

## Research Article

# The Association Between Risk Factor and Tooth Loss in Adults Age 18 and Older in Oudomxay Province

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## Article Info

**Keywords:** Tooth loss, Age group, Periodontal disease.

**Received:** 09.03.2026;

**Accepted:** 25.03.2026;

**Published:** 02.04.2026

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## Abstract

**Background:** Tooth loss is a worldwide public health problem, especially in developing countries. Negatively impact oral health-related quality of life, affecting chewing, swallowing, phonation, aesthetics, and social life. Tooth loss is considered as risk factor for malnutrition.

**Objective:** To study the association between risk factor and tooth loss in the population Age 18 Years and Older in Oudomxay province.

**Methodology:** The study was a cross-sectional analytical study using questionnaires forms to data with interviews and oral dental. By Stratified random sampling in 2 districts. the SPSS was used for Analysed: Chi-square test and Multiple Logistic Regression.

**Result:** Sample size of 422 people, the prevalence rate of tooth loss was 65.2%, average of 3.4 teeth/ person. 70.2% of people tooth loss between 1-5 teeth, 29.8% lost  $\geq 6$  teeth. The results found: Age is a risk factor associated with tooth loss is significant with a risk ratio  $OR_{(adj)} = 1.070$  (95% CI=1.05-1.09),  $P < 0.001$ , Periodontitis is a risk factor associated with tooth loss is significant with a risk ratio  $OR_{(adj)} = 3.868$  (95% CI=1.23-11.04),  $P = 0.020$ .

**Conclusion:** Prevalence of tooth loss is high, the age group of 45 year and older with periodontitis being risk factors for tooth loss, Smoking was not associate with tooth loss.

## 1. Introduction

Oudomxay province is located in the center of 5 northern Lao provinces: Phongsaly, Luang Namtha, Bokeo, Xayaburi and Luang Prabang. It shares a border with China, has three railway stations, and covers an area of approximately  $15,370 \text{ km}^2$ , with 80% of its area mountainous, and includes 7 districts: Xay, La, Nga, Namo, Beng, Houn and Pak Beng; there are a total of 470 villages, 12 ethnic groups, and a population of 343,444 males and 169,478 females [1].

The World Dental Federation (FDI) defines “oral health” as an essential part of overall physical and mental health. Good oral health in an appropriate environment contributes to the health and quality of life of people of all ages [2]. The World Health Organization (WHO) has also stated that the key to oral health is the maintenance of functional teeth throughout life, which means having at least 20 teeth without the need for dentures [3].

Tooth loss is a major public health problem worldwide, especially in developing countries [4], which affects oral health-related quality of life [5], affecting chewing, swallowing [6], speech, aesthetics and social life [5]. Tooth loss is considered a risk factor for malnutrition [6]. In

2010, oral health problems affected 3.9 billion people worldwide, with tooth loss being one of the top 100 conditions that have had the greatest impact on the health of the global population in the past two decades.

In the past two decades, tooth loss has been ranked as the 36th most common condition in the world and is a major public health problem [7].

Many studies have reported that the main causes of tooth loss are dental caries, periodontal disease, trauma, and extraction for orthodontic treatment. Untreated dental caries is the main cause of tooth loss, and another important cause is periodontal disease [8]. Smoking increases the risk of tooth loss [9]. Oral health behaviours such as regular brushing and regular dental visits help reduce the risk of tooth loss [10]. Lack of knowledge and poor oral health attitudes are associated with dental caries and periodontal disease, which ultimately lead to tooth loss [11]. Systemic diseases such as diabetes are also associated with tooth loss [12].

In Laos, tooth loss is still a major problem and previous studies are still limited. In 2009, Mr. Phonesavanh Soundara [13] conducted a study to find factors affecting tooth loss in the capital. He found that: the rate of tooth loss was 64.3%, the age group 35–44 years old lost 38.1% of teeth, 45–60 years old had 61.9%, lost between 1–5 teeth 76.6%, lost  $\geq 6$  teeth 23.4%, there was a relationship with age, gender, dental caries and periodontal disease with a statistically significant  $P < 0.001$ ; In Oudomxay province, there is no study on tooth loss yet. Only a study by Soulid Inthakon in 2022 [14] studied the factors affecting tooth loss in people who came to receive services in 5 provincial hospitals: Oudomxay, Houaphan, Luang Prabang, Khammouane and the Faculty of Dentistry. The rate of tooth loss was found to be 50.7%. Factors related to tooth loss include: age, level of education; this data may have been collected in Oudomxay province, but the rate of tooth loss is not specific to Oudomxay province. Therefore, the reason for this study was to find factors related to tooth loss in people aged 18 and over in Oudomxay province.

## 2. Research Methodology

This is an analytical cross-sectional study, collecting data using interview forms and oral examinations among the population aged 18 years and older in Oudomxay province. Once the data has been collected as required, the data is checked for accuracy and completeness of the answers and recordings, and then coded using SPSS to analyze descriptive statistics: numbers, percentages, and averages. To analyze the relationship between two variables using Chi-square test, T-test. To analyze multivariate relationships using Multiple Logistic Regression.

This study starts from determining research topic, develop proposal and request for research fund, collect data and oral check, data analysis, result interpretation and writing report as following conceptual frameworks chart:

### Ethical Aspects

This study was approved by the Research Ethics Committee of the Faculty of Dentistry, University of Health Sciences, Laos. Under no. 778/2024.

## 3. Results

### 3.1. Population geographic

A total of 422 participants were included in the study. The mean age of the population was  $44.28 \pm 15.62$  years. The majority of participants were female (288; 68.2%), while 134 (31.8%) were male. Regarding occupation, most participants were farmers (277; 65.6%), followed by employees (82; 19.4%), traders (51; 12.1%), students (10; 2.4%), and workers (2; 0.5%). In terms of educational level, 118 participants (28.0%) had completed primary school, 93 (22.0%) high school, 67 (15.9%) secondary school, 59 (14.0%) college, and 36 (8.5%) held a bachelor's degree or higher, while 49 (11.6%) had no formal education. Most participants reported no personal illness (353; 83.6%), whereas 69 (16.4%) reported having a personal illness. Among those with illness, the most common condition was hypertension (51; 74.0%), followed by heart disease (5; 7.2%), diabetes (4; 5.8%), rheumatism (3; 4.3%), anemia (2; 2.9%), and other diseases (4; 5.8%). These findings are summarized in Table 1.

### 3.2. Personal habits

The majority of participants were non-smokers (357; 84.6%), while 65 (15.4%) reported current smoking. The mean duration of smoking was  $25.32 \pm 15.07$  years. Regarding smoking frequency, 21 participants (32.3%) smoked 1–5 cigarettes per day, 22 (33.8%) smoked 6–10 cigarettes per day, 7 (10.8%) smoked 11–20 cigarettes per day, and 15 (23.1%) smoked  $\geq 1$  pack per day. Most participants did not chew tobacco or betel products (415; 98.3%), whereas only 7 (1.7%) reported chewing. The mean duration of chewing was  $17.71 \pm 13.31$  years. In terms of chewing frequency, 2 participants (0.5%) chewed 1–2 times per day, and 5 (1.2%) chewed 3–5 times per day. Regarding alcohol consumption, 317 participants (75.1%) reported drinking alcohol, while 105 (24.9%) were non-drinkers. The mean duration of alcohol consumption was  $18.95 \pm 12.06$  years. Among those who drank alcohol, 248 (78.2%) consumed alcohol  $\geq 1$  time per week/month, 63 (19.9%) drank 1–2 days per week, 4 (1.3%) drank 3–5 days per week, and 2 (0.6%) reported daily alcohol consumption. In Table 2

Table 1: Population geographic

Variables	Number (n= 422)	Percent (%)
Age Mean $\pm$ SD: 44.28 $\pm$ 15.618		
<b>Sex</b>	<b>Number (n= 422)</b>	<b>Percent (%)</b>
Female	288	68.2
Male	134	31.8
<b>Occupation</b>	<b>Number (n= 422)</b>	<b>Percent (%)</b>
Government officials	82	19.4
Trader	51	12.1
Worker	2	0.5
Farmer	277	65.6
Student	10	2.4
<b>Education level</b>	<b>Number (n= 422)</b>	<b>Percent (%)</b>
None	49	11.6
Primary school	118	28.0
Secondary school	67	15.9
High school	93	22
College	59	14
Bachelor or higher	36	8.5
<b>Medical conditions</b>	<b>Number (n= 422)</b>	<b>Percent (%)</b>
No	353	83.6
Yes	69	16.4
<b>Personal illness</b>	<b>Number (n= 69)</b>	<b>Percent (%)</b>
Diabetes	4	5.8
Blood pressure	51	74.0
Heart disease	5	7.2
Rheumatoid	3	4.3
Anemia	2	2.9
Other	4	5.8

Table 2: Personal habits of the sample population

Tobacco smoking	Number (n= 422)	Percent (%)
No	357	84.6
Yes	65	15.4
Duration of smoking Mean $\pm$ SD: 25.32 $\pm$ 15.07		
<b>Frequency of smoking</b>	<b>Number (n= 65)</b>	<b>Percent (%)</b>
1-5 cigarettes/day	21	32.3
6-10 cigarettes/day	22	33.8
11-20 cigarettes/day	7	10.8
$\geq 1$ pack ( $\geq 20$ cigarettes/day)	15	23.1
<b>Alcohol drinking</b>	<b>Number (n= 422)</b>	<b>Percent (%)</b>
No	105	24.9
Yes	317	75.1
Duration of drinking Mean $\pm$ SD: 18.95 $\pm$ 12.06		
<b>Frequency of drinking</b>	<b>Number (n= 317)</b>	<b>Percent (%)</b>
Rarely	2	0.6
3-5 days/week	4	1.3
1-2 day/week	63	19.9
dinking $\geq 1$ week/month	248	78.2
<b>Betel quid chewing</b>	<b>Number (n= 422)</b>	<b>Percent (%)</b>
No	415	98.3
Yes	7	1.7
Duration of betel quid chewing Mean $\pm$ SD: 17.71 $\pm$ 13.31		
<b>Frequency of betel quid chewing</b>	<b>Number (n= 7)</b>	<b>Percent (%)</b>
1-2 time/day	2	28.5
3-5 times/day	5	71.4

### 3.3. Oral and dental hygiene

A total of 422 people (100%) brushed their teeth. The majority brushed twice a day: 257 people (60.9%), followed by once a day: 140 people (33.2%), and three times a day: only 25 people (5.9%). The majority used a combination brushing method: 186 people (44.1%), followed by back-and-forth brushing: 174 people (41.2%), up-and-down brushing: 42 people (10%), and circular brushing: 20 people (4.7%). Details are shown in Table 3.

**Table 3:** Oral cleaning

<b>Oral cleaning</b>	<b>Number (n= 422)</b>	<b>Percent (%)</b>
Tooth brushing	422	100
<b>Frequency of oral and tooth cleaning</b>	<b>Number (n= 422)</b>	<b>percent (%)</b>
1 time/day	140	33.2
2 times/day	257	60.9
≥ 3 time/day	25	5.9
<b>Brushing techniques</b>	<b>Number (n= 422)</b>	<b>percent (%)</b>
Rub forward-backward	174	41.2
Rub up-down	42	10
Rub in circles	20	4.7
Mouth washing	74	17.5
Dental floss	34	8.1
Tooth picking	165	39.1
Saline	6	1.4

### 3.4. Visiting the dentist

In this study, 302 participants (71.6%) reported having visited a dentist, whereas 120 participants (28.4%) had never visited a dentist. Regarding the frequency of dental visits, most participants reported visiting a dentist once per year or less frequently (265; 62.8%). Additionally, 19 participants (4.5%) visited every 6 months, 9 (2.1%) every 3 months, and 9 (2.1%) reported visiting once per month. Among those who had never visited a dentist, the most common reason was the belief that dental care was unnecessary or the absence of dental problems (62; 51.7%). Other reasons included lack of time (26; 21.7%), long distance to service locations (17; 14.2%), high cost of treatment (14; 11.7%), and fear of dentists (1; 0.8%). as detailed in Table 4

**Table 4:** Visiting the dentist

<b>Visiting the dentist</b>	<b>Number (n= 422)</b>	<b>Percent (%)</b>
Yes	302	71.6
No	120	28.4
<b>Frequency of dental visiting</b>	<b>Number (n= 302)</b>	<b>Percent (%)</b>
1 time/month	9	3.0
Every 3 months	9	3.0
Every 6 months	19	6.3
Every 1 year or more	265	87.7
<b>The reason of visiting</b>	<b>Number (n= 120)</b>	<b>percent (%)</b>
Far from home	17	14.2
Afraid of dentist	1	0.8
No time	26	21.7
Expensive	14	11.7
Thought unnecessary	62	51.7

### 3.5. Tooth loss history

In this study, 275 participants (65.2%) reported having had at least one tooth extracted, whereas 147 (34.8%) had never undergone tooth extraction. Regarding the place of extraction, most procedures were performed at private clinics (150; 54.5%), followed by community hospitals (64; 23.3%) and provincial hospitals (20; 7.3%). Notably, 41 participants (14.9%) reported self-extraction. Concerning the reasons for tooth extraction, the majority of cases were due to the primary reported cause (200; 72.4%), followed by the second reason (61; 22.2%), the third reason (9; 3.3%), and the fourth reason (5; 1.8%). Detailed information is presented in Tables 5 and 6.

**Table 5:** Tooth Loss

<b>Extraction</b>	<b>Number (n= 422)</b>	<b>Percent (%)</b>
Yes	275	65.2
No	147	34.8
<b>Tooth extraction location</b>	<b>Number (n= 275)</b>	<b>Percent (%)</b>
Private clinic	150	54.5
Community hospital	64	23.3
Provincial hospital	20	7.3
Self-extraction	41	14.9
<b>Etiology of tooth loss</b>	<b>Number (n= 275)</b>	<b>Precent (%)</b>
Decayed	200	72.7
Periodontal disease	61	22.2
Accident	9	3.3
Extraction for orthodontic	5	1.8

**Table 6:** Comparison of dental status by age group (DMF)

Ages	Number	Decayed D	Missing M	Filled F	(DMFT)
	N	M (Sd)	M (Sd)	M (Sd)	M (Sd)
18-34	136	2.74 (2.46)	0.88 (1.41)	0.83 (1.41)	4.45 (2.81)
35-44	98	2.95 (1.77)	1.54 (2.04)	0.42 (0.87)	4.91 (2.71)
45-60	113	2.11 (1.61)	4.11 (4.83)	0.19 (0.85)	6.41 (4.82)
≥61	75	1.64 (1.64)	9.31 (7.06)	0.19 (1.07)	11.13 (6.70)
<b>Total</b>	<b>422</b>	<b>2.42 (2.01)</b>	<b>3.40 (5.07)</b>	<b>0.45 (1.13)</b>	<b>6.27 (4.90)</b>
<b>Sex</b>					
Female	288	2.68 (2.13)	2.19 (3.16)	0.43 (1.08)	6.34 (4.84)
Male	134	1.87 (1.62)	3.11 (4.79)	0.49 (1.23)	6.12 (5.02)
<b>Total</b>	<b>422</b>	<b>2.42 (2.01)</b>	<b>3.40 (5.07)</b>	<b>0.45 (1.13)</b>	<b>6.27 (4.90)</b>

### 3.6. Periodontal status

From the examination of the periodontal condition using the CPI index, it was found that: 144 people had bleeding (34.1%), 298 people had calculus (70.6%), 40 people had 4-5 mm deep pockets (9.5%), 19 people had ≥ 6 mm deep pockets (4.5%), and 151 people had bleeding and calculi (35.8%) as detailed in Table 7, 8, 9 and 10.

**Table 7:** Incidence of periodontal disease

Periodontal disease	Yes		No	
	Number	(%)	Number	(%)
Bleeding	144	(34.1)	278	(65.9)
Calculus	298	(70.6)	124	(29.4)
Pocket 4-5 mm	40	(9.5)	382	(90.5)
Pocket ≥ 6 mm	19	(4.5)	403	(95.5)
Bleeding & Calculus	151	(35.8)	271	(64.2)

**Table 8:** Decay and periodontal disease

Variables	Decayed		Periodontal	
	Number	(%)	Number	(%)
Yes	346	(82.0)	56	(13.3)
No	76	(18.0)	366	(86.7)
<b>Total</b>	<b>422</b>	<b>100</b>	<b>422</b>	<b>100</b>

**Table 9:** The relationship between age group, gender, and the number of teeth lost

Age group	Tooth loss		Total	p-value
	1-5 n= 193 (%)	≥ 6 n= 82 (%)		
18 – 34	56 (29.0)	0 (0)	56	<0.001
35 –	51 (26.4)	4 (4.9)	55	
45 – 60	65 (33.7)	28 (34.1)	93	
≥ 61	21 (10.9)	50 (61.0)	71	
<b>Sex</b>				
Female	131 (67.9)	53 (64.4)	184	0.601
Male	62 (32.1)	29 (35.4)	91	

A comparison of educational attainment showed a relationship with tooth loss. Among people with no education, 42 teeth were lost (15.3%), while only 7 teeth remained (4.8%). Those with primary education had the highest tooth loss, with 92 teeth lost (33.5%) and 26 remaining (17.7%). People with lower secondary education lost 45 teeth (16.4%) and had 22 remaining (15.0%). Those with upper secondary education lost 49 teeth (17.8%) and had 44 remaining (29.9%). Individuals with a bachelor's degree lost 36 teeth (13.1%) and had 23 remaining (15.6%), while those with a bachelor's degree or higher lost only 11 teeth (4.0%) and had 25 remaining (17.0%). Overall, the results showed a statistically significant correlation between education level and tooth loss ( $p < 0.001$ ).

**Table 10:** Relationship between personal factors and tooth loss

Occupation	Tooth loss		Total	p-value
	Yes, n=275%	No, n=147%		
Government stuff	43 (15.6)	39 (26.5)	82	
Others	33 (12.0)	18 (12.2)	51	
Worker	1 (0.4)	1 (0.7)	2	0.003
Farmer	195 (70.9)	82 (55.8)	277	
Educational	3 (1.1)	7 (4.8)	10	
<b>Personal illness</b>				
Yes	60 (21.8)	9 (6.1)	69	<0.001
No	215 (83.6)	138 (93.9)	353	
<b>Educational level</b>				
None	42 (15.3)	7 (4.8)	49	
Primary school	92 (33.5)	26 (15.0)	118	
Secondary school	45 (16.4)	22 (15.6)	67	<0.001
High school	49 (17.8)	44 (29.9)	93	
Collage	36 (13.1)	23 (15.6)	59	
Bachelor or higher	11 (4.0)	25 (17.0)	36	

### 3.7. Risk factors related to tooth loss

Among smokers, 51 individuals (18.5%) experienced tooth loss, while 14 (9.5%) had no tooth loss. Among non-smokers, 224 (81.1%) had tooth loss and 133 (90.0%) had no tooth loss. This association was statistically significant ( $p = 0.014$ ). The duration of smoking showed a mean  $\pm$  SD of  $28.49 \pm 14.82$  years and was significantly associated with tooth loss ( $p < 0.01$ ). However, smoking frequency was not significantly related to tooth loss ( $p = 0.832$ ), and chewing habits also showed no statistical significance ( $p = 0.430$ ). Regarding alcohol consumption, individuals who drank alcohol regularly or occasionally accounted for 192 cases of tooth loss (69.8%) and 125 without tooth loss (85.0%). In contrast, non-drinkers had 83 cases of tooth loss (30.2%) and 22 without tooth loss (15.0%). This association was statistically significant ( $p = 0.01$ ). The duration of alcohol consumption had a mean  $\pm$  SD of  $22.46 \pm 13.04$  years and was significantly associated with tooth loss ( $p < 0.01$ ). However, drinking frequency showed no significant relationship with tooth loss ( $p = 0.622$ ). in Table 11

**Table 11:** The relationship between risky behaviours and tooth loss

	Tooth loss		Total	p-value
	Yes, n=275%	No, n=147%		
<b>Tobacco smoking</b>				
No	224 (81.5)	133 (90.5)	357	
Yes	51 (18.5)	14 (9.5)	65	0.014
Duration of smoking	Mean $\pm$ SD: $28.49 \pm 14.819$			0.011
<b>Frequency of smoking (n = 65)</b>				
1-5 cigarettes/day	16 (31.4)	5 (35.7)	21	
6-10 cigarettes/day	17 (33.3)	5 (35.7)	22	
11-20 cigarettes/day	5 (9.8)	2 (14.3)	7	0.832
$\geq 20$ cigarettes/day	13 (25.5)	2 (14.3)	15	
<b>Betel quid chewing</b>				
No	269 (97.8)	146 (99.3)	415	0.430
Yes	6 (2.2)	1 (0.7)	7	
Duration of chewing	Mean $\pm$ SD: $20.71 \pm 12.734$			0.267
<b>Frequency of chewing (n = 7)</b>				
1-2 times/day	1 (0)	1 (100)	2	
3-5 times/day	5 (100)	0 (0)	5	0.286
<b>Alcohol drinking</b>				
No	83 (30.2)	22 (15.0)	105	
Yes	192 (69.8)	125 (85.0)	317	0.001
Duration of drinking	Mean $\pm$ SD: $22.46 \pm 13.037$			<0.001
<b>Frequency of drinking (n = 317)</b>				
$\geq 1$ week/month	151 (78.6)	97 (77.7)	248	
1-2 days/week	36 (18.8)	27 (21.6)	63	0.622
3-5 days/week	3 (1.6)	1 (0.8)	4	
Rarely	2 (1.0)	0 (0.0)	2	

### 3.8. The relationship between dental caries, periodontal disease, and tooth loss

A study on the relationship between tooth caries and tooth loss revealed that: 221 individuals (80.4%) had tooth caries and experienced tooth loss, while 123 individuals (40.2%) did not experience tooth loss, showing no statistically significant difference ( $p = 0.511$ ); 52 individuals

(18.9%) had periodontal disease and experienced tooth loss, while 4 individuals (2.7%) did not experience tooth loss, showing a statistically significant difference ( $p < 0.01$ ). Details are shown in Table 12.

**Table 12:** Relationship between dental caries, periodontal disease, and tooth loss

Decayed	Tooth loss		Total	p-value
	Yes n= 275 (%)	No n= 147 (%)		
No	54 (19.6)	24 (39.5)	78	0.511
Yes	221 (80.4)	123 (40.2)	344	
<b>Periodontal disease</b>				
Yes	223 (81.1)	143 (97.3)	366	<0.001
No	52 (18.9)	4 (2.7)	56	

### 3.9. Variables

This study initially identified correlations between several variables and tooth loss. However, multivariate logistic regression analysis showed that only two risk factors remained statistically significantly associated with tooth loss:

- **Age:** Age was a statistically significant risk factor, with an adjusted odds ratio  $OR_{(adj)}$  of 1.070 (95% CI: 1.05–1.09,  $p < 0.001$ ).
- **Periodontal disease:** Periodontal disease was also a statistically significant risk factor, with an adjusted odds ratio  $OR_{(adj)}$  of 3.868 (95% CI: 1.23–11.04,  $p = 0.020$ ).

Other factors-including education level, occupation, chronic diseases, smoking status, duration of smoking, alcohol consumption, and duration of alcohol use-showed associations with tooth loss in preliminary analyses. However, these factors were not statistically significant in the multivariate logistic regression model.

**Table 13:** Variables

Variables	Un Adjusted OR 95% CI	p-value	Adjusted OR 95% CI	p-value
Age				
18-44	1		1	
≥ 45	7.752 (4.59-12.47)	<0.001	1.070 (1.05 - 1.09)	<0.001
<b>Periodontal disease</b>				
No	1		1	
Yes	8.336 (2.95-23.54)	<0.001	3.686 (1.23-11.04)	0.020

## 4. Discussion

### 4.1. The rate of tooth loss

This study investigated factors associated with tooth loss in the population aged 18 years and older in Oudomxay Province. The results of the study found that: 422 people, there was a prevalence of tooth loss of 65.2%. The rate of tooth loss was higher compared to the results of Aguilar-Diaz Fatima's study in Mexico in 2021 [15], which found that the rate of tooth loss was 52.7%, because most of the population in Mexico participated in the oral health program with dental examinations and treatment, which reduced the rate of tooth loss more than this study. In Thailand in 2017 [16] found a tooth loss rate of 62.2%, found a cumulative tooth loss rate of 64.3%, which shows that the tooth loss rate is similar to that of this study. The average value of decayed, extracted, and filling DMFT DMFT in this study was 6.72 teeth per person. Compared to the severity classification specified by the World Health Organization (WHO 1986), this study found that more than 6.6 teeth is at a very high level.

### 4.2. Factors related to tooth loss

This study started from the age of 18 years and above. When using multiple logistic regression to study the relationship, it was found that age was statistically significantly associated with tooth loss. When the population was 45 years and above, the risk of tooth loss was increased by  $OR_{(adj)} = 1.070$  (95% CI, 1.05 - 1.09),  $P$ -value <0.001, consistent with the study by Aguilar-Diaz Fatima in 2021, Mexico [15] found: Age was associated with the risk of tooth loss at 1.051 (95% CI, 1.048-1.054);  $P$ -value <0.001, and the study by [17] found: Age was associated with the risk of tooth loss at  $OR = 3.45$  (95% CI, 2.79-4.26);  $P$ -value <0.001, In addition, a study by Hiroo Kawahara [18] found that age was not a risk factor for tooth loss, with an  $OR$  of 1.13 (95% CI, 0.80-1.60);  $P$ -value=0.47, although the risk of tooth loss with age was  $OR > 1$ , the Japanese population received dental treatment in the mid- and long-term, which was effective and did not increase the risk of tooth loss. In addition to age, periodontitis was also significantly associated with tooth loss, with an  $OR_{(adj)}$  of 3.868 (95% CI=1.23-11.04);  $P=0.020$ , consistent with a study by Jeerateep [16] which found that periodontitis was a risk factor for tooth loss, with an  $OR$  of 2.14 (2.71-5.22);  $P=0.001$ , and similar to the study by Gondinho [19] who found that periodontal disease was a risk factor for more than 12% of tooth loss, with a risk of:  $OR = 2.44$ (1.10-1.90);  $P=0.009$ .

In addition, the initial correlation analysis found that these factors were also associated with tooth loss, such as: comorbidities were associated with tooth loss ( $P < 0.001$ ), population with personal illness (hypertension, diabetes, heart disease) had more tooth loss than

people without the disease, consistent with the study by Watcharaporn Sensorn in Thailand, 2012 [20] who found that: diabetes and high blood pressure were associated with tooth loss with statistical significance ( $P=0.034$ ) and ( $P=0.019$ ), respectively. Education level was associated with tooth loss ( $P<0.001$ ), with populations with higher levels of education, college education or higher, having lower rates of tooth loss than those with secondary education or lower. It is possible that those with higher education have better access to dental services, better oral health care, and better preservation of natural teeth. Behavioral risk factors such as smoking and duration of smoking were also found to be associated with tooth loss ( $P=0.014$ ) and ( $P=0.011$ ), which is similar to the study by Katarzyna Gabiec et al., Poland, 2022 [21] which found that: education level was associated with tooth loss ( $P<0.001$ ), the population with higher education reduced the risk of tooth loss by 4.18 times, the population who smoked was associated with tooth loss ( $P<0.001$ ), and the duration of smoking was a factor associated with tooth loss in all age groups ( $P<0.001$ ), similar to the study by Aguilar-Diaz Fatima [15] which found: education level and smoking were statistically significantly associated with tooth loss ( $P=0.024$ ) and ( $P<0.001$ ). Risk factors for alcohol consumption and duration of drinking in this study were associated with tooth loss ( $P=0.001$ ) and ( $P<0.001$ ), consistent with the study by Jorge M. et al. in 2018 in India, which found that people who drink alcohol were 2.5 times more likely to have tooth loss ( $P=0.005$ ), which found that there was an association with age, dental caries, and periodontal disease ( $P<0.001$ ) and the study by Hiroo Kawahara [18], which found that gender was not associated with tooth loss ( $P=0.015$ ).

## 5. Conclusion

This cross-sectional study investigated factors associated with tooth loss among individuals aged 18 years and older in Oudomxay Province. A total of 422 participants were included from two representative districts: Beng District and Houn District. The prevalence of tooth loss among adults in the study population was 65.2%, with an average of 3.4 teeth lost per person. The prevalence of dental caries was 82.0%, while periodontitis was found in 15.3% of participants. The study found that age was significantly associated with tooth loss. The risk of tooth loss increased with age, and individuals aged 45 years and above had a higher risk compared to those aged 44 years and below. This association was statistically significant, with an adjusted odds ratio  $OR_{(adj)}$  of 1.070 (95% CI: 1.05–1.09;  $p < 0.001$ ). Periodontitis was also significantly associated with tooth loss. Individuals with periodontitis had a higher risk of tooth loss compared to those without the condition ( $OR_{(adj)} = 3.868$ ; 95% CI: 1.23–11.04;  $p = 0.020$ ), which supports the study hypothesis. Smoking, however, was not found to be significantly associated with tooth loss in this study, which was inconsistent with the initial hypothesis.

## Article Information

**Acknowledgments:** “I would like to express my sincere gratitude to the people of Oudomxay Province, Lao PDR, for their invaluable participation and cooperation in this research. Their contributions and insights were essential to the successful completion of this study.”

**Author Contributions:** Souksida Xaykhambanh - Conceptualization, Methodology, Data curation, Formal analysis, Writing – original draft, Writing – review & editing, Supervision; Thiphapon khamphouvong - Conceptualization; Chanthavisao Phunthanalay - Methodology, Sombath Atsaphangthong and Soulideth Inthakone - Data curation; Kamkeo Bouphe - Formal analysis; Chanvilay Soukhaseum - Writing – original draft; Amphayvanh Homsavath - Writing – review & editing; Ketsaline Xayamoungkhun and Chanthida Phoxay - Supervision.

**Funding / Financial Support:** The authors received no external funding.

**Conflict of Interest:** The authors declare no competing interests.

**Disclaimer (Artificial Intelligence):** The author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.), and text-to-image generators have been used during writing or editing of manuscripts.

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