

**ASSOCIATION BETWEEN SHAMMAH USE
WITH PERIODONTAL DISEASE AND
SHAMMAH-INDUCED LEUKOPLAKIA-LIKE
LESION AMONG ADULT MALES IN DAWN
VALLEY, YEMEN**

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UNIVERSITI SAINS MALAYSIA

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LESION AMONG ADULT MALES IN DAWN
VALLEY, YEMEN**

by

BADR ABDULLAH SAEED AL-TAYAR

**Thesis submitted in fulfillment of the requirements
for the degree of
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DEDICATION

To my parents, I ask Allah to guide them; to my wife, Umm Maryam; my daughters, Maryam and Marya; and my brothers and sisters.

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LIST OF ABBREVIATIONS

AOR	Adjusted Odds Ratio
CPI	Community Periodontal Index
CI	Confidence Interval
OR	Odds Ratio
ROC	Receiver Operating Characteristics
SD	Standard Deviation
SES	Socio-economic Status
SLT	Smokeless Tobacco
WHO	World Health Organization
YER	Yemeni Rial

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**PERKAITAN DI ANTARA PENGGUNAAN SHAMMAH DENGAN
PENYAKIT PERIODONTAL DAN LESI LEUKOPLAKIA TERARUH OLEH
SHAMMAH DALAM KALANGAN LELAKI DEWASA DI LEMBAH DAWN,
YEMEN**

ABSTRAK

Latarbelakang kajian: Tembakau tanpa asap yang digunakan secara tradisional di Semenanjung Arab, khususnya di Yemen di panggil Shammah. Shammah dan faktor-faktor risiko yang lain, memainkan peranan yang amat penting dalam kejadian penyakit mulut. **Objektif:** Kajian kali ini telah dilakukan untuk mengenal pasti prevalan penggunaan shammah dan hubungkait antara penggunaan shammah terhadap penyakit gusi serta keatas penyakit lesi menyerupai leukoplakia mulut. Faktor-faktor lain yang mempunyai hubung kait dengan pembentukan penyakit gusi dan lesi menyerupai leukoplakia mulut turut sama di kenal pasti. **Bahan dan Kaedah:** Satu kajian keratan rentas telah di lakukan keatas 346 lelaki dewasa yang telah dipilih secara rawak. Pensampelan secara rawak berperingkat telah digunakan untuk memilih lokasi kajian. Selepas melengkapkan temuramah menggunakan soalan berstruktur, kesemua peserta menjalani pemeriksaan klinikal untuk mengenal pasti status kesihatan gusi dan lesi menyerupai leukoplakia mulut. Status gusi direkodkan menggunakan indek periodontal komuniti (IPK). Ciri klinikal lesi menyerupai leukoplakia mulut pula di kategorikan menggunakan kaedah oleh Axell *et al.* (1976). Ujian Chi-square telah digunakan untuk menilai perbezaan yang signifikan status penggunaan shammah dalam hubungannya dengan penyakit gusi dan lesi menyerupai leukoplakia mulut. Regressi logistic peringkat satu pembolehubah dan peringkat berbilang pembolehubah telah di pilih untuk menilai potensi factor-faktor yang mempunyai hubungkait. **Keputusan:** Dari 346 peserta

lelaki yang berumur 18 tahun dan keatas, 68 orang adalah pengguna shamamah pada masa kajian. Prevalan pengguna shamamah pada masa kajian adalah 19.7% [95% confidence interval (CI): 15.6%, 24.2%]. Ujian Chi-square menunjukkan terdapat perbezaan signifikan di antara kumpulan-kumpulan kajian (iaitu tak pernah, bekas serta pengguna shamamah) berdasarkan kehadiran penyakit gusi ($P= 0.001$) begitu juga dengan kehadiran lesi menyerupai leukoplakia mulut ($P= 0.001$). Analisis regresi logistic berbilang pembolehubah mendapati umur, pendapatan isirumah, bekas pengguna shamamah, pengguna shamamah terkini, dan lamanya shamamah digunakan adalah berkait secara statistic dengan kehadiran kejadian penyakit gusi [ratio odd terkawal (AOR) = 1.05; 95%: 1.03, 1.07; $P= 0.001$], (AOR= 2.01; 95% CI: 1.16, 3.47; $P= 0.012$), (AOR= 2.92; 95% CI: 1.20, 7.10; $P= 0.018$), (NKD= 7.25; 95% CI: 3.84, 13.70; $P= 0.001$), dan (AOR= 2.19; 95% CI= 1.47, 3.24; $P= 0.001$) masing-masing. Analisis regresi logistic berbilang pembolehubah juga turut mendapati umur, berpelajaran rendah atau tiada, bekas pengguna shamamah, pengguna shamamah terkini, dan bilangan shamamah digunakan sehari adalah berkait secara statistic dengan kehadiran kejadian lesi menyerupai leukoplakia mulut (AOR= 1.03; 95% CI: 1.01, 1.06; $P= 0.006$), (AOR= 8.65; 95% CI: 2.81, 26.57; $P= 0.001$), (NKD= 3.65; 95% CI: 1.40, 9.50; $P= 0.008$), (AOR= 12.99; 95%: 6.34, 26.59; $P= 0.001$), dan (AOR= 1.17; 95% CI: 1.02, 1.36; $P= 0.026$), masing-masing.

Kesimpulan: Keputusan kajian menunjukkan bahawa penyakit gusi dan lesi menyerupai leukoplakia mulut adalah berkaitan secara signifikan dengan penggunaan shamamah. Oleh itu, adalah penting untuk menghasilkan satu program pencegahan yang menyeluruh di Yemen.

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AMONG ADULT MALES IN DAWN VALLEY, YEMEN**

ABSTRACT

Background: The traditional type of smokeless tobacco (SLT) used in the Arabian Peninsula, especially common in Yemen is called shammah. Shammah and other risk factors play an important role in development of oral diseases. **Objectives:** The present study has been undertaken to determine the prevalence of shammah use and to determine the association between shammah use with periodontal disease and oral leukoplakia-like lesions. Other associated factors with periodontal disease as well as with oral leukoplakia-like lesions were also determined. **Materials and Methods:** A cross sectional study was conducted on 346 randomly selected adult males. Multi-stage random sampling was used to select the study location. After completing the structured questionnaire interviews, all the participants underwent clinical examination for periodontal health status and oral leukoplakia-like lesions. Periodontal status was recorded using the Community Periodontal Index (CPI). Clinical features of oral leukoplakia-like lesions were characterized based on the grades of Axéll et al. (1976). Chi-square test was used for assessing significant differences in shammah status in respect to periodontal disease and oral leukoplakia-like lesions. Univariable logistic regression and multivariable logistic regression were selected for assessing potential associated factors. **Results:** Out of 346 male participants aged 18 years and older, 68 reported being current shammah users. The prevalence of current shammah use was 19.7% (95% CI: 15.6%, 24.2%). Chi-square test detected that significant differences exists between the study groups (i.e., never, former, and current shammah users) in respect to the presence of periodontal disease

($P= 0.001$) as well as to the presence of oral leukoplakia-like lesion ($P=0.001$). Multivariable logistic regression analysis revealed that age, family income, former shammah user, current shammah user, and annual duration of shammah use were statistically associated with the presence of periodontal disease [Adjusted odds ratio (AOR)= 1.05; 95% CI: 1.03, 1.07; $P= 0.001$], (AOR= 2.01; 95% CI: 1.16, 3.47; $P= 0.012$), (AOR= 2.92; 95% CI: 1.20, 7.10; $P= 0.018$), (AOR= 7.25; 95% CI: 3.84, 13.70; $P= 0.001$), and (AOR= 2.19; 95% CI: 1.47, 3.24; $P= 0.001$), respectively. The multivariable analysis also revealed that age, no formal or primary level of education, former shammah user, current shammah user, and frequency of shammah use per day were statistically associated with the presence of oral leukoplakia-like lesion (AOR= 1.03; 95% CI: 1.01, 1.06; $P= 0.006$), (AOR= 8.65; 95% CI: 2.81, 26.57; $P= 0.001$), (AOR= 3.65; 95% CI: 1.40, 9.50; $P= 0.008$), (AOR= 12.99; 95% CI: 6.34, 26.59; $P= 0.001$), and (AOR= 1.17; 95% CI: 1.02, 1.36; $P= 0.026$), respectively. **Conclusion:** The results revealed that periodontal disease and oral leukoplakia-like lesions were significantly associated with shammah use. Therefore, it is important to develop comprehensive shammah prevention programmes in Yemen.

CHAPTER ONE: INTRODUCTION

1.1 Background

Good health is essential in ensuring high quality of life and facilitating social, economic, and personal development. The World Health Organization (WHO) defines health as “a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity” (WHO, 1946). This description measured the quality of life within the context of health, and those decades ago, quality of life had already considered mental and social development, and implied spiritual aspects. Hence, health was not only measured in terms of physical factors.

One significant aspect of ensuring quality of life is good oral health (WHO, 2012a). Oral health refers to “a state of being free from mouth and facial pain, oral and throat cancer, oral infection and sores, periodontal (gum) disease, tooth decay, tooth loss, and other diseases and disorders that limit an individual’s capacity in biting, chewing, smiling, speaking, and psychosocial wellbeing” (WHO, 2012a)

Having good oral health practices allows people to eat, talk, and socialize normally and confidently (Locker, 1988). By contrast, the psychological impact of oral diseases diminishes the quality of life (Petersen, 2003). Incidences of oral diseases are huge public health concerns, as these problems are among the most chronic and prevalent diseases. Over the years, oral infections, such as dental caries and periodontal problems, have been identified as burdens to the state of global oral

health. Petersen *et al.* (2005) revealed that dental diseases are responsible for expensive health care services. Around 5% to 10% of expenses of the total health care expenditures are allotted to the cost of treating dental diseases. In societies with lower economic status, treating dental diseases, such as a traditional restorative treatments, would probably surpass the available resources allotted to the health care programs of the entire country (Kathmandu, 2002; Watt, 2005).

Several factors are responsible for the cause of many diseases, specifically, oral diseases, as well as for the spread of such ailments. The socio-environmental factor is the most important one that should be noted in the progression of diseases. Certain socio-cultural factors, such as poor living conditions, low education, lack of tradition, beliefs, and cultural practices, result in the high risk of dental problems (Watt, 2005). In addition to these factors, poor oral hygiene practices, usage of tobacco, and consumption of sugar add to the occurrences of dental diseases (Petersen, 2005; Watt, 2005). Unfortunately, in Yemen there are some inappropriate life habits such as smoking, chewing chat, and using shammah. These habits affect oral health in one way or another.

The wide differences in oral health in different regions are traced back to socioeconomic status, race, ethnicity, age, gender, or general health status (Petersen, 2005). In appropriate life habits might also be influenced by socioeconomic status, race, ethnicity, age, and gender. While most oral diseases are preventable, some communities have yet to take advantage of the healthcare system of their areas. This situation is indicated by the frequency of specific groups of people who suffer from dental diseases. Therefore, this study was conducted to explore the prevalence of shammah use and to identify which determinants influence the formation of oral

mucosal lesions and periodontal diseases among the citizens of Dawn Valley, Yemen.

1.2 Impact of Tobacco on Oral and General Health

Tobacco can be used either in smoked or smokeless forms (chewed, sniffed, or dipped). Regardless of use or form, tobacco releases harmful substances, such as nicotine. Nicotine has been proven to affect the brain in a manner similar to other addictive substances, like caffeine, cocaine, and amphetamine (Jha *et al.*, 2006; Benowitz, 2008). In addition to nicotine, tobacco contains tobacco specific nitrosamines (TSNA), which are strong carcinogenic substances that are similarly found in smokeless tobacco (SLT) (Hecht, 1997; Hoffmann and Djordjevic, 1997). Stepanov *et al.* (2008) and Stepanov *et al.* (2009) found toxic chemicals, namely, polycyclic aromatic hydrocarbons, nitrite, nitrate, formaldehyde, acrolein, and crotonaldehyde in SLT.

The presence of such chemicals explains the strong association of tobacco with oral pre-cancer and cancer (Lin *et al.*, 2011; Meurman and Bascones - Martinez, 2011; Sridharan, 2014), cell death and apoptosis in cultured cell lines, including oral keratinocytes (Bagchi *et al.*, 1999; Costea *et al.*, 2010), increased predisposition to periodontal diseases (Biddle *et al.*, 2001; Singh *et al.*, 2011), and interference in the response to periodontal therapies (Balaji, 2008). In addition, other adverse effects are tooth discoloration, halitosis (Alkhatib *et al.*, 2005; Rad *et al.*, 2010), and implant failures (Palma-Carrió *et al.*, 2011; Lin *et al.*, 2012). Tobacco use is said to be connected to lung cancer, coronary heart diseases, and pancreatic cancer (Rahman and Zaman, 2008; Parkin, 2011; IARC, 2014).

1.3 Prevalence of Tobacco Use

Whereas laws and public health interventions have decreased the prevalence of tobacco use (Pierce *et al.*, 2012), the number of tobacco users is still significant. The WHO reports that globally, 43% (36% are males and 7% are females) of adults smoke, and 30% (23% are males and 7% are females) correspond to users of SLT (WHO, 2012b).

The number of adult smokers and the frequency of tobacco use vary according to region and gender. Male smokers have higher prevalence rates than females. For instance, the WHO found that 18% and 48% of males were smokers in the African and Western Pacific regions, respectively, 3% of females from the African, South-East Asia, and Eastern Mediterranean regions were smokers, and 19% of females smoked in the European Region. The differences based on gender have the greatest disparity in the Eastern Mediterranean and Western Pacific regions, with rates for males being 12 times higher than that for females (WHO, 2012b). The frequency rates of male adult SLT users varied from 1% in the American and Western Pacific regions to 36% in the Southeast Asia region. For females, these rates varied from close to 0% in the US to 10% in the Southeast Asia region (WHO, 2012b).

Further, WHO identifies that Yemen ranks second among countries in the Arabian Peninsula in terms of the number of smokers (WHO, 2009). Yemenis smoke 604 billion cigarettes per year (WHO, 2009). Another study in 2012 estimated that as much as 27.4% of adult males are tobacco smokers and that 15.1% use shammah (IARC, 2012).

1.4 Shammah

Although smoking tobacco in the form of cigarettes seem to be common worldwide, smokeless tobacco is commonly used in various forms, such as chewing tobacco and snuff. Studies in South and Southeast Asia have identified that the practice of using smokeless tobacco is similar to the habit of betel quid chewing (Gupta and Ray, 2004) and snuff dipping or snus habits in the US and Scandinavia, respectively (Axéll, 1993; Warnakulasuriya, 2004). In the Arabian Peninsula, very few studies on the use of traditional smokeless tobacco have been conducted. The traditional type of SLT used in the Arabian Peninsula is called the shammah. The use of shammah is common in Yemen as well as in some parts of the Kingdom of Saudi Arabia and Algeria.

Shammah is a traditional SLT (snuff dipping form) used in Yemen, with various varieties, including white, black, and gray powders (locally known as Toombak) (Figure 1.1). These varieties differ in terms of composition. Black and white shammah are made from powdered tobacco leaf, slaked lime, ash, oil, and other substances and flavors (Amer *et al.*, 1985; Samman *et al.*, 1998), whereas gray shammah (locally known as Toombak) is sun-dried powdered tobacco leaves (Figure 1.2) mixed with ash. The shammah that is used in Southern Yemen differs in composition from the Sudanese toombak (the traditional variation of snuff dipping). Shammah is usually placed in the buccal lower or labial vestibules (Salem, 1992), as shown in figure 1.3.



Figure 1.1 Types of shammah. A: White shammah; B: Black shammah; C: Toombak



Figure 1.2 Sun-dried toombak



Figure 1.3 Shammah in the lower labial vestibule of the oral cavity

1.5 Periodontal Diseases

Periodontal disease comes in two conditions, namely, gingivitis and periodontitis. Gingivitis is the inflammation of the gingival, whereas periodontitis is the inflammation of the periodontal ligament and alveolar bone (Harvey, 2005). Studies revealed that the primary etiological agent in gingivitis (Löe *et al.*, 1965) and periodontitis (ten Cate, 2006) is bacterial plaque. However, the severity and prevalence of periodontal disease can still be progressed by other factors. The most important factors include age (Genco, 1996), sex (Alam *et al.*, 2012), income level, tobacco use (Singh *et al.*, 2011; Prasanna *et al.*, 2012), and educational level (Boillot *et al.*, 2011).

1.6 Prevalence of Periodontal Disease

The prevalence of periodontal disease is determined by numerous factors, such as age, socio-economic status, and risk habits. Petersen and Ogawa (2005) found that gingival bleeding is common among adults and affects the periodontal pockets (6 mm or more) of 10% to 15% of adults worldwide. The occurrence of periodontitis among adults in the US was 47% or 64.7 million, with American adults having mild, moderate, or severe forms of the disease (Eke *et al.*, 2012). Singh *et al.* (2012). Conducted a study on 10,260 subjects from the Meerut district in India and found that 52.7% and 37.4% of the subjects had deep and shallow periodontal pockets, respectively.

With regards to the prevalence of periodontal disease in the Arab world, most published studies focusing on oral health status including periodontal diseases in the Arab world have been conducted in schoolchildren and adolescents (Al-Ismaily *et al.*, 1996; Abid, 2004; Elamin *et al.*, 2010; Imran and Ataa, 2010).

El - Qaderi and Quteish Ta'ani (2004) showed that the prevalence rates of periodontal disease (Scores 3 and 4 of the community periodontal index, CPI) were 18.6% and 11.1%, respectively, in a 50–60-year-old age group in Jordan. Peeran *et al.* (2012) estimated the prevalence of periodontitis on 452 adults in Sebha City, Libya. Data were collected using CPI. Their study revealed that 52.7%, 30.1%, 12.17%, and 3.31% of the subjects had shallow pockets, calculi, deep pockets, and bleeding, respectively.

Mengel *et al.* (1996) presented the periodontal status of 1001 Yemenis in Yemen. In their study, 84.5% and 12.5% of the subjects in a 35–44-year-old age group had shallow pockets (CPI scores 2 and 3) and deep pockets (CPI score 4), respectively. Amran *et al.* (2011) conducted another study from January to October 2010 on 602 participants with ages >20 years old and with complete sets of teeth. The participants were patients of the learning dental clinics of the Faculty of Dentistry at Tamar University and Tamar General Hospital in Yemen. In their study, 60.5% of the patients had gingival recession.

1.7 Oral Leukoplakia- like Lesion

Changes in the surface of oral mucosa are oral mucosal lesions. Clinically, these changes may be described as red or white ulcerative or pigmented, any swelling, or as variants of development defect (Espinoza *et al.*, 2003). Oral mucosal lesion occurs due to various causes. Reichart (2000) lists various factors that have a negative impact on the oral mucosa, including infection from bacteria, viruses, fungi, parasites as well as physical and thermal causes, changes in immune system, systemic diseases, trauma, and chronic habits, such as the use of tobacco and alcohol.

The oral mucosal changes due to the use of SLT can usually be observed in the mucosal surfaces that the product touches. The clinical appearance of SLT-induced lesions has been described in several studies (Andersson and Axèll, 1989; Greene *et al.*, 1993; Chitroda *et al.*, 2011; Wallström *et al.*, 2011). SLT-induced lesions may be white or yellow-brown in color and thicken and wrinkle later on (Hirsch *et al.*, 1982), or the lesions could appear in chronic white or translucent gray. The lesion is usually found in areas that directly come in contact with SLT (Shulman *et al.*, 2004; Lesan *et al.*, 2014). SLT use is a significant predictor of leukoplakia-like lesions (Axéll *et al.*, 1990; Chung *et al.*, 2005; Saraswathi *et al.*, 2006; Scheifele *et al.*, 2007).

Leukoplakia is the most common likely malignant lesion of the mouth (Sciubba, 2001; Feller and Lemmer, 2011). Leukoplakia is indicated by a white patch or plaque that cannot be clinically or pathologically characterized as any other ailment (Lodi *et al.*, 2006; Roosaar *et al.*, 2007; Amagasa *et al.*, 2011). More importantly, such patch or plaque cannot be rubbed off (Petersen *et al.*, 2005).

About 70–90% of oral leukoplakias are related to tobacco use, and there is a direct relationship between the frequency and the duration of tobacco use and the prevalence of oral leukoplakia (Dietrich *et al.*, 2004) . According to its clinical appearance, oral leukoplakia can be divided into two main types: homogeneous and non-homogeneous. Either type may occur as an isolated lesion or as multiple lesions. The leukoplakic lesion can vary in size from a few millimetres to several centimetres (Lodi *et al.*, 2006; Warnakulasuriya *et al.*, 2007; Van der Waal, 2009).

Homogeneous leukoplakia is a consistently white flat plaque with a smooth or relatively smooth surface; non-homogeneous leukoplakia may be scabrous or verrucous having a wrinkled or corrugated surface or may be a mixing of white and red areas termed erythroleukoplakia (Reibel, 2003; Warnakulasuriya *et al.*, 2007). The clinical appearance of oral leukoplakia may transform over time. Some homogeneous lesions may become larger, or non-homogeneous, but most oral leukoplakias will remain stable or will regress, while some few will undergo carcinomatous transformation (Scully *et al.*, 2003; Holmstrup *et al.*, 2006; Napier and Speight, 2008).

1.8 The Malignant Potential of Oral Leukoplakia

The development of oral leukoplakia to carcinoma is unpredictable but is relatively infrequent with an estimated overall risk of less than 2% per year (Suarez *et al.*, 1998; Napier and Speight, 2008) ; if progression occurs, it may take a few months or many years (Neville, 2009). The carcinomatous transformation of oral leukoplakia is not only predictably associated with tobacco use (Partridge *et al.*, 2000), and the frequency of carcinomatous transformation of idiopathic leukoplakia is higher than that of tobacco-associated leukoplakia (Reibel, 2003).

In populations where tobacco use is very prevalent, most squamous cell carcinoma progresses from pre-existing leukoplakias; while in populations with a lower prevalence of such habit, most squamous cell carcinoma arise in normal looking epithelium (Suarez *et al.*, 1998). It has been suggested that squamous cell carcinoma arising de novo usually runs a more aggressive course and has a less favourable prognosis than squamous cell carcinoma arising from pre-existing leukoplakia (van der Waal and Axell, 2002), but a recent study has demonstrated

little difference (Weijers *et al.*, 2008). Sometimes squamous cell carcinoma arises de novo in close proximity to oral leukoplakias (Neville, 2009). Non-homogeneous leukoplakia has a greater risk of carcinomatous transformation (20–25%) than homogeneous leukoplakia (0.6–5%) (Reibel, 2003; Napier and Speight, 2008). Most leukoplakias either remain stable or will regress (Holmstrup *et al.*, 2006; Napier and Speight, 2008). However, if proliferative verrucous leukoplakia is considered as a distinct entity, most such cases progress to carcinoma (Jacobson *et al.*, 1996; Bagán *et al.*, 2004).

1.9 Prevalence of Oral Leukoplakia- like Lesion

Studies on prevalence of oral mucosal lesions showed variations in the prevalence rate which may be related to materials and methods, difference in inclusion and exclusion criteria used, and could be due to variations in the risk habits practiced among the population.

A study conducted in Sweden focusing on the prevalence of oral mucosal lesions in adult Swedish population. About 60 oral mucosal lesions were showed. The results found that 0.11%, 49.1%, 8.5% and 1.9% were respectively focal epithelial hyperplasia, leukoedema, geographic tongue and lichen planus. The risk factors such as denture status and tobacco habits were found to be related of some lesions in this study (Axéll, 1975). Cebeci *et al.* (2009) studied 5000 patients in Turkey and estimated that the overall prevalence of oral mucosal changes was 15.5%. These changes were classified as anatomic changes (7%), ulcerated lesions (6.6%), and tongue lesions (4.6%) were the most common lesions. White lesions were observed in 2.2% of all patients. Among the white lesions, leukoplakia was identified in men four times more frequently than it was in women.

A cross-sectional study was also conducted in Iran to determine the prevalence of oral mucosal lesions. A total of 1581 participated in the study, which showed that the overall prevalence of oral mucosal lesion was 19.4%. The results of this study showed that the prevalence of leukoplakia was 0.1% (Ghanaei *et al.*, 2013).

In the Arabian Peninsula, the prevalence of oral mucosal lesions varies from one country to another. There are a variations among different countries with a prevalence from 58.1% (of 350 patients, 308 had one or more lesions) in Kuwait (Ali *et al.*, 2013) to 15.0% (of 2552 dental outpatients, 383 found to have oral mucosal lesions) in Saudi Arabia (Al-Mobeeriek and AlDosari, 2009). In Yemen, 58.4% of those aged 15 years and above were found to have oral mucosal lesions (Al-Maweri *et al.*, 2014).

The occurrence of oral mucosal lesions among adults is high and emphasize that risk habits have some relationship with the presence of such lesions. According to the Third National Health and Nutrition Examination Survey, SLT-related lesions consisted of 4.7% of all lesions found in 17,235 people. SLT users had the highest odds of having a lesion (odds ratio, 3.9) (Shulman *et al.*, 2004). In India, a study, comprising 840 participants, reported that 87% were SLT users and that 37% had different oral lesions, including leukoplakia, erythroplakia, oral submucous fibrosis, and lichen planus (Narasannavar and Wantamutte, 2014).

The clinical study of Scheifele of 200 shammah users from 48 Yemeni villages and cities revealed that 27% had oral leukoplakia and 58% had shammah-associated lesions. The prevalence of lichen planus was 0.5%, oral lichenoid was 4.0%,

frictional lesion was 4.0%, pseudomembranous was 4.0 %, morsicatio buccarum was 0.5%, and white sponge nevus was 0.5% (Scheifele *et al.*, 2007).

1.10 Gap Statement

Several studies have confirmed the association between SLT use and periodontal diseases (Fisher *et al.*, 2005; Singh *et al.*, 2011) and oral mucosal lesion (Shulman *et al.*, 2004; Lesan *et al.*, 2014). Nonetheless, data on the prevalence of shammah use as a traditional habit of smokeless tobacco use in Yemen and data on the association of shammah use with periodontal diseases and shammah-induced leukoplakia-like lesions in Yemen are not well established. Therefore, this gap in research raises the significance of obtaining data on the prevalence of shammah use and its association with periodontal diseases and shammah-induced leukoplakia-like lesion among Yemeni adult males. Factors that may influence the formation of periodontal diseases and shammah-induced leukoplakia-like lesions among Yemeni males have not been adequately investigated. Therefore, the study design is based on the summary of the possible interactions shown in the conceptual framework in Figure 1.4.

1.11 Objectives

1.11.1 General Objective

The general objective of this study is to determine the prevalence of the use of SLT and its association with oral diseases among adult males in Dawn Valley, Yemen.

1.11.2 Specific Objectives

1. To determine the prevalence of shammah use among Yemeni adult males.
2. To determine the association between shammah use and periodontal diseases among Yemeni adult males.
3. To determine the association between shammah use and oral leukoplakia-like lesion among Yemeni adult males.
4. To determine the association between anatomical location of shammah and oral leukoplakia like lesion among current shammah users.
5. To determine the association between shammah use and other associated factors with periodontal diseases among Yemeni adult males.
6. To determine the association between shammah use and other associated factors with oral leukoplakia-like lesion among Yemeni adult males.

1.12 Research Questions

1. What is the prevalence of shammah use among Yemeni adult males ?
2. Is shammah use associated with periodontal diseases among Yemeni adult males?
3. Is shammah use associated with oral leukoplakia-like lesions among Yemeni adult males?

4. Is the anatomical location of shammah associated with oral leukoplakia-like lesion among current shammah users?
5. Are shammah use and other factors associated with periodontal diseases in general among Yemeni adult males?
6. Are shammah use and other factors associated with oral leukoplakia-like lesions in general among Yemeni adult males?

1.13 Rationale of Study

This study aims to achieve a deeper understanding of the influence of shammah use on oral health. As this study is conducted among the people of Dawn valley in Yemen, the findings would provide local baseline data on the prevalence of shammah use and its association with periodontal diseases and oral leukoplakia-like lesions in the population. This study highlighted the other factors associated with development of periodontal diseases as well as with oral leukoplakia-like lesions to identify population at risk for targeted public health inferred diseases. The findings of this study add value and evidence for oral health practitioners in managing patients with history of shammah use. The results could be utilized in planning programs on public awareness of shammah-related oral problems. Information on the prevalence of shammah use among Yemeni adult males in Dawn Valley could provide a clearer picture of the magnitude and effects of this habit in this population segment.

CHAPTER TWO: LITERATURE REVIEW

2.1 Global Prevalence of SLT

Generally known as “spit tobacco” or “chewing tobacco,” more than 30 different products of SLT are manufactured worldwide (Ahmed *et al.*, 1997; Gupta and Ray, 2003; Gupta and Subramoney, 2006). The prevalence of SLT forms varies from region to region (Idris *et al.*, 1995b; Johnson, 2001; Scheifele *et al.*, 2007; Lin *et al.*, 2011; Hansson *et al.*, 2012).

In the US, SLT is currently used by 7.1% of adult men aged 18 years and older. The use of SLT is even higher at 10.5% among young adult males aged 18 to 25 years (Kott *et al.*, 2013). State-specific data from the 2009 Behavior Risk Surveillance System show a wide variation in SLT use of adults across the states, with the highest prevalence among adult men in West Virginia (17.1%) and Wyoming (16.9%) (CDC, 2010).

A telephone survey with 2914 respondents was conducted in Sweden. The respondents were randomly selected from the telephone directories of all Swedish regions to determine the prevalence of snus users. The survey showed that 96% of the respondents used either pouched snus or loose snus alone (Digard *et al.*, 2009).

A cross-sectional sample survey was also carried out in Bangladesh to determine the extent of betel quid chewing. A total of 30,874 adults participated in the survey, which showed that 31% of the participants regularly chewed betel quid (Flora *et al.*, 2012). In addition, a total of 1067 out of 1084 secondary school students

in Tanzania answered a filled questionnaire. The results showed that 2.2% and 4.4% have respectively dipped tobacco snuff and chewed tobacco at school (Kabulwa, 2011). A cross sectional study was conducted on a sample of 1776 adults in Yola, North-East Nigeria. The study found that out of 1776 interviewed respondents, 133 (7.49 %) were user of smokeless tobacco. Snuffing of smokeless tobacco was 6.8% (Desalu *et al.*, 2010).

Around 600 million of betel chewers in the world are in the Asia Pacific region (Gupta and Warnakulasuriya, 2002). Gupta and Ray (2003) conducted a population-based survey in India, Nepal, and Pakistan, which showed that 20%–40% of people aged 15 years old were quid chewers. Meanwhile, Ahmed (2013) carried out a community-based cross-sectional study in the North state of Sudan, where 207 respondents participated. A total of 38% of the respondents were Toombak dippers. This value was higher than that of tobacco smoking (29.5%) in this region of Sudan.

In Malaysia, a two cross sectional studies were carried out to determine the prevalence and practice habits among indigenous people of Sabah state. A total of 431 rural Bajau women and 472 rural Kadazan women participated in the study, which found that the prevalence of smokeless tobacco use among rural Bajau women in Kota Belud district was 77%, and that among rural Kadazan women in Tambunan district was 60%. This values was also higher than that of smoking prevalence in which the prevalence of smoking was only 3.3% among Bajau women and 11% among Kadazan women (Gan, 2000).

2.2 Prevalence of Shammah in Yemen

Shammah is the SLT used in Yemen. The literature review shows that very few studies are conducted on the prevalence of shammah in the Arabian Peninsula. Most of these studies focus on the prevalence of shammah among adolescents rather than among adults. A cross-sectional survey was conducted to determine the prevalence of tobacco use among school children in Saudi Arabia. The survey included 1019 respondents out of the 1186 seventh- to ninth-grade students. The prevalence of shammah use in the study sample was 2%, and all of these shammah users were males (Al Agili and Park, 2012). Similarly, very few studies have focused on the prevalence of shammah use among adults in Yemen (Hajeb, 2010; IARC, 2012).

A cross-sectional study was conducted on adult outpatients aged 18 year and above. These outpatients were attending dental clinics at the Al-Thawra Modern General Hospital in Sana'a, Yemen. The study results showed that 4.4% of the participants (23 patients out of 520) were shammah users (Hajeb, 2010).

2.3 Influence of Shammah Use and Other Factors on the Development of Periodontal Disease

Periodontal disease is a condition that results from a complex interaction of many factors. Factors such as age (Mahmud *et al.*, 2013), socioeconomic status (Kamath *et al.*, 2012), oral hygiene practice (Hopcraft *et al.*, 2012), and SLT use (Fisher *et al.*, 2005) may affect the progression of periodontal disease. However, bacterial plaque has been considered as the primary aetiological factor (Listgarten, 1988).

2.3.1 Periodontal Disease and SLT

The mechanisms by which tobacco use contributes to the pathogenesis of periodontitis are not yet clearly understood. However, the fundamental mechanisms leading to the development of chronic periodontitis are closely related to the dynamics of the host immune and inflammatory responses to the periodontal pathogens present in the dental biofilm immunoregulatory controlling the T helper 1/T helper 2 cytokine profiles in a periodontal disease (Gemmell and Seymour, 2004).

Immune and inflammatory responses are critical in understanding the pathogenesis of periodontal diseases, and they are orchestrated by a number of either intrinsic or induced host-related factors (Taubman *et al.*, 2005). A balance between microbial virulence factors and host response exists under normal circumstances. Accordingly, tissue homeostasis is maintained as long as this balance is preserved. The balance between microbial virulence factors and host response in periodontitis is impaired in favour of microbial challenge. Tobacco is an environmental factor suggested to interact with host cells and affect inflammatory responses to this microbial challenge (Palmer *et al.*, 2005). The toxic components of tobacco (mainly nicotine) may also directly or indirectly cause periodontal tissues to deteriorate.

Studies on the association between shammah and periodontal diseases are lacking. Hence, this literature review highlights the general effect of SLT on periodontal diseases. Some published studies on shammah in the Arabian Peninsula have also been considered.

Epidemiological and clinical studies with demographic variations from various parts of the world have shown the effect of SLT on periodontal health. Frithiof *et al.* (1983) and Montén *et al.* (2006) showed the effects of moist or dry “snuff” on periodontal tissues. Offenbacher and Weathers investigated the use of SLT products in a school population of 565 males with a mean age of 13.8 years. Their study was conducted to determine the possible relationship of SLT usage to gingivitis and gingival recession. The overall prevalence of SLT usage was 13.3%. They also found that the prevalence of gingival recession was significantly elevated in SLT users (Offenbacher and Weathers, 2006). Similar results were obtained by many previous studies (Greer and Poulson, 1983; Montén *et al.*, 2006; Parmar *et al.*, 2008; Chu *et al.*, 2010).

The occurrence of gingival recession among oral SLT users has been reported to occur in sites adjacent to mucosal lesions. This finding suggests that the recession is a result of a long-term injury caused by the SLT product in the gingival tissues (Poulson *et al.*, 1984; Robertson *et al.*, 1990; Rolandsson *et al.*, 2005; Montén *et al.*, 2006). Oral SLT users in a central Indian population were shown to have increased prevalence and severity of recession and attachment loss at the mandibular teeth, buccal surfaces, anterior teeth, and molars, the surfaces most likely to have prolonged exposure to SLT products because of the retention of the products at the mandibular buccal or anterior labial vestibule (Anand *et al.*, 2013).

An epidemiological data of 12,932 adults who participated in the National Health and Nutrition Examination Survey III (NHANES) demonstrated that adults who never smoked but currently use SLT were twice as likely to have severe

periodontal diseases at any site than non-users (OR: 2.1 95% CI 1.2, 3.7) (Fisher *et al.*, 2005).

A total of 2045 individuals from the local population of Lucknow in India participated in another study. Of this number, 1069 used some kind of tobacco, and 61% of these users smoked SLT. The effect of SLT was significantly higher in terms of plaque index, calculus, clinical attachment loss, gingival recession, and probing pocket depth (Singh *et al.*, 2011). Another study employed a purposive sample of 200 individuals aged between 18 and 55 years. This sample was divided into two groups: tobacco chewers and non-tobacco chewers. A comparison of the periodontal status mean showed that tobacco chewers had more calculus, shallow pocket (< 4 mm), and deep pocket (> 6 mm) than non-chewers. These associations were found to be statistically significant (Amjad *et al.*, 2012).

The incidence and severity of calculus, clinical attachment loss, gingival recession, mobility, furcation, and lesions were significantly higher among the subjects with longer use duration (> 5 years) than those with shorter use duration. Similar trends were obtained for the plaque index and probing pocket depth (Singh *et al.*, 2011).

Al Agili and Park (2013) described the oral health status of adolescents who were daily users of shammah in Saudi Arabia. Probing pocket depth, gingival recession, and clinical attachment loss were measured in this study. No association was found between periodontitis and the use of SLT in the young student sample. However, previous studies on adult tobacco users showed significant associations between periodontal disease and tobacco use (Bouquot and Schroeder, 1992; Fisher

et al., 2005). These associations were attributed to the long period of tobacco use by adults.

Oral SLT habits are common among all populations. However, strong associations between SLT habits and destructive periodontal disease have been mainly observed among Asian populations. In contrast, a systematic review that investigated the association between SLT habits and periodontal disease in a study conducted in Sweden and the US suggested that SLT habits may not be related to periodontal diseases (Kallischnigg *et al.*, 2008). Such contradictory observations may be due to several factors, such as differences in the trends of oral SLT practices and the type of SLT products used by the respective populations. The Swedish snus is less harmful than smoking and other SLT products (Lee, 2013). In comparison, the oral SLT products commercially available in India and other Asian countries contain more than 4000 toxic ingredients, which can cause tissue injury because of their mutagenic and carcinogenic properties (Nair *et al.*, 2004; Bhisey, 2012)

2.3.2 Periodontal Disease and Age

Numerous studies have shown that the prevalence and severity of periodontal disease increase with age (Papapanou and Wennström, 1989; Grossi *et al.*, 1995; Palmer, 2013). Papapanou *et al.* (1989) initially showed that 70-year-old participants had significantly more mean annual reduction of alveolar bone height (0.28 mm) than 25-year-olds (0.07 mm). According to Grossi *et al.* (1995) and Sarajlić *et al.* (2009), alveolar bone loss was also seen in older participant groups.

Eke *et al.* (2012) estimated the prevalence, severity, and extent of periodontitis on a sample of 3742 adults aged 30 years and older. They used the data from the 2009 and 2010 cycles of the National Health and Nutrition Examination Survey (NHANES). Attachment loss and probing depth were measured at six sites per tooth in all teeth except in the third molar. The study showed that periodontitis increased with age. The adults aged ≥ 65 years had periodontitis at rates of 5.9%, 53.0%, and 11.2% for mild, moderate, and severe forms, respectively.

Mahmud *et al.* (2013) studied 120 patients with type 2 diabetes who attended a diabetic centre in Bangladesh. Their study confirmed that the age is a predictor of periodontal diseases. In addition, the occurrence of periodontal diseases increases by 0.20% for each year the patient age increases.

2.3.3 Periodontal Disease and Socio-economic Status (SES)

Several studies have reported the possible relationship between socioeconomic factors and periodontal disease (Gilbert, 2005; Susin *et al.*, 2005; Gundala and Chava, 2010). Gundala and Chava (2010) conducted a cross-sectional study in the Department of Periodontics, Narayana Dental College and Hospital in Nellore, India. A total of 1350 subjects were examined. The statistical analysis showed a significant decrease in periodontitis with the increase of income and education levels. Moreover, a study involving 1187 employees in the Indian city of Mysore showed that 16.4% in the upper SES category had a community periodontal index score of 0 (healthy periodontium). None of the subjects in the lower middle, upper lower, and lower SES categories obtained this score (Chandra Shekar and Reddy, 2011).

The relationship between SES and periodontal status has been demonstrated by a study on adults aged 15 to 65 years. The postgraduate participants all had healthy periodontia, and none had deep pockets compared to the other groups ($P < 0.001$). The relationship between income and periodontal disease was also statistically significant ($P < 0.001$) when the association between these two factors was assessed (Kamath *et al.*, 2012).

Brodeur *et al.* (2001) further conducted a logistic regression analysis to control for potential confounding factors. The dependent variable used was the presence of at least one tooth with a periodontal pocket ≥ 6 mm. Family income was then associated with this periodontal problem after controlling for the potential confounding factors. People with low family income were at a higher risk of having at least one tooth with a pocket ≥ 6 mm (Brodeur *et al.*, 2001).

Boillot *et al.* (2011) searched studies to estimate the association between chronic periodontitis and education. They used the Embase and MEDLINE databases to search for studies published until November 2010, and included only general population-based studies conducted on adults aged 35 years and older. The overall odds ratio (OR) for chronic periodontitis was 1.86 (95% CI: 1.66, 2.10), which indicated an increased risk of periodontitis associated with low educational level. The association was partially attenuated after adjusting the covariates (OR= 1.55; CI: 1.30, 1.86; $P < 0.001$).

On the other hand, a study conducted in Nigeria focusing on the association between socio-economic classes and severity of periodontal diseases stipulated that there was no statistically significant relationship between socio-economic status and