

Review of Areca (Betel) Nut and Tobacco Use in the Pacific

A Technical Report



World Health
Organization

Western Pacific Region



Review of Areca (Betel) Nut and Tobacco Use in the Pacific

A Technical Report



WHO Library Cataloguing in Publication Data

Review of areca (betel) nut and tobacco use in the Pacific: a technical report.

1. Areca – adverse effects.
2. Tobacco, Smokeless.
3. Tobacco use disorder.
4. Pacific Islands.
5. World Health Organization Regional Office for the Western Pacific.

ISBN 978-92-9061-569-9

(NLM Classification: WM 290)

© World Health Organization 2012

All rights reserved.

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement.

The mention of specific companies or of certain manufacturers' products does not imply that they are endorsed or recommended by the World Health Organization in preference to others of a similar nature that are not mentioned. Errors and omissions excepted, the names of proprietary products are distinguished by initial capital letters.

The World Health Organization does not warrant that the information contained in this publication is complete and correct and shall not be liable for any damages incurred as a result of its use.

Publications of the World Health Organization can be obtained from Marketing and Dissemination, World Health Organization, 20 Avenue Appia, 1211 Geneva 27, Switzerland (tel: +41 22 791 2476; fax: +41 22 791 4857; email: bookorders@who.int). Requests for permission to reproduce WHO publications, in part or in whole, or to translate them – whether for sale or for noncommercial distribution – should be addressed to Publications, at the above address (fax: +41 22 791 4806; email: permissions@who.int). For WHO Western Pacific Regional Publications, request for permission to reproduce should be addressed to Publications Office, World Health Organization, Regional Office for the Western Pacific, P.O. Box 2932, 1000, Manila, Philippines, Fax. No. (632) 521-1036, email: publications@wpro.who.int



Contents

Executive summary	9
Introduction.....	10
A Platform for Action	11
Legislation and policies	13
Governance and local enforcement	14
Public awareness, education, communication and advocacy	15
Alliance and partnerships	17
Tobacco dependence treatment	17
Surveillance and knowledge management.....	18
ANNEX 1. Betel Nut and Tobacco Use: Origin, History and Current Trends.....	21
ANNEX 2. Health Concerns: Why is Betel Nut Use a Problem?	41
References	51
Acknowledgements	67





Executive summary

There is evidence to show that the frequency of betel nut use is increasing in the Western Pacific Region and that its use is more frequently associated with the chewing of tobacco. Betel nut chewing induces oral precancerous lesions that have a high propensity to progress. Betel nut itself has been classified as a Group 1 carcinogen (carcinogenic to humans) by the International Agency for Cancer Research (IARC). While it is clear that the use of betel nut alone is a threat to health, its combination with tobacco greatly increases an individual's risk of premature illness and death. In countries in the Western Pacific Region where this is observed, betel nut and tobacco chewing has become a significant public health problem.

With the entry into force of the WHO Framework Convention on Tobacco Control (WHO FCTC), there has been increasing concern about the promotion of smokeless tobacco use. The groundwork for this report began in 2006 when the Tobacco Free Initiative (TFI), the Western Pacific Regional Office, commissioned the Secretariat of the Pacific Community (SPC) to review the use of betel (areca) nut and tobacco in the Western Pacific Region. This was followed in August 2010 by a meeting of national focal points in tobacco control from the countries that report high use of betel nut and tobacco. Proposed actions have been mapped and linked to the Regional Action Plan for the TFI in the Western Pacific Region (2010-2014). This document is envisioned as a supplement for countries that wish to highlight specific tobacco control indicators and actions related to reduction of smokeless tobacco use.

A major effort needs to be made to provide decision-makers with evidence of the serious harm caused by betel nut chewing, with and without tobacco. Community-based strategies are also needed to overcome cultural beliefs and practices that are barriers to sound public health measures that can save lives and prevent unnecessary suffering from oral cancer and other diseases.



Use of tobacco is the leading preventable cause of death globally, killing up to one half of the people who consume it. The health, social and economic burdens of tobacco use -- in all of its forms -- are devastating. The increasing use of tobacco with areca nut, commonly referred to as betel nut throughout the Western Pacific, has played a significant role in the increased incidence of adverse health effects in many countries of the Western Pacific Region. In particular, studies have linked the high incidence of oral cancer in some western Pacific island countries to the concurrent use of betel nut and tobacco. This high incidence of oral cancer is associated with significant morbidity and mortality rates in some countries in the Region. The average worldwide mortality rate from oral cancer, based on a five-year cumulative mortality rate, is less than 50%; however, mortality rates as high as 67% and 80% have been reported for some countries in the Western Pacific Region.¹

It is now well-established that the habitual use of betel nut alone can lead to serious adverse health effects.² The use of betel nut with tobacco is increasing in many countries because of the aggressive marketing of tobacco products in combination with or alongside betel nut. Strong social norms also encourage the combination of betel nut and tobacco. Of particular concern is evidence that the use of betel nut and tobacco in some countries is increasing among youth and in some cases among women.³

In response to this growing health threat, the TFI commissioned the SPC to undertake a review of the use of betel nut and tobacco in the Western Pacific Region in 2006 and used the results to formulate the Regional Action Plan. In August 2010, the TFI convened in Manila, Philippines, bringing together international experts in tobacco control and focal points for tobacco from the countries in the Western Pacific Region that are known to have high prevalence rates of betel nut and tobacco use. The meeting provided participants with an opportunity to comment on and update the information contained in the review conducted by the SPC and to formulate recommendations to reduce the negative health consequences of betel nut and tobacco in the Region.

Those recommendations are presented in this addendum to the Regional Action Plan for the TFI in the Western Pacific Region (2010-2014). The full review, including current trends in betel nut and tobacco use in the Western Pacific Region, and a review of the current literature on the impact of betel nut and tobacco use on health, are included as appendices to this report.

The Regional Action Plan calls on Member States to formulate and strengthen national coordinating mechanisms and national action plans towards complete implementation of the WHO FCTC and sets targets and indicators for different levels of intervention. It contains both qualitative and quantitative indicators that are recommended to strengthen implementation of tobacco control strategies at the regional and country levels. These indicators have been used to map the specific action objectives in a *Platform for Action Towards the Control of Betel Nut and Tobacco Use*.

¹ (Barton et al. 2001; Parkin et al. 2005; Carpenter et al. 2005)

² IARC STRENGTHENS ITS FINDINGS ON SEVERAL CARCINOGENIC PERSONAL HABITS AND HOUSEHOLD EXPOSURES, International Agency for Research on Cancer, World Health Organization, Lyon France; Press Release No. 196; November 2009,

³ Ysaol, Y., Chilton, J.I., Callahan, P. 1996 'A survey of betel nut chewing in Palau', Journal of Micronesian Studies, Vol.4, pps. 244-255.



The prevention and control of tobacco-chewing with betel nut poses some unique challenges since the production and sale of betel nut are not regulated in most countries. Production of betel nut is encouraged in some countries as a commodity for both local consumption and for export and has become a significant source of income in some Pacific island countries. Therefore, addressing supply-side issues for betel nut control will require multisectoral collaboration among ministries of health and other sectors of government and community stakeholders.

This highlights the need for clear messages for both policy-makers and the public regarding the dangers of betel nut and tobacco use. Meeting these challenges requires recognition of the magnitude of the problem in each country and a mobilization of different sectors to take action. Participants at the August 2010 meeting on betel nut and tobacco use have recommended the following set of Key Messages to communicate the dangers of betel nut and tobacco use and to stimulate action for effective measures to address this serious public health issue:

Key Messages for Prevention and Control of Betel Nut and Tobacco Use

- Chewing betel nut causes oral cancer.
- Adding tobacco to betel nut-chewing greatly increases the risk of oral cancer.
- Measures need to be taken to discourage the use of betel nut with or without tobacco.
- A set of effective measures to discourage betel nut and tobacco use may include:
 - Policies and legislation
 - Education and advocacy
 - Strategies to promote behavioural change
 - Clinical services
 - Surveillance and research
 - Partnerships and alliances.

A Platform for Action

A clear framework for action that addresses both supply and demand for betel nut and tobacco products is needed in order to reduce the current trends towards increased use of betel nut and tobacco in the Western Pacific Region. The Platform for Action for the Control of Betel Nut and Tobacco Use, shown in Box 1, maps specific actions on six key Regional Action Plan indicators across four domains that include Social Determinants, Behavioural Risk Factors, Intermediate Conditions and End-stage Disease. Specific strategies from this list should be adopted based on each country's available resources and priorities. They should be included in National Action Plans for Tobacco Control and, as appropriate, in other national strategic plans such as those for non-communicable disease prevention and control, oral health care and health surveillance.



Box 1. Platform for Action for the Control of Betel Nut and Tobacco Use

Strategies	Social Determinants (Environmental, economic and sociocultural)	Risk Factors (Chewing betel nut alone; chewing betel nut with tobacco or other substances)	Intermediate Conditions (Oral leukoplakia and submucous fibrosis)	End Disease (Oral cancer, other tobacco-related cancers)
Legislation and policies	<ul style="list-style-type: none"> Regulate the sale of betel nut (e.g. laws restricting sales to minors) Establish import and export trade policies Establish laws and policies restricting betel nut use on school property, at health care facilities, etc. 	<ul style="list-style-type: none"> Implement relevant supply and demand reduction provisions of the WHO FCTC 	<ul style="list-style-type: none"> Mandate funding for oral screening and cessation services Establish guidelines for screening for precancerous conditions by oral health care providers 	<ul style="list-style-type: none"> Pass legislation to support cancer registries, including mandatory reporting of oral and other cancers
Governance and local enforcement	<ul style="list-style-type: none"> Enforce laws restricting sales of betel nut and tobacco products to minors Enforce anti-smuggling policies 	<ul style="list-style-type: none"> Include betel nut and tobacco control strategies within national and local action plans for tobacco control and establish targets to reduce prevalence 	<ul style="list-style-type: none"> Implement oral screening at all levels of the health care system 	<ul style="list-style-type: none"> Ensure accurate reporting from health care providers
Public awareness, education, communication and advocacy	<ul style="list-style-type: none"> Strengthen communication and advocacy activities in relation to changing social norms Use role models Support education and information campaigns that target youth and children Encourage citizens to monitor and report violations of bans on sales to minors 	<ul style="list-style-type: none"> Formulate and implement effective mass communication education regarding the dangers of betel nut and tobacco use, particularly the link to cancer Inform the public about where to get cessation services 	<ul style="list-style-type: none"> Educate the public about the early signs of these conditions and the importance of oral health exams for early detection 	<ul style="list-style-type: none"> Inform policy-makers that betel nut chewing causes oral cancer
Alliance and partnerships	<ul style="list-style-type: none"> Support multisectoral strategies to control betel nut production and the marketing of betel nut, especially in combination with tobacco products 	<ul style="list-style-type: none"> Actively share information with stakeholders about the health risks of betel nut use, with and without tobacco 	<ul style="list-style-type: none"> Mobilize dental associations to advocate for and expand training of providers to increase screening 	<ul style="list-style-type: none"> Mobilize cancer control advocates to support cancer registries and disseminate findings, lobby legislators and testify at hearings



Strategies	Social Determinants (Environmental, economic and sociocultural)	Risk Factors (Chewing betel nut alone; chewing betel nut with tobacco or other substances)	Intermediate Conditions (Oral leukoplakia and submucous fibrosis)	End Disease (Oral cancer, other tobacco-related cancers)
Tobacco dependence treatment	<ul style="list-style-type: none"> Work to ensure that appropriate cessation services are created and are promoted towards those who may wish to quit using betel nut and tobacco 	<ul style="list-style-type: none"> Ask about betel nut and tobacco use at every encounter with health workers 	<ul style="list-style-type: none"> Create effective referral systems for cessation services and treatment 	<ul style="list-style-type: none"> Use testimonials from individuals whose betel nut use led to oral cancer
Surveillance and knowledge management	<ul style="list-style-type: none"> Map social and economic determinants of betel nut use with tobacco 	<ul style="list-style-type: none"> Integrate questions about betel nut use into Global Tobacco Surveillance System and other national health risk behaviour surveys 	<ul style="list-style-type: none"> Support research to work out cost-effective techniques for screening and early detection 	<ul style="list-style-type: none"> Monitor and report morbidity and mortality from oral cancers Use the data for national health plans and noncommunicable disease prevention and control

Legislation and policies

The Regional Action Plan encourages countries to formulate legislation and related policies, regulations, ordinances, administrative issuances and other measures to ensure timely compliance with all provisions of the WHO FCTC. As a broad strategy, the WHO FCTC addresses both supply and demand reduction measures for tobacco products, and some of these measures also may be considered for the prevention and control of betel nut use.

Betel nut is commonly used in the Pacific island countries. Its regulation there has been almost exclusively limited to legislation or policies that ban spitting in public places, most notably in health care facilities and schools. The legislature in the Marshall Islands passed a law in 2010 banning the importation of betel nut and making it a crime to import, distribute or sell betel nut, backed by a fine of up to US\$ 100 and 30 days in jail.⁴ But the main reason cited by legislators for passing the law was that spitting from betel chewers was unsightly and might lead to the spread of disease.

Using the Key Messages contained in this report, tobacco control and other public health advocates actively should disseminate information to policy-makers about the serious threat that betel nut and tobacco use poses to public health. In terms of supply issues, policy-makers in the agricultural and economic development sectors of some western Pacific island countries have promoted the expansion of betel nut production as a viable commodity for both local and export markets.⁵ Tobacco control and public health advocates need to be proactive in communicating to planners and policy-makers that increased production of betel nut negatively impacts on the health and well-being of island populations and measures must be taken to identify economically viable alternative crops to betel nut.

⁴ Pacific Islands Report, Honolulu, March, 2010

⁵Federated States of Micronesia, Business Opportunities Report, Island Business Opportunities S. Lee, A. Ghandi, F. Eliptico; July, 2007; http://www.islandbusinessopportunities.com/links_resources/islands/FSM.pdf



There are some unique challenges in attempting to apply many of the WHO FCTC demand reduction measures to the control of betel nut use. Despite its classification as a Group 1 carcinogen by the IARC, betel nut in most countries is sold as an unregulated agricultural product. There is no packaging with labels to warn consumers about potential hazards to health and no taxation or pricing structure as commonly applied to substances known to be harmful to health. It is often sold in proximity to tobacco products, and in several countries tobacco products are sold in such a way as to accommodate their use in combination with betel nut (e.g. sales of single cigarettes). The lack of regulation of betel nut reinforces its acceptability and creates an environment that enables individuals to use it habitually.

In many areas, the high degree of social acceptability of betel nut use is likely to be the greatest challenge to implementing policies intended to reduce demand. Efforts to formulate demand reduction policies may need to be preceded by public education and awareness activities intended to convince people of the harmful effects of betel nut and tobacco use and then to mobilize support for demand reduction legislation and policies.

Governance and local enforcement

The Regional Action Plan calls for the implementation and enforcement of laws and policies through national coordinating mechanisms or their equivalent. Currently, such mechanisms may not be well-developed in many of the countries where betel nut and tobacco use are a major concern. Therefore, the formulation and implementation of national action plans should reflect specific measures to prevent and reduce the use of smokeless tobacco such as with betel nut.

In many Pacific island countries, governance for tobacco prevention and control activities may be folded into larger strategic plans for noncommunicable disease (NCD) prevention and control. Based on the large body of evidence linking betel nut use to the increased risk for many NCDs (Appendix B), enforcement measures for legislation and policies for prevention and control of betel nut use should be identified clearly in national action plans for tobacco and/or NCD control in all countries where betel nut use is common.

Countries should also formulate and enforce measures that will protect public health policies from commercial and vested interests of the tobacco industry. This is in accordance with WHO FCTC Article 5.3., which calls for full public disclosure by political leaders and policy-makers on any interaction with the tobacco industry. It is recommended that this be extended to include reporting of personal income gained from the sales and profit from betel nut in order to achieve transparency and accountability.

Two additional areas of governance include the formulation of clinical practice guidelines for screening for precancerous conditions by oral health care providers and establishing policies that will ensure accurate and timely reporting of oral cancer cases by health care providers.

There is some evidence that early detection of precancerous conditions (oral leukoplakia and submucous fibrosis) can lead to early treatment and prevention of oral cancer in many cases.⁶ The establishment of clinical practice guidelines for oral screening and support to apply them to appropriate settings will help to speed the broad implementation of such programmes in areas where they can be of benefit.

⁶ Sankaranarayanan, R. 1997 'Health care auxiliaries in the detection and prevention of oral cancer', *Oral Oncology*, Vol.33, No.3 pp.149-154



In most of the countries where betel nut and tobacco use is prevalent, accurate data on cancer is limited and there is a need for improved data to monitor the incidence of oral and other cancers. Very few countries in the Pacific have well-established cancer registries, although there has been significant collaborative work done in recent years to establish support for regional cancer registries which can serve smaller Pacific island nations.⁷ Establishing reporting requirements in statute is the best way to ensure consistent reporting by physicians to local or regional cancer registries.

Public awareness, education, communication and advocacy

Well-designed communication programmes can inform a variety of different audiences about the hazards of betel nut and tobacco use and interventions. The Regional Action Plan calls for the implementation of communication and advocacy activities in relation to changing social norms. This may be accomplished by using role models, supporting education and information campaigns that target youth and children and encouraging citizens to monitor and report violations of bans on sales to minors.

Successful health communication programmes involve more than the production of messages and materials. Ideally, they should use formative research to shape the development of key messages and determine the best channels that will deliver those messages to the right audiences.

On its own, a well-designed health communication strategy can increase the intended audience knowledge and awareness of a health issue and problem and increase the likelihood that the target audience will take action. It may also help to strengthen organizational relationships.

When combined with the other strategies contained in this document, health communication can lead to a sustained change in which an individual adopts and maintains a new health behaviour or an organization adopts and maintains a new policy direction.

Target audiences may include individuals, groups, organizations or whole communities, and communication strategies may use a wide range of strategies to design programmes to fit specific circumstances. The Platform for Action in Figure 1 shows a range of topics for public awareness, education, communication and advocacy as they relate to social determinants (e.g. changing social norms), understanding the health risks of betel nut and tobacco use, knowledge about the importance of early screening and detection and clearly communicating health data to policy-makers.

Regardless of the topic, certain attributes can make health communication campaigns more effective. The guidelines shown in Box 2 can be helpful in planning effective health communication campaigns and strategies.

⁷ <http://pacificcancer.org/Cancer/CaResources/PRCCR/>



Box 2. Characteristics of Effective Health Communications Campaigns

Define the communication campaign goal effectively:

- Identify the larger goal
- Determine which part of the larger goal could be met by a communication campaign
- Describe the specific objectives of the campaign; integrate these into a campaign plan

Define the intended audience effectively:

- Identify the audience to whom you want to communicate your message
- Consider identifying subgroups to which you could tailor your message
- Learn as much as possible about the intended audience; add information about beliefs, current actions and the social and physical environment to demographic information

Create messages effectively:

- Brainstorm messages that fit with the communication campaign goal and the intended audience(s)
- Identify channels and sources that are considered credible and influential by the intended audience(s)
- Consider the best times to reach the audience(s) and prepare messages accordingly
- Select a few messages and plan to pretest them

Pretest and revise messages and materials effectively:

- Select pretesting methods that fit the campaign's budget and timeline
- Pretest messages and materials with people who share the attributes of the intended audience(s)
- Take the time to revise messages and materials based upon pretesting findings

Implement the campaign effectively:

- Follow the plans formulated at the beginning of the campaign
- Communicate with partners and the media as necessary to ensure the campaign runs smoothly
- Begin evaluating the campaign plan and processes as soon as the campaign is implemented

*Adapted from "Making Health Communications Programs Work", U.S. Department of Health & Human Services, Public Health Service, National Institutes of Health, National Cancer Institute



Alliance and partnerships

Working with relevant stakeholders is recognized as one of the keys to achieving comprehensive and sustainable tobacco prevention and control. In the countries where betel nut and tobacco are commonly used, alone or in combination, tobacco control advocates should forge strong alliances that can advocate for a range of prevention and control strategies.

Partnerships should be forged among policy-makers, enforcement agencies, nongovernmental groups and professional organizations to address the need for stronger controls on the marketing and sale of betel nut in combination with tobacco products, especially to minors. In particular, tobacco control advocates should remind all partners that the WHO FCTC requires parties to adopt and implement a range of effective measures to prohibit the sale of tobacco products to minors and that this extends to the prohibition of the sale of cigarettes individually or in small packets, which increase the affordability of tobacco products to minors. These should include multisectoral partnerships with governmental agencies and community groups to explore viable alternative crops to betel nut.

Tobacco control advocates also should form and strengthen alliances and partnerships with professional organizations, particularly regional and national medical and dental associations that can serve as advocates for policies, programmes and practises to prevent and control betel nut and tobacco use. For example, the Papua New Guinea Medical Society began advocating in 2009 for the regulation of chewing and selling betel nut.⁸ These groups can also help in advocating for training of oral health care providers to increase screening and for improved data collection and reporting on the impact of betel nut and tobacco use.

Tobacco dependence treatment

Individuals who use tobacco products should be offered assistance to quit, and this assistance should be extended to those who chew betel nut with or without tobacco. The Regional Action Plan recommends that treatment of tobacco dependence be integrated into the health care system, with particular emphasis on primary health care. This includes asking every patient about tobacco use, providing brief advice about the dangers of betel nut and tobacco use and offering help to quit at every patient encounter. This should include dental care and, where appropriate, may be conducted in other community settings.

This may require training for primary health care workers and other stakeholders to provide brief cessation advice and working to secure appropriate health care financing for tobacco dependence treatment services. The *Guidelines for the Implementation of Article 14 of the WHO FCTC (Demand Reduction Measures Concerning Tobacco Dependence and Cessation)* will be a helpful reference for formulating cessation treatment services.⁹

Whenever possible, patients who are interested in quitting should be referred to more intensive counseling services that can increase their likelihood of quitting successfully. Appropriate mass media and educational materials should be designed to target both betel nut and tobacco users so as to ensure they know about available cessation services. An effective way to do this is to include testimonials from role models in the community who have successfully quit using betel nut or betel nut with tobacco.

⁸ PNG Post-Courier, Feb. 11, 2009, <http://www.indigenousportal.com/Health/BETEL-NUT-CHEWING-DEADLY-IN-PAPUA-NEW-GUINEA.html>

⁹ Parties are directed to the WHO FCTC web site (<http://www.int/fctc/>) where further sources of information on topics covered by these guidelines are maintained.



Surveillance and knowledge management

The accumulation of reliable adult and youth tobacco use data by 2014 is one of the overall indicators contained in the Regional Action Plan. Given the close association between betel nut and tobacco use in some countries of the Western Pacific Region, it is strongly recommended that these countries continue to gather reliable data on the use of betel nut among adults and youth and by gender. While many countries collect information on betel nut use through national surveys, there is no standardization of data collected on betel nut use, making comparisons among countries difficult. Through its technical support to countries to implement the Global Tobacco Surveillance System, the TFI can work with countries to formulate appropriate standardized questions about betel nut use with and without tobacco.

Countries also should use a variety of mechanisms to collect data that will help in mapping social and economic determinants of betel nut use with and without tobacco and ensure that data is linked to programmes, policies and health outcomes.



Annexes





Betel Nut and Tobacco Use: Origin, History and Current Trends

Betel (areca) nut

The use of psychoactive substances is an integral part of life in many societies (McDonald 1998). Psychoactive substances can be defined as those that change the way we think or feel (McDonald 1998). Pacific island communities traditionally have used substances such as tobacco, betel nut, coffee and kava as part of the social fabric of their societies. It has been estimated that 10%-20% of the world's population, or about 600 million people, use betel nut in some form (Gupta & Warnakulasuriya 2002). The habit of chewing betel nut is thought to have originated in South East Asia, most probably in Malaysia (Norton 1998).

While there are several varieties of Areca palm, the betel nut collected for chewing comes from the family known botanically as *Areca catechu* (Artero & Santos 2000). The cultivated Areca species is thought to have originated in the Philippines (Gowda 1951). It is probable that the Areca palm and the habit of using betel nut subsequently was spread to the southwestern Pacific by the makers and traders of Lapita pottery, about 3600 years ago (Lebot et al. 1992).

The Areca palm is a tall, slender tree which grows from 12-30 metres high. It can grow in a variety of soils, but grows and fruits poorly at altitudes above 1200 metres (Jamrozik 1985). The type of betel nut grown varies among regions. The nuts differ not only in appearance but also in flavour and strength. For example, the betel nuts from Guam and Saipan have a pink interior and are nonfibrous whereas nuts from Palau and Yap have a very fibrous coat and have a red interior. New palms start producing nuts after four to seven years, and the nuts can take between six and eight months to ripen (Artero & Santos 2000).

The raw cultivated nuts are used as a mild stimulant at all stages of ripening -- from young, green nut to old, dry and germinating nut (Thomas & MacLennan 1992). There is significant geographical variation in preferred usage, both within and among countries. Commonly, betel nut is chewed in combination with the leaf or fruit of a pepper plant (*Piper betle*) and lime powder. The common name "betel nut" originated from the association of chewing betel nut with the *P. betle* leaf. The term "betel quid" refers to the mixture of the betel nut, part of the betel pepper vine and lime. Other ingredients -- spices such as cardamom and cloves or tobacco -- may be added to the betel-quid to enhance the flavor or physiological effects. The quid, consisting of the betel nut, lime and other ingredients, may be wrapped in *P. betle* leaf or left unwrapped with the ingredients being added separately to the mouth.

While the Areca palm and *P. betle* vine grow in more southern regions, the Solomon Islands and the northern islands of Vanuatu is the southernmost extension of the betel nut chewing habit.

Prevalence of betel nut chewing

The use of betel nut has been well-documented throughout history within many societies in the Western Pacific Region. There is evidence that betel nut has been chewed in Guam and the Commonwealth of the Northern Mariana Islands for at least 2000 years (Pietruszewsky 2005) and in Solomon Islands for at least 1000 years (Alependava 1992). Evidence exists of a centuries-old tradition of chewing tobacco with betel nut in Cambodia (Reichart 1996).

Historically significant variations in the prevalence of betel nut chewing have been demonstrated within the Western Pacific Region. Betel nut traditionally has not been grown in the Marshall Islands and Kiribati and betel growth in Vanuatu is restricted to the Northern Province. The use of betel nut in these countries has not been traditional.



The tobacco industry has targeted the Pacific region to increase sales as smoking prevalence decreases in higher income countries. Consumption of tobacco in the Pacific region increased by 15% between 1988 and 1992 (Leung 1995). This occurred despite the adverse health effects of tobacco consumption being well-known throughout the Pacific (Marshall 1991). The tobacco grown in the Pacific is not sufficient to meet this increased demand and a significant amount of the tobacco used in the Region is imported either as manufactured cigarettes or twist tobacco (Brott 1981).

Current trends in usage of betel nut with tobacco

Within the Western Pacific Region, the frequency and method of betel nut use shows distinct geographical variation, both within and among countries. However, the major ingredients -- the betel nut, *P. betle* leaf and lime -- are relatively constant. The ingredients may be wrapped together and placed in the mouth as a whole or may be added individually (unwrapped quid). In Solomon Islands and Papua New Guinea, unwrapped quid is universal whereas wrapped quids are more common in the Federated States of Micronesia and Cambodia.

The betel nut provides the mild stimulant effect of the quid. The nuts are ovoid in shape with a pointed apex usually 3-5 cm in length and 2-4 cm long (IARC Monograph 2004). The outer fibrous shell is removed and the kernel is either chewed whole or split into smaller pieces before chewing (IARC Monograph Vol.85 2004). The shell of the nut may be chewed or used for cleaning teeth. It is reported to have a sweet taste and a mild stimulant effect and is used more commonly by women and children (Wilson et al. 1983).

The betel nut contains nine known alkaloids which are released on mastication (Farnworth 1976). Arecoline is the most abundant alkaloid with arecaidine, guvacine and guvacoline occurring to a lesser degree. Other constituents include protein, carbohydrates and copper. A comprehensive list of constituents can be found in the IARC Monograph (IARC Monograph Vol. 85, pp. 48).

The fine, white lime powder used in betel nut chewing is usually obtained from locally available sources. Commonly, it is produced by burning coral rock, sea coral or shells (Wilson et al. 1983). The product that remains after the burning and cooling process is used for the lime powder (calcium oxide or quicklime). Water then may be added to produce slaked lime (calcium hydroxide). The lime is hygroscopic and must be kept in sealed containers. The type of lime and the specific techniques used to reduce the source material show regional variation. Commercially produced builders lime also may be used in the betel quid (MacLennan et al. 1985).

In Papua New Guinea, the betel nut is placed in the mouth first. After it has been chewed for a few seconds, the lime is added to the mouth using a spatula or the betel pepper inflorescence. In other areas, the betel nut is cracked, covered with a thick layer of lime powder or paste and wrapped in betel leaf before chewing (Gupta & Ray 2004).

The lime powder is used to enhance the stimulant effect of the betel nut. This occurs as it hydrolyses the arecoline from the nut to produce the central nervous stimulant, arecaidine (Norton 1998).

Parts of the *P. betle* vine are added to the quid to enhance its flavour. The betel vine has edible leaves, stems and inflorescence that contain phenols which produce a spicy flavor (IARC Monograph Vol. 85 2004). Most commonly, the fresh green leaves of the vine are used in the betel quid. However, the dried leaves or part of the vine stem are used when the green leaves are unavailable. Conversely, in Papua New Guinea, the inflorescence of the female plant is the most frequently used part of the *P. betle* vine (Wilson et al. 1983).

When betel nut, lime and *P. betle* leaves are chewed together in the quid, the resultant chew turns bright red. During mastication, reddened fragments and saliva are either swallowed or spat out. The residual chew is usually spat out.



While betel nut use has been demonstrated for a long time in Guam among the Chamorro people, the usage patterns have changed. Before the 1800s, betel nut commonly was chewed as part of a “quid,” including the *P. betle* leaf. However, change occurred in the 1900s when chewing hard, ripe nut became the norm (Paulino 2009).

In Papua New Guinea, the use of unwrapped betel quid has been common in the coastal areas since that is where the Areca palm grows (McDonald 1998). Unwrapped quids without tobacco also are universal in Solomon Islands. Wilson et al. (1983) reported that betel nut and tobacco use in Solomon Islands was common at all levels of society, with most islanders having chewed betel nut at some time in their life. They estimated that more than 50% of adults chewed at least once a week. Both women and men were as likely to chew betel. But men had a lower age of initiation and were heavier users. Young children commonly chew the betel nut husk then progress to chewing betel nut. The regular chewing of betel quid was not commonly observed before puberty. The use of lime is common but not universal (Wilson et al. 1983).

The betel nut chewing habit was introduced to the Northern Province of Vanuatu in the 1950s during the evangelization of the region by elders of the Anglican Church, who previously were based in Solomon Islands (Jean-Jacques Rory, pers.comm.).

Commenting on the role of betel nut in traditional societies in the Pacific, Marshall (1987) states that “betel is used in informal interpersonal exchanges, in formal presentations, in ceremonials and rituals, in decorations and ornamentation, in trade and commerce, in magic and sorcery, and in medicinal preparations” (Marshall 1987, pg. 21). Yap elder statesman John Mangafel, commenting on the role of betel nut in consensus politics, said, “Stopping and chewing betel nut, means to consider and think how to reach consensus so there’s no ill-feeling”. This is his interpretation of the old Yapese phrase, “Wisdom comes out of the betel nut basket”. (Cited, Johnson Feb. 2005).

Currently, the use of betel nut is widespread in parts of Melanesia, principally Papua New Guinea, Solomon Islands, the Northern Province of Vanuatu and in the Federated States of Micronesia, particularly in Guam, Palau, the Commonwealth of the Northern Mariana Islands and the Marshall Islands. Melanesia is a region that includes most of the islands north and northeast of Australia. In Cambodia, the betel nut is predominantly used in rural regions.

Introduction of tobacco

Tobacco (*Nicotiana tabacum*) was not known in Pacific island communities before European contact (Marshall 1991). Evidence suggests that tobacco first was cultivated in the Philippines in 1600 by the Spanish (Gilmour 1931) and both the Dutch and Portuguese introduced tobacco to Java in 1601 (Gilmour 1931; Haddon 1947). Tobacco was introduced to Papua New Guinea by Malay traders (Brady 2001; Hays 2003; Marshall 1987). Once introduced there, it was swiftly distributed via trade channels and became a major medium of exchange (Marshall 1987).

Tobacco subsequently spread throughout the Pacific along with European contact. It was transported from Manila to Guam by the Spanish colonizers of what is now the Commonwealth of the Northern Mariana Islands in the late 17th century (Marshall 2005). From Guam, tobacco plants and the methods used for smoking it were distributed widely to other parts of what today is the Federated States of Micronesia (Marshall 2005).

The tobacco plant thrived in many regions of the Pacific with its warm climate and fertile soils, for example, on Chuuk’s high volcanic islands and in Papua New Guinea and Solomon Islands. By the end of the 19th century, techniques for growing and smoking tobacco were well established and it was traded whenever the opportunity arose (Marshall 1987, p. 32). Tobacco is frequently shared or exchanged as a way to demonstrate generosity and cement friendship and kinship ties (Kooijman 1962; Weiner 1976; Marshall 1987). As tobacco became integrated into Pacific island cultures, its manufacture and consumption increased.



Betel nut used in combination with tobacco

Tobacco is used with betel nut in one of two ways. It is either added to the betel quid or a smoking habit coexists with the betel nut chewing habit. In Melanesia, tobacco is not added to the betel quid. However, betel nut chewers may smoke tobacco, often at the same time as chewing the nut. In parts of the Federated States of Micronesia and Cambodia, tobacco is commonly added to the betel quid.

The tobacco added to the betel nut chew may be either loose tobacco or a section of cigarette inserted into the cracked nut before it is coated in lime and wrapped in the leaf. The use of lime lowers the intraoral pH, thereby enhancing the stimulant effect of the nicotine in the tobacco (Cawte 1985).

Social importance of betel nut

The long-established habit of betel nut use is integral to community life in many Western Pacific Region countries. It is a socially approved habit that is incorporated into both ceremonial situations and routine aspects of daily life. In addition, the reciprocal gifts of the ingredients contribute to the reinforcement of community links (MacLennan 1991). “In practical terms it is an affordable activity that meets the needs of its users at various levels, and has therefore maintained its status in the village despite negative external reactions to it” (Anne Ring, cited in MacLennan 1991, p.10).

Initially, the use of betel nut and tobacco was controlled by social norms. These norms governed the people who could use betel, the situations in which it was used and the ingredients that were added to the quid. Use was frequently restricted to elders and high-ranking members of society. In Papua New Guinea, there were various restrictions on the use of betel. For example, premenopausal women and young men of Gnau (Southern Madang Province) were not permitted to use lime with betel nut while Garia women were not permitted to chew betel nut until the 1960s. (Brunton 1989) Recent studies and observations suggest these social restrictions are no longer strictly observed.

The Secretariat for the Pacific Community (SPC) conducted Key Informant interviews in 2005 in several Pacific island countries where betel nut and tobacco are commonly used, including the Commonwealth of the Northern Mariana Islands, the Federated States of Micronesia, Guam, Palau, Papua New Guinea, the Marshall Islands and Solomon Islands. Those surveyed predominantly worked in the health sector, although employees of other sectors such as youth affairs and cultural affairs also were included in the interviews.

The social importance of betel nut use was examined through questions about the importance of betel nut use to the country and the changes observed in betel nut use within the last 10 years.

Of the respondents, 68% (15 of 22 people) replied that betel nut was culturally significant in their country. Several respondents replied that they considered that betel nut was not culturally significant because it no longer was used in traditional ways. One respondent considered that it was just a recreational habit that had been adopted from other cultures.

The changes observed by respondents over the last 10 years included an increase in the number of people using betel nut (81% agreed or strongly agreed) and an increase in the use of betel nut by young people (76% agreed or strongly agreed). Other indicators suggested an increase in the overall use of betel nut. For example, responses such as “it is more common to see red saliva patches on the street” (95% agreed or strongly agreed) and “betel nut is more readily available in the market” (all respondents agreed or strongly agreed).

In response to the question about whether people are now more likely to chew betel nut with tobacco, 48% agreed or strongly agreed. This result may not accurately reflect the current use of tobacco with betel nut in Melanesia since it is more common to smoke while chewing betel nut. Two respondents did agree with this statement, adding that they have observed an increase in smoking rather than chewing tobacco with the betel quid.



Studies and Observations

Cambodia

Significant sex and regional variation in tobacco use was reported in a recent study aimed at identifying the demographic characteristics of current tobacco users in Cambodia (Singh et al. 2009). Generally, cigarette smoking was more commonly reported in men (48.0%) as opposed to women (3.6%). However, women were much more likely to use chewing tobacco. It was estimated that 560 482 women (95% confidence interval, CI) currently chewed tobacco, typically as a component of betel quid. The prevalence of chewing tobacco more than doubles with each decade of adulthood up to the point that about half of all older women chew tobacco.

Both men and women cited the influence of older relatives as their main reason for starting to use tobacco. About one out of five rural women who used chewing tobacco started their habit for relief from morning sickness. The highest prevalence of chewing tobacco among women was seen among traditional birth attendants (67.9%) and traditional healers (47.2%). High rates (66.8%) of cigarette and pipe tobacco use occurred among ethnic minorities who represent hill tribes found throughout South East Asia.

The Commonwealth of the Northern Mariana Islands

The variety of Areca grown in the Commonwealth of the Northern Mariana Islands has a soft nonfibrous coat, so it is easier to chew alone than other varieties of Areca. However, Lee (1990) reported it was becoming common to add tobacco to betel quid containing *P. betle* leaf and lime. Other ingredients added to the chew to make it more palatable, including condensed milk (Joanne Ogo pers. comm.).

A recent unpublished study revealed that 90% of survey participants chewed betel nut in association with tobacco (Cabrera, in prep). Nearly all survey participants were initiated into betel nut use at about 12 years old. Initial use of betel nut was without tobacco, although tobacco was usually added to the chew about two years later. The onset of dependence on betel nut with tobacco was reported by many respondents (mean age of 15.6 years).

The 2000 Commonwealth Youth Tobacco Survey (CYTS) reported nearly 55% of middle school students and 85% of high school students had tried cigarettes, with nearly 10% of middle school students and 30% of high school students being regular smokers. In the previous 30 days, one third of the students reported to have chewed betel nut with tobacco (33.9% of high school and 34.7% of middle school students), with 30.0% of high school and 11.4% of middle school students chewing betel nut with tobacco during at least 20 of the past 30 days (CYTS 2000).

The Federated States of Micronesia

The Federated States of Micronesia (Pohnpei) Noncommunicable Diseases (NCD) Risk Factors STEPS (2008) reported on betel nut chewing among adults. About 29.9% of the total population reported chewing betel nut, with significantly more men (43.5% \pm 5.9)¹ than women (16.0% \pm 3.0) currently chewing betel nut. For both genders, the highest proportions of betel nut chewers were in the youngest age group, 25-34 years (men: 67.0%; women: 28.0%), declining thereafter with increasing age (the Federated States of Micronesia NCD 2008).

Overall, 26.9% of the population used betel nut daily. The highest proportion of daily betel nut chewers were in the 25-34-year age group (44.0%). Men reported a significantly higher proportion of daily betel nut chewing than women, 39.2 % (\pm 5.9) and 14.4% (\pm 3.1), respectively.

¹ 95% Confidence Interval



Among the current betel nut chewers, the mean number of nuts chewed at any one time was 1.3, with no significant difference between men and women. On average, adults chewed betel nut 14 times per day, with no significant gender difference between men and women (men 15.2 \pm 2.1 times and women 10.7 \pm 2.5 times, respectively).

The Federated States of Micronesia 2007 Global Youth Tobacco Survey (GYTS) of 2670 school students in grades 7-11 reported nearly half of the students currently use some form of tobacco 47.3% product (male 54.6%, female 38.7%) with one third of students currently smoking cigarettes (29.6% male, 37.1%, female 21.0%). Most students (86%) who currently smoked reported they wanted to stop (the Federated States of Micronesia GYTS 2007)

A study conducted on Ulithi Atoll in Yap into the health issues facing the isolated outer islands of the Federated States of Micronesia reported that 81% of people over 15 years old chewed betel nut there (Hancock et al. 2007). Only 24% of those using betel nut used the traditional mixture of betel nut, lime and pepper leaf, while 76% percent added tobacco to their betel nut. Most of those that added tobacco (71%) soak it in alcohol first, and this was more common on Mogmog (Hancock et al. 2007).

Guam

Recent data from the 2007 Guam Behavioral Risk Factor Surveillance System (BRFSS) identified two types of betel nut chewing behaviours: Chamorros who chewed the ripe, red nut and subsequently swallowed the nut and other Micronesians who chewed the unripe nut with lime and tobacco and did not swallow the betel nut (Paulino 2009).

The way betel nut is used appears to be changing among Guamians. A summary of the Youth Risk Behavioral Surveys (YRBS) between 1999 and 2003 showed that a significant percentage of school students chewed tobacco with betel nut. Chewing tobacco is highest among Micronesians (21.7% of high school and 31.7% of middle school students in 2003), and usage is increasing among Chamorro high school students (from 3.7% in 1999 to 6.8% in 2003). Recent qualitative studies on Guam revealed that while migrants from Chuuk had no tradition of betel use, this habit was adopted from other Micronesian students when they left home for schooling (Paulino 2009).

The YRBS in 2003 reported on smoking prevalence among high school students: 75.6% had tried smoking and 31.6% had smoked in the last 30 days. This mirrors the high rate of smoking among Guamanian adults, which is reported to be the highest among all U.S. states and territories (Guam's Epidemiological Workgroup, 2006).

Kiribati

In the 2009 Kiribati GYTS, 1461 school students aged 13-15 years were interviewed. Significant numbers of students reported currently using tobacco in some form, i.e. 19.8% of students were current cigarette smokers and 31.2% of students currently use other forms of tobacco (Kiribati GYTS 2009). A significant percentage of school students (68.3%) were exposed to tobacco smoke at home. Most students (92.3%) stated that cigarette smoking was probably or definitely harmful to health (Kiribati GYTS 2009).

A recent change in the use of chewing tobacco has been identified among the youth of Kiribati: that of chewing tobacco with immature green coconuts (Kireata Ruteru, pers. comm.).

Papua New Guinea

Some dramatic changes have occurred in Papua New Guinea in the use of betel nut and tobacco. Areca palms only grow and fruit well below 1200 metres and therefore betel nut chewing was not a traditional feature of highland societies. Before road links, planes were chartered to transport betel nut from the Sepik River plantations to the highlands. Trade in betel nut significantly increased with the improvement of the road system linking highland and coastal areas (Freeman 2001).



In a recent study into the impact of drug use in three provinces in Papua New Guinea, (National Capital District, Western Highlands Province and East Sepik Province), Baldwin et al. (2007) reported 89.6% of respondents had tried betel nut, with 11.7 years old being the average age of their first try. No difference was reported between men and women in betel nut usage. Common reasons for using betel nut were “people reported wanting to have a red-coloured mouth” and that “everyone else was doing it” (Baldwin et al. 2007).

The WHO STEPS survey conducted by HOPE worldwide (Papua New Guinea) during the period March 2007 to March 2008 in five regions in Papua New Guinea (National Capital District, Manus, Gulf, Madang and Simbu) surveyed adults about various risk factors for chronic disease and reported 79% (95% CI 77.8%-80.3%) of respondents were current betel nut users, with the mean number of times betel nut was chewed during a day being 5.5 (95% CI 4.9%-6.2%). The results were similar for both males and females. Betel nut was most commonly used with lime and mustard (78.3% of all betel nut users). While 44% of all respondents reported being current tobacco users, significantly more men (60.3%) than women (27.0%) reported using tobacco. The mean age of initiation of smoking was also younger in men, i.e. 17.9 years as opposed to 19 years for women (HOPE worldwide (Papua New Guinea, 2010).

Palau

Ysaol et al. (1996) surveyed 1110 Palauans and reported 55% of those aged 5-14 years and 86% of those aged 35-44 years chewed betel nut. Cigarettes were added to the betel nut by 80% of users and 24% added other tobacco.

Chewing was more prevalent with increasing age and educational status. Women were more likely to add tobacco to the quid (84% as opposed to 81% of men); the use of lime was universal. No significant difference was demonstrated in tobacco usage in the chew among age groups, with the youngest age group interviewed (5-14 years) reporting 87% usage of tobacco. They concluded that each year more than 1.21 million packs of cigarettes were consumed in association with betel nut chewing (Ysaol et al. 1996).

The use of piper leaf was less common among young people, probably to avoid red discoloration of the saliva and thereby disguise their betel nut use or because it was more cosmetically acceptable (Ysaol et al. 1996).

More recent Palau Youth Tobacco Surveys (PYTS) from 2001, 2005 and 2009 measured betel nut and tobacco use in school students. Although less than previous years, very high usage of betel nut was demonstrated in 2009, with 62.9% of middle school students (82% in PYTS 2005) and 74.8% of high school students (78.1% in PYTS 2005) having ever tried betel nut. Use was significantly higher among students of Palauan origin than other students (PYTS, 2009).

The 2009 survey reported 52.2% of high school students usually added tobacco to the chew (down from 61.1% in 2005), with the vast majority of students using cigarettes as the source of tobacco (PYTS 2009). Over one third of students using tobacco with betel nut had experienced cravings within three hours of their last chew.

These studies support the findings of the report questionnaire in which respondents from Palau considered that betel nut was no longer used in the traditional cultural context.

The Marshall Islands

In the Marshall Islands, the habit of betel nut use has grown recently after initially being introduced by betel nut users migrating from other Micronesian islands. The Areca nut palm is not widely grown in the Marshall Islands (although some palms exist) and betel nut is principally imported. With the rapid adoption of the betel nut habit, the social controls evident in traditional use do not seem to have been



adopted (Emi Chutaro pers. comm.). Commonly, the betel nut is chewed as part of the betel quid, with the habit being increasingly accessorized, i.e. users have special implements and bags for using and transporting the quid.

According to the 2007 Marshall Islands NCD Risk Factors STEPS Report, 4.5% of the total population use betel nut daily, with the highest proportion of users in the 25-34 age group (9.3 % \pm 3.8). Overall, 8.1% (\pm 3.6) of male respondents were daily chewers, but the majority (90.2% \pm 3.5) were non-betel users. The highest proportion of daily betel chewers (17.0% \pm 6.6) was reported in the 25-34 age group. Females were less likely to chew betel nut, with 97.9 being non-betel users (the Marshall Islands NCD 2007).

Solomon Islands

The Solomon Islands NCD Risk Factor STEPS 2010 reported 62.6% (\pm 8.0) of respondents had chewed betel nut in the past 12 months, with the largest proportion of chewers (69.2% \pm 7.9) in the 25-34 age group. Rates of betel use remained relatively constant in the age groups 35-44 and 45-54, but declined in the 55-64 age groups. Significantly, more men (67.8%) than women (57.3%) had chewed betel nut in the past 12 months.

Overall, 30.0 % (\pm 5.1) of the population were daily chewers, with the highest proportion of daily betel chewers (32.5% \pm 5.3) being in the 25-34 age group. Among current daily betel chewers, the mean age of starting betel use was younger in men (20.4 (\pm 1.1) years) than women (21.5 (\pm 0.7) years). This was reflected in the mean number of years of betel nut use being slightly longer in men (17.5 \pm 1.3 years) than women (16.4 \pm 1.2 years). However, women in the 55-64 age group reported starting at a younger age than men.

A higher percentage of youth aged 15-24 years reported betel nut use, with 77.5% (\pm 8.3) of men being current betel nut chewers compared with 66.3% (\pm 5.9) of women. Both genders reported starting betel use at a younger age than all other age groups (15.2 \pm 0.7 years) and having used betel nut for a mean of 5.3 (\pm 0.6 years). A significant percentage of youth were daily betel nut chewers, (34% \pm 8.9 of men and 20.9% \pm 5.9 of women), (Solomon Islands NCDRF 2010).

Vanuatu

Habitual use of betel nut is mainly restricted to the Northern Province of Vanuatu with people from Malaita, Makira, Guadalcanal and Temotu being cited as the heaviest users. The Vanuatu GYTS (2007) school-based survey of 1900 students in grades 7-9 reported over one fourth of students currently use tobacco in some form, with 18.5% of the students smoking cigarettes and 14.3% using some other form of tobacco (male = 14.8%, female = 12.0%). Three fourths (74.4%) of the current smokers reported wanting to quit smoking. A high percentage of students (65.1%) reported being offered a free cigarette by a tobacco company representative.

Various studies have been conducted in the Western Pacific Region to measure the prevalence of betel nut use and tobacco use. The results of these studies are summarized in Table 1.



Table 1. Summary of results of studies on the use of betel nut and tobacco in the Western Pacific Region

Country	Study & Year	Sample size	Surveyed Group	Betel nut (% using)	Tobacco (% using)	Additional information
Cambodia	Singh et al. 2009	13 988	Adults 18 years and older		Currently using tobacco, women 49% (cigarette 3.6% chewing 17%) men 49% (cigarette 48%, chewing 1%)	Marked sex and regional variation of chewing tobacco, 43.4% ,women over 48years old and 48% of rural women. Highest users were rural Traditional birth attendants, 67.9%
	GYTS, 2003	2011	Youth aged 13-15 years		8.8% currently use any tobacco product (male 11.4%, female 3.2%) 5.5% currently smoke cigarettes (male 7.9%, female 1.0%) 4.2% currently use other tobacco products (male 4.8%, female 2.5%)	
	National Institute of Statistics. Cambodian Socioeconomic Survey, 2007	3600 households			30% of men over 15 years old smoke daily 20% of rural population smokes 5% of Phnom Penh population smokes	Higher smoking prevalence in rural areas
	National Institute of Statistics. Cambodian Socioeconomic Survey, 2004	15 000 households	over 14 years		40% Cambodian men over 14 years smoke 4% women smoke	
	National Institute of Statistics. Cambodian Socioeconomic Survey, Phnom Penh1999	6000 households			4.5% were regular smokers, male 8.1%, female 1.1%	



Country	Study & Year	Sample size	Surveyed Group	Betel nut (% using)	Tobacco (% using)	Additional information
Commonwealth of the Northern Mariana Islands	YRBS 2007	2292	High school students		31.1% currently smoked cigarettes 78.1% have ever smoked cigarettes	5.9% smoked more than 10 cigarettes a day, 74% of whom had tried to quit smoking. Many risk factors surveyed, including use of alcohol and drugs
	Oakley, Demaine et al. 2005	309	Cross-sectional study of school children	63.4% regular users of betel nut	24.9% smoked tobacco 17.5% chewed tobacco	Oral lesions present
	Factors Associated with Nut Use – study conducted 2005, Cabrera, unpublished	41 nut chewers	Adults recruited from public health clinic	Participants selected as they- used betel nut	90% chew tobacco with nut, 16% of whom also smoke	Mean age of initiation - betel nut 12.2 years, and with tobacco 14.5 years
	Youth Tobacco Survey 2000	2809	Middle (MS) and high school (HS) students	77.2% HS and 64% MS have tried betel nut 33.1% HS and 34.7% MS had chewed betel nut with tobacco in last 30days	39.2% currently smoke 52.7% currently using other tobacco products	Environmental smoke exposure. Means of obtaining cigarettes and age at first trying smoking, chewing tobacco and chewing betel nut
	YRBS 1993		School students from grades 7–12		52% of grade 12 students smoked	Ethnic variation also cited – 27% of Carolinian youth and 42% of Chamorro youth smoked.
	The Commonwealth of the Northern Mariana Islands household survey 1981	150 households		81% Carolinians and 29% of Chamorros chewed betel nut	62% Carolinian adults smoke cigarettes	Ethnic variation in chewing patterns



Country	Study & Year	Sample size	Surveyed Group	Betel nut (% using)	Tobacco (% using)	Additional information
The Federated States of Micronesia	GYTS, 2007	2670	School children grades 7-11		Ever smoked 46.4% (male 55.7%, female 36.0%) 47.3% current users, any tobacco male, 54.6%, female 38.7% 29.6% currently smoke cigarettes, male 37.1%, female 21.0% Currently use other tobacco products, 37.5%; male 44.2%, female 30.4%	
	The Federated States of Micronesia (Pohnpei) NCD STEPS Survey, 2002	1638 selected using random cluster sampling	Adults aged 25-64 years	29.9% currently chew betel nut (men: 43.5% women: 16.0% both sexes: 29.9%) 26.9% daily betel nut chewer (men: 39.2% women: 14.4%)	31.6% Current Smoker (men: 42.0% women: 21.0%) 25.5% daily smokers (men: 34.8% women: 16.1%)	
	Pohnpei Youth Health Behaviour and Lifestyle Survey Phongsavan et al. 2005	507	Students aged 13-15 years		19.6% boys and 17.3% girls smoked cigarettes at least weekly	Use of kava, methylated spirits and marijuana
	Pohnpei Nutritional survey, Corsi 2004	293 adult women	Food patterns in adult women	36.8% used betel nut during the previous week	34.7% used tobacco during previous week	
	Ulithi Atoll, Yap Health Assessment, Handcock, et al. 2007	301		81% use betel nut; of chewers, 76% added tobacco	55% of respondents over 18years smoked, 2% of those under 18 years smoked	71% of betel nut chewers who used tobacco, dipped chew in alcohol before chewing



Country	Study & Year	Sample size	Surveyed Group	Betel nut (% using)	Tobacco (% using)	Additional information
	SPC/Chuuk Dept of Health 2002	444	Nutritional Survey	31% used betel nut or snuff	18.7% smoked tobacco	
	UNICEF Health Behaviour and Lifestyle of Pacific Youth (HBLPY) Report, Pohnpei 2001	1516 youth	Health Behaviour and Lifestyle of Pacific Youth	47.9% students used betel nut daily	One third chewed tobacco	Betel nut most common substance used
Guam	Paulino, 2009			Current betel nut chewers 12% (Chamorro 24%, non-Chamorro 24%, Micronesians 24%, non-Micronesians 0.3%) Ever chewed betel nut 37%	Current smokers 31% (Chamorro, 44% non-Chamorro, 16%, Micronesians 41%, non-Micronesians 21%)	79% of smokers and 36% of betel nut chewers consumed alcohol
	QMark report on substance use 2008		Youth 10-17years	6% had chewed betel nut in last 30 days. Of betel nut chewers, 52% chewed betel only,	Of betel nut chewers, 28% chewed with tobacco	Age of initiation of tobacco and betel nut 25% 13 or 14 years, 50% at 15-16 years and 25% at 17 years+
	QMark report on substance use 2008		Adults aged 18 years and older	17% had chewed betel nut chewers in last 30 days, of whom 69% chewed betel nut by itself.	Of betel nut chewers, 29% chewed it with tobacco	
	YRBS 2007	1716	High school students		20.4% girls and 25.4% boys are current cigarette smokers. 6.3% use of non smoking tobacco (5.6% girls and 6.9% boys)	Many risk factors surveyed, including use of alcohol and drugs
	YRBS 2003	1722	Middle and high school students		31.6% of high school students smoked in last 30 days	
	YRBS 2001	3059	Middle and high school students		62% said their friends smoked	Risk prevalence by ethnicity



Country	Study & Year	Sample size	Surveyed Group	Betel nut (% using)	Tobacco (% using)	Additional information
	Behavioral Risk Factor Surveillance System (BRFSS) 1999	506	Adults		80% Pacific islanders smoking or had smoked	Risk factor by ethnicity Pacific islanders, Asian, non-Asian Pacific islanders
	YRBS 1999	1211	Middle and High school students		38% all high school students (44% Pacific islanders)	Risk prevalence by ethnicity
	BRFSS 1995	896	Adults		75% Pacific islanders had smoked or are current smokers	Risk factor by ethnicity Pacific islanders, Asian, non-Asian Pacific islanders
	Jarvis et al., Health Risk Factor Study, 1993	402	Adult betel nut use by ethnicity	48% Chamorros, 37.5% Micronesians, 18.6% whites chew betel nut		
	BRFSS Pinhey et al. 1992	175 women	Chamorro and Philippine women	Yes	Yes	
	Haddock et al. 1981	714	screening project in senior citizens	24.65% used betel nut 8.4% chewed betel nut and smoked	18.49% smoked cigarettes	Risk factors for oral lesions
Kiribati	GYTS 2009	1461	Students aged 13-15 years		Current cigarette smoker 19.8% Current user of other tobacco 31.2%	Exposed to cigarette smoke at home, 68.3%.
Papua New Guinea	HOPE worldwide and WHO STEPS 2010	2944	Adults 15-64 years from five regions (NCD, Manus, Gulf, Madang and Simbu)	79% currently use betel nut, of whom 78.3% use it with mustard and lime Mean number of times betel nut is chewed daily, 5.5	44% currently smoke tobacco (men 60.3%, women 27.0%), of whom 72.0% smoke manufactured cigarettes. 43.7% were daily tobacco smokers	Alcohol consumption – 7.1% current drinkers. Other NCD risk factors reported on included consumption of fruit and vegetables, body mass index (BMI), fasting blood glucose levels and levels of physical activity.



Country	Study & Year	Sample size	Surveyed Group	Betel nut (% using)	Tobacco (% using)	Additional information
	Baldwin et al. 2007	615	Age range 10-50 years from three provinces, Port Moresby, Mount Hagen, East Sepik	89.6% had tried betel nut. 85% had used betel nut in last two weeks		Within the last two weeks 56.9% had used alcohol, 26.7% had used home brew and 35.7% had used cannabis.
	GYTS 2007	1867	School children grades 6-9		61.6% of students had ever smoked (males 69%, females 52.8%) 53.7% were current users of tobacco (males 59.7%, females 46.1%) 49% were current smokers (males 55.8%, females 40.7%)	Attitudes to smoking and tobacco use 84.1% of smokers had tried to quit during the past year
	Smoking prevalence in young people in Papua New Guinea Hiawalyer, G. 2002	3000	Students from National Capital District (NCD) and Manus		In NCD 12% males and 8% females smoked cigarettes	In NCD 10% males and 37% females did not smoke cigarettes, marijuana or mutrus
	Gibson 1998	1400	Urban demand for food, beverages, betel nut and tobacco	Used by 75% of urban households	Used by 70.6% of urban households	
	Tobacco use survey 1991, Collins and Dawse 1996	1285	Coastal and Highlands provinces adults		Coastal men 58% and 17% women. Highlands women 38% used tobacco	Regional variation in prevalence
	Thomas 1992, prevalence of leukoplakia in adult	1678	adults in New Ireland Province	94% chewed betel nut	75% of men and 27% of women smoked	Prevalence of oral leukoplakia



Country	Study & Year	Sample size	Surveyed Group	Betel nut (% using)	Tobacco (% using)	Additional information
	Vallace et al. 1987 Vallace et al. 1987	413 (1970) 257 (1984)	Smoking habits of adults in a rural Highlands community, 1970 and 1984		Reduction in smoking prevalence from 55% to 41%, especially in young adults	Increase in use of commercial cigarettes among smokers from 28% to 93%
Palau	PYTS 2009	1125 h		58.6% HS students and 47.6% MS students used betel nut, 53.3% HS students and 36.3% MS students used betel nut with tobacco	52.9% HS students and 41.6% MS students used any form of tobacco, 41.4% HS students and 36.3% MS students currently smoke	Minors' access to tobacco, knowledge and attitudes of young people about tobacco and betel nut use, exposure to second-hand smoke
	YRBS 2007	732	High school students		30.6% girls and 44.4% boys currently	
	PYTS 2005	943	High school and middle school students	43.1% MS students and 61.1% of HS students currently chew betel nut with tobacco	55.3% MS students and 69.3% HS students currently use tobacco	Patterns of nut and tobacco use. Attitudes and knowledge of nut and tobacco
	PYTS 2001	973	High school and middle school students	Daily betel nut use with tobacco in 68% of HS students and 54% MS students		Patterns of nut and tobacco use. Attitudes and knowledge of nut and tobacco
	Ministry of Health, 2001	227	Ministry of Health employees	74% Ministry of Health staff and 79% Oral Health Division staff chew betel nut with tobacco	50% smoked	
	1997 substance abuse needs assessment	802		70% of adults chewed betel nut	Most chewers added tobacco	
	Ysaol et al. 1996	1110	From age 5 years	55% those aged 5-14 chewed betel nut 86% those aged 35-44 years chewed betel nut	80% of chewers added cigarette, 24% added chewing tobacco	



Country	Study & Year	Sample size	Surveyed Group	Betel nut (% using)	Tobacco (% using)	Additional information
The Marshall Islands	2007 YRBS	1522	High school students		24.4% girls and 40.9% boys currently smoke cigarettes. 53.1% girls and 71.2% boys had ever smoked cigarettes	Many risk factors surveyed, including use of alcohol and drugs.
	The Marshall Islands NCD STEPS Survey, 2002	1865	Random cluster sample of adults aged 25-64 years	Currently chew betel nut (men: 9.8% women: 2.1% both sexes: 6.1%) Daily betel nut chewer Men: 8.1 Women: 0.8 Both sexes: 4.5	Current smoker men: 38.8 Women: 7.0% Both sexes: 23.4% Daily smoker (men: 35.3% women: 5.4% both sexes: 20.8%)	
	Chen T-H, et al. 2004	3294	Students aged 9–20 years	Betel nut chewing rate currently not available	10.6% smoking rate overall, 33.5% those aged 18 years or more	Risk factors for smoking
Solomon Islands	NCD STEPS Survey, 2005	1925	Random cluster sampling of adults aged 25-64 years	62.6% currently chew betel nut (men: 67.8% women: 57.3%) 30.0% daily betel nut chewer (men: 35.8% women: 24.0%) Mean duration of betel nut habit (men: 17.5% women: 16.4% both sexes: 17.1%)	39.8% current smoker (men: 54.1% women: 25.0%) 30.6% daily smoker (men: 43.9% women: 16.9%)	Mean age started smoking (men: 20.3 women: 23.1 both sexes: 21.0) Mean age started chewing (men: 20.4 women: 21.5 both sexes: 20.8) Mean duration of smoking (men: 17.2 women: 15.0 both sexes: 16.6)



Country	Study & Year	Sample size	Surveyed Group	Betel nut (% using)	Tobacco (% using)	Additional information
	Smoking and Chewing Habits of Oral Cancer Patients – Lumukana & King, 2003	48 cases	Retrospective study between 1994 and 1997 and 1999 of oral cancer patients at National Referral Hospital	90% of oral cancer patients chewed betel nut and smoked		Site of cancer. Statistical risk of smoking and chewing nut on oral cancer
	1995 YRBS		High school students		23.8% current users	
Vanuatu	2007	1900	School children grades 7-9		28.0% of students had ever smoked cigarettes (male 27.0%, female 29.9%) 26.3% currently use any tobacco product (male 26.4%, female 25.3%) 18.5% currently smoke cigarettes (male 18.1%, female 19.8%) 14.3% currently use other tobacco products (male 14.8%, female 12.0%)	
	Smoking in Port Vila; 1988 Vanuatu Youth People's Project, 1998	1000	Youth		58.20% males 17.7% females	Reported in Western Pacific Regional Office Country Profiles, Tobacco or Health, 2000. URL: http://www.wpro.who.int
	National Non-communicable Diseases Survey. 1998		Adults		49.0% males 5% females	



Migration

Several studies have linked the use of betel nut to migrant status (Pinhey et al. 1992). Migration has a dual impact on the use of betel nut. Firstly, the continued use of betel nut helps migrants reinforce their cultural identity in the new country. Pinhey et al. (1992) reported the use of betel nut was significantly related to migrant status for younger Philippine women on Guam. In addition, the broader effects of migrants introducing a new habit to a community, or a new way of using a substance, are important. For example, Micronesian immigrants have introduced betel nut chewing to the Marshall Islands and immigrants from the Federated States of Micronesia to Hawaii and the mainland of the United States of America have created a demand and, subsequently, a trade market for betel nut there.

Multiple drug use

Concern has been expressed as to whether the habitual use of betel nut provides a gateway to other, potentially more harmful drugs. Pacific prevalence studies seem to suggest the combination of tobacco and betel nut is alarmingly common, particularly among young people (Ysaol et al. 1996, PYTS 2001, 2005, 2009). In communities where tobacco is commonly added to the betel quid, initiation occurs with betel nut alone, especially in the youngest groups. There is a subsequent graduation to the use of lime and tobacco.

While there are studies that link tobacco and betel nut use, few studies exist which explore the link to abuse of other substances, particularly alcohol and marijuana, which are widely available in the Western Pacific Region. Betel nut is a readily available and cheap alternative to other mood-enhancing drugs. Sales to minors are not restricted, as may be the case for alcohol and tobacco.

Pinhey et al. (1992) reported several variables were related to the use of betel nut, tobacco and alcohol among Chamorro and Philippine women in Guam. There was a limited relationship between socioeconomic factors and betel nut use. Education levels were negatively associated with tobacco use for both Philippine and Chamorro women (Pinhey et al. 1992).

The McDonald survey of substance use in Papua New Guinea reported a significant percentage of drug users used or had used a combination of different drugs. Of particular interest, 91% reported use of betel nut, 87% of tobacco and 82% of alcohol (McDonald 1998).

A more recent study in Papua New Guinea reporting on the use of alcohol, home brew, cannabis and betel nut showed the age of first trying betel nut was significantly lower (11.7 years) than for other drugs (alcohol 16.53 years, home brew 18.5 years and cannabis 18.02 years). A significant finding to emerge from the study was a strong culture of intoxication in Papua New Guinea (Baldwin 2007).

Socioeconomic aspects of betel nut

Apart from the traditional use of betel nut in intergroup exchange, the use of the betel nut as a commercial product is a relatively recent phenomenon in the Pacific (Watson 1987). The market for betel nut has grown along with the growth of urban centres and has increased along with the number of waged employees. Demand also has increased with improved communication routes. This has been especially significant with better road access to the highland provinces of Papua New Guinea.

The growth of interisland trade and export of betel nut has been enhanced by different regional growing seasons and regional migrants wanting to access products from their homelands. There is evidence of demand for particular varieties of betel nut. For example, betel nut from Yap is reported to be stronger than other varieties (Ben Yoromad, cited Radway 2004).

Betel nut products are now increasingly available in Pacific countries that have no previous history of usage – the mainland of the United States of America, Australia and New Zealand. An extensive array of betel nut products is available through the Internet.

The socioeconomic effects of betel nut include income expenditure and generation as well as environmental impacts.



Income generation

For growers and distributors, betel nut provides an essential source of income for the family. School fees, food, medicine and other household items are bought with the income generated from betel nut (Vele 1982). This is also true for suppliers of other quid ingredients -- tobacco, lime and *P. betle* leaves.

In the Chris Owen documentary "Betelnut Bisnis", filmed in Goroka, Eastern Highlands Province, Papua New Guinea, comments made by interviewees reflect the social and economic importance of betel nut to the community. Betel nut is referred to as "green gold" and called "the life blood of Papua New Guinea" (Betelnut Bisnis 2004).

Baldwin also reported the sale of betel nut is a very important source of income for many people in certain provinces of Papua New Guinea, especially those who are outside the formal economy. Betel nut sales ranged from small-scale opportunistic exchanges to well-planned business ventures (Baldwin 2007).

The 1996 Mapping Agricultural System estimated 1,227,234 people received income from betel nut in Papua New Guinea and the total income from betel nut was USD 7,094,993, or 9.5% of the total income from agricultural products (Caven & McKillop 2000).

Figures from the Solomon Islands 2010 STEPS survey reported a betel nut seller could earn up to USD 63.49 per day (Solomon Islands NCD 2010).

Yap is the leading supplier of betel nut to the region. Betel nut from Yap is primarily sent to Guam and the Commonwealth of the Northern Mariana Islands, with smaller amounts to Chuuk, Palau and the Marshall Islands (Radway, 2006). The Yap Department of Agriculture reported during the financial year March 2003-February 2004 that 211 tonnes of betel nut and 16.3 tonnes of pepper leaf were exported. These figures were obtained from the export records of air freighted betel nut (Cited Radway 2006). Betel nut is now the most important cash crop for Yap, with an estimated value of USD 3,000,000 between 2003 and 2004 (Gov. Robert Robuecho, cited Radway 2004). The true value of the crop is likely to be even higher because the statistics do not include betel nut transported in personal luggage.

The United States Food and Drug Administration lifted the ban on betel nut importation for personal use in 2000. The main reason was that people were ignoring the ban anyway, which was regarded as posing a greater agricultural risk (Department of Agriculture, Animal and Plant Health Inspection Service). Some states in the United States of America require the husk to be removed from the betel nut because it is the husk that poses the greatest risk of introducing agricultural pests and diseases.

Income expenditure

Gibson reported that betel nut and tobacco accounted for 2.32% and 3.09%, respectively, of total household expenditure in urban households in Papua New Guinea. When urban household incomes increased, the most significant increase in demand occurred for betel nut, fresh vegetables and sweet potato (Gibson 1998).

Frequent users of betel nut and betel quid may buy it in preference to other essential items. Several questionnaire respondents remarked that habitual users will sacrifice food and medicine in favor of betel quid ingredients, especially tobacco. These appetite suppressant products may be bought instead of food to satiate hunger. Economic impact figures from Palau have predicted a regular betel nut chewer spends USD 32.55 a week on betel nut, which equates to USD 1,692.60 per year. A 1995 survey on the prevalence of betel nut use estimated the cost to Palauans of betel nut use and its associated additives (slaked lime, pepper leaf and tobacco) was USD 9.2 million annually (Country Profiles 2000).



In the Western Pacific Region, increasing areas of arable land are being converted to the production of betel nut (Vele 1982; Gibson 1998). Statistics from Guam show 4100 pounds of betel nut were harvested from 16 farms in Guam alone (Guam Statistical Yearbook 2008). In the Region, larger scale plantations are more visible and home gardens are being planted with Areca palms rather than food crops.

Families may compromise their food security in changing from food production to cash crops. Food insecurity could result if the price obtained for the betel nut crop drops due to market saturation or if the price of food staples (e.g. sweet potato) increases due to scarcity. Experience in Guam with the Areca palm blight demonstrates that heavy reliance on one crop can be disastrous if the crop fails. In addition, Areca palms take at least four years to become productive, creating a significant lead time before income is generated from the land.

Experience in Taiwan has shown there may be other unforeseen problems in changing from traditional crops. The rapid expansion of betel nut cultivation has placed farmers at risk of the progressive loss of fertile soil and land erosion because the Areca palms do not retain soil during the rainy season (Ko et al. 1992).

Reef destruction

In Solomon Islands, harvesting of *Acropora* coral to obtain lime for betel quid has destroyed important reef habitats and caused changes in coral reef communities as reefs become devoid of stag horn *Acropora* corals. To reverse these negative impacts of coral harvesting, local women have been trained as coral farmers. The coral grown has been used to regenerate the reefs and supply coral for the United States of America aquarium market, generating essential export revenue (Solomon Islands Development Trust (SIDT). Marked destruction of reef coral for use in betel quid also has been noted in parts of Papua New Guinea (McEldowney 1993).

Betel nut was viewed as an important part of the economy by 55% of respondents. It was noted that it was more important to the micro-economy at a family group level.



Health Concerns: Why is Betel Nut Use a Problem?

While betel nut has been used for its stimulant properties, concern has long been expressed over its association with negative health consequences. A significant percentage of respondents (73%, i.e. 16 of 22 people) to the questionnaires believe that betel nut use affects the health of their community. The physiological effects of betel nut use may be caused by the betel nut alone or by the combination of the additional ingredients -- the lime, P. betle leaf and tobacco. These ingredients may act in their own right, or synergistically with the betel nut, to cause the health effects commonly associated with habitual betel nut use.

Pharmacology

The use of betel nut is associated with both immediate and long-term physiological effects. The immediate effects can occur within minutes of chewing the betel nut because the ingredients are absorbed directly into the blood stream via the oral mucosa. These effects are caused by activation of the sympathetic pathway by the betel nut alkaloids and have been described as a combination of the following symptoms (Rooban et al. 2005):

- Dizziness and heart palpitations
- Heightened awareness
- Hot sensation and sweating
- Epigastric discomfort and diarrhoea
- Increased respiration and heart rate
- Diminished thirst and hunger
- Relaxed, happy feeling

The effects of betel nut are more pronounced in first-time users and if the chewer is suffering from malnutrition or a physical illness such as malaria (Cawte 1985). Regular users of betel nut may develop tolerance and therefore experience less dramatic initial symptoms (Burton-Bradley 1979; Winstock 2002).

Habitual use of betel nut has been associated with a number of long-term adverse health effects: specific oral effects, including oral precancer and cancer and other types of cancer, heart and respiratory effects, diabetes mellitus, poor pregnancy outcomes and mental illness, addiction and toxic effects.

Effects on Oral Hard Tissues

Tooth discoloration and dental caries

Chewing a combination of betel nut, lime and P. betle produces the copious red saliva associated with betel quid use. With regular betel quid chewing, this stain becomes embedded in the teeth, gingiva and oral mucosa. The colour deepens from red to black with increasing duration and frequency of use.

Traditionally, this tooth colouration was regarded as aesthetically pleasing by some societies, but with Western influence it seems to be becoming less so (Norton 1998). Vigorous brushing of the teeth, particularly with the fibrous husk of the betel nut, is used to reduce the amount of staining.

Several studies have discussed the role of tooth stain in a reduced rate of dental caries in regular betel nut users (Moller et al. 1977; Howden 1984; Nigam & Srivastava 1990). Howden (1984) reported that the stain acted as a physical barrier to tooth demineralization.



It also has been suggested that the use of lime with betel nut contributes to the reduced rate of dental caries in some betel nut users because it increases the intra-oral pH and provides a source of calcium for remineralization of the tooth enamel. (Alependava 1992).

Excessive tooth abrasion and fractured teeth

The hard fibrous nature of the betel nut causes fractured teeth and extensive abrasion of the occlusal tooth surface of regular users. The molars, premolars and canine teeth frequently completely lose their cuspal form and the incisors become shortened. The abrasive nature of the lime further increases this effect. A survey of oral health of the Huli people from Southern Highlands Province, Papua New Guinea, reported nearly half of those aged 45–64 years had back teeth that were completely smooth and flattened (Newell 2001). Tooth attrition is more pronounced in coastal areas that have higher rates of betel nut use (Davies 1990).

Temporomandibular joint pathology

It has been speculated that the chewing forces generated during habitual betel nut use could give rise to deterioration of the temporomandibular joint (TMJ) (Trivedy et al. 2002). This is difficult to prove because many of the symptoms associated with TMJ pathology, e.g. trismus, also occurs in fibrotic conditions linked to betel nut use.

Effects on Oral Soft Tissues

Periodontal Disease

Periodontitis is a significant cause of tooth loss for adult Pacific islanders (Cutress & Tapealava 1996; Cutress 2003). It is a progressive gum disease that results in the loss of the supporting structures of the teeth and is linked directly to inadequate oral hygiene. Poor oral hygiene is frequently associated with betel nut chewing (Nigam & Srivastava 1990; Pickwell et al. 1994). Studies of betel extracts containing arecoline have suggested betel may be cytotoxic to periodontal fibroblasts, thus exacerbating pre-existing periodontal disease (Trivedy et al. 2002).

Tobacco use is associated with increased severity of periodontitis and tooth loss (Bergstrom 1989). Therefore, it is likely that the concurrent use of tobacco with betel nut predisposes users to periodontitis. The Ministry of Health in Palau states that as a consequence of the majority of the population in Palau using tobacco products, “the entire population in Palau is considered to be at very high risk for development of periodontal disease” (MOH Palau 2005, p. 9).

Periodontitis is further exacerbated by diabetes mellitus, a disease also associated with betel nut use (see section on Diabetes Mellitus below).

Treatment of periodontal disease and stain removal from teeth and repairing fractured teeth due to betel nut chewing, may require continuing dental treatment at significant cost to the betel nut user.

Betel chewer’s mucosa

Betel chewer’s mucosa (BCM) first was described by Mehta et al. (1972). It is characterized by a brownish-red discolouration of the oral mucosa localized to the site of betel quid placement and is associated with epithelial hyperplasia (Trivedy et al. 2002). Although BCM is not considered to be a premalignant lesion, it frequently coexists with premalignant lesions, e.g. leukoplakia.

The use of lime in betel quid damages the oral mucosal membrane, leading to direct abrasion of the mucosal surface and ulceration.



Betel -induced lichenoid lesions

Daftary et al. (1980) identified lesions in regular betel quid users at the site of betel quid retention, principally the buccal mucosa and tongue, which histologically showed a lichenoid reaction. These lesions disappeared with the cessation of betel nut use.

Leukoplakia, erythroplakia and oral submucous fibrosis

Oral leukoplakia can be defined as a predominantly white patch on the oral mucosa that cannot be characterized clinically as another lesion (Axell et al. 1984). Various types of leukoplakia exist, including speckled, nodular and verrucous leukoplakia (Trivedy et al. 2002). Erythroplakia is a bright red velvety patch on the oral mucosa that cannot be characterized as another condition (Hashibe et al. 2000).

There is extensive evidence of oral leukoplakia among betel nut chewers who chew with or without tobacco. Ikeda et al. (1996) reported the prevalence of leukoplakia in selected Cambodian populations was 2.2% among men and 0.6% among women. Several studies report that the prevalence of oral leukoplakia appears particularly high in Papua New Guinea (4.6%-17%), with the prevalence in the Papua New Guinea lowlands being among the highest in the world (Pindborg et al. 1968; Forlen et al. 1965; Atkinson et al. 1964; Bailit et al. 1968; Thomas 1993; Newell 2002).

A significant dose-related relationship of the frequency and duration of betel nut chewing has been demonstrated for both erythroplakia and leukoplakia (Gupta 1984; Hashibe et al. 2000; Lee et al. 2003).

A malignant transformation rate for oral leukoplakia of 0.1%–17.5% is reported in the literature (Van der Wall et al. 2002). Downer and Petti (2005) calculated the global incidence of oral cancer incidence due to leukoplakia was 6.2–29.1 cases for every 100 000 people. Lee et al. (2003) reported a statistically significant interaction between betel nut and tobacco in the causation of oral leukoplakia.

Oral submucous fibrosis (OSF) is characterized by persistent and recurrent stomatitis leading to progressive sclerosis of the dermal and muscular tissue of the oropharynx (Norton 1998). Early stages may present with fibrotic bands across the palate which progress to other areas of the oral mucosa and the oropharynx. Advanced stages are characterized by restricted oral opening and protrusion of the tongue, making eating, swallowing and speech difficult (Rajendran 1994). Betel nut chewing is now widely accepted as the most important etiological factor in the development of OSF (Warnakulasuriya et al. 1997).

OSF also has shown a malignant transformation rate of between 3% and 7.6% (Pindborg et al. 1984; Murti et al. 1985; Sinor et al. 1990). Murti et al. (1985) followed a group of patients with OSF for 17 years, after which the malignant transformation rate of OSF was 7.6%. Given that oral cancer can take many decades to develop, it is possible that these studies may underestimate the long-term malignant transformation rate.

Oakley et al. (2005) reported a significant number of high school students in the Commonwealth of the Northern Mariana Islands presented with oral lesions associated with betel nut and tobacco use. Oral leukoplakia was present in 12.9% of students while 8.8% had OSF (one third of whom already showed a restriction in mouth opening). Cessation of betel nut and tobacco use has been shown to decrease the severity of lesions, sometimes leading to their complete resolution (Gupta et al. 1995).

Oral cancer

Cancer of the oral cavity is the sixth most prevalent cancer worldwide (Hamner et al. 1986; Parkin et al. 2005), with squamous cell carcinoma accounting for between 90% and 99% of all oral cancers (Pindborg 1980; Jamrozik 1985; Forastiere et al. 2001). In 2002, oral cancer cases were estimated at 274 000 worldwide, almost two thirds of which were men. Melanesia is reported to be the Region with the highest incidence -- 31.5 per 100 000 in men and 20.2 per 100 000 in women. This compares with an incidence in Australasia of 10.2 per 100 000. Australasia is defined as Australia, New Zealand, New



Guinea and neighbouring islands. The average mortality is commonly less than half the incidence (Parkin et al. 2005); however, the mortality rate from oral cancer in the Federated States of Micronesia and Melanesia is significantly higher. Barton et al. (2001) reported that 80% of the people with cancer in Papua New Guinea will die of the disease. The Micronesian oral cancer cases that received treatment at the Tripler Army Medical Center in Hawaii, reviewed by Carpenter et al. (2005), had a 67% mortality rate.

The use of tobacco and alcohol are the major etiological factors in the development and recurrence of treated oral cancer in Western populations. Detailed evaluations are available elsewhere for the role of tobacco and alcohol in the etiology of oral cancer (IARC 1985 b; IARC 1988; NIH 1992). Individually, regular use of tobacco and alcohol increase the risk of developing cancer and the recurrence of treated oral cancer by about sixfold (Silverman 1972). When tobacco and alcohol habits coexist, they act synergistically to increase the risk of oral cancer dramatically to a multiple of each individual risk factor (Rothman & Keller 1972).

The association between the use of betel nut and oral cancer has been known for many years (Orr 1933; Eisen 1946). The International Agency for Research on Cancer conducted an extensive review of the available literature on betel nut chewing in the production of the 2004 monograph "Betel-quid and Areca-nut chewing and some Areca-nut-derived nitrosamines". The evaluation, based on expert opinion and the available literature, resulted in the following conclusions (IARC Monograph 2004, p.239):

- Betel quid with tobacco is carcinogenic to humans (Group 1)
- Betel quid without tobacco is carcinogenic to humans (Group 1)
- Areca nut is carcinogenic to humans (Group1)

This evaluation was based on strong evidence of betel nut causing the precancerous condition, OSF, and sufficient evidence of carcinogenicity in experimental animals. There was also strong supporting evidence. The IARC linked oral cancer to the use of betel quid without tobacco and oropharyngeal cancers to betel quid use with tobacco.

Commonly, 70% of oral squamous cell carcinomas present in just 20% of the oral mucosa. However, the dominant site differs greatly among countries. In Western countries, the floor of the mouth and tongue are the most common sites, but betel-associated lesions usually present in the buccal mucosa from the corner of the mouth posteriorly and the lateral border of the tongue (Thomas & MacLennan 1992). This finding was supported by Endican et al. (2010) in their review of the oral cancer cases treated at Goroka General Hospital, Papua New Guinea, between April 2008 and August 2009, where over 97% of cases were located in these sites within the oral cavity.

Pacific studies

The Federated States of Micronesia

Palafox et al. (2004) reported that the age-adjusted cancer prevalence for the Federated States of Micronesia during the period 1985-1998 showed marked geographical variation. Yap showed the highest oral cancer prevalence of 22.1 per 100 000. The other states had much lower prevalence rates with Kosrae 7.9, Pohnpei 6.2 and Chuuk 3.8 per 100 000.

The Yap Memorial Hospital medical records reported oral cancer represented the second most common cancer at 14.1% of all cancer cases between 2000 and 2002 and 7.7% of cancer deaths between 1998 and 2002.



Guam

Early studies in Guam suggested betel nut chewing posed no increased risk of oral cancer (Wells 1925; Gerry et al. 1952) or that the risk of oral cancer from betel nut chewing was equivalent to the risk posed by tobacco use (Haddock 1981). Commonly, the study's subjects were Chamorro, who had used betel nut alone, not in combination with other ingredients. However, since the Compact of Free Association (United States Public Law 99–239, 1986), there has been significant immigration from the Federated States of Micronesia, which may have changed the risk profile of oral cancer.

The Guam Cancer Registry 2003-2007 ranks oral cancer as tenth in cancer incidence for Guam (Guam Comprehensive Cancer Control Coalition 2009). Oral cancer incidence is higher for males (sixth in incidence). Deaths due to oral cancer were ranked ninth in cancer-related mortality for both men and women.

The Guam Cancer Registry also reports a large variation in the age-adjusted incidence of oral cancer among ethnic groups; Micronesians (29.4) and Caucasians (26.7) had a very high incidence, Chamorro (18.0) had a high incidence and other ethnic groups had significantly lower oral cancer incidences: Filipino 2.7, Asian 6.2 and USA 10.3.

It has been suggested these statistics may be skewed slightly because Micronesians may travel to Guam for medical treatment. However, even taking this into consideration, the etiology behind the differences in oral cancer incidence rates should be explored further. The frequency of betel nut use and the mode of use, i.e. with or without tobacco, definitely should be considered in determining the factors that contribute to the difference in incidence rates (Haddock 2005).

Papua New Guinea

Oral cancer in Papua New Guinea has been known and reviewed for many years (Eisen 1946; Backhouse 1955). The Tumor Registry of Papua New Guinea was established in 1958, and within six years Atkinson et al. (1964) reported a disproportionately high incidence of oral cancer in the country (17.4%) and a distinct geographical variation in oral cancer prevalence. A higher incidence of oral cancer was shown to closely match areas of betel nut use.

Thomas (1993) provides a thorough discussion and extensive literature review of the etiology, geographical distribution and incidence of oral carcinoma in Papua New Guinea. Notable features are the high incidence of oral cancer there, particularly in men, where it is the most frequently reported cancer and a distinct geographical variation in prevalence. The annual average reported oral cancer rate per 100 000 for the highlands was 3.5 for men and 1.9 for women compared with 50.7 for men and 21.8 for women in island provinces. Typically, oral cancer was most prevalent in the 45-year age group, which is 20 years earlier than Western populations (Coates & Armstrong 2000). Further, it was site-specific with the site of tumor presentation corresponding to the site of lime application in 77% of reviewed cases. Typically, cases of oral cancer presented very late when the disease was well advanced and difficult, if not impossible, to treat (Thomas 1993).

In a further case-controlled study of cancer cases in Papua New Guinea, Thomas et al. (2007) showed that betel quid is an independent risk factor for the development of oral cancer (Thomas et al. 2007).

Barton et al. (2001) reported the high mortality rate from oral cancer in Papua New Guinea because of the late presentation of cases and lack of knowledge of the availability of treatment. The authors reported 80% mortality from all types of cancer in Papua New Guinea. Endican et al. (2010) reported 80% of the oral cancer cases presenting at Goroka General Hospital between 2006 and 2008 had been in the third or fourth stage.



Oral cancer incidence in the highlands has been increasing dramatically along with the increase in betel nut use, and Barton et al. (2001) reported an impending epidemic in oral cancer in the highlands of Papua New Guinea. One specialist interviewed for the report stated there was already an oropharyngeal cancer epidemic at the Kudjip Health Centre (Dr Bill McCoy, cited Barton et al. 2001, p. 14).

Palau

The Palau Cancer Registry reported an oral and pharyngeal cancer incidence rate of 11.5 per 100 000 between 1991 and 1995. A dramatic increase was reported between 1997 and 2002 when the incidence rose to 18.0. The Oral Health Division reports that these figures may be underestimates because cases only are registered if there is a formal diagnosis in Palau. Suspected cases that are referred for treatment and formally diagnosed elsewhere may not be registered (Palau Ministry of Health 2005).

The Marshall Islands

Palafox (2004) reported that the oral cancer prevalence for the Marshall Islands was 12.6 per 100 000 between 1985 and 1998. While this is lower than other regions in the Pacific, it is still a significant figure and could reflect a trend towards higher incidence associated with increasing betel nut use.

Solomon Islands

Reed (1977), in his review of the age-adjusted cancer incidence in Solomon Islands in the mid-1970s, reported cancer of the lip, mouth and pharynx represented 15% of all cancers. This percentage was significantly higher than the histologically-proven oral cancers diagnosed in the Honiara Central Hospital, which accounted for 9% of malignancies in men and 8% of malignancies in women.

Wilson et al. (1983) estimated the annual reported incidence of oral cancer in Solomon Islands as 10 per 100 000 between June 1980 and July 1983, while the annual incidence of histologically-proven oral cancer was five per 100 000.

A small case-control study of oral cancer showed that the group identified as the highest consumers of betel nut had a significantly greater risk of oral cancer than those who did not chew betel nut or only chewed occasionally (Wilson et al. 1983). It also was shown that chewers who added lime had five times the risk of those who did not add lime.

In a review of 48 newly diagnosed cases of oral cancer between 1994 and 1997 and in 1999, Lumukana and King (2003) reported the annual incidence ranged from seven to 13 cases per 100 000.

Treatment for oral cancer

The treatment for oral cancer usually involves surgical removal of the lesion with or without radiotherapy (Bhandary 2003). Chemotherapy as an adjunctive therapy recently has been used to reduce the invasiveness of oral cancer and improve the survival rate. A recurrence rate of 80%-90% for oral cancers treated with aggressive surgery alone has been reported at Goroka General Hospital, Papua New Guinea (Endican et al. 2010).

Traditionally, oral cancer that is diagnosed and treated early has a good prognosis and outcome. However, oral cancer can spread rapidly along tissue planes, invade bone and muscles and show a high rate of lymphatic spread (Bhandary 2003). Bhandary reported a five-year survival rate of 86% for patients treated within a month of becoming symptomatic as opposed to 47% for those treated within seven months. None of the patients who waited for 12 months for treatment survived.



Even among those successfully treated for oral cancer, many have a significantly reduced quality of life as a result of their cancer treatment (BDA 2000). Subsequent alterations in appearance and difficulties in eating, drinking, swallowing and speaking can have devastating consequences for those affected.

Carpenter et al., in their review of the Tumor Registry (1977–2003) of the Tripler Army Medical Center in Hawaii, which provides tertiary care for remote Pacific island nations, concluded that “betel nut induced oral carcinomas are aggressive malignancies requiring aggressive treatment and long-term follow-up” (Carpenter et al. 2005, p.158). In particular, first and second stage betel nut-induced oral carcinomas, particularly those in the buccal mucosa, behaved more invasively than normally would be expected and therefore required adjunct therapy to surgery alone as well as intensive and long-term follow-up (Carpenter et al. 2005).

Barton et al. (2001) reported that a significant barrier to obtaining treatment for oral cancer in Papua New Guinea was the general lack of knowledge about cancer in the country. “Few people in the community knew what cancer was, how it was caused, and that treatment was available”, (Barton et al., 2001, p. 14). This lack of awareness was demonstrated at all levels of society, from community health workers through to government. Therefore, increasing general awareness of oral cancer in Papua New Guinea is regarded as an integral part of treatment for oral cancer.

Other Cancers

Betel nut chewing has been associated with a higher risk of other cancers. Rajkumar et al. (2003) demonstrated a significant association between chewing more than five betel quids a day (with or without tobacco) and cervical cancer.

Chewing betel quid without tobacco has been demonstrated to be associated with an increased risk of liver cancer in a dose-dependent manner (Tsai et al. 2001). This increased risk was demonstrated after controlling for sex, age, alcohol, smoking, drinking, anti-hepatitis C virus (anti-HCV) and hepatitis B surface antigen (HBsAg). The association of betel nut chewing and liver cancer may be important in Yap, where liver cancer was the most prevalent cancer (15.6% of total cancer cases) between 1998 and 2002 and the leading cause of death by cancer (23.1% of cancer deaths) between 2000 and 2002 (Taoka et al. 2004).

The highlands of Papua New Guinea already have a high incidence of liver cancer because of a high rate of hepatitis B infection (WHO 1998). The increased prevalence of betel nut use may further increase the burden of liver cancer in this region.

A recent study of women in northeastern India identified betel nut use as an important risk factor in the development of breast cancer (Kaushal et al. 2010). The risk factors of tobacco smoking, tobacco chewing, betel quid chewing and alcohol were analysed in 117 breast cancer cases and 174 cancer-free controls, and betel quid chewing was reported as the main risk factor for the development of breast cancer. Also, women with a betel quid chewing history had five times the risk of contracting breast cancer than those who did not chew betel nut (Kaushal et al. 2010).

Other Effects

Cardiovascular and respiratory effects

Studies in humans suggest betel nut chewing is associated with activation of the sympathetic pathway, with elevation of adrenaline and noradrenaline (Chu 1995) and, in higher doses, the parasympathetic pathway (Chu 1994). The resulting symptoms can range from tachycardia, palpitations, tachypnea or dyspnea, hypotension to acute myocardial infarction. Usually the effects of betel nut use are mild and transient. However, acute betel nut toxicity and subsequent death has been reported (Deng et al. 2001).



Bronchoconstriction and aggravation of asthma have been demonstrated in betel nut chewers (Kiyingi 1991; Kiyingi & Saweri 1994). The authors of the paper recommend that asthma sufferers avoid using betel nut.

The long-term use of betel nut on respiratory and cardiovascular health remains unclear. Singh (1994) warns against betel nut chewing before the administration of a general anesthetic.

The detrimental effect of tobacco on cardiovascular and respiratory health is well documented (IARC Monograph Vol. 37 1985, NIH, 1992). A recent meta-analysis of cardiovascular disease (CVD) in Taiwan concluded there is an association between betel nut chewing with or without tobacco and the risk of CVD and betel nut use may even impose a greater risk of CVD than smoking (Zhang et al. 2010).

The development of a betel nut habit also may increase the use of tobacco and thereby increase its adverse effects on cardiovascular and respiratory health.

Adverse pregnancy outcomes

Acute and chronic fetal exposure to betel nut has been associated with placental abnormalities, spontaneous abortion, lower birth weight of infants and preterm birth (Yang et al. 2001). These occurrences are further exacerbated by the use of tobacco with betel nut during pregnancy (WHO 1999). Animal studies have shown prenatal betel nut exposure can produce teratogenic effects (Sinha et al. 2001).

In a study on the effect of maternal betel quid exposure during pregnancy on birth outcomes among aborigines in Taiwan, Yang et al. (2008) reported that betel quid chewing during pregnancy has a substantial effect on a number of birth outcomes, including sex ratio at birth (fewer males born), lower birth weight and reduced birth length (Yang et al. 2008).

Senn et al. (2009) in a study of betel nut chewing among pregnant women of Madang Province, Papua New Guinea, reported betel nut chewing had a statistically significant impact on birth weight reduction. The main reasons for pregnant women chewing betel nut were reported as a means of preventing morning sickness and preventing a foul-smelling mouth. Fully 80% of the women thought that chewing betel nut would not have any effect on the fetus (Senn et al. 2009).

Dependency, addiction and withdrawal

Chronic daily use of betel nut has been demonstrated across many cultures (Gupta et al. 2002). Frequent heavy users often experience withdrawal symptoms, which may include anxiety, mood swings, irritability, paranoia, lack of concentration, sleep disturbance and increased appetite (ADF 2006). Evidence of the development of tolerance to betel nut and betel quid has been shown (Winstock et al. 2000), with the effects of betel nut use being stronger for first-time or occasional users than for habitual users.

Burton-Bradley (1966) identified three syndromes associated with frequent betel nut use -- habituation, addiction and toxic psychosis. Using tobacco with betel nut significantly increases its addictiveness. In one Indian study, dependence on betel nut was demonstrated in 38.8% of those who used betel nut alone as opposed to 79.6% who used it with tobacco (Velayudhan et al. 1999). Ysaol et al. (1996) also reported heavier usage of betel nut among tobacco users in Palau. Winstock et al. (2000) reported that typical dependency symptoms in users of betel quid with tobacco included difficulty abstaining, lethargy, headache and sweating on withdrawal. Symptoms were relieved by partaking of betel quid and continual sequential use, analogous to chain-smoking.

Some studies have reported cases of neonatal withdrawal syndrome in infants born to chronic betel nut users and arecoline, the principal neuroactive alkaloid in betel nuts, has been found in the placental tissue (Garcia-Agar et al. 2005; López-Vilchez et al. 2006).



Mental illness

Burton-Bradley (1966) reported that the use of betel nut may be associated with acute, reversible toxic psychosis with subsequent auditory hallucinations and delusions. This was a rare occurrence found in susceptible people. Errington (1970) reported that people of the Duke of York Islands in Papua New Guinea used particular nuts to promote visions and spiritual access.

Sullivan et al. (2000) reviewed schizophrenia patients in Palau and reported a beneficial effect on the primary symptoms of schizophrenia in people who chewed betel nut. They suggested the benefits were caused both by the muscarinic agonist actions of the arecoline along with some social functions of betel nut chewing.

Diabetes and glucose intolerance

The use of betel nut has been linked to the development of hyperglycemia and diabetes mellitus, both experimentally in the laboratory (Boucher et al. 1994) and in human case studies (Tung et al. 2004): "This association is dose-dependent with respect to the duration of betel nut use and the quantity of betel nut chewed per day". Mannon et al. (2000) demonstrated an association between chewing betel nut and increased waist size and weight, factors known to be related to the development of glucose intolerance and diabetes. Paulino (2009) found betel nut chewers in Guam were 5.7 times more likely to be obese than nonchewers (Paulino 2009).

Using betel nut may further exacerbate complications due to diabetes. Tseng (2008) reported betel nut chewing was significantly associated with hypertension in Taiwanese patients with type 2 diabetes mellitus, and the association was stronger in women (Tseng 2008).

Hsin-Fen et al. (2010) demonstrated the first in vitro evidence of a betel-quin-induced change in fat cell metabolism that could help explain the mechanism by which betel nut chewing could cause metabolic syndrome disorders.

A further study suggested that exposure to paternal betel quid chewing also increased the risk of early-onset metabolic syndrome in human offspring in a dose-dependent manner (Chen et al. 2006).

The association between betel nut use and diabetes mellitus is particularly relevant to many Pacific island communities already struggling to cope with the growing burden of diabetes. There is a misconception by some users of herbal medicine that betel nut use is a treatment for diabetes (Benjamin 2001; and Dennie Iniakwala, pers. comm.), rather than a causal agent or associative factor.

Benjamin (2001) concluded, after reviewing the literature and conducting a community screening in Papua New Guinea that betel nut chewers have high fasting capillary blood glucose and diabetics should therefore be advised not to chew betel nut. Tobacco, whether chewed or smoked, also has been implicated in the development of, and increased severity of, complications in diabetes mellitus (Kawakami et al. 1997; Persson et al. 2000). Concurrent use of both betel nut and tobacco could significantly increase an individual's risk of developing diabetes mellitus.

Communicable diseases

Concern has been expressed that the frequent expectoration of excess saliva caused by chewing betel quid poses an environmental health hazard (Emi Chutaru, pers. comm.; Divi Ogaoga, pers. comm.). Saliva may contain bacterial and viral matter, thereby providing a vehicle for disease transmission.

Tuberculosis, a bacterial infection transmitted by inhalation of infected particles, is prevalent in many Pacific island communities (WHO 2006). The control of spitting and coughing in infected people is advised to minimize the possibility of disease transmission. The spitting of excess saliva as a result of betel nut chewing may provide a significant vehicle for infection in countries with a high prevalence of betel nut use and tuberculosis infection.



Sputum receptacles, which frequent chewers of betel nut may carry with them or leave lying around, may contain viable viral particles of hepatitis B or C.

Oral lesions associated with betel nut can provide an infection pathway for blood borne diseases.

Dietary effects

The use of betel nut affects the diet in three main ways. Firstly, the ingredients contained within the betel nut chew supply some dietary nutrients. Weegels et al. (1994) reported betel nut contains a negligible amount of protein and energy, which could play a role in the diet of consumers of very high quantities of betel nut. P. betle leaf contains large amounts of carotenes (80.5mg/g) and some vitamin C (1.9mg/g), (Wang & Wu 1996) Inclusion of the leaves in the betel quid may be an important source of carotenes if the leaves are swallowed.

Secondly, the physiological effects of betel nut use may affect the consumption and absorption of nutrients consumed as part of the regular diet. Finally, betel nut and the associated betel quid ingredients may be bought in preference to nutritious food.

How significant these factors are in affecting an individual's overall diet will depend on many variables, including the general basic diet, level of addiction to betel nut, relative price of betel nut and associated products and frequency of use.



References

- Aghi, M.B., Gupta, P.C., Mehta, F.S., Pindborg, J.J. 1992 'An intervention study of tobacco habits among rural Indian villagers', In: *Smokeless Tobacco or Health – An International Perspective*. USA Smoking and Tobacco Control Monograph 2. NIH Publication No. 92-3461, pp.307-312
- Alependava, C. 1991 'Betel nut', *Proceedings from the First Pacific Workshop on Tobacco and Cancer*, ed. Stanton, pp. 80-84
- Allen, M., Price, L., Fieldsend, A., Liberman, J., Driskell, S., 2005 '*Tobacco and alcohol in the Pacific Island Countries Trade Agreement: impacts on population health*', Secretariat on the Pacific Community, Noumea
- Australian Drug Foundation 2006 'Betelnut: The effects of chewing areca nut and betel quids', DRugInfo Clearinghouse, http://druginfo.adf.org.au/article_print.asp?ContentID=betelnut (accessed 20 September 2006).
- American Clinical Health Practice Research (ACHPR) 1998 '*Best practice guidelines for smoking cessation*' US Department of Health and Welfare, Washington DC.
- Anonymous (1994). *1993-1994 CMNI teen behavioral risk survey*. Saipan, CNMI: CMNI Public School System and Dept. of Health Services.
- Anon. 2003 'Betelnut: Mama'on', <<http://ns.gov.gu/pugua.html>>, (accessed 20 June 2006)
- Artero, V.T., Santos, V.M. Date 'Betel-Nut Palm Care' Guam Cooperative Extension, University of Guam. <http://www.hawaii.edu/hivandaids/Betel-Nut%20Palm%20Care.pdf> (accessed 12 June 2006)
- Atkinson, L., Chester I.C., Smyth, F.G., Ten Seldam R.E. 1964, 'Oral cancer in New Guinea: a study in demography and etiology'. *Cancer*, Vol. 17, pp.1289 1298.
- Axell, T., Kramer, I.H.R., Pindborg, J.J., Shear, M. 1984 'International seminar on oral leukoplakia and associated lesions related to tobacco habits', *Community Dentistry and Oral Epidemiology*, Vol.12, pp.145-154
- Backhouse, R.C. 1955 'Malignant tumours of Melanesia', *Medical Journal of Australia*, Vol.2, pp. 139-141
- Bailit HL, Ogan E, Leigh R. 1968, 'Oral Health of the Nasioi of Bougainville', *Australian Dental Journal*; Vol.13, pp.353 359.
- Barton, M., Kricker, W., Kron, T., Smylie, J., Tattersall, M. 2001 'The Hidden Burden. Cancer in Papua New Guinea'. Report for the Australian Agency for International Development (Papua New Guinea Health Services Support Program), Liverpool, NSW: IDP Education Australia, GRM International PTY Ltd, Jane Thomason and Associates
- Benjamin A.L. 2001 'Community screening for diabetes in the National Capital District, PNG: is betelnut chewing a risk factor for diabetes?', *Papua New Guinea Medical Journal*, Vol. 44, No.3-4, pp. 101-107
- Bergstrom, J.1989 'Cigarette smoking as a risk factor in chronic periodontal disease', *Community dentistry and Oral Epidemiology*, Vol. 17, pp. 245-247



- Betelnut Bisnis 2004, Ronin Films, Australian Capital Territories, producer Chirs Owen (documentary film)
- Bhandary, S., Bhandary, P. 2003 'Cancer of the oral cavity – a growing concern in the Micronesia: a case report from the Marshall Islands', *Pacific Health Dialogue*, Vol.10, No.1, pp. 76-78
- Boucher BJ, Ewen SW, Stowers JM. 1994 'Betel nut (Areca catechu) consumption and the induction of glucose intolerance in adult CD1 mice and in their F1 and F2 offspring' [see comments]. *Diabetologia*, Vol.37, pp.49-55.
- Brady, M.2001 'Historical and Cultural Roots of Tobacco Use among Aboriginal and Torres Strait Islander People', *Australian and New Zealand Journal of Public Health*, Vol.26, No.2, pp.120–124
- British Dental Association 2000 'Opportunistic oral cancer screening' *British Dental Association*, occasional paper No.6, April
- Brott, K. 1981 'Tobacco smoking in Papua New Guinea'. *Papua New Guinea Medical Journal*, Vol. 24, pp. 229-236.
- Brunton, R. 1989 'The Abandoned Narcotic', Cambridge University Press. The Bath Press, Avon
- Burton Bradley, B.G.1966, 'Papua and New Guinea transcultural psychiatry: Some implications of betel chewing', *Medical Journal of Australia*; Vol.2, pp.744 746.
- Burton-Bradley, B.G. 1978 'Betel chewing in retrospect' *Papua New Guinea Medical Journal*, Vol.21, pp. 236-41
- Burton-Bradley, B.G. 1979 'Arecaidism: betel chewing in trans-cultural perspective' *Canadian Journal of Psychiatry*, Vol. 24, pp. 481-488
- Burton-Bradley, B.G., 1980, 'Psychosomatics of arecaidism' *Papua New Guinea Medical Journal*, Vol. 23, pp.3-7
- Cabrera, F.T. 2005 'Factors associated with the use of tobacco in betel nut chewing on Saipan, Commonwealth of the Northern Mariana Islands', (unpublished)
- Carpenter, J.M., Syms, M.J., Sniezek, J.C. 2005 'Oral carcinoma associated with betel nut chewing in the Pacific: an impending crisis', *Pacific Health Dialogue*, Vol. 12, No.1, pp. 158-162
- Caven, R.D., McKillop, R.F. 2000 'Improving Agricultural Services in Papua New Guinea', in *Food Security for Papua New Guinea* Eds: R.M. Bourke, M.G. Allen and J.G. Salisbury, Proceedings of the Papua New Guinea Food and Nutrition 2000 Conference, PNG University of Technology, Lae, 26–30 June
- Cawte J. 1985 'Psychoactive substances of the South Seas: betel, kava and pituri', *Australian New Zealand Journal of Psychiatry*, Vol.19, pp.83-87.
- Chapman, S. 1998, 'Smokefree workplace policies and declines in tobacco consumption in Australia and the United States', *Australian Journal of Public Health*, Vol.29, pp.345–348.



- Chen, T.H., Chiu, Y.H., Boucher, B.J. 2006 'Transgenerational effects of betel-quid chewing on the development of the metabolic syndrome in the Keelung Community-based Integrated Screening Program', *American Journal of Clinical Nutrition*, Vol.83, No.3, pp.688-692
- Chen, T-H, Ou, A.C., Haberle, H., Miller, V.P., Langidrik, J.R., Palafox, N.A. 2004 'Smoking rates and risk factors among youth in the Republic of the Marshall Islands: results of a school survey', *Pacific Health Dialogue*, Vol.11, No.2, pp.107-113
- Choudhury, S.N.S. 1980 'Betel nut syndrome – a rare cause of bronchospasm following general anaesthesia', *Bangladesh Medical Journal*, Vol. 9, pp.84-88
- Chu NS. 1993 'Cardiovascular responses to betel chewing', *Journal of the Formosan Medical Association*, Vol.92, pp.835-837.
- Chu NS. 1994 'Sympathetic skin responses to betel chewing', *Journal of the Formosan Medical Association*, Vol.93, pp.260-262.
- Chu NS. 1994 'Effects of betel chewing on electroencephalographic activity: spectral analysis and topographic mapping', *Journal of the Formosan Medical Association*; Vol.93, pp.167-169.
- Chu NS. 1994 'Effect of betel chewing on performance reaction time', *Journal of the Formosan Medical Association*, Vol.93, pp.343-345.
- Chu NS. 1995 'Effect of betel chewing on RR interval variation' *Journal of the Formosan Medical Association*, Vol.94, pp.106-110.
- Chu N.S.1995.'Sympathetic response to betel chewing' *Journal of Psychoactive Drugs*, Vol.27, pp.183-186.
- Chu, N-S. 2001 'Effects of betel chewing on the central and autonomic nervous systems', *Journal of Biomedical Science*, Vol.8, pp. 229-236
- Coates, M., Armstrong, B., 2000 *Cancer incidence in New South Wales incidence and mortality in 1997 New South Wales*, Cancer Council Sydney
- Collins,V.R.,Dowse, G.K. 1996 'Smoking prevalence in the Pacific', *Pacific Health Dialogue*, Vol.3 No.1, pp.87-95
- Corsi, A. 2004 'An Exploratory Study of Food and Nutritional Beliefs and Practices in Pohnpei, Federated States of Micronesia', A thesis submitted to the Department of International Health Rollins, School of Public Health Emory University B.A., University of Colorado http://www.islandfood.org/publications/al_thesis.pdf, (accessed 2 December 2006)
- Country Profiles 2000 'Tobacco or Health' Tobacco-Free Initiative Western Pacific Region, www.wpro.who.int/interne./country+profiles+2000.pdf
- Croucher, R. & Islam, S. 2002 'Socio-economic aspects of areca nut use' *Addiction Biology*, Vol. 7, No1, pp.139 – 146.
- Cutress, T.W., Tapealava, N.M. 1996 'Oral conditions among Tongan children and adults, 1966 and 1986', *Pacific Health Dialogue*, Vol.3, pp. 8-13
- Cutress, T.W. 2003 'Periodontal health in South Pacific populations: A review', *Pacific Health Dialogue*, Vol.10, No.1, pp.68-75



- Daftary, D.K., Bhonsle, R.B., Murti, R.B., Pindborg, J.J., Mehta, F.S., 1980 'An oral lichen planus-like lesion in Indian betel-toabacco chewers', *Scandinavian Journal of Dental Research*, Vol.88, pp. 244-9
- Davies G. N. 1990 'The future of the dental services in Papua New Guinea: A Draft Report: Port Moresby: Department of Health
- de Costa C, Griew AR. 1982 'Effects of betel chewing on pregnancy outcome', *Australian New Zealand Journal of Obstetrics and Gynaecology*, Vol.22, pp.22-24.
- Deahl M. 1989 'Betel nut-induced extrapyramidal syndrome: an unusual drug interaction', *Movement Disorders*, Vol.4, pps.330-332.
- Deng, F-J, Ger, J., Tsai, W-J., Kao, W-F., Yang, C-C. 2001 'Acute toxicities of betel nut: Rare but probably overlooked events', *Clinical Toxicology*, Vol.30, No.4, pp.355-360
- Dobbin, J. 1996 'Drugs in Micronesia', *Micronesian Counselor*, Series 2, No. 1 Micronesian Seminar, FSM
- Downer, M.C., Petti, S. (2005) 'Leukoplakia prevalence estimate lower than expected. What is the global prevalence of leukoplakia?' *Evidence-Based Dentistry*. Vol.6, pp.12–14.
- Dowse GK. 1994 'Betel-nut chewing and diabetes in Papua New Guinea and elsewhere' [letter; comment]. *Diabetologia*, Vol.37, pp.1062-1064.
- Eisen MJ. 1946 'Betel chewing among natives of the southwest Pacific islands. Lack of carcinogenic action', *Cancer Research*, Vol.6, pp. 39 141.
- Errington, F.C. 1970 'The eyes of the Tubuam: a study in the Symbols of social relations', Ph.D. dissertation, Cornell University, New York
- Farnworth ER. 1976. 'Betel nut: it's composition, chemistry and uses', *Science in New Guinea*, Vol.4, No.2, pp.85 90.
- Farnworth ER. 1975 'Areca catechu and Pi per betel in Papua New Guinea: an elemental analysis', *Science in New Guinea*; Vol. 3, pp. 211 214.
- Farago C. 1963 'Review of 110 cases of cancer of the oral cavity in Papua New Guinea', *British Medical Journal*, Vol.1, pp.1264 1266.
- Federated States of Micronesia (Pohnpei) 2008 NCD Risk Factors STEPS Report, Suva, Fiji,
- Federated States of Micronesia GYTS 2007
- Forastiere, A., Koch, W., Trotti, A., Sidransky, D. 2001 'Head and k cancer', *New England Journal of Medicine*, Vol.345, pp.1890-1900
- Forlen H.P., Hornatein, O., Stuttgen, G. 1965 'Betel quid and leukoplakia', *Archiv für klinische und experimentelle Dermatologie*, Vol.220, pp.463-480 (in German)
- Freeman, P. 2001 'The current tobacco situation in Papua New Guinea', *Development Bulletin*, Vol.54; April: pp. 72-75
- Frewer, L.V. 1990 'The effect of betel nut on human performance.' *Papua New Guinea Medical Journal*, Vol. 33, pp. 143-145.



- Futterman, A., Lyman, A. 1998 'Palau Substance Abuse Needs Assessment (SANA). Koror: Palau Ministry of Health
- Garcia-Algar, O., Vall, O., Alameda, F., Puig, C., Pellegrini, M., Pacifici, R., Pichini, S. 2005 'Prenatal exposure to arecoline (areca nut alkaloid) and birth outcomes', *Archives Disease Child Fetal Neonatal Education*, Vol.90, pp.276-277
- Gerry RG, Smith ST, Calton, ML. 1952 'The oral characteristics of Guamanians including the effects of betel chewing on the oral tissues', *Oral Surgery, Oral Medicine, Oral Pathology*; Vol.5, pp.762 781, 884 894,1004 1011
- Gilmour, J.S.L. 1931 'The Species of Tobacco Grown in New Guinea' *Anthropological Report*, No. 11.Port Moresby: Government Printer, Territory of Papua.
- Gibson, J. 1998 'Urban demand for food, beverages, betelnut and tobacco in Papua New Guinea', *Papua New Guinea Journal of Agriculture, Forestry and Fisheries*, Vol.41, No.2, pp.37-42
- Gowda, M.1951 'The Story of Pan Chewing in India', *Botanical Museum Leaflets*, 14,8, Harvard University, pp. 181-214.
- Guam State Epidemiological Working Group 2006 'Strategic prevention framework: State Incentive Grant(SPF-SIG) Guam Substance Abuse Epidemiological
- Gupta PC. 1984 'A study of dose-response relationship between tobacco habits and oral leukoplakia' *British Journal of Cancer*, Vol.50, pp.527-531.
- Gupta PC. 1991 'Betel quid and oral cancer: prospects for prevention', *IARC.Sci.Publ.* pp.466-470.
- Gupta, P.C., Murti, P.R., Bhonsle, R.B., Mehta, F.S., Pindborg, J.J. 1995 'Effect of cessation of tobacco use on the incidence of oral mucosal lesions in a 10 year follow-up study of 12, 212 individuals users', *Oral Disease*, Vol. 1 pp. 54-58
- Gupta PC, Mehta FS, Daftary DK, Pindborg JJ, Bhonsle RB, Jainawalla PN, Sinor PN, Pitkar VK, Murti PR, Irani RR, Shah HT, Kadam PN, Iyer KSS, Iyer HM, Hegde AK, Chandrashekar GK, Shroff BC, Sahiar BE, Mehta MN. 1980 'Incidence rates of oral cancer and natural history of oral precancerous lesions in a 10 year follow up study of Indian villagers', *Community Dentistry and Oral Epidemiology*; Vol.8, pp.287 333.
- Gupta PC, Pindborg J.J., Bhonsle R.B., Murti, P.R., Mehta, F.S., Aghi, M.B.1990 ' A primary prevention study of oral cancer among Indian villagers. Eight year follow-up results. In Hakama, Beral, V., Cullen, J.W., Parkin, D.M. eds. Evaluation effectiveness of primary prevention of cancer. Lyon: International Agency for Research on Cancer IARC Monograph No 103: pp. 149-156
- Gupta PC, Pindborg JJ, Mehta FS. 1982 'Comparison of carcinogenicity of betel quid with and without tobacco: an epidemiological review', *Ecology of Disease*, Vol.1, pp.213-219.
- Gupta, P.C., Ray, C.S. 2004 'Epidemiology of betel quid usage', *Annals Academy of Medicine Singapore*, Vol.33(suppl), No.4, pp. S31- S36
- Gupta, P.C. & Warnakulasuriya, S. 2002. 'Global epidemiology of areca nut usage', *Addiction Biology*, Vol. 7, No.1. pp.77 - 84



- Haddock, R.L., Hoffman, J.H., and Williams, W.R. 1981 'Betel Nut Chewing on Guam', *Fiji Medical Journal*, August/September, pp. 139-149
- Haddock, R. 2005 'Oral cancer incidence disparity among ethnic groups on Guam', *Pacific Health Dialogue*, Vol.12, No. 1, pp. 153-154
- Haddon, A.C. 1931 'Tobacco in New Guinea. *American Anthropologist*, 33: 657-659' Cited by Marshall M.1987 'An overview of drugs in Oceania'. In *Drugs in Western Pacific Societies: Relations of substance*, (Association for Social Anthropology in Oceania Monograph no. 11), ed. L. Lindstrom, Lanham, MD: University Press of America
- Hammond, D., Fong, G.T., McDonald, P.W., Brown, K.S., Cameron, R. 2004 'Graphic Canadian Cigarette Warning Labels and Adverse Outcomes: Evidence from Canadian Smokers', *American Journal of Public Health* Vol. 94, No. 8, pp.1442-1445
- Hamner, J.E. 1986 'Aetiology and epidemiology of oral cancer', in: *Cancer and the Oral Cavity*, ed. L.W. Carr and K.Sako, Chicago, Quintessence, pp.17-30
- Hashibe, M., Mathew, B., Kuruvilla, B., Thomas, G., Sankaranarayanan, R., Parkin, D.M., Zhang Z-F. 2000 'Chewing tobacco, alcohol, and the risk of erythroplakia', *Cancer Epidemiology Biomarking and Prevention*, Vol. 9, pp. 639-645
- Hays, T. E.1991 'No Tobacco, No Hallelujah': Missions and the Early History of Tobacco in Eastern Papua. *Pacific Studies* 14(4):91–112.
- Hay, T.E. 2003 'They Are Beginning to Learn the Use of Tobacco. Cultural Context and the Creation of a Passion in Colonial Papua New Guinea' In *Drugs, Labor, and Colonial Expansion*, eds. W. Jankowiak and D. Bradburd, pp. 59–71, University of Arizona Press, Tucson.
- Henderson BE, Aitken GH. Cancer in Papua New Guinea.1979 *National Cancer Institute Monograph*, Vol. 53, 67 72 .
- Hiawalyer, G. 2002, 'Smoking prevalence among young people in Papua New Guinea', *Pacific Health Dialogue*, Vol.9, No.2 pp.209-213
- Hirsch, E.1990 'From Bones to Betelnuts: Processes of Ritual Transformation and the Development of 'National Culture in Papua New Guinea', *Man*, New Series, Vol. 25, No. 1, pp. 18-34
- Ho, C-S., Gee, M-J, 2002 'The Parental Influence of Betel-Chewing Behavior Among Junior High School Students in Taiwan' *Substance Abuse*, Vol. 23, No.3, pp.183-189
- Howden, G.F. 1984 'The cariostatic effect of betel nut chewing', *Papua New Guinea Medical Journal*, Vol.27, pp.123-131.
- Hsin-Fen Hsu, Tsui-Chun Tso, How-Ran Chao, Cherng-Gueih Shy, Ya-Ting Kuo, Feng-Yuan Tsai, Szu-Ching Yeh and Ying-Chin Ko., 2010,' Effects of arecoline on adipogenesis, lipolysis, and glucose uptake of adipocytes—A possible role of betel-quid chewing in metabolic syndrome', *Toxicology and Applied Pharmacology*, Volume 245, Issue 3, pp. 370-377
- IARC 1985a Monographs on the evaluation of the Carcinogenic Risk to Humans, Vol. 37, Tobacco Habits Other Than Smoking; Betel-Quid and Areca-nut chewing; and some Related Nitrosamines, Lyon, IARC Press
- IARC (2004) *Monographs on the Evaluation of Carcinogenic Risks to Humans, Vol. 85, Betel-quid and Areca-nut chewing and Some Areca-nut-derived Nitrosamines*, Lyon, IARC Press



- Ichihō, H.M., Wong, V., Hedson, J., David, W.J. 2004 'Cancer in Pohnpei State, Federated States of Micronesia' *Pacific Health Dialogue*, Vol.11, No.2, pp.44-49
- Jamrozik, K. 1985 'Regional variation of oral cancer in Papua New Guinea'. *Papua New Guinea Medical Journal*, Vol. 28, pp. 9-13
- Jarvis, G.K., Wood, D.W., Bachtold, J. 1993 'Betel nut users in Guam', International Centre for Health Promotion and Disease Prevention Research, School of Public Health, University of Hawaii, June
- Jayant K, Deo MG. 1986 Oral cancer and cultural practices in relation to betel quid and tobacco chewing and smoking. *Cancer Detection and Prevention*, Vol.9, pp.207-213.
- Jensen GD, Polloi AH. 1988 'The very old of Palau: health and mental state', *Age and Ageing*; Vol.17, pp.220-226.
- Johnson, F. Y. 1994 'Clinical Observations on Substance Abuse Related Health Problems at the Port Moresby General Hospital, National Capital District, Papua New Guinea', *Medical Law* Vol.13, No.3-4: 251-62.
- Johnson, F. Y. A. 1990 'An Epidemiological Survey of Alcohol and Drug Abuse in the National Capital District of Papua New Guinea', *Medical Law* Vol. 9, No2, pp. 797-830.
- Johnson, F. Y. A. (1998). 'A Study of Substance Abuse on Two Campuses of University of Papua New Guinea', *Med Law* Vol.17, pp. 229-241.
- Kanandru, K. 1991 'Papua New Guinea: The accomplishment to date report' *Proceedings from the First Pacific Workshop on Tobacco and Cancer*, ed. H. Stanton, pp. 80-84
- Kaushal, M, Mishra,AK, Raju,B.S., Ihsan,R., Chakraborty,A., Sharma,J., Zomawia,E., Verma,Y., Kataki,A., Kapur,S., Saxena,S., 2010 'Betel quid chewing as an environmental risk factor for breast cancer', *Mutation Research/Genetic Toxicology and Environmental Mutagenesis*, doi:10.1016/j.mrgentox.2010.08.011
- Kawakami, N., Takatsuka, N., Shimizu, H., Ishibashi, H. 1997 'Effects of smoking on incidence of non-insulin-dependent diabetes mellitus: replication and extension in a Japanese cohort of male employees', *American Journal of Epidemiology*, Vol.145, pp.103-109
- Zhang, L, Yang, Y-M, Xu, Z-R, Gui, Q-F., HU,Q-q 2010 'Chewing substances with or without tobacco and risk of cardiovascular disease in Asia: a meta-analysis', *Biomedicine & Biotechnology*, Vol. 11(9,), pp.681-689
- Khawaja, MI et al. 2005 ' Preventing the oral cavity cancer epidemic' *Asian Pacific Journal of Cancer Prevention*, Vol. 6, No.3, pp. 420
- Kiyingi, K.S., Saweri, 1990 , 'Betel nut and asthma', in Abstracts and Proceedings of the Twenty-sixth Annual Symposium of the Medical Society of Papua New Guinea, Goroka, 6-8 September.
- Kiyingi KS.,1991. 'Betel-nut chewing may aggravate asthma', *Papua New Guinea Medical Journal*; Vol. 34, pp.117-121.
- Kiyingi, K.S., Saweri A.1994 'Betelnut chewing causes bronchoconstriction in some asthma patients', *Papua New Guinea Medical Journal*, Vol.37, No.2, pp. 90-99



- Knauff, B. 1987 'Managing Sex and Anger: Tobacco and Kava Use among the Gebusi of Papua New Guinea'. In *Drugs in Western Pacific Societies: Relations of Substance*, ed L. Lindstrom, pp. 73–98. ASAO Monograph No. 11. Lanham, MD: University Press of America.
- Ko YC, Chiang TA, Chang SJ, Hsieh SF. 1992 'Prevalence of betel quid chewing habit in Taiwan and related sociodemographic factors', *Journal of Oral Pathology and Medicine*; Vol.21, pp.261-264.
- Lebot, V., Merlin, M., Lindstrom, L. 1992. Kava: The Pacific drug. *New Haven*, Yale University Press, pp.25-26, 54-55, 141.
- Lee CH, Lin RH, Liu SH, Lin-Shiau SY 1996. Mutual interactions among ingredients of betel quid in inducing genotoxicity on Chinese hamster ovary cells. *Mutation Research*; 367:99-104.
- Lee, C.H., Ko, Y.C., Huang, H.L., Chao, Y.Y., Tsai, C.C., Sheih, T.Y., Lin, L.M. 2003 'The precancer risk of betel quid chewing, tobacco use and alcohol consumption in oral leukoplakia and oral submucous fibrosis in southern Taiwan', *British Journal of Cancer*, Vol.88, pp.366-372.
- Lee, H. 1990 The health effects of kava/sakau and betel nut. Western Regional Centre for Drug-Free Schools and Communities, Portland, Northwest Regional Educational Laboratory.
- Lee, P.H., Chang, M.C., et al. 2006 'Prolonged exposure to arecoline arrested human KB epithelial cell growth: Regulatory mechanisms of cell cycle and apoptosis', *Toxicology*, March 15: Vol. 220 (2-3), pp. 81-9
- Lee Jie-Min, 2007 'The synergistic effect of cigarette taxes on the consumption of cigarettes, alcohol and betel nuts', *BMC Public Health*, Vol.7, Iss. 1, pp.121
- Lepowsky M. 1982 'A comparison of alcohol and betel nut use on Vanatinai (Sudest Island)' In Marshall M (Ed) *Through a Glass Darkly: Beer and Modernization in Papua New Guinea*. Monograph 18, Institute of Applied Social and Econ Research, Boroko, Papua New Guinea.
- Leung, C. 1995 'The Problem of tobacco in the Pacific', prepared for Western Pacific Regional Office of the World Health Organization, for the Pacific Regional Tobacco Conference, Saipan, CNMI, July 5-7
- Lopez-Vilchez MA, Seidel V, Farre M, Garcia-Algar O, Pichini S, Mur A. 2006 'Areca-nut abuse and neonatal withdrawal syndrome' *Pediatrics*, Vol.117, pp. 129-131.
- Lumukana, R. & King, T. 2003, 'Smoking and Chewing Habits of Oral Cancer Patients in the Solomon Islands', *Pacific Health Dialogue*, Vol. 10, No.1, pp. 41-44
- Lyman, A. 2001 'Tobacco use prevention and control activities in the Republic of Palau' *Development Bulletin*, Vol. pps.54-55
- MacLennan R, Paissat D, Ring A, Thomas S., 1985 'Possible aetiology of oral cancer in Papua New Guinea,' *Papua New Guinea Medical Journal*, Vol. 28, pp.3-8.
- MacLennan, R. Thomas, S.J., Battistutta, D., Paissat, D. 1991 'Oral Cancer in Papua New Guinea. Project Report' unpublished
- McDonald, D. 1999 'Rapid Situation Assessment of drug abuse in Papua New Guinea, 1998', Papua New Guinea National Narcotics Bureau, Papua New Guinea



- Mahoney D, Quinn N, Afenya P, Hugman S, Sappu M. 1985. The technology and economics of slaked lime manufacture for betel nut mastication in Papua New Guinea. Proceedings of the Papua New Guinea Institute of Chemistry Congress 1985. University of Papua New Guinea, Port Morsby
- Mannon, N., Boucher, B.J., Evans, S.J. 2000 'Increased waist size and consumption of Areca catechu (betel-nut); a risk factor for increased glycaemia in Asians in east London', *British Journal of Nutrition*, Vol. 83, pp. 267 -275
- Marshall LB. 1985 'Substance use in pregnancy among two groups of urban women in Papua New Guinea', *Papua New Guinea Medical Journal*; Vol.28, pp.195-204.
- Marshall, M. 1987 'An overview of drugs in Oceania', in: *Drugs in Western Pacific societies: Relations of substance*, ed. L. Lindstrom (Association for Social Anthropology in Oceania Monograph no. 11), Lanham, MD: University Press of America
- Marshall, M. 1990 'Combining insights from epidemiological and ethnographic data to investigate substance use in Truk, Federated States of Micronesia', *British Journal of Addiction*, 85, 1457-1468.
- Marshall, M. 1991 'Beverage alcohol and other psychoactive substance use by young people in Chuuk, Federated States of Micronesia (Eastern Caroline Islands)' *Contemporary Drug Problems*, 18, 331-371.
- Marshall, M. (1993b). 'A Pacific haze', In: *Contemporary Pacific societies: studies in development and change*, eds. V. S. Lockwood, T. G. Harding, & B. J. Wallace., (pp. 260-272). Englewood Cliffs, NJ: Prentice Hall.
- Marshall M. 1997 'Tobacco prevention in FSM', *Drug Alcohol Review*, Dec. 16(4), pps. 411-9
- Marshall, M. 2005 'Carolina in the Carolines: a survey of patterns and meanings of smoking on a Micronesian Island', *Medical Anthropology Quarterly*, Vol. 19, No. 4, pp. 365-382
- Martin C. 1990. 'Cancer on the increase in Papua New Guinea: The failure of Preventive measures'. *Papua New Guinea Medical Journal*; Vol.33, pps.85-87.
- Martin, W.M.C., Sengupta, S.K. et al 1992 'The Spectrum of Cancer in Papua New Guinea – An analysis Based on the cancer registry 1979 – 1988', *Cancer*, Vol.70(12) pp.2942-2950
- Martin, W.M.C. 1990 'Cancer on the increase in Papua New Guinea: the failure of preventive measures, *Papua New Guinea Medical Journal*, Vol. 33, pps. 85-87
- Mathew, B., Sankaranarayanan, R., Wesley, R., Nair, M.K. 'Evaluation of mouth self-examination in the control of oral cancer', *British Journal of Cancer*, Vol.71, No.2, pp.397-399
- Mehta, F.S., Gupta, P.C., Daftary, D.K., Pindborg, J.J., Choksi, S.K., 1972 'An epidemiologic study of oral cancer and precancerous conditions among 101, 761 villagers in Maharashtra, India', *International Journal of Cancer*, Vol.10, pps. 134-141
- Mokuau, N. (Ed.). 1998 *Responding to Pacific Islanders: Culturally Competent Perspectives for Substance Abuse and Prevention*. Washington, DC: US Department of Health and Human Services (DHHS Publication No. SMA 98-3195).
- Moller, I.J., Pindborg, J.J., Effendi I. 1977 'The relation between betel chewing and dental caries', *Scandinavian Journal of Dental Research*; Vol.85, pps. 64-70.



- Murti, P.R., Bhonsole R.B, Pindborg J.J, Daftary, D.K., Gupta PC, Mehta, F.S., 1985 'Malignant transformation rate in oral submucous fibrosis over a 17-year period', *Community Dentistry and Oral Epidemiology*, Vol. 13, pp. 340-341
- Nair J, Ohshima H, Friesen M, Croisy A, Bhide SV, Bartsch H. Tobacco-specific and betel nut-specific N-nitroso compounds: occurrence in saliva and urine of betel quid chewers and formation in vitro by nitrosation of betel quid. *Carcinogenesis* 1985;6:295-303.
- Norton, S.A. 1998 'Betel: Consumption and consequences' *Journal of the American Academy of Dermatology*, Vol. 38, No.1 pp 81- 87
- Newell, P. 2002, 'Huli oral health', *Papua New Guinea Medical Journal*, Vol. 45 (1-2), pps. 63-79
- Nigam, P. Srivastava, A.B. 1990 'Betel chewing and dental decay', *Federation of Operative Dentistry*, Vol.1, pp.36-38.
- Oakley, E., Demaine, L. Warnakulassuriya, S. 2005 'Areca (betel nut) chewing habit among high-school children in the Commonwealth of the Northern Mariana Islands (Micronesia)', *Bulletin of the WHO*, Vol. 83 (9), pp.656-659
- Orr, I.M. 1933 'Oral cancer in betel nut chewers in Travancore; its aetiology, pathology and treatment', *Lancet*; 2:575 580.
- Pacific Regional Central Cancer Registry (PRCCR), 2008, <http://pacificcancer.org/Cancer/CaResources/PRCCR/>
- Palafox, N.A., Yamada, S. Ou, A.C., Minami, J.S., Johnson, D.B. Katz, A.R., 2004 'Cancer in Micronesia' *Pacific Health Dialogue*, Vol. 11, No.2, pp. 78-83
- Palau Ministry of Health 2005 'Oral health in Palau – Disease Burden and Plan', Ministry of Health, Bureau of Public Health, Oral Division <http://palaugov.net/minhealth/publichealth/divoralhlth/oralhlthdoc/ohbrndocplan.pdf>, (accessed 21 August 2006)
- Parkin, M.D., Bray, F., Ferlay, J., Pisani, P., 2005 'Global Cancer Statistics, 2002', *CA A Cancer Journal for Clinicians*, Vol. 55, pp.74-108
- Persson, P.G., Carlsson, S. Svanström, L., Östenson, C.G., Efendic, S.V., 2000 'Cigarette smoking, oral moist snuff use and glucose intolerance', *Journal of Internal Medicine*, Vol. 248, No.2, pp.103
- Petrucci, L. 1991 'Betel mania', *Islands* Vol.11, pp. 25-26
- Petersen, P.E. 2003 'Global Framework Convention on Tobacco Control: The Implications for Oral Health' *Community Dental Health*, Vol. 20, pp.137-138
- Phongsavan, P., Olatunbosun-Alakija, A., Havea, D., Bauman, A., Smith, B.J., Galea, G., Chen, J. 2005 'Health behaviour and lifestyle of Pacific youth surveys: a resource for capacity building', *Health Promotion International*, Vol.20, No.3, pp.238-248.
- Pickwell, S.M., Williams, S.A., Curzon, M.E., 1994 'Betelmania. Betel quid chewing by Cambodian women in the United States and its potential health effects', *Western Journal of Medicine*, Vol.160, pp. 326-30



- Pietrusewsky M, Douglas MT, Ikehara-Quebral RM. 1997 'An assessment of health and disease in the prehistoric inhabitants of the Mariana Islands', *American Journal of Physical Anthropology*, Vol.104:315-342.
- Pindborg JJ, Barmes D, Roed Peterson B. 1968 'Epidemiology and histology of oral leukoplakia and leukoedema among Papuans and New Guineans' *Cancer*, Vol.22, pps.379-384.
- Pindborg JJ, Kiaer J, Gupta PC, Chawla TN. 'Studies in oral leukoplakias. Prevalence of leukoplakia among 10 000 persons in Lucknow, India with special reference to use of tobacco and betel nut' *Bull Wild Hlth Org* 1967; 37:109-116.
- Pindborg JJ, Mehta FS, Daftary DK. 1970. 'Occurrence of epithelial atypia in 51 Indian villagers with oral submucous fibrosis', *British Journal of Cancer*; Vol.24, pps.253-257.
- Pindborg JJ, Zheng KH, Kong CR, Lin FX. 1984 'Pilot survey of oral mucosa in areca (betel) nut chewers on Hainan Island of the People's Republic of China', *Community Dentistry and Oral Epidemiology*, Vol.12, pps.195-196.
- Pinhey, T.K., Workman, R.L., Borja, J.P. 1992 'Women's use of betel nut, alcohol and tobacco on Guam'. *Journal of Micronesian Studies*, Vol.1, pps. 413-423.
- Radway, S. 2004 'The Cuban cigar of Micronesia? Yap's betel nut fuels entrepreneurial spirit' in: *Pacific Magazine*, <http://www.pacificmagazine.net/pm52004/pmdefault.php?urlarticleid=0004>, (accessed 24 July 2006)
- Rajendran, R., 1994 'Oral submucous fibrosis: etiology, pathogenesis, and future research' *Bulletin of the World Health Organization*, Vol. 72 no.6 pp. 831-1016
- Rajkumar, T., Franceschi, S., Vaccarella, S., Gajalakshmi, V., Sharmila, A., Snijders, P.J.F., Munoz, N., Meijer, C>J.L.M., Herrero, R., 2003 'Role of paan chewing and dietary habits in cervical carcinoma in Chennai, India', *British Journal of Cancer*, Vol.88 pp. 1388-1393
- Reed, D. 1977 'Current status of cancer studies in the South Pacific', *National Cancer Institute Monograph*, 47: pp.61-66
- Riesenfeld A. 1956 'Tobacco in New Guinea and the other areas of Melanesia'. *Royal Anthropological Journal*; 81:69
- Rooban T, Joshua, E., Rooban, A., Govind, G.K. 2005 'Health hazards of chewing arecanut and products containing arecanut', *Calicut Medical Journal*, Vol.3, No.2 <<http://www.calicutmedicaljournal.org/2005/3/2/e3/index.htm>> (Accessed 8 August 2006).
- Rothman K, Keller A. 1972 'The effect of joint exposure to alcohol and tobacco on risk of cancer of the mouth and pharynx'. *Journal of Chronic Disease*, Vol. 25, pp. 711-716.
- Republic of Marshall Islands 2007 NCD Risk Factors STEPS Report, Suva, Fiji,
- Sankaranarayanan, R. 1997 'Health care auxiliaries in the detection and prevention of oral cancer', *Oral Oncology*, Vol.33, No.3 pp.149-154
- Scrimgeour EM, Jolley D. 1983 'Trends in tobacco consumption and incidences of associated neoplasms in Papua New Guinea', *British Medical Journal*, Vol.286, pps.1414-1416.



- Senn,M., Baiwog,F., Winmai,J, Mueller,I., Rogerson, S., Senn,N., 2009, 'Betel nut chewing during pregnancy, Madang province, Papua New Guinea', *Drug and Alcohol Dependence*, Volume 105, Issues 1-2, pp. 126-131
- Shah, N., Sharma, P.R. 1998 'Role of chewing and smoking habits in the etiology of oral submucous fibrosis (OSF): a case-controlled study', *Journal of Oral Pathology and Medicine*, Vol27, pps.475-479
- Silverman, j., Griffiths, M., 1972 'Smoking characteristics of patients with oral carcinoma and the risk for a second oral primary carcinoma' *Journal of the American Dental Association*, Vol.85, pp.637-640
- Silverman S, Bhargava K, Mani NJ, Smith LW, Malaowalla AM. 1976 'Malignant transformation and natural history of oral leukoplakia in 57 518 industrial workers of Gujarat, India', *Cancer*, Vol.38, pp.1790 1795
- Sinha, A., Rao, A.R. 2001 'Embryotoxicity of betel nuts in mice', *Toxicology*, Vol.37, pp.315-326
- Sinor, P.N., Gupta, P.c., Murti, P.R., Bhonsle, R.B., Daftary, D.K., Mehta, F.S., Pindborg, J.J., 1990 'A case controlled study of oral submucous fibrosis with special reference to the etiologic role of areca nut', *Journal of Oral Pathology and Medicine*, Vol.19, No.2, pp.94-98
- Singh, B., Dua, R., Chabra, B., Dua, M. 1994 'A 'peep' before sleep', *Middle East Journal of Anaesthesiology*, Vol. 12, pp. 493-495
- Solomon Islands 2010 NCD Risk Factors STEPS Report, Suva, Fiji,
- SPC Pin <http://www.spc.int/Lifestyle/Resources/PIN%2057%20web.doc>
- Stanton, H. 2001 'The social and economic impacts of tobacco in Asia and the Pacific', *Development Bulletin*, Vol.54, pp.55-58
- Stich HF, Brunnemann KD, Mathew B, Sankaranaryanan R, Nair MK. 1989 'Chemopreventive trials with vitamin A and beta-carotene: some unresolved issues', *Preventative Medicine*; Vol.18, pp.732-739.
- Strickland, S.S. 2002 'Anthropological perspectives on use of the areca nut' *Addiction Biology*, Vol. 7, No. 1, pp. 85-98
- Sullivan, R.J., Allen, J.S., Otto, C., Tiobech, J., Nero, K. 2000 'Effects of chewing betel nut (Areca catechu) on the symptoms of people with schizophrenia in Palau, Micronesia', *British Journal of Psychiatry*, Vol. 177, pp. 174-178
- Talonu, N.T. 1989 'Observations on Betel-Nut Use, Habituation, Addiction and Carcinogenesis in Papua New Guinea', *Papua New Guinea Medical Journal*, Vol. 32, pp.195 –197
- Talonu, T. 1982 "'Buai" addiction', Paper presented at the Medical Society of Papua New Guinea, Eighteenth Symposium
- Taoka, S., Hancock, T., Ngaden, V., Yow, A.R., Durand, A.M. 2004 'Cancer in Yap State, Federated States of Micronesia', *Pacific Health Dialogue*, Vol.11, No.2, pp. 50-56
- Taufa T. 1988 Betel-nut chewing and pregnancy. *Papua New Guinea Medical Journal*; Vol. 31, pp.229-233.



- Taylor, R, Parker, M. et al. 1983 'Cancer in Solomon Islands 1970-1982' *Papua New Guinea Medical Journal*, Vol.26, No.2, pp. 102-110
- Taylor RF, al-Jarad N, John LM, Conroy DM, Barnes NC. 1992 'Betel-nut chewing and asthma', *Lancet*, May 9 Vol.339 (8802), pp. 1134-1136
- Thomas, S.J. 1993 'Studies of the aetiology of oral neoplasia in Papua New Guinea', University of Queensland, Faculty of Medicine.
- Thomas, S., Brennan, J., Martel, G., Frazer, I., Montesano, R., Sidransky, D., Hollstein, M. (1994) Mutations in the conserved regions of p53 are infrequent in betel-associated oral cancers from Papua New Guinea', *Cancer Research*, Vol. 54, No.13, pp. 3588-3593,
- Thomas, S.J., MacLennan, R. 1992 'Slaked lime and betel nut cancer in Papua New Guinea', *Lancet*, Vol.340, pp 577
- Thomas, S.J., Bain, C., Battistutta, D., Ness, A.R., Paissat, D., MacLennan, R.L.(2007) 'Betel quid not containing tobacco and oral cancer: a report on a case-control study in Papua New Guinea and a metaanalysis of current evidence', *International Journal of Cancer* 120:1318-1323. PMID:17163423
- Thomas SJ, MacLennan R, Olszowy H, Hegarty J. Variation in oral cancer and in the composition of lime in Papua New Guinea (unpublished)
- Trivedy, C.R., Craig, G., Warnakulasuriya, S. 'The oral health consequences of chewing areca nut', *Addiction Biology*, Vol. 7, (1), pp. 115-126
- Tsai, J.F., Chuang, L.Y., Jeng, J.E., Ho, M.S., Hsieh, M.Y., Lin, Z.Y. 2001 'Betel quid chewing as a risk factor for hepatocellular carcinoma: A case-control study', *British Journal of Cancer*, Vol.84, pp. 709-713
- Tseng Chin-Hsiao, 2008 'Betel Nut Chewing Is Associated with Hypertension in Taiwanese Type 2 Diabetic Patients', *Hypertension Research* Vol.31, pp.417-42
- Tung, T.H., Chiu, Y.H., Chen, L.S., Wu, H.M., Boucher, B.J., Chen, T.H.; 2004 'A population-based study of the association between areca nut chewing and type 2 diabetes mellitus in men (Keelung Community-based Integrated Screening programme No. 2)', *Diabetologia*, Vol.47, No.10, pp.1776-1781
- UNICEF 2001 'The State of Health Behaviour and Lifestyle of Pacific Youth, Pohnpei State, Federated States of Micronesia', Report' UNICEF Pacific. Suva, Fiji.
- US Department of Health and Human Services 1992 Monograph 2'Smokeless Tobacco or Health: An International Perspective', National Institute of Health September 1992
- US Department of Agriculture, Animal and Plant Health Inspection Service
- U.S. Public Law 99-239, The Compact Act of Free Association <http://www.fm/jcn/compact/introfr.html>, (accessed 20 November 2006).
- Vallace, P.J.T., Anderson, H.R. Alpers, M.P. 1987 ' Smoking habits in a rural community of Puaa New Guinea in 1970 and 1984', *Papua New Guinea Medical Journal*, Vol:30, pp. 277-280
- Van der Waal I, Axell T. 2002 'Oral leukoplakia: a proposal for uniform reporting', *Oral Oncology*, Vol.38, pp.521-526



- Van McCrary, S., 1998 'The Betel Nut: An emerging public health threat? Health Law and Policy Institute, www.law.uh.edu/healthlawperspectives/HealthPolicy/980908Betel.html, 09/08/1998
- Velayudhan, A., Kumar, S., Benegal, V. 1999 'Betel Nut: A socially sanctioned drug of abuse', National Institute of Mental Health and Neurosciences, Bangalore, <http://www.nimhans.kar.nic.in/deaddiction/lit/Betel%20Nut-Socially%20Sanctioned%20Drug.pdf> (accessed 20 July 2006)
- Vele, A. 1982 'Cash economy from betel nut' Medical Society of Papua New Guinea, Eighteenth Symposium.
- Wang, C-K., Wu, M-J. 1996 'The separation of phenolics from Piper betle leaf and the effect on the mutagenicity of arecoline', *Journal of Chinese Agriculture and Chemistry Society*, Vol.34, pp.623-632 (in Chinese)
- Wang S.C., Tsai C.C., Huang S.T. Hong Y.J.2004 'Betel nut chewing: the prevalence and the intergenerational effect of parental behavior on adolescent students', *Journal of Adolescent Health*. Mar;34(3):244-9.
- Warnakulasuriya, S. 2002 'Areca nut use following migration and its consequences' *Addiction Biology*, Vol. 7, No. 1, pp. 127-132
- Waterhouse J, Muir C, Shanmugaratnam K, Powell J, (Ed). Cancer Incidence in Five Continents, Volume IV. IARC Scientific Publications No 42, International Agency for Research on Cancer, Lyon, 1982.
- Watson, P. 1991 'Does abundant supply of drugs lead to heavy consumption? A Papua New Guinea case study', *Drugtext*
- Watson, P.1987 'An overview of drugs in Oceania', in: *Drugs in Western Pacific societies: Relations of substance*, ed. L. Lindstrom (Association for Social Anthropology in Oceania Monograph no. 11), Lanham, MD: University Press of America, Chp 5
- Weegels P, Heywood P, Jenkins C. 1984 'Consumption of betel nut and its possible contribution to protein and energy intakes', *Papua.New Guinea Medical Journal*, Vol.27, pp.37-39.
- Warnakulasuriya, S. 2002 'Areca nut use following migration and its consequences' *Addiction Biology*, Vol. 7, No. 1, pp. 127-132
- Wells, C.R., 1925 'Betel nut chewing and its effects', *US Navy Medical Bulletin*, Vol.22 pp. 437
- Winstock, A. 2002 'Areca nut-abuse liability, dependence and public health' *Addiction Biology*, Vol. 7, (1), pp. 133-138
- Workman, R.L. 2001 'Tobacco use among Pacific Islanders: risk-behavior surveys and data sets for the study of smoking behavior in Guam', *Asian American Pacific Islander Health*, Vol.9(1), pps. 15-24
- World Health Organization 1978 Declaration of Alma-Ata, in: *Primary health care – Geneva,WHO,p79*
- World Health Organization 1980 Guide to epidemiology and diagnosis of oral mucosal diseases and conditions. *Community Dentistry and Oral Epidemiology*, Vol. 8, pps1 26.



- World Health Organization 1995 'Healthy Islands', The Yanuca Island Declaration on Health, Conference of Ministers of Health for the Pacific Islands (Suva and Yanuca Island 1995), Manila, WHO WPRO, pp.51-65
- World Health Organization 1998 Manual on the prevention and control of common cancers (20), WHO Regional Publication, Western Pacific Series
- World Health Organization 1999 'International Consultation on Environmental Tobacco Smoke (ETS) and child health' Tobacco Free Initiative, 11-14 January, Geneva, <http://www.who.int/tobacco/research/en/ets_report.pdf> (accessed 16 November 2006)
- World Health Organization 2003 The Crete Declaration on Oral Cancer Prevention <http://www.who.int/oral_health/events/crete_declaration_05/en/> (accessed 20 June 2006)
- World Health Organization 2003 Tonga Commitment to Promote Healthy Lifestyles and Supportive Environment, <<http://www.wpro.who.int/NR/rdonlyres/21E2A8CB-3321-426E-B2DA-4C568F4C65CB/0/TongaEnglish2.pdf>>, (accessed 20 November 2006)
- World Health Organization Global Oral Health Programme, <http://www.who.int/oral_health/objectives/en/index.html> (accessed 20 June 2006)
- World Health Organization 2006 'Tuberculosis control in the Western Pacific Region: 2006 Report', WHO Regional Office for the Western Pacific, Manila, <http://www.wpro.who.int/publications/pub_9290612193.htm> (accessed 20 November 2006)
- World Health Organization Stepwise approach to chronic disease risk factor surveillance (STEPS) <<http://www.who.int/chp/steps/riskfactor/en/index.html>> (Accessed 9 September 2006)
- World Health Organization 2005 'Best Practices in Tobacco Control. Cambodia's experience with smoke-free Buddhist Monks and WATS. <http://www.wpro.who.int/NR/rdonlyres/B07E573D-8249-4833-9E4F-567585B07E21/0/BestPracticesforSFMonksproject.pdf>
- World Health Organization 2003 WHO Framework Convention on Tobacco Control. <http://www.who.int/fctc/en/>
- Yang, M.S., Chung, T.C., Yang, M.U., Hsu, T-Y, Ko, Y.C. 2001 'Betel quid chewing and risk of adverse birth outcomes among aborigines in eastern Taiwan', *Journal of Toxicology and Environmental Health*, Vol.64, pp.465-72
- Youth Risk Behavioural Survey, www.cdc.gov/nmwr/PDF/ss/ss5712.pdf#
- Ysaol, Y., Chilton, J.I., Callahan, P. 1996 'A survey of betel nut chewing in Palau', *Journal of Micronesian Studies*, Vol.4, pps. 244-255.
- Zain, R.B. 2000, 'Cultural and dietary risk factors of oral cancer and precancer – a brief overview', *Oral Oncology*, Vol 37 pp. 205-210
- Zhang, L., Yang, Y-m, XU, Z-r., Qi-feng GUI, Q-f., Hu, Q-q. 2010 'Chewing substances with or without tobacco and risk of cardiovascular disease in Asia: a meta-analysis', *University Science B (Biomedicine & Biotechnology)*, Vol.11(9) pp. 681-689





Acknowledgements

This report was prepared by Dr Donna Kennedy Langly in collaboration with the Tobacco Free Initiative unit of the WHO Regional Office for the Western Pacific. The review of this report and the development of recommendations were done through key informant interviews conducted in 2006 and during the Meeting on Control of Betel Nut and Tobacco Chewing held in Manila, Philippines in August 2010. In this regard, we recognize the outstanding contributions of the following:

RESPONDENTS TO KEY INFORMANT INTERVIEWS

Republic of Marshall Islands

Dr Ohnmar Tut

Preventive Services Dentist, Ministry of Health

Ms Emi Chutaru, Communication Officer, HIV/AIDS and STI Section, Secretariat of the Pacific Community

Federated States of Micronesia

Dr Marcus Samo, Assistant Secretary of Health

Dr Kino S. Ruben, Epinet Focal Point; Cancer Program Coordinator; Chief of Primary Health Care (Chuuk)

Dr Mark Durand, Director Health Services (Yap)

Commonwealth of Northern Mariana Islands

Ms Louise Oakley, Public Health Registered Dietician

Dr Alberto B. Ventura, Clinical Supervisor for the Community Health Centre Dental Services

Nauru

Ms Maree Bacigalupo, Secretary for Health and Medical Services

Niue

Ms Karen Fukofuka, Nutrition Adviser, HPL Section, Secretariat of the Pacific Community

Republic of Palau

Mr Tino Faatuala, Nutritionist

Ms Valerie N. Remengesau Whipps, Palau Tobacco Control Program Manager

Mrs Joanne Sengebau-Kingzio, Environmental Health

Mrs Henrietta Merei, TB Control Program Manager

Papua New Guinea

Paul Aia, TB Control Program

Mr Charles Semwakesa, Technical Services Manager, National Youth Commission

Solomon Islands

Dr Lorraine Oti Maekera, Director of Dental Services

Ms Jillian Tutuo-Wate, Nutritionist

Dr Divi Ogaogo, Undersecretary for Health Improvement

Dr Dennie Iniakwala, HIV and STI Section Head, Secretariat of the Pacific Community

Tonga

Dr Viliami Puloka, Physical Activity Adviser, HPL Section, Secretariat of the Pacific Community

United States of America

Mr Michael S. O'Mallan, Environmental Health Specialist, Guam

Ms Marie B. Luarca, Secretary, Department of Public Health and Social Services, Guam

Mr Ken Agustin, Administrative Assistant, Department of Public Health and Social Services, Guam

Ms Joann Diego, Administrative Officer, Department of Public Health and Social Services, Guam

Dr Mark Greer, Hawaii



PARTICIPANTS OF THE MEETING ON CONTROL OF BETEL NUT AND TOBACCO CHEWING

NATIONAL FOCAL PERSONS

Cambodia

Dr Khun Sokrin, National Center for Health Promotion

Guam

Dr Annette M. David

Kiribati

Mr Kireata Ruteru, Ministry of Health and Medical Services

Republic of Marshall Islands

Mr Russell Edwards, Ministry of Health

Federated States of Micronesia

Mrs Shra Alik, Department of Health and Social Affairs

Commonwealth of Northern Mariana Islands

Ms Joanne C. Ogo, Department of Public Health

Republic of Palau

Mr Roman B. Oseked, Sr., Tobacco Use Prevention and Control Program, Ministry of Health

Solomon Islands

Mr Albino Lovi, Ministry of Health

Vanuatu

Mr Jean-Jacques Alberick Rory, Ministry of Health

TEMPORARY ADVISERS

Dr Prakash Gupta, Healis - Sekhsaria Institute for Public Health, India

Ms Annabel Lyman, Framework Convention Alliance (FCA), Republic of Palau

Dr Yvette C. Paulino, University of Guam

SECRETARIAT

Dr Susan Mercado, WHO Regional Office for the Western Pacific

Mr James Rarick, WHO Regional Office for the Western Pacific

Dr Ali Akbar, WHO Regional Office for the Western Pacific

Dr Yel Daravuth, WHO Cambodia

Mr Kia Henry Nema, WHO Papua New Guinea

Dr Li Dan, WHO South Pacific

Mr Raj Shalvindra, WHO South Pacific





WHO Western Pacific Region
PUBLICATION



ISBN -13 978 92 9061 569 9