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Authors: Rahena Akhter, Nur Mohammad Monsur Hassan, Jun Aida, Shuichi Takinami and Manabu Morita

Title: Relationship between betel quid additives and established periodontitis among Bangladeshi subjects

Journal Title: Journal of Clinical Periodontology

ISSN: 1600-051X

Year: 2008

Volume: 35

Issue: 1

Pages: 9-15

DOI/URLs:
http://dx.doi.org/10.1111/j.1600-051X.2007.01164.x
http://www.ncbi.nlm.nih.gov/pubmed/18021263#
http://researchoutput.csu.edu.au/R/-?func=dbin-jump-full&amp;object_id=58004&amp;local_base=GEN01-CSU01

Author Address: rakhter@csu.edu.au

CRO Number: 58004
Relationship between betel quid additives and established periodontitis among Bangladeshi subjects

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Running title: Betel quid additives and periodontitis

Keywords: Betel quid; tobacco; masala; periodontal disease; Bangladeshi subjects

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Conflict of interest
The authors declare that there are no conflicts of interest in the study.

Source of funding statement:
No external funding, apart from the support of the authors’ institution, was available for this study.
Abstract

Aim: To determine the relationship between betel quid chewing additives and established periodontitis in Bangladeshi subjects.

Materials and Methods: A total of 864 subjects participated in this study. Among them, 140 pairs of sex- and age-matched case subjects and control subjects were selected. A case was defined as a person who had at least two sites with clinical attachment level (CAL) ≥ 6 mm and at least one site with probing depth (PD) ≥ 5 mm. Subjects without these criteria were considered as controls. Information on sociodemographic variables, psychological stress, dental health behavior, smoking and betel quid chewing habits was obtained.

Results: Multiple logistic regression analysis showed that current betel quid chewers had greater probabilities to have established periodontal disease than did non-chewers (OR= 3.79, P<0.05). Mean PD, mean CAL, mean percentage of bleeding on probing and number of missing teeth were significantly higher in chewers of betel quid with tobacco and masala than in chewers of betel quid without such additives adjusting for age, sex, smoking habit, BMI, dental visit pattern, stress, and plaque index. Higher frequency and longer duration of betel quid chewing showed a significant relation with increase in periodontal parameters.

Conclusions: The results indicate that betel quid additives might significantly enhance periodontitis in the population studied.
Clinical Relevance:

Scientific rationale for the study: Very few studies have shown a correlation of betel quid chewing with periodontal disease. There have been no studies on betel quid additives (tobacco leaf, and masala) as possible risk indicators for periodontitis.

Principal findings: Significant associations were found between betel quid additives and periodontal clinical parameters. Higher frequency and long duration of betel quid chewing were significant predictors of established periodontitis.

Practical implications: Dentists in this community need to inform people about the harmful effect of betel quid additives as well as the harmful effect of betel quid chewing on periodontal health. The findings of this study will provide guidance for planning public health programs to reduce the habit of betel quid chewing.
Introduction

Betel quid chewing is incorporated in many religious and cultural rituals of ethnic groups within the Indian subcontinent and has gained a degree of social acceptance (Bedi & Gilthorpe 1995). An estimated 200 million people chew betel quid habitually. The style of betel quid chewing varies not only between nations but also between communities and individuals. The habit is commonly termed “pan chewing” in Bangladesh. The main components are the leaf of Piper betel L. (pan), nut of Areca catechu L. (supari), lime (chuna) and extract of the wood of Acacia catechu (katha). Normally, lime, Acacia catechu L, and Areca catechu extract are smeared on the betel leaf, which is then partially folded into a funnel shape. Once folded completely, the quid is placed in the mouth, usually in the cheek, and gently chewed or sucked for as long as is desired, sometimes even during sleep (Prabhu et al. 2001, Summers et al. 1994). The habitual chewer may keep a “chew” in his/her mouth from 15 to 30 minutes (Mehta et al. 1955).

Results of many studies have revealed relationships of betel quid chewing with oral cancer and oral soft tissue lesions (Ahmed & Islam 1990, Ko et al. 1992, 1995, Yang et al. 2005, Thomas et al. 2007). Despite the fact that the betel quid chewing is the fourth most common addictive habit worldwide (Yen et al. 2006), there have been only a few studies in which the relationship between betel quid chewing and periodontal disease (Mehta et al. 1955, Choudhury et al. 2003, Chatrchaiwiwatana 2006, 2007). There has been no such study in Bangladeshi people. In Bangladesh, betel quid chewers commonly add tobacco leaf and/or one of a wide variety of other compounds named masala, a complex of spices such as cardamom, ginger, clove and grated coconut, to the quid (Gupta & Ray 2004). Although the periodontal effects of such additives are not known, it is possible that such additives lead to a distinct profile of periodontal disease in betel chewers. As far as we know, no investigations have focused on associations between additives in betel quid chewing and periodontal disease.

This study was designed to determine whether the habit of betel quid chewing with additives is a contributing factor to the rise in incidence of periodontal disease among Bangladeshi people. In addition, the dose-response effects (frequency and duration) of habitual betel quid chewing were examined.
Materials and Methods

Ethics and informed consent

Before the start of the study, ethical approval was obtained from the Executive Committee of Dhaka Dental College and Hospital. The aims of the investigation and the nature of the study were fully explained to the subjects, who gave informed consent before participation.

Subject recruitment

A total of 864 subjects who received dental treatment at the periodontal clinic of Dhaka Dental College & Hospital, Dhaka, Bangladesh participated in this study. Among them, 140 pairs of sex and age (±3 years) -matched periodontal cases and controls were selected. A periodontal case was defined as a person who had at least two sites with clinical attachment level (CAL) ≥ 6 mm and at least one site with probing depth (PD) ≥ 5 mm. However, these conditions did not have to be present in the same site or tooth (Machtei et al. 1992, Solis et al. 2004). Subjects without these criteria were considered as controls.

Exclusion criteria

Subjects were excluded if there were oral conditions present that could interfere with examination procedures, if they were pregnant, if they suffered from systemic disease such as cardiovascular disease, liver dysfunction, hepatitis or any disease requiring continuous medication, if they had received antibiotic therapy within the past three months, or if they had taken non-steroidal anti-inflammatory drugs in the past 6 weeks.

Questionnaire

The subjects completed a questionnaire with questions on habit of betel quid chewing, educational level, height, weight, smoking, psychosocial stress, oral hygiene practices and dental visiting behavior. Betel quid chewing status (current chewers, former chewers and non-chewers) was defined as follows. Current chewers were subjects who were currently consuming betel quid, former chewers were
subjects who reported that they had quit betel quid chewing, and non-chewers were subjects who had never chewed betel quid. Consumption of betel quid was expressed as the number of units used per day (frequency) and the number of years of consumption (duration) (Croucher et al. 2002). Usage of additives (tobacco and/or masala) was also recorded.

History of smoking habit was categorized as current, former, or never having smoked cigarettes. A questionnaire based on the life events scale was used to estimate stress (Solis et al. 2004, Akhter et al. 2005), and subjects were asked to indicate the extent (never, rarely, sometimes, often) to which they agreed with a statement that had occurred during the past 12 months. Subjects’ responses were coded as 0 =‘never or rarely’ (stress-negative) or 1 = ‘sometimes or frequently’ (stress-positive). Questions on oral hygiene dealt with frequency of tooth brushing. Dental attendance pattern was defined as “regular” if the subject had visited a dentist once/year or more on a regular basis for maintenance care, and dental attendance pattern was defined as “irregular” if the subject visited a dentist only for emergency dental treatment or had not visited a dentist within the past year (Dalla Vecchia et al. 2005). BMI was calculated as body weight (kg) divided by height² (m²). Subjects with incomplete records were excluded from the study.

Clinical measurements

Two experienced examiners performed clinical measurements. All permanent fully erupted teeth, excluding 3rd molars, were examined under artificial light with mouth mirrors and a manual periodontal probe. Periodontal status was examined at six sites per tooth (mesio-buccal, mid-buccal, disto-buccal, disto-lingual, mid-lingual and mesio-lingual). Probing depths (PD) were measured with the probe tip parallel to the long axis of the tooth and positioned interproximally as close as possible to the contact point. Measurements were made to the nearest millimeter and the lowest value was scored where doubt existed. Clinical attachment level (CAL) was recorded as the distance from the cemento-enamel junction to the base of the clinical pocket. This was calculated by measuring the distance from the CEJ to the gingival margin and subtracting this value from the probing depth measurement (regression recorded as a negative value) (Linden et al. 2007). Gingival bleeding on probing (BOP) was recorded as percentage positive sites of whole mouth measures. The PD and CAL
measurements were averaged for each subject. The presence of plaque was recorded according to the plaque index (PI) (Löe & Silness 1964). The number of missing teeth was also recorded.

Calibration was performed by the clinical examiners. The inter-examiner reproducibility was assessed through duplicate measurements of 10 individuals. During the study period, measurement was repeated in six individuals. Weighted κ coefficients PD and CAL ranged between 0.79 and 0.83.

Statistical analysis
Comparisons of demographic features (age, gender, BMI, educational level), smoking habit, betel quid chewing status, stress, oral hygiene behavior and dental visiting pattern between cases and controls were made by using chi-square and Mann-Whitney tests for categorical and continuous variables, respectively. Binary logistic regression was used to obtain adjusted odds ratios (ORS) and their 95% CI (confidence interval) for the presence of periodontitis in relation to betel quid use (classified as current chewer, former chewer, and non-chewer).

The correlations of additives of betel quid (tobacco and/or masala) and the duration and frequency of betel quid chewing with periodontal disease were examined. The mean values of PD, CAL, BOP% and % of missing teeth (MT) were compared in different subgroups using one-way analysis of covariance along with Bonferroni post hoc adjusting for age, sex, smoking habit, BMI, dental visit pattern, stress, and plaque index.

The data were analyzed using the SPSS software package (SPSS Inc., version 15.0 Family, Chicago, IL., USA). Probability levels at P<0.05 were considered statistically significant.

Results
One hundred and forty pairs of sex and age (±3 years) -matched cases (established periodontitis) and controls (healthy) were selected. Among them, 59 subjects (21.1%) had never chewed betel quid (non-chewers), 41 subjects (14.6%) had chewed betel quid previously (former chewers), and 180 subjects (64.3%) chewed betel quid everyday (current chewers).
Table 1 shows demographic and clinical variables of the controls and cases. The number of current betel quid chewers was significantly larger in the case group than in the control group (P<0.001). Regarding educational level, a larger proportion of subjects with incomplete elementary education was observed in the case group (P<0.001). The mean BMI was significantly greater in the case group than in the control group (P<0.001). There were significant associations of smoking habit (P<0.001), high stress (P<0.001), frequency of cleaning <1 time/day (P<0.001) and irregular visits to dentists (P<0.01) with severity of periodontal disease. Mean plaque index (P<0.001) was also significantly higher in the case group than in the control group.

The results of multiple logistic regression analysis showed significant differences between the case and control groups in betel quid chewing status (current chewer, OR=3.788, P<0.05) after controlling other confounding factors (Table 2). Higher BMI (OR=1.285, P<0.001), current smokers (OR= 5.025, P<0.001), high stress (OR=5.051, P<0.001), and irregular dental visits (OR=4.534, P<0.05) were also significantly associated with the presence of established periodontitis.

Associations of betel quid additives and the frequency and duration of betel quid chewing with periodontal disease were examined by comparing the mean scores of clinical parameters among subgroups adjusting for age, sex, smoking habit, BMI, dental visit pattern, stress, and plaque index (Table 3). Chewers of betel quid with tobacco and masala showed significantly higher scores of BOP%, PD, CAL and MT% than those of chewers of betel quid without any additives. All of the clinical parameters examined in the chewers of betel quid with tobacco and masala were also significantly higher than those in chewers of betel quid with tobacco only. All clinical scores of chewers of betel quid without any additives were not significantly different from those of chewers of betel quid with masala. However, the mean values of PD and CAL were significantly higher in chewers who use tobacco leaf only than in chewers of betel quid without additives. Subjects with frequency of betel quid intake >10 times/day had significantly higher mean values of PD and CAL than those in subjects with intake frequency of 6-10 times/day and than in subjects with intake frequency of 1-5 times/day. The mean BOP% of chewers with intake frequency of 6-10 times/day was significantly greater than that in chewers with intake frequency of 1-5 times/day. Subjects who...
had chewed betel quid for >3 years showed significantly higher scores of BOP%, PD and MT% than those of subjects who had chewed for <1 year. The mean BOP % and mean PD of subjects who had chewed for 1-3 years were significantly higher than those of subjects who had chewed for <1 year.

**Discussion**

Epidemiological studies have clearly shown an association of betel quid chewing habit with increased risk of oral cancer and oral submucous fibrosis in India and Southeast Asian countries (Ko et al. 1992, 1995, Reichart et al. 1996). Recent studies have also shown a significant relationship between the presence of periodontitis and betel quid chewing habit in Taiwan (Jeng et al. 1996), Sri Lanka (Amarsena et al. 2002, 2003), Thailand (Chatrchaiwiwatana 2006, 2007) and India (Mehta et al. 1955, Choudhury et al. 2003). The results of the present study conducted in Bangladesh support the results of those studies. Choudhury et al. (2003) reported that betel quid chewing leads to poorer periodontal health as a result of the presence of *H. pylori* among dyspeptic subjects. Mehta et al. (1955) reported that teeth become dark brown from chewing betel leaves because of deposits of lime on teeth. The deposits become thick and can encompass the whole tooth. The gingival and then periodontal membrane then separates from the necks of teeth and the teeth become loose. Another possible reason for the harmful effect of betel quid on periodontal health is the cholinergic effect of betel quid together with calcium salt in the saliva (“hypersalivation-caused calculus deposition”). The increased heavy deposition of calculus then destroys gingival tissue and periodontal membrane in habitual betel quid chewers (Chatrchaiwiwatana 2006). Additionally, arecoline (a main alkaloid found in areca nut), has been shown to inhibit cell attachment, cell spreading and cell migration and to decrease cell growth and collagen synthesis in human cultured periodontal fibroblasts (Chang et al. 1998; Trivedy et al. 2002). However, those reports did not provide any information about the detrimental effect of betel quid additives (tobacco leaf and masala) on periodontal health of betel quid chewers.

Chewers of betel quid with tobacco and masala showed higher mean values of periodontal parameters, including mean probing depth (PD), clinical attachment level (CAL), percentage of missing teeth (MT%) and percentage of sites with bleeding on probing (BOP%), than did chewers of betel quid without any additives (Table 3). The mean values of PD and CAL were significantly
higher in chewers who use tobacco leaf only than in chewers of betel quid without additives. Chewing betel quid combined with tobacco is a culture-specific habit unique to south Asians, including Bangladeshis, and constitutes more or less the only form of smokeless tobacco used in that part of the world (World Health Organization 1988). Since tobacco has a harmful effect on periodontal health, the results are reasonable. One of the biological effects of tobacco chewing is vasoconstriction of the gingival vasculature, thereby impairing the gingival blood flow. This in turn might suppress the normal gingival inflammatory response to plaque infection and consequently conceal the actual levels of gingival inflammation in smokers (Bergstrom & Preber, 1994, Amarasena et al. 2003) and gradually causes harmful effect on periodontal health.

Masala is a commercially available product containing cardamom, grated fresh coconut, cloves, ginger and some sweetners. All of the clinical parameters examined in chewers of betel quid with tobacco and masala were significantly higher than those in chewers of betel quid with tobacco only. However, there were no significant differences in clinical parameters between chewers of betel quid without any additives and chewers of betel quid with masala only. Therefore, masala, despite the fact that it has little direct effect on periodontal health, might synergistically enhance the detrimental effect of tobacco leaf on periodontal disease progression. Recently, it has been found that masala has mutagenic properties (Trivedy et al. 2002). Although the mechanism remains unclear, it is possible that interactive and/or additional effects of these different additives affect periodontal health. Since there were 10 subjects who used masala only, the results from a larger number of subjects might reveal the direct effect of masala.

Reichart et al. (1996) found a strong correlation between the duration and frequency of betel quid used per day and the presence of oral mucosal lesions in elderly Cambodian women. However, they did not examine periodontal status. In the present study, we found the dose-response effects (frequency and duration) of betel quid chewing on periodontal disease. The mean BOP% was significantly higher in subjects who chewed 6-10 times/day than in those who chewed 1-5 times/day, but there were no significant differences between these groups in mean values of PD, CAL and MT%. Mean BOP% and mean PD were also significantly higher in subjects who had chewed for 1-3 years than in subjects who had chewed for < 1 year, but there was no significant difference between
these groups in mean values of CAL and MT%. Since formation of periodontal pocket and gingival bleeding are occasionally reversible condition of periodontal disease, frequency of 1-5 times/day or duration for less than 1 year might be the first benchmark when implementing a health care program for betel quid chewers.

BMI (body mass index) was significantly associated with periodontitis, as was found in the previous studies (Saito et al. 1998, Bouchard et al. 2006, Linden et al. 2007). Saito et al. (1998) used the community periodontal index of treatment needs (CPITN) and reported a strong association between BMI and periodontal disease in a Japanese group sampled from a health promotion center. The mechanisms by which obesity may affect the periodontium have not yet been clearly determined (Dalla Vecchia et al. 2005). It has been reported that alterations may take place in the structure of the periodontium that affect blood vessel walls in obese rats (Perlstein & Bissada 1977). In addition, obesity has been shown to be associated with an impaired immune response and increased risk for infectious diseases (Marti et al. 2001). From an epidemiological viewpoint, it is noteworthy that studies conducted in developing countries, including Bangladesh, showed results similar to those of studies conducted in developed countries. The relationships between obesity and periodontal disease might be the same regardless of race, culture or lifestyle.

The results of the present study agree with the results of past epidemiological studies that have shown higher prevalence and severity of periodontal disease among individuals of lower educational level (Solis et al. 2004, Castro et al. 2006). The possibility of stress, a factor in the progression of periodontitis is also supported by results of other studies (Linden et al. 1996, Akhter et al. 2005).

There were some methodological limitations in the present study that should be considered when interpreting the results. First, it is not possible to draw strong conclusions over significant correlations between betel quid chewing habit and periodontal disease in such a cross-sectional study. However, the finding of dose-response effects supports the possibility of a causal relationship between betel quid chewing and periodontal disease. Second, several other factors that have been shown to be associated with periodontal disease status, including blood chemistry variables (cholesterol, blood glucose, etc.) and profile of microorganisms were not examined in this study.
In conclusion, the present cross-sectional study indicates that betel quid additives are positively associated with established periodontal disease. Dose-response effects (frequency and duration) of betel quid chewing were also observed. It is important to raise awareness of the periodontal risks among these populations. These practices have deep-seated cultural roots, and educational initiatives must be sensitive to the community’s belief systems (Summers et al. 1994, Chen & Shaw 1996). Longitudinal community-based studies are needed to confirm these findings. In addition, new avenues of research should include qualitative assessment of attitudes to betel quid additives and betel quid chewing, and effective ways to inform those concerned of its possible health consequences.

Acknowledgements

The authors wish to thank Professor Mohiuddin Ahmed and Professor Khurshid-uz-Zaman, Dhaka Dental College & Hospital, Dhaka, Bangladesh and Dr. Zubair Akhtar, Bangladesh Dental College for their invaluable contribution to the study.
References


Löe, H. & Silness, J. (1964) Periodontal disease in pregnancy II. Correlation between oral hygiene


