Dental Caries and Periodontitis Associated with Betel Quid Chewing: Analysis of Two Data Sets

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Background: *Not much research evidence concerning the relationship between betel quid chewing and oral health has been established although betel quid chewing is a common practice among people in many Asian countries including rural areas of Thailand.*
Objective: *The present study employed two existing data sets to evaluate the association between betel quid chewing and oral diseases.*
Material and Method: *The study populations for phase I comprised a total of 796 females, aged 30-89 years, residing in five districts of Khon Kaen province, Thailand during 1990-91. In phase II, there were 2,253 females, aged 31-86 years, residing in Chonnabot district, Khon Kaen province, Thailand during 1992-94, respectively. The data were obtained through oral examination and interview. The analyses employed descriptive, bivariate, and multivariable logistic regression.*
Results: *Findings from final multivariable logistic regression models revealed the inverse relationship between betel quid chewing and dental caries adjusting for other variables. In addition, results from the final multivariable logistic regression models predicting periodontitis showed that betel quid chewing was directly associated with periodontitis in the presence of several confounding factors. The consistent findings from both data sets suggest that although betel quid chewing may reduce dental caries, it was directly related to periodontitis and enhanced the possibility of increasing tooth loss.*
Conclusion: *Therefore, preventive programs aiming at discouraging Thai people from chewing betel quid should be established to preserve favorable oral health.*

Keywords: *Betel quid chewing, Dental caries, Periodontitis, Tooth loss, Thailand*

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Betel quid chewing has been practiced among people in many Asian countries including rural areas of Thailand for quite a long time and research evidence on the effects of betel quid chewing towards oral cancer and oral soft tissue lesions is ample[1-10]. However, only a limited number of studies have investigated the relationship between betel quid chewing and oral diseases namely dental caries and periodontitis, particularly among Thai people[11-18]. In order to maintain effectively favorable oral health, the evidence of oral diseases associated with betel quid chewing among Thai people should be investigated. Therefore, the objective of the present study was set to evaluate the association between betel quid chewing and oral diseases including dental caries and periodontitis among rural Thai females using two existing data sets.

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Material and Method

I. Power and sample size determination

For both data sets, the required sample size for studying the relationship between dental caries and betel quid chewing as well as between periodontitis and betel quid chewing was calculated based on the test for difference between proportions. The 10-20% of the required sample size was added to account for the nature of study as multivariable type. The sample size was estimated based on the following information: 1) Proportion of betel quid users having dental caries (or

periodontitis), 2) Proportion of non-betel quid users having dental caries (or periodontitis), 3) Alpha level = 0.05; two-tailed test; $Z_{1\text{-alpha}/2} = 1.96$, 4). Power of the study = 0.80; $Z_{1\text{-beta}} = 0.84$.

For data set I (phase I study), the calculations yielded a required sample size for studying the association between betel quid chewing and dental caries of 372 subjects, and between betel quid chewing and periodontitis of 410 subjects. Therefore the sample size of 796 females was adequate for controlling simultaneous effects of more than five major confounding factors in the final multivariable model[19,20].

Likewise, for phase II, the calculations yielded a required sample size for studying the association between betel quid chewing and dental caries of 364 subjects, and between betel quid chewing and periodontitis of 424 subjects. Therefore, the sample size of 2,253 females was adequate for simultaneously assessing effects of more than 10 major confounding factors in the final multivariable model[19,20].

II. Study population

The data used in the present study were taken from the Mobile Screening Clinic for Leading Cancers in Khon Kaen province, Thailand, phase I and phase II. The study population in phase I comprised a total of 796 female adults, aged 30-89 years, residing in five districts of Khon Kaen province, Thailand during 1990-91. Phase II included 2,253 females, aged 31-86 years, residing in Chonnabot district of Khon Kaen province, Thailand during 1992-1994. All the study populations participated in the screening program and had completed both the oral examination and the interview. The present study was approved by Khon Kaen University Ethics Committee for Human Research.

III. Oral examination

All the oral examinations were conducted at the village centers, using mainly a mobile dental chair, a sterilized mouth mirror, a sterilized no. 3 explorer and a sterilized WHO periodontal probe. The examinations were carried out under natural light. Trained licensed dentists from the Department of Community Dentistry, Faculty of Dentistry, Khon Kaen University conducted the examinations. Before conducting oral examinations in the study villages, all the examiners participated in an extensive calibration session, where the activities involved reviewing the examination criteria, applying the criteria in ten people, and discussing any discrepancies regarding the examination criteria to reach consistent clinical judgments. According to the time constraints, only the simple and easy-to-perform examination indexes and criteria were selected for use in the oral examinations.

Data concerning clinical oral examination included dental caries status, debris index and periodontal status, where the indexes and criteria were previously described[18].

IV. Interview

Trained nurses from the Cancer Unit, Faculty of Medicine conducted the interview. The information on sociodemographic and lifestyle characteristics was gathered. Sociodemographic factors included age, education level, monthly income (baht), occupational status and district of residence. Information regarding lifestyle characteristics covered betel quid chewing, tobacco smoking, alcohol consumption, and tooth brushing (only in phase I).

V. Data management and data analysis

The data were first recorded on-site by a well-trained dental assistant, then were entered into the computing database at the Cancer Unit, Faculty of Medicine, Khon Kaen University, and were verified at the Department of Community Dentistry, Faculty of Dentistry, Khon Kaen University. The data were analyzed using SAS version 8.0 and SPSS version 10.0. The descriptive, mean, standard deviation and bivariate using unpaired t test, chi-square test where appropriated and multivariable logistic regression with 95% confidence limit of odds ratio. A p-value of less than 0.05 was considered significant difference.

Results

Results from the descriptive analyses in phase I showed that 52.1% of people experienced one or more teeth with decayed or filled condition, while 38.7% had either shallow or deep periodontal pockets. The proportion of betel quid users accounted for 30.5%. For phase II, 59.1% of people experienced one or more decayed or filled teeth and 39.9% had either shallow or deep periodontal pockets. The proportion of betel quid users accounted for 25.5%. This was much lower than in phase I (data not tabulated).

Findings obtained from bivariate analyses from both phases gave similar results; dental caries (defined as decayed plus filled teeth), were associated with betel quid chewing, missing teeth and periodontitis. Age, tooth brushing, and mild debris deposit (debris deposit less than 1/3 of enamel crown) were related to dental caries only in phase I, while dental

Table 1. Results from bivariate analyses between dental caries (decayed plus filled teeth) and selected variables for phase I and phase II data sets[a]

Variable	p-value	
	Phase I (N = 766)	Phase II (N = 2253)
Age (mean ± SD in years)	0.0009[b]	0.1087
Monthly income (mean ± SD in baht)	0.8741	0.9831
Marital status (married vs single)	0.092	0.579
Education (none / primary school / beyond primary school)	0.440	0.555
Betel quid chewing (no vs yes)	0.001[c]	0.001[c]
Tobacco smoking (no vs yes)	0.917	0.958
Alcohol use (no vs yes)	0.628	0.116
Tooth brushing (no vs yes)	0.001[c]	na[d]
Missing teeth (no vs yes)	0.001[c]	0.001[c]
Periodontitis (no vs yes)	0.001[c]	0.001[c]
Debris deposits (mean ± SD in sextants)		
Mild (< 1/3 of enamel)	0.0145[b]	0.2046
Moderate (1/3-2/3 of enamel)	0.2530	0.5678
Heavy (> 2/3 of enamel)	0.8796	0.9390
Periodontal status (mean ± SD in sextants)		
Gingival bleeding	0.4522	0.5244
Dental calculus	0.0883	0.0253[b]
Shallow periodontal pocket	0.9476	0.0006[b]
Deep periodontal pocket	0.4880	0.8861

[a] Total sample may not add up to 100 per cent due to incomplete data for some variables
[b] Test of difference between means (*t*-test), $p < 0.05$
[c] Test of difference between proportion (Chi-square test), $p < 0.05$
[d] na: not available

calculus, and shallow periodontal pockets were connected to dental caries only in phase II (Table 1).

Bivariate relationship between periodontitis and selected variables showed a significant relationship of periodontitis with age, betel quid chewing, and missing teeth for both phases. However, sociodemographic variables including marital status and education were related to periodontitis only in phase I. Likewise, tooth brushing, mild, moderate, and heavy debris deposits (debris deposit less than 1/3, 1/3-2/3, and greater than 2/3 of enamel crown, respectively) were significant in phase I only while income and dental caries were associated with periodontitis in phase II only (Table 2).

Variables demonstrating statistical significance with dental caries and periodontitis in bivariate analyses were entered into multivariable logistic regression models predicting dental caries and periodontitis for both phases and the findings were consistent for both data sets. From Table 3, after adjusting for potential confounding factors in the final multivariable logistic regression models, betel quid chewing and missing teeth consistently retained predicting dental caries in both data sets. Mild debris deposit was marginally significant in phase I only and periodontal pocket retained in the final multivariable logistic regression model as a predictor of dental caries solely in phase II. From both data sets, betel quid chewing was inversely related to dental caries while all other factors were associated directly with dental caries, with the odds ratios and 95% confidence limits shown in Table 3.

Table 4 displays variables predicting periodontitis for both phases. Betel quid chewing, age, debris deposits, and missing teeth were associated directly with periodontitis, with the odds ratios and 95% confidence limits shown in the table. Decayed teeth remained in the final multivariable logistic regression model predicting periodontitis only in phase II. For analyses of the final multivariable logistic regression models predicting dental caries and periodontitis in phase I, tooth brushing was not significant Missing data in the final multivariable logistic regression models were kept under 10% in general.

Table 2. Results from bivariate analyses between periodontitis and selected variables for phase I and phase II data sets[a]

Variable	p-value	
	Phase I	Phase II
Age (mean ± SD in years)	0.0001[b]	0.0001[b]
Monthly income (mean ± SD in baht)	0.4842	0.0150[b]
Marital status (married vs single)	0.001[c]	0.526
Education (none / primary school / beyond primary school)	0.001[c]	0.578
Betel quid chewing (no vs yes)	0.001[c]	0.001[c]
Tobacco smoking (no vs yes)	0.787	0.128
Alcohol use (no vs yes)	0.731	0.326
Tooth brushing (no vs yes)	0.001[c]	na
Missing teeth (no vs yes)	0.001[c]	0.001[c]
Dental caries (no vs yes)	0.613	0.001[c]
Debris deposits (mean ± SD in sextants)		
Mild (< 1/3 of enamel)	0.0002[b]	0.2046
Moderate (1/3-2/3 of enamel)	0.0011[b]	0.5678
Heavy (> 2/3 of enamel)	0.0001[b]	0.9390
Decayed, Missing, and Filled Teeth (mean ± SD of teeth affected)		
Decayed teeth	0.2420	0.5244
Missing teeth	0.0001[b]	0.0253[b]
Filled teeth	0.6709	0.0006[b]

[a] Total sample may not add up to 100 per cent due to incomplete data for some variables
[b] Test of difference between means (*t*-test), $p < 0.05$
[c] Test of difference between proportion (Chi-square test), $p < 0.05$

Table 3. Conditional odds ratio and 95%CI of variables predicting dental caries in the final multivariable logistic regression models for phase I and phase II data sets[a]

Phase I study[b]			
Variable	95% Confidence limit		
	Odds ratio	Lower	Upper
Betel quid chewing	0.339	0.240	0.479
Mild debris deposit	1.005	1.000	1.010
Missing teeth	2.754	2.001	3.790

Phase I study[b]			
Variable	95% Confidence limit		
	Odds ratio	Lower	Upper
Betel quid chewing	0.488	0.395	0.603
Periodontal pocket	1.236	1.020	1.498
Missing teeth	3.053	2.535	3.677

[a] Total sample for phase I = 796 subjects, phase II = 2,253 subjects
[b] Missing data for phase I = 54 subjects (6.8 per cent)
[c] Missing data for phase II = 60 subjects (2.7 per cent)

Table 4. Conditional odds ratio and 95%CI of variables predicting periodontitis in the final multivariable logistic regression models for phase I and phase II data sets[a]

Phase I study[b]			
Variable	95% Confidence limit		
	Odds ratio	Lower	Upper
Betel quid chewing	12.104	1.119	130.940
Age	1.064	1.034	1.095
Mild debris deposit	1.016	1.007	1.025
Moderate debris deposit	1.026	1.018	1.034
Heavy debris deposit	1.026	1.018	1.034
Missing teeth	1.141	1.080	1.206
Interaction (betel quid chewing and age)	0.951	0.909	0.995
Phase II study[c]			
Variable	95% Confidence limit		
	Odds ratio	Lower	Upper
Betel quid chewing	13.361	3.538	50.454
Age	1.055	1.041	1.069
Heavy debris deposit	1.019	1.016	1.023
Decayed teeth	1.047	1.012	1.082
Missing teeth	1.034	1.013	1.056
Interaction (betel quid chewing and age)	0.953	0.931	0.976

[a] Total sample for phase I = 796 subjects, phase II = 2,253 subjects
[b] Missing data for phase I = 57 subjects (7.2 per cent)
[c] Missing data for phase II = 83 subjects (3.7 per cent)

The relative odds ratios having baseline odds ratio as 1, calculating from the interaction between betel quid chewing and age for both data sets are given in Table 5. It is evident that the risk of periodontitis increased among women who chewed betel quid compared to those who did not at all levels (mean + SD, mean, mean - SD of age).

Discussion

Conclusions from the present study were reached that betel quid chewing was inversely related to dental caries and it was directly related to periodontitis, leading to increased periodontitis and tooth loss. This result is in agreement with several studies[11-18]. The reasons that betel quid chewing diminishes dental caries are given as: 1). mechanical cleansing due to abrasive properties of betel quid chewing, 2). increased salivary buffer capacity, 3). high pH of lime in betel quid chewing neutralizes acid formation, 4). ion effect of calcium inhibits enamel dissolution, 5). betel film covers the enamel preventing acid attack, 6). high fluoride content of betel quid and 7). anti-cariogenic effect of etheric oils present in betel quid[14]. On the other hand, the ingredients of betel quid including betel leaf, areca nut, slaked lime, and tobacco exhibit harmful effects to periodontal tissue. The possible reason that betel quid chewing damage periodontal tissue can be described as the cholinergic effect of betel quid together with calcium salt in the saliva produced hypersalivation-caused calculus deposition. The increased heavy deposition of calculus then can induce destruction of gingival tissue and periodontal membrane among habitual betel quid chewers[21,22]. Additionally, the effects of arecoline (a main alkaloid found in areca nut) inhibit cell attachment, cell spreading and cell migration, and decrease cell growth and collagen synthesis[23,24]. The finding that betel quid users experienced a higher severity of periodontitis than the non-user counterparts suggests that quitting chewing betel quid is beneficial for maintaining good oral health.

Table 5. Relative odds ratio calculating from the interaction between betel quid chewing and age in the final multivariable logistic regression models predicting periodontitis for both data sets

Phase I study[a]		
Variable	Relative odds ratio	
	Non-betel quid users	Betel quid users
At mean + standard deviation of age[b]	1.06	12.25
At mean of age[b]	17.59	21.24
At mean - standard deviation of age[b]	1.00	12.10
Phase II study[a]		
Variable	Relative odds ratio	
	Non-betel quid users	Betel quid users
At mean + standard deviation of age[c]	1.05	13.43
At mean of age[c]	14.13	17.29
At mean - standard deviation of age[c]	1.00	13.36

[a] The calculations are based on the beta estimates in final multivariable logistic regression model predicting periodontitis for each data set

[b] Mean age = 46.1, standard deviation = 11.5 years

[c] Mean age = 49.6, standard deviation = 10.4 years

Although the conclusions of the present study were reached based on a large sample size available in both data sets, some limitations exist. One limitation of the present study includes the cross-sectional study design, which by itself provides no assessment of a true epidemiological cause-effect relationship. However, the causal relationships between betel quid chewing and the outcomes of interest were assumed based on previous experimental, randomized controlled trials, or observational cohort studies. Moreover, the strength of association between betel quid chewing and periodontitis should have been stronger. That the magnitude of association was underestimated was due to the effect of healthy volunteer bias occurring from the fact that people who experienced a higher severity of periodontitis tended not to participate in the present study.

Conclusion

The present study has made best use of existing data in establishing epidemiologic evidence relating oral diseases to betel quid chewing among rural Thai females. The findings would provide guidance for planning of preventive public health programs to reduce the habit of chewing betel quid so that healthy periodontal tissue can be maintained.

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โรคฟันผุและโรคปริทันต์อักเสบที่สัมพันธ์กับการเคี้ยวหมาก: การวิเคราะห์ข้อมูลสองชุด

สุภาภรณ์ ฉัตรชัยวิวัฒนา

การศึกษาวิจัยเกี่ยวกับความสัมพันธ์ระหว่างการเคี้ยวหมากกับสุขภาพช่องปากยังนับว่าขาดแคลน แม้ว่าการเคี้ยวหมากเป็นพฤติกรรมที่พบได้มากในประชากรในภูมิภาคเอเชีย รวมทั้งในแถบชนบทของประเทศไทย การศึกษาครั้งนี้มีวัตถุประสงค์เพื่อนำข้อมูลสองชุดที่มีอยู่แล้วมาใช้ในการประเมินความสัมพันธ์ระหว่างการเคี้ยวหมากกับโรคในช่องปาก ในกลุ่มประชากรศึกษาระยะที่ 1 อันประกอบด้วยสตรีไทยอายุ 30-89 ปีที่อาศัยอยู่ในอำเภอต่าง ๆ ห้าอำเภอของจังหวัดขอนแก่น ในระหว่างปี พ.ศ. 2533 – พ.ศ. 2534 จำนวน 796 คน ส่วนกลุ่มประชากรศึกษาระยะที่ 2 ประกอบด้วยสตรีไทยอายุ 31-86 ปี ที่อาศัยอยู่ในอำเภอชนบท จังหวัดขอนแก่น ในระหว่างปี พ.ศ. 2535 - พ.ศ. 2537 จำนวน 2,253 คน วิธีการเก็บข้อมูลประกอบด้วยการตรวจสุขภาพช่องปากและการสัมภาษณ์การวิเคราะห์ผลการศึกษากระทำทั้งแบบพรรณนา การวิเคราะห์ความสัมพันธ์ระหว่างตัวแปรสองตัว และการวิเคราะห์ความสัมพันธ์ถดถอยแบบลอจิสติกที่มีตัวแปรต้นหลายตัว ผลการวิเคราะห์ความสัมพันธ์ถดถอยลอจิสติกในแบบจำลองสุดท้ายสำหรับการศึกษาทั้ง 2 ระยะ พบความสัมพันธ์เชิงผกผันระหว่างการเคี้ยวหมากกับโรคฟันผุ โดยมีการควบคุมผลของตัวแปรอื่น ๆ ในแบบจำลอง ส่วนผลการศึกษาที่พบจากแบบจำลองความสัมพันธ์สุดท้ายระหว่างการเคี้ยวหมากกับโรคปริทันต์อักเสบสำหรับการศึกษาทั้ง 2 ระยะ พบว่าการเคี้ยวหมากมีความสัมพันธ์ โดยตรงกับโรคปริทันต์อักเสบท่ามกลางปัจจัยรบกวนอื่น ๆ ที่ปรากฏในแบบจำลองสุดท้าย ผลจากการศึกษาที่สอดคล้องกันระหว่างข้อมูลทั้งสองชุดบ่งชี้ว่า แม้ว่าการเคี้ยวหมากจะมีผลในทางทำให้เกิดโรคฟันผุน้อยลง แต่การเคี้ยวหมากมีความสัมพันธ์โดยตรงกับโรคปริทันต์อักเสบ ซึ่งสามารถส่งผลให้มีความเสี่ยงต่อการสูญเสียฟันเพิ่มขึ้น ดังนั้นจึงควรมีการดำเนินการเพื่อให้ประชาชนลดละเลิกพฤติกรรมการเคี้ยวหมาก เพื่อนำไปสู่การมีสุขภาพ ช่องปากที่ดีต่อไป