands: their culture, environment, and use. Honolulu: Permanent Agriculture Resources; 2006. p. 69-84.
38. Cunningham, LJ. Ancient Chamorro society. Honolulu: Bess Press, Inc.; 1997.
39. Rogers, RF. Destiny's Landfall: A History of Guam. Honolulu: University of Hawaii Press; 1995.
40. Leigh RW. Dental morphology and pathology of prehistoric Guam. *Memoirs of the Bernice P Bishop Museum*. 1929; 11:257–72.

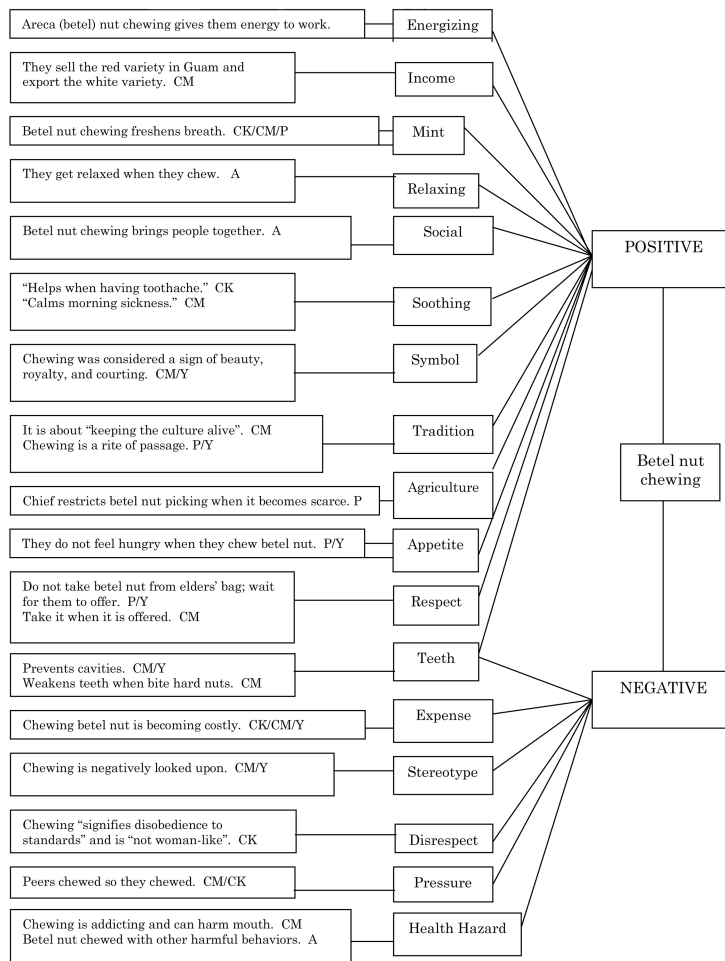


Figure 1. Themes of areca (betel) nut chewing in Micronesian populations.
 Legend: CK = Chuukese, CM = Chamorro, P = Palauan, Y = Yapese, A = All

Table 1

Questions used in the focus groups and the Behavior Risk Factor Surveillance System.

Focus Groups
<i>Prompts for discussion</i>
How old were you when you first chewed betel nut?
Who or what encouraged you to chew betel nut?
What kind (variety) of betel nut did you first start chewing?
What other ingredients did you put on your betel nut?
Since then, why did you decide to continue chewing betel nut?
<i>Prompts for recipes</i>
What kind (variety) of betel nut do you currently chew?
What other ingredients do you add?
How much of each ingredient?
Describe what you do with the betel nut (mixture).
Do you swallow the betel nut or do you spit it out?
Behavioral Risk Factor Surveillance System
Have you ever chewed betel nut in your life?
Do you now chew betel nut?
How often do you chew betel nut?
Do you include lime when you chew betel nut?
Do you include tobacco when chewing betel nut? (Tobacco can be twist tobacco, cigarettes, or canned tobacco.)
Do you include <i>pupulu</i> or pepper leaf when chewing betel nut?
What variety of betel nut do you most often chew?
Do you ingest (swallow) your chew?

Table 2

Summary of areca (betel) nut recipes submitted by focus group participants.

Ethnic group	Number of Participants	Ingredients reported	Swallow quid	Comments
Chamorro	18	Nut, red variety, ripe Betel leaf	Yes	One male used areca nut (white, soft variety), lime (calcium hydroxide), and tobacco from cigarette.
Chuukese	11	Nut, white variety, unripe Betel leaf Lime Tobacco from cigarette (not smoked)	No	One male did not use tobacco. Two males added ginger. One female added ginger and cardamom. Two males added vodka.
Palauan	9	Nut, white variety unripe Betel leaf Lime Tobacco from cigarette (not smoked)	No	Two females added cardamom.
Yapese	10	Nut, unripe Betel leaf Lime Tobacco from cigarette (not smoked)	No	One female sometimes swallowed the betel quid. Two males added cardamom. One male added vodka.

Note: One participant refused to submit a recipe.

Table 3

Comparison of demographic and behavioral characteristics (weighted mean \pm standard deviation or weighted mean % \pm standard error) of the two types of areca (betel) nut chewers in Guam.

	Overall n = 43	Class 1 n = 31	Class 2 n = 12
<i>Demographics</i>			
Age, years	43 \pm 3	44 \pm 3	40 \pm 4
Education, % with post-secondary	32 \pm 8	41 \pm 11	11 \pm 10
Ethnicity, % Chamorro	88 \pm 5	*100	58 \pm 15
Gender, % males	56 \pm 9	58 \pm 10	52 \pm 16
Marital status, % married	65 \pm 9	64 \pm 11	66 \pm 14
<i>Behavioral Characteristics</i>			
% that chew mature nut	73 \pm 8	*93 \pm 7	22 \pm 12
% that chew red variety	85 \pm 6	*99 \pm 1	50 \pm 16
% that swallow betel quid	63 \pm 9	*86 \pm 7	7 \pm 7
<i>Characteristics used to determine classes</i>			
% that add <i>Piper betle</i> (be tel leaf)	41 \pm 9	35 \pm 10	57 \pm 16
% that add lime (calcium hydroxide)	27 \pm 8	*0	96 \pm 4
% that add tobacco	17 \pm 6	*0	60 \pm 16
Alcohol drinks per month	144 \pm 59	154 \pm 62	122 \pm 47
% smoke cigarettes	62 \pm 8	66 \pm 10	51 \pm 16

* Statistically different from Class 2 at $p < .05$ level.