**Objective** To investigate the prevalence of its use by high-school children in Saipan in Micronesia. Usage of the areca nut is indigenous to south Asia and the western and south Pacific. Some serious health effects of areca nut chewing are recognized and the International Agency for Research on Cancer has recently classified regular use of areca nut as being carcinogenic to humans. Information on usage by young people, however, is scarce.

**Methods** Data on consumption of areca nut were obtained by a self-administered questionnaire. Following an oral mucosal examination using WHO criteria any detectable oral mucosal lesions were recorded.

**Findings** Of 309 schoolchildren surveyed (mean age 16.3 ± 1.5 years), 63.4% claimed regular use, the highest level recorded in any school population survey. Significant oral diseases detected were oral leukoplakia in 13% and oral submucous fibrosis in 8.8% of children.

**Conclusion** These findings from Saipan suggest that areca nut chewing starts at a young age in Micronesia. As many users develop dependency this raises important concerns regarding its consequences for oral health.

**Keywords** Areca/adverse effects; Substance-related disorders/ethnology/psychology; Mouth mucosa/physiopathology; Leukoplakia, Hairy/epidemiology/etiology; Oral submucous fibrosis/epidemiology/etiology; Oropharyngeal neoplasms/epidemiology/etiology; Child; Adolescent; Cross-sectional studies; Micronesia (Federated States of). (source: MeSH, NLM).

**Mots clés** Arec/effets indésirables; Troubles liés substance toxique/éthnologie/pychologie; Muqueuse buccale/pathophysiologie; Leucoplasie chevelue/épidémiologie/étiologie; Fibrose buccale sous-muqueuse/épidémiologie/étiologie; Tumeur oropharynx/épidémiologie/étiologie; Enfant; Adolescent; Etude section efficace; Micronésie (Etats fédérés de) (source: MeSH, INSERM).

**Palabras clave** Areca/efectos adversos; Trastornos relacionados con sustancias/etnología/psicología; Mucosa bucal/fisiopatología; Leucoplaquia vellosa/epidemiología/etiología; Leucoplaquia vellosa/epidemiología/etiología; Fibrosis bucal submucosa/epidemiología/etiología; Neoplasias orofaringeas/epidemiología/etiología; Niño; Adolescente; Estudios transversales; Micronesia (Estados Federales de) (fuente: DeCS, BIREME).

**Introduction**

The adverse health effects associated with areca (betel) nut use include oral and oropharyngeal cancer, oral premalignant lesions and conditions (oral leukoplakia and submucous fibrosis), gum disease and addiction (1, 2). Chewing areca nut is widespread in south Asia and in the Pacific region (3). A study in Papua New Guinea has reported that areca nut use is highly prevalent among adults in Melanesia (4). In Taiwan, China, where the habit is practised widely, particularly in the aboriginal areas (5), many reports suggest that this chewing habit starts at a young age (6–9).

Guam, the Commonwealth of the Northern Mariana Islands (CNMI), Republic of Palau, the Federated States of Micronesia and the Republic of the Marshall Islands belong to the geographical area of Micronesia which covers a large portion of the central and western Pacific Ocean. Apart from their geographical separation from Melanesia and Polynesia, the Micronesians are distinct in their physical appearance. In addition, each island group represents a unique culture with specific customs.

Together Guam and the CNMI form the Northern Mariana Island chain which extends in a north–south direction...
between the equator and Japan. The CNMI is an unincorporated territory of the USA and consists of 14 principal islands, three of which are inhabited. Saipan, 12.5 miles long and 5.5 miles wide, is the CNMI’s largest island and is home to 90% of its population (about 58,000 people in 1995). The indigenous ethnic group are the Chamorro people, who comprise approximately 60% of the population. In the late nineteenth century a migration of islanders from the Caroline Islands (now the Federated States of Micronesia) occurred. The descendants of these immigrants are called Carolinians. Due to the proximity of the CNMI to Asia, there is also a large representation of other racial groups such as Chinese, Filipinos, Japanese and people from the Republic of Korea.

Areca nut use among the inhabitants of Guam has been reported to be widely prevalent (10). In Guam, areca nut (pugua) chewing is an old tradition, particularly among Chamorro people (the indigenous people of Guam and Saipan) (http://ns.gov.gu/pugua.html). Most of the chewers in the islands surrounding Micronesia use the soft immature nut, split open and filled with lime (calcium hydroxide) and wrapped with piper betel leaf. Chamorros traditionally chewed the hard mature nut with lime with or without the leaf. The chewing habits among adolescents in Micronesia have not been reported. We conducted a cross-sectional study on high-school students in Saipan with the objective of describing the prevalence, correlates of use, reasons for chewing and reasons for disliking the habit, and to characterize the associated clinically detectable oral mucosal lesions.

Materials and methods
Sample
On Saipan there are three public high schools with a total of 2415 students of whom 1186 are female and 1229 are male. Several small private high schools, all religion-based, were excluded from the study. Permission to undertake the study in the three schools was obtained from the school authorities. Information about the study and consent forms were sent to the parents and legal guardians by schoolteachers and collected prior to the study. Participation was voluntary. All consenting students (with the signed consent of their parent(s) or guardian(s)) who attended the school on the days of the examinations and were physically present in the science classroom in each school at the time of the visits by the research team participated in the study. The mean age of the high-school students was 16 years (range 14–18 years).

During 2004, the three schools were visited by a dentist who acted as a screener and a registered dental hygienist who administered the questionnaire to the participants. The 15-item questionnaire was self-completed by students during class time under the supervision of the dental hygienist. The dentist was blinded as to the responses to the questionnaire. Altogether four visits were made to the schools to collect data.

Questionnaire
Questions on demographic characteristics, areca nut use, daily frequency of use, other ingredients mixed with nut (e.g. leaf and lime), tobacco use (smoking and/or chewing), age of initiation of nut chewing, reasons for use, social influence factors, risk perceptions and reasons for disliking the habit were included in the study questionnaire. The questionnaire (available on request from the authors) was developed on the basis of a previous study undertaken on Asian schoolchildren by one of the authors (11). The questionnaire was administered in English as the school classes are taught in English, and this is the spoken language, although many students also speak one of the other two languages, i.e. Chamorro and Carolinian.

The age of initiation of areca nut use was taken as first age of regular nut use. Patterns of nut use were established according to the other ingredients added to the quid. The questionnaire also presented a list of reasons for chewing areca nut which had to be answered with either yes or no. The source of nut was established as: own purchase, from parents, friends, plucked off the trees, or other, to collect information on sharing of the habit with parents or friends. Finally we asked an open question about knowledge and beliefs regarding the adverse health effects associated with nut use and any reasons for not chewing. Information on tobacco smoking or chewing, and alcohol use was also collected.

Clinical examination
All oral examinations were done by one specialist examiner who was familiar with oral mucosal lesions in the local population. The students were seated on a school chair and lighting was provided by a handheld halogen diving light. A sterile mouth mirror was used for retraction of tissue, and where necessary sterile packs of gauze were used. WHO criteria for the detection of oral mucosal lesions were used (12), and mouth opening (inter-incisal distance) was measured in millimetres using a sterile metal ruler to establish any limitation of opening to confirm oral submucous fibrosis. The location and description of oral lesions noted were charted, and if a lesion was found, the parent or guardian was informed.

A brief education programme followed immediately after the screening to encourage schoolchildren to quit their habits.

Data analysis
Data were entered on an Excel worksheet, and frequency distributions of areca nut, tobacco and alcohol use by this group of schoolchildren, together with other variables, were estimated. The present focus is on the description of risk factors and the prevalence of oral mucosal diseases in the population under study.

Results
Data were collected on the 309 high-school students who participated in the study. Of these, 153 were male and 156 female and their mean age was 16.3 ± 1.5 years (Table 1). Most children were from the Chamorro tribe (n = 128; 41%) and other ethnic groups included Carolinian (16%), Filipino (14%) and Palauan (9%).

The lifestyle habits as shown by the percentage distributions are described below. A total of 169 students (63.4%) claimed to use areca nut regularly (Table 1). The habit was more prevalent among male students (73% of males versus 54% of females). There were some variations in the prevalence of chewing habits in the three schools visited; the means ranged from 52.8–85.9%. Two students were chain-chewers and 21 (7%) reported chewing more than 20 areca quids per day. The preferred nut was the soft variety and most schoolchildren added powdered lime to the quid mixture. Piper betel leaf was also often consumed with the nut. The mean age of initiation of areca nut chewing was 12.0 years, and 60 students had started the habit at 10 years of age or younger.
Tobacco use was also widely prevalent among these schoolchildren; almost a quarter of students of both sexes reported smoking tobacco. Tobacco chewing and/or sniff dipping was practised by 17.5%. Alcohol drinking was reported by 26% of high-school students, and the habit was more prevalent among male students (37% of males versus 15% of females).

The percentage distribution of answers on the source of betel nut for individual consumption was examined. The majority (44%) bought betel nut out of their own pocket money. Just over 10% reported being supplied by their parents and there was some sharing of the nut with friends (25%). Some students (9%) had access to the nut from home-grown trees from which they plucked the nuts themselves.

The results from the attitude section of the survey are shown in Table 2, which lists the reasons that users gave for chewing betel nut. Overall, the five most common reasons given were: craving for the nut, boredom, as an aid to concentration, to refresh their breath or to look mature and none used it at times of unhappiness and to postpone hunger. Very few used were: craving for the nut, boredom, as an aid to concentration, chewing betel nut. Overall, the five most common reasons given shown in Table 2, which lists the reasons that users gave for chewing betel nut for individual consumption was examined. The majority (44%) bought betel nut from out of their own pocket money. Just over 10% reported being supplied by their parents and there was some sharing of the nut with friends (25%). Some students (9%) had access to the nut from home-grown trees from which they plucked the nuts themselves.

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take several decades to exhibit their mutagenic action. It is important to note that cessation of the habits can lead to resolution of some oral lesions or a decrease in the severity of oral symptoms (22).

Following migration from south Asia and the western Pacific to both Europe and North America the habit has remained prevalent among new settlers (11, 23). The health consequences of areca nut chewing should therefore be recognized in these migrant communities that have settled in other parts of the world.

In a study of cancer trends in Guam from 1971 to 1995, a continued high incidence of oral cancer on Guam, particularly among Chamoru people was reported among habitual users of betel nut (24). The authors concluded that it therefore seems reasonable at least to try to discourage the adoption of this habit by young people.

The big challenge therefore is to discover effective strategies to motivate young children not to initiate the habit, and to enable adolescent children to realise the potential health risks of this substance. Among the opinions concerning factors that discouraged areca nut use in this study group it is striking that substantial numbers believed that staining of teeth, leading to poor aesthetics was a social problem among chewers. Young people differ from adults in the ways they perceive and interact and it is of interest to note that dental aesthetics was a factor that discouraged them to chew, a factor not suggested by studies in older adults (25). School health education programmes in the future should capitalize on such views of schoolchildren in efforts to emphasize important health-related messages.

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