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## Areca (betel) nut chewing practices of adults and health behaviors of their children in the Freely Associated States, Micronesia: Findings from the Children's Healthy Living (CHL) Program

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### Abstract

**Background:** Chewing areca (betel) nut has been deemed carcinogenic. The practice has become a public health concern in Micronesia. The Children's Healthy Living (CHL) Program included an areca (betel) nut questionnaire in a survey of household characteristics in the Freely Associated States (FAS). This paper describes areca (betel) nut chewing practices of adults and the health behaviors of their children.

**Methods:** A cross-section of 1200 children (2–8 year-olds) and their caregivers in Chuuk, Kosrae, Pohnpei, Republic of Palau, Republic of the Marshall Islands (RMI), and Yap were recruited. Socio-demographics, adult areca (betel) nut chewing practices, and other health

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#### Contributions

YCP participated in the betel nut and oral health survey design, performed the statistical analysis, and developed the initial manuscript draft. RE assisted with data collection and initial draft and edits of the manuscript. RN obtained funding, participated in the study and survey design, trained data collection staff, and contributed to interpretation of findings. LRW contributed to the study design, and reviewed and edited the manuscript. MS, CS, EJ, SR, JA, and DG contributed to the collection of data in the Freely Associated States and reviewed the manuscript.

#### Conflicts of interest

LRW received financial support from USDA NIFA-AFRI-003037 to complete work on this study. All other authors have no conflicts to disclose.

behaviors of children and adults were assessed. Child anthropometric measurements were collected to estimate weight status.

**Results:** The FAS areca (betel) nut chewing prevalence was 42%, ranging from 3% (RMI) to 94% (Yap). Among chewers, 84% added tobacco, 97% added slaked lime, 85% added betel leaf, and 24% mixed the components with alcohol. Among FAS children, 95% practiced daily teeth-brushing and 53% visited the dentist annually. Compared to non-chewing households, areca (betel) nut chewing households were more likely to have very young children enrolled, more highly educated adults, and members that used tobacco and alcohol.

**Conclusion:** The FAS areca (betel) nut chewing prevalence (42%) is above the world prevalence of 10–20%, with wide variability across the islands. The oral health findings in this study may inform future oral cancer prevention programs or policies. Regular monitoring of areca (betel) nut use is needed to measure the impact of such programs or policies.

### Keywords

Alcohol; Areca; Betel; Childhood obesity; CHL; Micronesia; Oral cancer; Tobacco

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## 1. Background

Chewing areca nut, the seed of the *Areca catechu*, has been deemed carcinogenic by the International Agency for Research on Cancer (IARC) [1]. Positive health benefits of chewing areca nut have been documented [2,3]. However, the IARC evaluation, plus literature on areca nut chewing and associations with all-cause mortality and chronic diseases [4], and other health risks (including the effects on the nervous, endocrine, reproductive, and respiratory systems) [5], outweigh the health benefits. Approximately 600 million people chew areca nut [6]. The majority reside in the Indian Subcontinent, East-Southeast Asia, and some Pacific Islands [1,6].

Areca nut use is highly variable across populations [7], including within Micronesia [8], a group of small islands in the Western Pacific. The areca nut ranges from green when young to brown when mature [9]. The common patterns of chewing among populations in Micronesia are: 1) the mature areca nut alone, where the nut is ingested; 2) the betel quid without tobacco (areca nut or areca fruit with components of *Piper betle* or betel leaf and any other ingredients, such as slaked lime, except tobacco), where the quid may or may not be discarded; and 3) the betel quid with tobacco (areca fruit with components of betel leaf and any other ingredients including tobacco), where the quid is discarded [8]. Throughout Micronesia, the areca nut is known as betel nut from its association with the betel leaf.

Areca (betel) nut chewing has become a public health concern in Micronesia [10]. Associations between areca (betel) nut chewing and oral potentially malignant disorders have been seen in Guam [11] and the Commonwealth of the Northern Mariana Islands (CNMI) [11,12], in addition to issues with dependence in Guam [13] and low birth weight of children born to women in Palau [14]. In 2011, the Children's Healthy Living (CHL) Program was started in Micronesia as part of a larger initiative to prevent childhood obesity in the Pacific Region [15]. Considering the effect that areca (betel) nut, tobacco, and alcohol

use by adults in the households may have on the lives of young children, the Freely Associated States (FAS), specifically Chuuk, Kosrae, Pohnpei, Republic of Palau, Republic of the Marshall Islands, and Yap jurisdictions, opted to include areca (betel) nut use into their prevalence survey. The objective of this paper is to describe areca (betel) nut chewing practices of adults and health behaviors of their children in the FAS CHL Program. This represents the first report of areca (betel) nut use for the entire Micronesia, apart from Guam and CNMI.

## 2. Methods

The CHL program is a partnership of universities, local organizations and stakeholders across the remote Pacific region (Alaska, Hawaii, Guam, CNMI, American Samoa, and FAS) working to prevent childhood obesity in the Pacific. Detailed information on the prevalence study and survey design can be found elsewhere [15,16]. This paper will focus solely on information from the prevalence survey in the FAS, namely on the participants' oral behaviors and related health risks. Communities were chosen to ensure representation from the populous areas, more remote villages, and outer atolls in the FAS. The communities had to be reasonably accessible by boat or scheduled air services and be representative of the geographic region. Data collection took place in phases, beginning in fall 2013 in Pohnpei and concluding in summer 2015 in Chuuk.

Children (2–8 year-olds) and their caregivers living in selected communities were recruited to participate in the study. Recruitment efforts occurred primarily at the early childhood education centers and elementary schools in the FAS. Recruitment details for CHL have been published elsewhere [17]. In brief, each jurisdiction recruited and measured approximately 200 children. This number was selected to provide reasonable precision for prevalence estimates within each jurisdiction. All study forms and recruitment materials were translated into the local language of the particular nation. A total of 1200 children were recruited from the six FAS jurisdictions.

All study protocols and procedures were approved by the Institutional Review Boards (IRB) of the University of Hawai'i at Manoa and the Republic of Palau. All other jurisdictions in the FAS prevalence survey ceded to the University of Hawai'i. Parental consent and child assent were obtained.

### 2.1. Anthropometry and questionnaires

Each child was measured for height, weight, and waist circumference by trained and standardized staff [18]. Body mass index (BMI) percentiles and z-scores were calculated according to the CDC reference data [19] and BMI categories were assigned accordingly: underweight (<5th percentile), healthy weight (5th–84th percentile), overweight (85th–94th percentile), and obese (>95th percentile).

Parents completed a series of health questionnaires. Relevant questions included demographics, socioeconomic status, and oral health behaviors including child oral hygiene and dental visits, and household areca (betel) nut chewing, tobacco, and alcohol use by the caregiver and by adults in the household.

Demographic information included age and sex of all children, marital status and education of the caregiver, and household income. Child's age was categorized into two groups: 2–5 year-olds and 6–8 year-olds. Marital status was categorized into two groups (married or unmarried) and education level was categorized into two groups (<12th grade and high school graduate or higher). Total household income categorized into two groups (<\$35,000 annually and \$35,000 annually). Other indicators of income sufficiency were also collected. These included questions on food insecurity and utilities insecurity.

The oral health behaviors of children included questions on teeth-brushing habits and dental visits, and areca (betel) nut use (including years of chewing, frequency, addition of other ingredients), alcohol and tobacco use of all adults in the household.

## 2.2. Data analysis

Survey sampling techniques were used, which accounted for the clustering of participants in communities within jurisdictions. The sample was weighted based on 2010 census data on population size of young children <10 years of age in each community; this weighting allowed for representative prevalences for the FAS overall where larger jurisdictions have a bigger contribution [16]. Prevalence was estimated for all of FAS and for each jurisdiction. Comparisons were performed between households with and without a caregiver who used areca (betel) nut by the chi-square test for categorical data and ANOVA for continuous data; alpha was 0.05.

## 3. Results

### 3.1. General characteristics

The general characteristics of the children, caregivers, and households in the FAS CHL Program are summarized in Table 1. Of the 1200 children enrolled in the CHL Program from the FAS, the majority (64%) were 2–5 year-olds. The distribution of children was similar between sexes and among the six jurisdictions. The majority of the children (80%) were categorized as having healthy weight while 5% were underweight, and 15% were overweight or obese. The majority of the children (74%) lived in households where the caregiver was married. The majority of the caregivers completed high school or attended college (59%). Income information was missing from 431 caregivers. Of the 769 households that reported income, the majority (96%) fell below \$35,000 in annual income.

### 3.2. Oral health among jurisdictions

Table 2 describes the oral health characteristics of the enrolled children and caregivers of households in the FAS CHL Program. Among the children in the FAS, the overall prevalence was 95% for daily teeth-brushing (94% among boys, 96% among girls) and 53% for regular dental visits (48% among boys, 57% among girls). The caregivers and others in the household were asked about their use of areca (betel) nut, tobacco and alcohol. Among adults caregivers in the FAS, the overall prevalence was 42% for areca (betel) nut chewing, 14% for tobacco use other than with areca nut, and 17% for alcohol use. Among the areca (betel) nut chewers, 89% were daily chewers, 84% added tobacco, 97% added slaked lime, 85% added betel leaf, and 24% mixed any of the components with alcohol. The mean

chewing duration (16 years) included recent (1 year) and long-term (59 years) chewers. The prevalence among other adults in the FAS households was 63% for areca (betel) nut chewing, 53% for tobacco use not with the areca nut, and 45% for alcohol use. The use of areca (betel) nut, tobacco and alcohol was similar between households where the enrolled child was a boy or a girl.

### 3.3. Chuuk

The majority of children (93%) in Chuuk brushed their teeth daily, however, regular dental visits (32%) were the lowest among the FAS jurisdictions (Table 2). The prevalence of areca (betel) nut chewing among caregivers in Chuuk was 21% and 87% were daily chewers. Individuals from Chuuk had the shortest duration of chewing with a mean of 5 years. Among the areca (betel) nut chewers in Chuuk, 81% chewed with tobacco, 98% chewed with slaked lime, 95% chewed with betel leaf, and 21% mixed any components with alcohol. Approximately 11% of the adults used tobacco other than with areca nut and 12% used alcohol. Among others in the household, 58% chewed areca (betel) nut. Chuuk had the highest prevalence of other tobacco (68%) and alcohol (57%) use among others in the household among the FAS jurisdictions.

**3.3.1. Kosrae**—The majority of children (96%) in Kosrae brushed their teeth daily, and regular dental visits (61%) was above the FAS average of 53%. The prevalence of areca (betel) nut chewing among caregivers in Kosrae was 11%, and 72% were daily chewers. The mean chewing duration was 10 years. Among the areca (betel) nut chewers in Kosrae, 81% chewed with tobacco, 95% chewed with slaked lime, 83% chewed with betel leaf, and 19% mixed any components with alcohol. Approximately 8% of the adults used tobacco use other than with areca nut and 8% used alcohol. Among others in the household, 45% chewed areca (betel) nut, 46% used tobacco other than with the areca nut, and 40% used alcohol.

**3.3.2. Republic of Palau**—Palau had the highest prevalence of children who brushed their teeth daily (99%). Regular dental visits (59%) was above the FAS average of 53%. The prevalences were 76% for areca (betel) nut chewing and 18% for tobacco use separate from areca (betel) nut among caregivers, and 50% for tobacco and 40% for alcohol use among others in the household. Adults in Palau chewed the longest (20 years). Additionally, Palau experienced the highest prevalence of those who chewed daily (97%), added slaked lime (99%), and consumed alcohol (34%); whereas Palau experienced the lowest prevalence of chewers who added betel leaf (71%) and mixed any components with alcohol (6%) among all the FAS jurisdictions.

**3.3.3. Pohnpei**—The majority of children (97%) in Pohnpei brushed their teeth daily, but the percentage that had regular dental visits (40%) was below the FAS average of 53%. The prevalence of areca (betel) nut chewing among caregivers in Pohnpei was 51%, and 73% were daily chewers. The mean chewing duration was 8 years. Among the areca (betel) nut chewers in Pohnpei, 79% chewed with tobacco, 93% chewed with slaked lime, 79% chewed with betel leaf, and 24% mixed any components with alcohol. Approximately 22% of the adults used tobacco other than with areca nut and 24% used alcohol. Among others in the

household, 73% chewed areca (betel) nut, 52% used tobacco other than with the areca nut, and 44% used alcohol.

**3.3.4. Republic of the Marshall Islands (RMI)**—The majority of children (97%) in the RMI brushed their teeth daily, and 54% visited the dentist regularly. The RMI had the lowest prevalence in the FAS of areca (betel) nut chewing (3%), daily chewers (50%), those who chewed with slaked lime (85%), and those who used tobacco other than with areca nut (3%). Among other users in the household, 33% chewed areca (betel) nut and 42% used tobacco other than with the areca nut. All of the chewers in the RMI chewed with the betel leaf, 85% chewed with tobacco, and 35% mixed any of the components with alcohol. The mean chewing duration was 6 years. Approximately 11% of the RMI caregivers and 54% of others in the household consumed alcohol.

**3.3.5. Yap**—Yap had the lowest prevalence of children who brushed their teeth daily (87%), but the highest prevalence of regular dental visits (67%). The prevalence of areca (betel) nut chewing was highest in Yap (94%) including among others in the household (91%), as was the prevalence of those who mixed any components with alcohol (40%) and those who used tobacco other than with the areca nut (26%) among the FAS jurisdictions. The mean chewing duration was 19 years. Among the areca (betel) nut chewers, 85% added tobacco, 98% added slaked lime, and 96% added betel leaf. Twenty-one percent of the caregivers consumed alcohol. Among the households, 62% used tobacco other than with areca nut and 40% used alcohol.

#### 3.4. Areca (betel) nut chewing versus non-chewing households

The child, caregiver and household characteristics were compared between households where areca (betel) nut chewing was and was not reported among caregivers in Table 3. For child characteristics, the distribution of sex (50% boys, 50% girls), those who brushed their teeth daily (95%), those who visited the dentist regularly (52%), and those who were overweight or obese (13%) were similar between chewing and non-chewing households. There was a significant difference in age distribution (74% of chewing households enrolled a child 2–5 years old versus 57% in non-chewing households;  $p = 0.034$ ). For caregivers, marital status (74%), income level (96% earning below \$35,000 annually), and the insecurity of food (24% reported frequent insecurity) and utilities (25% reported frequent insecurity) were similar between chewing and non-chewing households. There was a significant difference in education of the caregiver, with 29% reporting less than a high school education in chewing households versus 49% in non-chewing households ( $p = 0.032$ ), use of tobacco with 29% reporting tobacco use in chewing households versus 4% in non-chewing households ( $p < 0.0001$ ), and use of alcohol with 29% reporting alcohol use in chewing households versus 10% in non-chewing households ( $p = 0.004$ ).

## 4. Discussion

Areca (betel) nut chewing in the FAS has been reported sporadically elsewhere [10,20–24], however, this study is the first to report the FAS prevalence and compare usage among the six jurisdictions. The chewing prevalence of 42% among the FAS adults is well above the

estimated world prevalence of 10–20% reported by Gupta and Warnakulasuriya [6]. The differences in prevalence across the islands, from as low as 3% in the RMI and as high as 94% in Yap, reflects different degrees of areca (betel) nut acculturation, or the adoption of areca (betel) nut use into one's culture, throughout Micronesia. Culturally, areca (betel) nut chewers from the Mariana Islands (Guam, Rota, Saipan, and Tinian), Palau, and Yap were traditional chewers, proud to claim their traditions and eager to pass them on [8]. Some of the longest areca (betel) nut chewers in this study were from Palau (20 mean years, 50 years maximum) and Yap (19 mean years, 59 years maximum). The habit was recently introduced to other islands, including Chuuk, Kosrae, Pohnpei and RMI, where areca (betel) nut is not traditionally grown, but rather imported. Perhaps, Yap is the most traditional (as they claim to have the strongest betel nut)<sup>8</sup> and RMI the most recent areca (betel) nut chewing jurisdiction in Micronesia (as they recently amended their Betel Nut Prohibition Act of 2016) [25].

Compared to non-chewing households, areca (betel) nut chewing households in the CHL Program were more likely to have very young children (2–5 year-olds) enrolled, caregivers who graduated from high school or pursued postsecondary education, and members that use tobacco and alcohol. The association between areca (betel) nut chewing and higher education in this study is inconsistent with the general literature showing higher usage among those with lower education levels [1], although the practice has been documented among well-educated males with more chewing occasionally (27.5%) than regularly (12.5%) [26]. Furthermore, proportionally more chewers who prefer the areca nut alone or with only the addition of betel leaf have been reported to have attained postsecondary education compared to chewers who prefer to add tobacco and slaked lime to their betel quid (41% versus 11%) [8].

The association between areca (betel) nut chewing, tobacco, and alcohol use among adults in this study is consistent with past findings [1]. It has been found that areca (betel) nut chewers are more likely to be smokers [27], or smokers and consumers of alcohol [28]. The University of Guam/University of Hawai'i Cancer Center Partnership Program is currently conducting the Betel Nut Intervention Trial to study the effectiveness of a cessation program. Pilot test findings suggest that areca (betel) nut chewing among Micronesian populations can be costly and some participants try to quit to save money [29]. Although the insecurities of food and utilities were not associated with household areca (betel) nut chewing in this study, the economic impact may be further explored as a messaging strategy in areca (betel) nut cessation, intervention, or prevention programs.

This study was limited to a non-random, cross-sectional sample of children and caregivers from six jurisdictions in the FAS. Although these characteristics are limitations of prevalence studies, the authors believe the findings are representative of the FAS based on the near complete coverage of young children in selected communities, the use of population weights, and the consistency of results with other reports from the region.

In conclusion, the prevalence of adult areca (betel) nut chewing as reported among caregivers in the FAS is 42%, while 14% consumed tobacco, apart from inclusion in the quid, and 17% consumed alcohol. The mean chewing duration was 16 years. The majority of

the children (95%) practiced daily teeth-brushing, and half (53%) visited the dentist regularly. Compared to non-chewing households, areca (betel) nut chewing households were more likely to have very young children enrolled, caregivers who graduated from high school and pursued postsecondary education, and members that use tobacco and alcohol. These findings may inform future programs or policies targeting oral health as a preventative measure for related diseases. Regular monitoring and surveillance of areca (betel) nut use among the FAS jurisdictions is needed to measure the impact of any programs or policies on oral health, including oral cancer prevention.

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Characteristics<sup>a</sup> of the study participants from the Freely Associated States, Micronesia enrolled in the Children's Health Living (CHL) Program.

**Table 1**

CHARACTERISTICS	TOTAL SAMPLE SIZE n	PERCENT% ± Standard Error
<b>Child Enrolled in CHL</b>		
Sex	1172	
Boys		50.0 ± 2.2
Girls		50.0 ± 2.2
Age	1201	
2 to 5 years old		63.9 ± 4.7
6 to 8 years old		36.1 ± 4.7
<sup>b</sup> Jurisdictions	1201	
Chuuk		16.3 ± 7.6
Kosrae		16.0 ± 7.8
Pohnpei		16.7 ± 8.1
Republic of Palau		16.1 ± 11.5
Republic of the Marshall Islands		17.8 ± 11.3
Yap		17.0 ± 8.1
<sup>c</sup> Body mass index category	1201	
Underweight		4.6 ± 1.3
Overweight or obese		15.0 ± 2.6
Healthy weight		80.4 ± 2.2
<b>Caregiver/Household</b>		
Marital status	1192	
Married		74.2 ± 5.4
Not married		25.8 ± 5.4
<sup>d</sup> Education	1198	
Less than 12th grade		40.6 ± 8.1
12th grade/GED or higher		59.4 ± 8.1
Household income	769	
Less than \$35,000 annually		95.5 ± 1.1

CHARACTERISTICS	TOTAL SAMPLE SIZE n	PERCENT% ± Standard Error
\$35,000 or more annually		4.5 ± 1.1

<sup>a</sup> Statistics were weighted for the population size of children (< 10 years of age) in communities and the analysis accounted for the clustering of children in communities with jurisdiction strata.

<sup>b</sup> Percentages do not equal to 100 due to rounding.

<sup>c</sup> BMI: Body mass index categories based on BMI percentiles <5th percentile is underweight, 5th to 85th percentile is healthy weight, 85th to <95th percentile is overweight, and 95th percentile is obese.

<sup>d</sup> GED: General Education Development.

Table 2  
 Oral health characteristics<sup>a</sup> of the study participants enrolled in the Children's Health Living Program, by sex and site in the Freely Associated States, Micronesia.

CHARACTERISTICS(Total sample n)	OVERALL% ± Standard Error	<sup>b</sup> SEX-SPECIFIC% ± Standard Error		SITE-SPECIFIC% ± Standard Error					
		Boys	Girls	Chuuk	Kosrae	Palau	Pohnpei	̑RMI	Yap
Child									
Brushed teeth (n = 1074) At least once per day	95.0 ± 1.0	94.2 ± 1.2	95.8 ± 1.2	93.4 ± 2.4	96.1 ± 1.5	98.8 ± 0.3	97.2 ± 1.2	96.5 ± 0.7	87.2 ± 1.6
Visited dentist (n = 1,1119) Within the past 12 months	52.7 ± 3.4	48.3 ± 3.3	57.2 ± 4.0	31.7 ± 15.5	61.2 ± 2.3	58.5 ± 3.8	40.0 ± 2.5	53.6 ± 6.3	67.3 ± 3.9
Caregiver/Household									
Areca nut or betel quid use									
Chewed areca nut or betel quid (n = 1202)	42.2 ± 9.0	43.9 ± 8.7	44.4 ± 9.8	21.1 ± 4.6	10.7 ± 2.5	75.5 ± 2.1	50.5 ± 7.0	3.0 ± 0.3	93.5 ± 2.7
Mean [range] for years of chewing	15.9 ± 1.4 [1 to 59]	16.4 ± 1.7 [1 to 50]	15.5 ± 1.4 [1 to 59]	5.3 ± 1.4 [1 to 24]	9.9 ± 0.4 [2 to 15]	19.5 ± 0.6 [3 to 50]	8.2 ± 0.7 [1 to 25]	5.6 ± 1.9 [1 to 13]	18.5 ± 0.9 [1 to 59]
Chewed daily (n = 489)	88.7 ± 2.9	92.1 ± 2.4	85.3 ± 3.9	86.6 ± 5.9	72.2 ± 5.0	97.4 ± 0.6	73.0 ± 1.9	50.0 ± 0	92.8 ± 2.9
Chewed with tobacco (n = 489)	83.9 ± 2.1	82.7 ± 2.3	85.2 ± 2.9	80.5 ± 5.8	80.8 ± 7.8	88.3 ± 2.0	79.2 ± 4.1	84.6 ± 8.5	84.5 ± 2.8
Chewed with slaked lime (n = 489)	97.1 ± 1.0	96.0 ± 1.6	98.2 ± 0.9	98.3 ± 1.6	94.8 ± 2.9	99.2 ± 0.2	93.0 ± 2.1	84.6 ± 8.5	97.7 ± 1.6
Chewed with betel leaf (n = 489)	84.6 ± 4.5	82.8 ± 3.6	86.4 ± 5.5	94.6 ± 2.3	82.7 ± 8.5	70.8 ± 1.3	79.3 ± 0.8	100 ± 0	95.7 ± 2.1
Mixed any components with alcohol (n = 489)	24.1 ± 5.8	21.2 ± 5.2	27.0 ± 6.8	21.3 ± 3.4	18.6 ± 6.5	6.2 ± 0.3	23.5 ± 5.1	34.6 ± 8.5	40.4 ± 9.5
Used among household members (n = 1202)	62.5 ± 5.8	62.6 ± 5.6	62.5 ± 6.5	57.6 ± 14.7	44.6 ± 4.1	76.4 ± 1.0	73.0 ± 2.8	33.3 ± 3.6	91.2 ± 2.4
Tobacco use									
Used aside from with areca nut (n = 1153)	14.0 ± 2.5	14.5 ± 2.4	13.6 ± 2.8	11.4 ± 3.0	8.3 ± 1.4	17.7 ± 3.8	21.6 ± 1.4	2.7 ± 0.8	25.8 ± 6.5
Used among household members (n = 1152)	52.9 ± 2.7	53.9 ± 3.6	51.8 ± 2.8	67.6 ± 5.2	46.2 ± 5.8	50.2 ± 1.9	52.0 ± 3.1	42.4 ± 4.0	61.6 ± 2.0
Alcohol use									
Drank alcohol in the past 30days (n = 1152)	17.4 ± 2.8	18.3 ± 2.8	16.6 ± 3.2	11.6 ± 3.0	8.4 ± 3.1	33.5 ± 2.9	23.7 ± 5.0	10.7 ± 0.9	20.9 ± 7.7
Used among household members (n = 1149)	45.2 ± 3.0	44.2 ± 3.1	46.3 ± 3.6	57.2 ± 7.5	40.2 ± 4.9	39.7 ± 2.1	44.3 ± 1.6	54.1 ± 6.1	39.7 ± 2.1

<sup>a</sup> Statistics were weighted for the population size of children in communities and the analysis accounted for the clustering of children in communities with jurisdiction strata.

<sup>b</sup> Sex-specific reflects the sex of the child selected into the study, including his/her household.

<sup>c</sup> RMI: Republic of the Marshall Islands.

Table 3

Comparison of weighted characteristics<sup>a</sup> between areca nut (AN) or betel quid (BQ) chewing households and non-chewing households in the Freely Associated States (FAS), Micronesia enrolled in the Children's Health Living (CHL) Program.

CHARACTERISTICS	TOTAL SAMPLE SIZE <sup>b</sup> n	OVERALL% ± Standard Error	HOUSEHOLDS WITH CAREGIVER CHEWING <sup>b</sup> AN/BQ% ± Standard Error	HOUSEHOLDS WITHOUT CAREGIVER CHEWING AN/BQ% ± Standard Error	P
Child Enrolled in CHL					
Sex	1172				0.987
Boys		50.0 ± 2.2	50.1 ± 2.1	50.0 ± 4.1	
Girls		50.0 ± 2.2	49.9 ± 2.1	50.0 ± 4.1	
Age	1201				0.034
2–5 years old		63.9 ± 4.7	74.0 ± 4.9	56.6 ± 7.7	
6–8 years old		36.1 ± 4.7	26.0 ± 4.9	43.4 ± 7.7	
Brushed teeth	1158				0.891
At least once per day		94.8 ± 1.7	94.6 ± 2.9	95.0 ± 1.3	
Less than once per day or never		5.2 ± 1.7	5.4 ± 2.9	5.0 ± 1.3	
Visited dentist	1144				0.899
Within the past 12 months		52.3 ± 5.4	51.7 ± 8.1	52.8 ± 5.9	
Never to more than 12 months ago		47.7 ± 5.4	48.3 ± 8.1	47.2 ± 5.9	
Body mass index	1201				0.572
Overweight or obese		12.9 ± 2.9	14.1 ± 2.5	12.0 ± 3.7	
Not overweight or obese		87.1 ± 2.9	85.9 ± 2.5	88.0 ± 3.7	
<b>Caregiver/Household</b>					
Married	1192				0.807
Married		74.2 ± 5.4	75.3 ± 3.5	73.4 ± 8.0	
Not married		25.8 ± 5.4	24.7 ± 3.5	26.6 ± 8.0	
<sup>c</sup> Education	1198				0.032
Less than 12th grade		40.6 ± 8.1	28.9 ± 6.4	49.1 ± 7.5	
12th grade/GED or higher		59.4 ± 8.1	71.1 ± 6.4	50.9 ± 7.5	
Income	769				0.184
Less than \$35,000 annually		95.5 ± 1.1	97.2 ± 1.3	94.2 ± 1.3	
\$35,000 or more		4.5 ± 1.1	2.8 ± 1.3	5.8 ± 1.3	

CHARACTERISTICS	TOTAL SAMPLE SIZE/ n	OVERALL% ± Standard Error	HOUSEHOLDS WITH CAREGIVER CHEWING <sup>b</sup> AN/BQ% ± Standard Error	HOUSEHOLDS WITHOUT CAREGIVER CHEWING AN/BQ% ± Standard Error	P
Household tobacco use	1181				<0.0001
Yes		14.5 ± 3.7	29.3 ± 3.4	3.5 ± 0.7	
No		85.5 ± 3.7	70.7 ± 3.4	96.5 ± 0.7	
Household alcohol use	1180				0.004
Yes		18.0 ± 3.9	29.1 ± 4.1	9.8 ± 2.1	
No		82.0 ± 3.9	70.9 ± 4.1	90.2 ± 2.1	
<sup>d</sup> Ran out of money for food	1011				0.333
Frequently to always		24.3 ± 5.5	26.8 ± 7.2	21.7 ± 5.0	
Never to sometimes		75.7 ± 5.5	73.2 ± 7.2	78.3 ± 5.0	
<sup>d</sup> Ran out of money for utilities	988				0.324
Frequently to always		25.2 ± 5.2	28.6 ± 7.1	22.4 ± 5.2	
Never to sometimes		74.8 ± 5.2	71.4 ± 7.1	77.6 ± 5.2	

<sup>a</sup>Statistics were weighted for the population size of children in communities and the analysis accounted for the clustering of children in communities with jurisdiction strata.

<sup>b</sup>AN/BQ: Areca Nut/Betel Quid use.

<sup>c</sup>GED: General Education Development.

<sup>d</sup>Insecurity of food and utilities were defined by the frequency in which money for food/utilities ran out before the end of the month.