Periodontitis Associated with Tobacco Smoking among Rural Khon Kaen Thai Males: Analysis of Two Data Sets

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Background: *Periodontitis is a common disease-related reason for tooth extraction. Although several studies have related tobacco smoking to periodontitis among other populations, not many investigations concerning the relationship between tobacco smoking and periodontitis among rural northeastern Thai people have been conducted although tobacco smoking is a common practice among these Thai people.*
Objective: *The present study used two existing data sets to evaluate the association between tobacco smoking and periodontitis among rural Khon Kaen Thai males.*
Study Design: *Cross-sectional analytic study.*
Material and Method: *The study populations for phase I and phase II comprised a total of 625 males, aged 30-89 years, residing in five districts of Khon Kaen province, Thailand during 1990-91 and 1,218 males, aged 33-86 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 identified tobacco smoking as a risk indicator for periodontitis in the presence of several factors in the final models including age, gingival bleeding, debris deposits, and missing teeth.*
Conclusion: *It is evident that tobacco smoking is a risk indicator for periodontitis and that tobacco smoking, which is directly associated with periodontitis among these populations, could enhance the possibility of increasing periodontitis and tooth extraction. Therefore, targeted interventions aimed at encouraging people to quit smoking tobacco would help in maintain favorable oral health.*

Keywords: *Tobacco smoking, Periodontitis, Tooth extraction, Thailand*

J Med Assoc Thai 2009; 92 (11): 1524-31
Full text. e-Journal: *http://www.mat.or.th/journal*

Periodontitis is a common disease-related reason for tooth extraction. It has been demonstrated elsewhere that tooth extraction is associated with untreated periodontitis and dental caries[1-4]. A number of studies around the world[5-9] as well as a few investigations in Thailand[10-11] have related tobacco smoking to periodontitis and tooth loss. However, not much of the evidence concerning the relationship between tobacco smoking and oral health among rural northeastern Thai people has been documented[12]. The harmful effects of tobacco smoking towards periodontal tissue include depressed numbers of T-helper lymphocytes, impairment of chemotoxis and phagocytosis of oral and peripheral phagocytes. In addition, nicotine disturbs fibroblast attachment making periodontal tissue more susceptible to destruction and decreasing response to new attachment after periodontal therapy. The local effects of nicotine and its by-products include vasoconstriction of peripheral circulation and gingival blood vessels. Tobacco smoking also reduces oxidation- reduction potential of dental plaque and decreases polymorphonuclear leukocytes' mobility as well as increases virulence of anaerobic bacteria in plaque[13-21]. To maintain effectively a favorable oral health, evidence regarding

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the association between periodontitis and tobacco smoking among Thai people should be established. Therefore, the objective of the present study was set to determine the association between tobacco smoking and periodontitis among Thai males residing in rural areas of Khon Kaen province using two existing data sets.

Material and Method

Power and sample size determination

For both data sets, the required sample size for studying the relationship between periodontitis and tobacco smoking 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 required sample size for studying bivariate relationship between tobacco smoking and periodontitis was estimated based on the following information:

1) Proportion of smokers having periodontitis, 2) Proportion of non-smokers having 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 phase I study, to evaluate the bivariate association between tobacco smoking and periodontitis 214 subjects are required. Therefore, the sample size of 625 males was adequate for simultaneously controlling effects of more than 10 major confounding factors in the final multivariable model[22].

Likewise, for phase II, the calculations yielded required sample size for studying the bivariate relationship between tobacco smoking and periodontitis of 372 subjects. Thus, the sample size of 1,218 males was sufficient for simultaneously assessing effects of more than 10 major confounding factors in the final multivariable model[22].

Study population

The data used in the present study were obtained from the Mobile Screening Clinic for Leading Cancers in Khon Kaen province, Thailand, phase I and phase II. The study subjects for phase I comprised of 625 males, aged 30-89 years, residing in 5 districts of Khon Kaen province, Thailand during 1990-91, while phase II consisted of 1,218 males, aged 33-86 years, residing in Chonnabot district, Khon Kaen province, Thailand during 1992-94. All the people participated in the screening program and had completed both the oral examination and the interview. The study protocol was approved by Khon Kaen University Ethics Committee for Human Research.

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 based on the method and criteria described by the World Health Organization[23]. Before conducting oral examinations in the villages, all the examiners participated in the extensive calibration sessions, whereby 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, of which the indexes and criteria were previously described[12,24].

For the present study, the outcome of interest (periodontitis) was defined as having either shallow or deep periodontal pocket at least one out of six examination sites.

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 (year), education level (none/primary school/ beyond primary school), monthly income (baht), marital status (married/single), and district of residence. Information regarding lifestyle characteristics covered tobacco smoking (yes/no), alcohol consumption (yes/no), betel quid chewing (yes/no), and tooth brushing (yes/no) (only in phase I).

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 for descriptive, bivariate, and multivariable logistic regression using SPSS for Windows version 11.0.

Results

Results from descriptive analyses in phase I showed that approximately 58.7% of people had either shallow or deep periodontal pocket. The proportion of smoker accounted for 80.2%. For phase II, about 53.7% had either shallow or deep periodontal pocket and the proportion of smoker accounted for 78.8% (data not tabulated).

Findings obtained from bivariate analyses of the relationship between periodontitis and selected variables from both data sets gave similar results in that periodontitis was related to a number of variables. Those variables included age, tobacco smoking, missing teeth, dental caries, debris deposits, gingival bleeding, and calculus deposit, while income and education were related to periodontitis only in phase I.

Table 1. Bivariate analyses of the relationship between periodontitis and selected variables for phase I[a]

Variable	Periodontitis		p-value
	No (n = 258)	Yes (n = 367)	
Age (mean ± SD in years)	41.8 ± 10.2	49.8 ± 11.7	0.0001[b]
Monthly income (mean ± SD in baht)	2124 ± 2714	1720 ± 2122	0.0459[b]
Marital status			0.165
Married	244 (95.31%)	336 (92.56%)	
Single	12 (4.69%)	27 (7.44%)	
Education			0.001[c]
None	3 (1.17%)	13 (3.55%)	
Primary school	215 (83.66%)	334 (91.26%)	
Higher than primary school	39 (15.18%)	19 (5.19%)	
Tobacco smoking			0.001[c]
No	71 (27.52%)	53 (14.44%)	
Yes	187 (72.48%)	314 (85.56%)	
Alcohol use			0.480
No	46 (17.90%)	74 (20.16%)	
Yes	211 (82.10%)	293 (79.84%)	
Tooth brushing			0.001[c]
No	11 (4.26%)	52 (14.21%)	
Yes	247 (95.74%)	314 (85.79%)	
Missing teeth			0.001[c]
No	178 (68.99%)	176 (47.96%)	
Yes	80 (31.01%)	191 (52.04%)	
Dental caries			0.001[c]
No	161 (62.40%)	177 (48.23%)	
Yes	97 (37.60%)	190 (51.77%)	
Debris deposits (mean ± SD in sextants)			
Mild (< 1/3 of enamel)	37.27 ± 29.34	32.51 ± 31.89	0.0601
Moderate (≥ 1/3-≤ 2/3 of enamel)	20.41 ± 25.91	24.41 ± 26.94	0.0603
Heavy (> 2/3 of enamel)	12.47 ± 24.35	25.82 ± 34.61	0.0001[b]
Decayed missing and filled teeth (mean ± SD)			
Decayed teeth	0.84 ± 1.58	1.55 ± 2.69	0.0001[b]
Missing teeth	0.91 ± 2.69	4.40 ± 7.91	0.0001[b]
Filled teeth	0.02 ± 0.21	0.02 ± 0.21	0.9420
Periodontal status (mean ± SD in sextants)			
Gingival bleeding	4.99 ± 13.44	0.74 ± 4.50	0.0001[b]
Calculus	83.57 ± 30.68	43.89 ± 30.39	0.0001[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), $p < 0.05$

Tooth brushing was present only in phase I and this variable was related to periodontitis in the bivariate analysis (Table 1, 2).

Variables demonstrating statistical significance with periodontitis in the bivariate analyses were entered into multivariable logistic regression models predicting periodontitis and the findings were consistent between the two data sets.

After adjustment for other variables in the final multivariable logistic regression models, tobacco smoking was related to periodontitis for both phases. Other variables in the models including age, heavy debris deposits, and missing teeth were directly associated with periodontitis, with comparable odds ratio and 95% confidence interval for both data sets. Gingival bleeding was inversely related to periodontitis

Table 2. Bivariate analyses of the relationship between periodontitis and selected variables for phase II[a]

Variable	Periodontitis		p-value
	No (n = 564)	Yes (n = 654)	
Age (mean ± SD in years)	50.3 ± 11.7	53.8 ± 9.9	0.0001[b]
Monthly income (mean ± SD in baht)	2029 ± 2750	2209 ± 3280	0.3877
Marital status			0.998
Married	299 (83.29%)	344 (83.29%)	
Single	60 (16.71%)	69 (16.71%)	
Education			0.917
None	17 (4.33%)	19 (4.22%)	
Primary school	347 (88.30%)	401 (89.11%)	
Higher than primary school	29 (7.38%)	30 (6.67%)	
Tobacco smoking			0.001[c]
No	145 (25.71%)	113 (17.28%)	
Yes	419 (74.29%)	541 (82.72%)	
Alcohol use			0.986
No	519 (92.02%)	602 (92.05%)	
Yes	45 (7.98%)	52 (7.95%)	
Tooth brushing			
No	na	na	na
Yes			
Missing teeth			0.001[c]
No (0 teeth missing)	338 (59.93%)	215 (32.87%)	
Yes (1-32 teeth missing)	226 (40.07%)	439 (67.13%)	
Dental caries			0.001[c]
No	343 (60.82%)	298 (45.57%)	
Yes	221 (39.18%)	356 (54.43%)	
Debris deposits (mean ± SD in sextants)			
Mild (< 1/3 of enamel)	28.36 ± 26.03	21.48 ± 22.75	0.0001[b]
Moderate (≥ 1/3-≤ 2/3 of enamel)	26.58 ± 27.44	24.46 ± 24.57	0.1668
Heavy (> 2/3 of enamel)	18.86 ± 25.58	34.71 ± 30.80	0.0001[b]
Decayed missing and filled teeth (mean ± SD)			
Decayed teeth	1.06 ± 2.13	1.56 ± 2.36	0.0001[b]
Missing teeth	3.66 ± 8.40	4.31 ± 5.97	0.1222
Filled teeth	0.03 ± 0.39	0.03 ± 0.37	0.7226
Periodontal status (mean ± SD in sextants)			
Gingival bleeding	1.47 ± 7.37	0.36 ± 2.58	0.0011[b]
Calculus	86.35 ± 29.38	40.87 ± 30.56	0.0001[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), $p < 0.05$
na = not applicable

for both data sets (Table 3). Tooth brushing was related to periodontitis only in the bivariate analyses but the association disappeared when entering the final multivariable logistic regression model. Therefore, the absence of this variable in phase II study did not have any impact on the pattern of association found in the final multivariable logistic regression model predicting periodontitis.

Discussion

The finding that tobacco smoking was related to periodontitis in the presence of several confounding factors in the final logistic regression models is in agreement with prior studies[25-29]. The findings that decreased gingival bleeding was inversely related to periodontitis for both phases may have some connections with the association between tobacco smoking and delayed gingival bleeding, which supported the findings from a number of prior investigations[30-33]. In addition, research evidence confirms that quitting smoking increases gingival bleeding upon probing[34].

Several studies have reported harmful effects of tobacco smoking towards periodontal tissue, which include depressed numbers of T-helper lymphocytes, impairment of chemotoxis and phagocytosis of oral and peripheral phagocytes. Moreover, nicotine has an effect on disturbing fibroblast attachment, and therefore making periodontal tissue more susceptible to destruction and less responsive to new attachment after periodontal therapy. The local effects of nicotine and its by-products include vasoconstriction of peripheral circulation and gingival blood vessels. Tobacco smoking also reduces oxidation-reduction potential of dental plaque and decreases polymorpho-nuclear leukocytes' mobility as well as increases virulence of anaerobic bacteria in plaque[13-21].

The findings from both data sets suggest that tobacco smoking is directly associated with periodontitis, and thus enhances the possibility of increasing tooth extraction. Although the conclusions of the present study were reached based on large sample size available in both data sets, some limitations exist. One of which is the cross-sectional study design. By itself, this type of design provides no assessment of a true epidemiological cause-effect relationship. However, the causal relationship between tobacco smoking and periodontitis was assumed based on previous experimental, randomized controlled trials, or observational cohort studies. Moreover, the strength of association between tobacco smoking 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 higher severity of periodontitis tended not to participate in the study. The problem of missing cases (approximately 3%) in the final multivariable logistic regression models did not affect the power of the present study as the remaining sample size was adequate for taking care of the power of statistical test for all variables in the final multivariable models. Moreover, the results obtained from both data sets were consistent and this evidence supports the relationship between periodontitis and several factors in the present study.

In summary, the present study has made best use of large existing data sets in evaluating the relationship between tobacco smoking and periodontitis among the Thai people in rural areas of Khon Kaen province. The results of the present study would become baseline information for future

Table 3. Conditional odds ratio and 95% CI of variables associated with periodontitis in the final multi-variable logistic regression models for phase I and phase II data sets[a]

Phase I study[b]			
Variable	Odds ratio	95% confidence limit	
		Lower	Upper
Tobacco smoking	1.624	1.041	2.535
Age	1.053	1.033	1.073
Gingival bleeding	0.942	0.914	0.971
Heavy debris deposit	1.012	1.005	1.018
Missing teeth	1.575	1.068	2.323
Phase II study[c]			
Variable	Odds ratio	95% confidence limit	
		Lower	Upper
Tobacco smoking	1.516	1.121	2.051
Age	1.015	1.002	1.028
Gingival bleeding	0.967	0.938	0.997
Heavy debris deposit	1.018	1.013	1.023
Missing teeth	2.610	1.996	3.413

[a] Total sample for phase I = 625 subjects, phase II = 1,218 subjects

[b] Missing data for phase I = 20 subjects (3.2 per cent)

[c] Missing data for phase II = 42 subjects (3.4 per cent)

investigations. Also, this would provide guidance or support for policy-making concerning reduction the habit of smoking tobacco among Thai people. In addition, adjustment of the curricula arranged for Thai dental students may be achieved so that they will be able to instruct their patients to quit smoking tobacco.

Acknowledgments

The authors wish to thank the Cancer Unit, Faculty of Medicine and Faculty of Dentistry, Khon Kaen University, Khon Kaen, Thailand for providing the data used in the present study.

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ความสัมพันธ์ระหว่างโรคปริทันต์อักเสบกับการสูบบุหรี่ในชายชนบทขอนแก่น: การวิเคราะห์ข้อมูลสองชุด

สุภาภรณ์ ฉัตรชัยวิวัฒนา, อมรรัตน์ รัตนศิริ

ภูมิหลัง: *โรคปริทันต์อักเสบเป็นสาเหตุหลักของการถูกถอนฟันในคนส่วนใหญ่ หลักฐานการศึกษาถึงความสัมพันธ์ระหว่างโรคปริทันต์อักเสบกับการสูบบุหรี่ในประชากรของชนชาติอื่นพบมีอยู่มาก แต่หลักฐานการศึกษาดังกล่าวในประชากรชาวชนบทของภาคตะวันออกเฉียงเหนือยังขาดแคลน ถึงแม้พฤติกรรมการสูบบุหรี่สามารถพบได้โดยทั่วไปในกลุ่มประชากรดังกล่าวมาเป็นเวลานานแล้ว*

วัตถุประสงค์: *เพื่อนำข้อมูลที่มีอยู่แล้วมาศึกษาความสัมพันธ์ระหว่างโรคปริทันต์อักเสบกับการสูบบุหรี่ในชายชนบทจังหวัดขอนแก่น*

การออกแบบการศึกษา: *การศึกษาระยะสั้นเชิงวิเคราะห์*

วัสดุและวิธีการ: *กลุ่มตัวอย่างในการศึกษาระยะที่ 1 ประกอบด้วยชายไทยอายุระหว่าง 30-89 ปี จำนวน 625 คน ที่อาศัยอยู่ในเขต 5 อำเภอในเขตชนบทของจังหวัดขอนแก่น ระหว่างปี พ.ศ. 2533-2534 และระยะที่ 2 ประกอบด้วยชายไทยอายุระหว่าง 33-86 ปี จำนวน 1,218 คนที่อาศัยอยู่ในอำเภอชนบทของจังหวัดขอนแก่น ระหว่างปี พ.ศ. 2535-2536 วิธีการเก็บข้อมูลประกอบด้วยการตรวจสุขภาพช่องปากและการสัมภาษณ์ ส่วนการวิเคราะห์ข้อมูลกระทำโดยการพรรณนา การวิเคราะห์ความสัมพันธ์ระหว่างโรคปริทันต์อักเสบกับตัวแปรต่าง ๆ แบบสองตัวแปร และการวิเคราะห์ความสัมพันธ์ในสมการถดถอยลอจิสติกเพื่อควบคุมตัวแปรรบกวน*

ผลการศึกษา: *ผลจากการวิเคราะห์ความสัมพันธ์ในสมการถดถอยลอจิสติกในแบบจำลองสุดท้ายจากการศึกษาทั้งสองระยะสอดคล้องกัน โดยพบว่าการสูบบุหรี่มีความสัมพันธ์กับโรคปริทันต์อักเสบ โดยตัวแปรอื่น ๆ ที่ปรากฏร่วมอยู่ด้วยในแบบจำลอง ได้แก่ อายุ การมีภาวะเหงือกอักเสบ การมีแผ่นคราบจุลินทรีย์ และการสูญเสียฟัน*

สรุป: *การสูบบุหรี่เป็นปัจจัยบ่งชี้ความเสี่ยงของโรคปริทันต์อักเสบ ซึ่งสามารถส่งผลให้ถูกถอนฟันต่อไปได้ดังนั้นการทำให้กลุ่มเป้าหมายซึ่งเป็นกลุ่มที่มีความเสี่ยงสูงลดละเลิกพฤติกรรมการสูบบุหรี่ จะทำให้ประชากรดังกล่าวมีสุขภาพช่องปากที่ดีได้*