PERCEIVED STRESS, COPING STYLES AND PERIODONTITIS: A CROSS
CULTURAL ANALYSIS

by

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To my mother Mufida,

To my husband, Nabil,

To my children, Noor and Zahid, Alaa, Amr, and Momin, and

To my grandchildren Tamer and Dana

To my brothers and sisters

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CHAPTER I

INTRODUCTION

Periodontitis is a chronic bacterial infection that involves the gingiva and the periodontal supporting structures of the tooth. It is a common disease that affects about 35% of the US dentate population 30 to 90 years of age, with about 12.6% having a moderate to severe form of the disease [1]. Furthermore, the susceptibility of individuals to periodontal disease seems to vary greatly depending on which risk factors are involved. Data from many parts of the world have shown that 7-15% of almost all populations suffer from severe, generalized forms of destructive periodontitis [2,3]. These figures persist regardless of the populations' state of economic development, oral hygiene, or availability of dental care [2,3].

Because periodontitis progresses with age, as more individuals keep their teeth because of the decline of dental caries [2], and as the life span is expanded in the US, periodontitis is likely to become an increasingly significant disease. Epidemiological evidence indicates that the initiation of periodontal disease is multifactorial with a complex interaction between bacterial infection and host responses often modified by behavioral factors [4]. Moreover, there is a reasonable amount of research indicating that periodontitis may be associated with psychosocial stress, financial stress, distress, and

depression [5-8]. Although additional research is needed to define these relationships more clearly, these findings help to emphasize the impact that these factors may have on individuals' health.

Psychosocial stressors present a direct physical threat to one's well being [9]. There is substantial evidence that psychosocial stress may affect the endocrine and immune system and enhance the likelihood of infection leading to health changes [9]. This evidence makes stress a possible candidate for being classified as a risk factor for periodontitis.

In spite of the public health importance of periodontitis and stress exposure, the association between these two factors has rarely been systematically investigated. Stress is not yet confirmed as a risk factor for periodontitis, but has been identified in several observational studies [8,10]. In a large cross-sectional study, Genco et al. found that psychosocial stress factors associated with financial strain are significant risk indicators for adult periodontitis [5]. Moss et al., in a case control study, also found more periodontal disease among those respondents who scored higher than their peers on measures of social stress [8]. In contrast, other studies found no association between stress and periodontal disease [11-13]. Accordingly, further studies are needed to get a clear understanding of the relationship between stress and periodontitis.

This study primarily aimed at examining possible associations between perceived stress and periodontitis in two different adult samples. It also explored the role of coping strategies in moderating this relationship. This study was important, because it controlled for major confounding variables such as age, gender, smoking, and diabetes, and allowed to investigate the relationships in two culturally different samples.

CHAPTER II

BACKGROUND AND SIGNIFICANCE

This chapter will discuss the literature on periodontitis and its measurement. It will give an idea about stress and its measurement. It also describes the systemic disease-stress and the periodontal disease-stress relationships. It reviews the literature on stress and periodontal disease with a consideration of coping as a modifying factor in the association between stress and periodontal disease. In addition, it proposes some of the possible mechanisms which could link these conditions. Finally, it includes the roles of known periodontitis risk factors and sheds some light on methodological issues in assessing the association between psychosocial stress and periodontitis.

Diagnosis of periodontitis and Measurement

Pocket depth (PD) has been used in many studies as an indicator for periodontal disease [14]. However, this measure is not accurate since it depends to a great extent on gingival inflammation. Clinical attachment level (CAL) is considered a better measure of periodontal disease, since it is measured from a fixed point on the tooth, and at the present time attachment level appears to be the best available estimate of

periodontal conditions [15]. According to Burt [2] CAL remains a diagnostic "gold standard" for periodontitis, even though it is a measurement of accumulated past disease at a site rather than current disease activity. CAL has been measured on all teeth, all teeth in two quadrants, the worst teeth in each sextant, and selected index teeth [16]. Studies have measured CAL on one, two, four and six sites per tooth [16]. Currently, there is no clear-cut definition of what represents a case of periodontitis, which makes research progress difficult. Studies have employed variable definitions to establish what constitutes disease presence. Depth of CAL at designated sites, number of sites and teeth measured and the inclusion of other measures such as PD and Bleeding on Probing (BOP) vary among different researchers [5,6,8,13]. A common method of analyzing attachment level measurements is to calculate a mean attachment loss for each individual. Some researchers employ categorized mean attachment loss using various cut-off points for AL. The mean value however, does not distinguish whether many sites show a little attachment loss (AL) or whether few sites show widespread AL. Other studies use the Machtei definition of "established periodontitis" [8]. According to the Machtei criteria, a case of periodontitis should have two sites or more with AL $\geq$ 6 mm and one site or more with PD $\geq$ 5mm [17]. Another approach that has been used is the Extent and Severity Index [18]. "Extent" refers to the number of teeth in the mouth with clinical AL of predetermined value above a threshold and "severity" is the mean AL for the teeth exhibiting the threshold of AL [19,20]. In this study, we defined periodontitis as having AL $\geq$ 5 mm in more than 30% of the sites examined.

Stress Measurement

Overall, this research is concerned with stress, specifically perceived stress, and periodontitis. There have been multiple definitions of stress over the years. For the purpose of this paper, Lazarus' definition of stress was used, "an inharmonious fit between the person and the environment, one in which the person's resources are taxed or exceeded, forcing the person to struggle, usually in complex ways, to cope" [21]. Lazarus' definition was chosen due to the breadth of its scope which includes both individuals and systems. Stress in epidemiologic research is measured objectively or subjectively. An overview of each of these approaches is provided.

The Objective Approach

This approach focuses on events and experiences that are assumed to be stressful and thus require adaptation. The purpose of the early research was to identify and quantify potential environmental stressors. Much of the early work on stressors focused on major life events [9]. The classic work of Holmes and Rahe [22] had a major impact on early stressful life events research with the construction of the Social Readjustment Rating scale (SRRS). SRRS incorporated major life events such as death of a family member and loss of a job. A major criticism of Holmes and Rahe's work was the inadequate representation of stressful life events [9]. In addition, no consideration was given to groups who might experience different kinds of stressors, such as children, the elderly, and different ethnic and racial populations.

Stress researchers of the 1970s and 1980s extended the previous work by adding a subjective component to the measures of major stressful life events [9]. The inclusion of subjective perceptions of stressful events was used to explain and clarify variations in individual responses to similar stressors.

The Subjective approach

This approach emphasizes the importance of the appraisal of potentially harmful environmental events and individuals' perceptions of stress. Individuals appraise situations and then evaluate their ability to deal with them [23]. When demands exceed an individual's self-assessed ability to manage the stressor, due to inadequate resources or lack of abilities, stress is perceived [23].

Lazarus and Folkman's Transactional Model of Stress and Coping was the first theory emphasizing the importance of subjective stress appraisal [24]. In their view, actual stressors such as events are not as important as individual perceptions of stress. Individuals first go through a course of primary appraisal which includes their interpretation of events as extraneous, benign, or stressful to the person's well-being. Secondary appraisal which includes assessment of coping resources and options follows the primary appraisal [24]. Stress is experienced if individuals perceive that they do not possess or cannot mobilize resources to effectively manage a situation that they have appraised as stressful. They perceive themselves as unable to control the situation or manage their emotional response to it. The Subjective Model of Stress and Coping represents a dynamic and evolving process of stress perception. They perceive

themselves as unable to handle the situation or to control their emotional response to it [24].

In the coping phase, coping is comprehended as a transactional process between a person and the environment, with an emphasis on process rather than on personality traits [24,25]. Coping is defined as "ongoing cognitive and behavioral efforts to manage specific external and/or internal demands that are appraised as taxing or exceeding the resources of the person" [25]. As a process, coping is highly specific both to the individual and to the context, varying among individuals rather than remaining constant [24].

Systemic Disease and Stress

Life events and associated psychological and behavioral reactions usually have an impact upon people's daily lives and are believed to predispose them to disease. Psychosocial factors such as stress, depression, feelings of hopelessness, hostility, and control beliefs are thought to be associated with physical health [26]. Several observational studies have demonstrated that an accumulation of stressful life events increases the risks of mental disorders [27], acute infections such as the common cold [28,29], and total and cause-specific mortality [30]. Stress also has been suggested to contribute to several other diseases such as heart disease [31], cancer [32,33], diabetes, infectious diseases [34], and asthma [35]. There is evidence from an increasing number of studies that psychological factors play a part in the etiology of coronary heart disease (CHD). Higher psychological stress has predicted coronary heart disease in several

observational studies. For example, in the Alameda County Study, a longitudinal study extending over 29 years, Kaplan et al. examined the role of various behavioral, psychological, social, and demographic factors on the health and mortality of a community sample of men and women [36]. Furthermore, the results of the Whitehall II study provide evidence that particular psychosocial factors may account for some of the missing predictive power for coronary heart disease [37]. These associations between psychosocial factors and physical health appear to persist after adjustment for behavioral factors and adjustments for measures of material disadvantage [26].

On the other hand, researchers have increasingly recognized that psychological problems may exert substantial influence on glycemic control in diabetic patients [38]. There is evidence from an increasing number of studies that stress can affect blood glucose levels in diabetic individuals [39-41]. The mechanism behind these effects is related to the so-called "stress hormones." Adrenaline and cortisol have as one of their primary effects, the mobilization of glucose and fatty acids [39]. Direct effects of stress on the nerves controlling the pancreas can also inhibit insulin release [41]. In a longitudinal study of 60 patients, Surwit found that people receiving stress management training showed a significant reduction of blood glucose control. In addition, stress has been shown to increase the risks of poor glycemic control, "brittle diabetes," and diabetic ketoacidosis [40,42].

Periodontitis and Stress

Our understanding of the etiology of periodontitis has changed markedly in the last few years. In the early days of modern periodontal research, "periodontal disease" was identified as a single entity, which began with gingivitis and progressed to periodontitis and tooth loss. It is well-demonstrated today that periodontitis occurs in bursts with quiescent periods between bursts of disease activity, and the scars of the disease accumulate throughout the years [2]. Based on this change in concept, the philosophical basis for measuring periodontal disease has changed several times over a relatively short period of time. Consequently, indexes based on this old model are now considered invalid and periodontal epidemiology based on these indexes has been accordingly hampered. Besides, as noted above, only 7%-15% of any adult population- which still represents many people-, is significantly affected by destructive periodontal disease [43]. Thus, as with many chronic infections, the onset and progression of this disease depend on several host conditions that markedly affect the resistance of the host to infecting periodontal pathogenic bacteria.

In the past, researchers have assumed a universal susceptibility to periodontal disease, and a slow gradual progression of the disease throughout life [2]. Our current understanding of periodontal diseases has departed from this earlier model. Present-day knowledge of the etiology of periodontal disease shows that it is an inflammatory disease associated with specific sub-gingival bacteria [44].

An analysis of systemic and microbial factors in epidemiological studies points to several risk factors associated with periodontitis. These risk factors include local,

systemic, demographic, and behavioral host conditions which markedly affect the resistance to infecting pathogens [45-47]

A significant proportion of the variation in disease severity cannot be explained when only these risk factors are taken into account [48]. This finding suggests that there are other risk factors, perhaps some which are barely recognized, that may explain the remaining variance. Psychosocial factors have been suggested by several studies to play a possible role in periodontal disease [6,8,49,50] though the data to support these contentions are sparse. There are few studies that have been conducted in this field [5,6,8,49,51] and further studies are considered necessary in order to strengthen the evidence for a possible relationship between psychosocial factors and periodontal disease.

Coping styles on the other hand have proven to have a direct influence on periodontitis, although the influences are perhaps clearer among destructive (inadequate) styles of coping than among adaptive styles [5].

A chronic inflammatory disease, periodontitis also has long been thought to be correlated to stress by some means [6,46,52,53]. It is not only stressful events that determine health or disease. In fact, how do individuals perceive these events and cope with them is as important as the stresses themselves. If people perceive an event as more than they could deal with and exceed the resources available to them, then only at this point do they perceive stress that could lead to disease. At that point too, people try to cope with their stress [24]. Thus Lazarus suggests that coping operates not directly by affecting disease status but by moderating the impact of the stress [24].

Experimental Studies of Stress and Periodontitis

There have been a few laboratory animal studies that might suggest a causal relationship between stress and periodontitis. Most early studies were based on Selye's general Adaptation Syndrome, which makes use of a variety of stressors [54,55]. Only Gupta has shown that restraint stress (immobilization) increased bone resorption in rats and hamsters [54].

Animal studies have consistently found a depressed immune response in association with stressors such as noise, isolation, increased population density, male female proximity, handling by animal keepers, exposure to cold temperatures and deliberate physical trauma. In a series of laboratory studies using mice, Shapira et al. found that isolation as an emotional stressor, and cold as a physical stressor, modified the inflammatory response following introduction of *P. gingivalis* [56,57]. Modifications took place via suppression of macrophages, increased secretion of nitric oxide and reduction of tumor necrosis factor. These decreased levels of immune system function did not seem to be mediated by corticosteroids. The findings showed that the number of macrophages that were recruited after stimulation by *P. gingivalis* lipopolysaccharide (LPS) was significantly reduced in stressed mice compared to non-stressed animals. On the other hand in mice injected with corticosterone the number of macrophages was similar to that of control animals. Breivik and coworkers showed in a series of well-designed studies of ligature-induced alveolar bone resorption in rats [58], that the central nervous system in general and stress in particular can accelerate alveolar bone loss. A newer study conducted by Haddad and coworkers justified Breivik's results on a cellular

basis and showed that stress may shift the response to a more Th1 (T helper cells)-type [59].

These studies do not necessarily provide evidence, however, that stress generates a similar effect in humans. For instance, one issue to consider is the eventual similarity of bacteria produced from the pure culture to those found in the oral environment. Furthermore, the immune response is intensely complicated and there are many disparities between the human immune response and the immune response of animals. Accordingly, the extent to which results can be applied to humans cannot be determined from these studies alone. In fact, the ideal condition for reaching conclusions is when results from laboratory studies are confirmed in clinical and epidemiological studies in humans.

Epidemiological Studies of Stress and Periodontitis

Periodontal disease has been found to be significantly associated with psychosocial stress [8], life events [6,14], and job stress [48,49]. These associations often remained significant after adjusting for potential confounders [5,6,8]. However, there are studies that did not find a significant association between periodontitis and stress after adjustment for potential confounders [11,13].

Documented confounders for the periodontitis-stress relation include commonly shared factors such as gender, age, socioeconomic status (SES), diabetes, and smoking [5]. Studies on the relation between stress and periodontitis have been around for a long time [53,60,61]. This subject has long been of interest, but a relationship has not been

clearly defined. A large number of the studies conducted in this area took place to assess the relation of stress to Acute Necrotizing Ulcerative Gingivitis (ANUG) [62-64]. Only a few studies have directly addressed the issue of emotional stress and development of periodontitis, and none of these have been conclusive. Studies concerning the relationship between stress and periodontitis have yielded only correlative findings. Furthermore, interpretation of these studies has been hampered by their use of the plaque index (PI) which is considered no longer valid, because it measured both gingivitis and periodontitis features [48,53,61] Based on these results it's not clear that the scientific evidence is sufficient to support the hypothesis that stress are of etiological importance in periodontitis pathology.

There is some early research on the role of stress in the etiology of periodontal disease. Most of the early studies basically have found a positive link between stress and inflammatory periodontal diseases [60,61]. Interpretation of periodontal data from these early studies is extremely difficult because, as discussed above, the indexes used to measure periodontal diseases are now considered invalid. In these studies, it is possible to observe a presumed primary relationship between stress and periodontitis, though their interpretation is difficult because many of them lacked the principles of good quality research. They were conducted generally on psychiatric patients, and lacked valid and reliable stress measurement scales. Most of these studies, for example, used univariate models to investigate the effects of stress and did not adjust for other risk factors. But even though, those studies have not provided any significant contribution concerning this relationship, they collectively laid down the foundation for subsequent epidemiology researchers to work from in studying a possible relationship between psychosocial stress

and periodontal diseases.

A large number of studies conducted in the 1990s and 2000s reported a positive association between stress and periodontal diseases. These studies had improved methodological quality when compared to the older studies listed above. However, most of these studies did not adjust for major confounders that were found to be associated with periodontal diseases, such as age, SES, and diabetes [8,13,14,49,51]. The first study to systematically relate self-reported measures of life-events stress and periodontal disease generally was conducted by Green and coworkers [6]. They studied individual "life events" such as divorce and bereavement, and stated that an increased number of stressful life events was associated with a greater prevalence of periodontal disease [6]. These results were supported by more recent studies conducted by Croucher and colleagues who found that stress and oral health risk behaviors clustered together as important correlates of periodontitis [14]. Furthermore, these researchers measured only pocket depth which on its own is not a good indicator of periodontitis.

Other studies used different kinds of information and scales to measure psychosocial stress. Moss et al., in a two-part investigation, examined the relation between daily strains and symptoms of depression with established periodontitis [8]. In the cross sectional part they found positive associations between social strains and established periodontitis, though they could not replicate these results in the longitudinal part of the study. By increasing the cut-off point of daily strains, they were able to achieve a positive relation.

The association of coping behavior in addition to stress and distress was investigated by Genco et al. in a cross-sectional study [5]. Genco found that those

respondents with more financial strain who were emotion-focused copers were at a higher risk of having more severe AL. Wimmer et al. also investigated the association between coping strategies and periodontal disease [51]. They used the amount of clinical AL to classify the severity of periodontal disease, with AL ≥ 5 mm being classified as severe periodontal disease. Wimmer and colleagues examined periodontal parameters at 4 sites in all intact teeth. They found that the stress-coping behavior of periodontal patients differed from that of controls. Their selection of volunteers as control subjects, however, may have introduced selection bias into this study which in turn may have led to a distortion in the estimate of effect [51]. An investigation by Hugoson et al. also found an association between severe periodontal disease and a poor ability to cope with stress [65].

Studies varied not only in criteria used to define stress, but also with respect to periodontitis case-definition and the measures used to assess periodontal status. In a case-control study, Teng et al. looked into the relation of stress and chronic periodontitis [66]. They defined cases according to Machtei: a) with two or more inter-proximal sites at different teeth with AL of 6 mm, and b) at least one additional site with a pocket depth (PD) of 5mm [17]. Vettore et al. also studied the relation between stress and anxiety with chronic periodontitis, and found that cases and control respondents did not differ with respect to the percentage of stress and anxiety [13]. However, they used pocket depths as the measure of chronic periodontitis.

Other studies have explored the relation between stress and the onset and progression of rapidly progressive periodontitis [10,11]. In a longitudinal study conducted by Merchant et al., the authors studied the association between social support, anger expression and self reported periodontitis [7]. They reported that increased social

isolation and anger expression may play an important role in the development of periodontitis.

In summary, there has been a long-held belief that psychosocial stress is directly associated with periodontal disease. To date, most epidemiological studies suggest that psychosocial stress and inadequate coping are important risk factors for periodontal disease. A number of these studies are of questionable quality, which does not allow to easily reach a clear-cut judgment. Given the high variability associated with self-reported measures of psychological stress and coping styles it is likely that studies with small samples will be statistically underpowered to detect hypothesized relationships among psychosocial factors and indicators of disease. In addition, the use of different major dependent variables across studies - plaque levels, gingival bleeding on probing, pocket depth, AL, and loss of alveolar bone - limits the ability to generalize about the specificity of the relationship between psychosocial stress and periodontal disease. Yet, in spite of all these shortcomings, it seems fair to say that these studies have collectively provided evidence of some relationship between stress and periodontal disease, although etiological mechanisms have not yet been fully explored.

Although the relationship between stress and periodontitis has been studied for many years, there have been no reported studies of the effects of stress on periodontitis in comparable studies using the same techniques and procedures. This study allowed to investigate the relation between stress and periodontitis in two culturally different samples using the same design and procedures. In addition, it explores whether individuals' styles of coping with stress will moderate this relation. Moreover, this study controlled for the effect of possible confounding factors such as age, gender, smoking,

and diabetes as mentioned in the next section.

Specific Aims and Hypotheses

The aim of this project is to study the association between perceived stress and periodontitis in a sample of Syrian and of US adults. The possible association between stress and periodontitis was investigated using AL as the outcome, and perceived stress. Also, the effect of coping styles as a moderator in the relation between stress and periodontitis was explored.

The specific aims for this study were:

- To study the association between perceived stress and periodontitis in a Syrian and a US adult population adjusted for known and possible confounders such as age, gender, smoking, and diabetes.

  Hypothesis 1: American and Syrian adults between 30-75 years who suffer from a high-to-moderate level of perceived stress are more likely to exhibit periodontitis than people with less stress.

- To explore the possible moderating effect of coping strategies in the association between perceived stress and periodontitis.

  Hypothesis 2: Coping styles modify the relation between perceived stress and periodontitis.

Other Determinants of Periodontitis

Evidence of the importance of host resistance in the pathogenesis of periodontitis comes from some notable associations between severity and progression of periodontitis with some systemic and behavioral conditions that lower the host resistance. Examples of such conditions are diabetes [67-71], chronic neutropenia [72-74], phagocytosis [75,76] and chemotaxis [77,78]. Research findings indicated that periodontal diseases are more prevalent, more severe and more widespread among smokers, poorly controlled diabetics, nonwhites, people with less than a high school education, and those with income less than $20,000 a year [79]. Moreover, there are a number of demographic, socioeconomic, and behavioral characteristics that have been shown to influence periodontitis occurrence, including age, race, gender, education, and socio economic status (SES) [5]. Those factors, however, are not considered a part of the causal pathway. For example, aging does not cause periodontitis even though older individuals may have more AL due to the accumulation of disease throughout life.

Data concerning smoking, diabetes, age, and gender were collected in this study to allow to control for possible confounding effects. Starting with smoking, a major risk factor for periodontitis, a brief description of the possible role of each of these factors will be included in following section.

Role of Smoking

Smoking, the major known risk factor for periodontitis, contributes to the alteration

of host resistance [80], although its role in the development of periodontitis is not yet

perfectly understood. Smoking is a significant risk factor in the development of

periodontal disease [47,81,82]. Recent evidence showed that cigarette smokers are at a

risk of 2.5-6.0 times that of nonsmokers for the development of periodontitis [82,83].

Other clinical [84] and epidemiological [82,83,85,86] studies supported the findings that

tobacco use is an important variable affecting the prevalence and progression of

periodontal disease. Significant associations between cigarette smoking and both clinical

AL and alveolar bone loss were shown in a study of clinical risk indicators [85,86]. In

addition, results from the first National Health and Nutrition Examination Survey

(NHANES I) demonstrated that current smokers had greater periodontal destruction than

former or never smokers after adjusting for oral hygiene and other confounding variables

[87]. Based on data from NHANES III, Tomar and Asma also concluded that current

smokers were about four times as likely as never-smokers to have periodontitis [88].

Smoking could lead to increased periodontal destruction by altering the host

response through 2 mechanisms: a) impairment of the normal host response in

neutralizing infection [89], and b) alterations that result in destruction of the surrounding

healthy periodontal tissues [89]. Another hypothesis regarding the role of smoking in the

development of periodontal disease is that smokers have more plaque or harbor more or

different types of plaque bacteria [90]. However, cross-sectional data from the large Erie

County Study population have found an association between smoking and AL after

adjusting for confounders such as age, plaque and calculus, gender, income, education, and socioeconomic status [85,86].

Role of Diabetes

One of the strongest systemic risk factors for periodontal disease is diabetes mellitus; periodontitis has been referred to as the sixth complication of diabetes [67]. Researchers found that diabetic individuals, particularly those with insulin-dependent diabetes, are 2-3 times more likely to have more pocketing, more calculus, and a higher prevalence of tooth loss than individuals without diabetes [89,91]. There is strong evidence of a bi-directional adverse interrelationship between diabetes mellitus and periodontal diseases [92]. In a systematic review evaluating the evidence of a bi-directional relationship between diabetes and periodontal diseases, Taylor reported that 44 out of 48 studies reviewed provided consistent evidence of greater prevalence, severity, extent, or progression of at least one manifestation of periodontal disease [92]. The majority of the studies in this field have reported an association between poorer glycemic control and poorer periodontal health [68-70]. Finally, in a longitudinal epidemiologic study, Taylor et al. tested the hypothesis that severe periodontitis in persons with type 2 diabetes increased the risk of poor glycemic control [70]. They found that subjects with severe radiographic bone loss as well as severe clinical AL at baseline were approximately 6 times more likely to have poor glycemic control after approximately 2 years of follow-up [70]. The report by Taylor et al. provided epidemiologic evidence for an association between severe periodontitis and increased risk

for poor glycemic control over time [71].

Age and Periodontal Disease

The incidence of periodontitis appears to vary among differing background determinants. Several epidemiologic studies have shown that older age groups are more likely to exhibit periodontal disease compared to younger age groups [85,86]. Aging is generally associated with periodontal disease, however, this relationship is thought to be more related to the cumulative periodontal scars over-time than to an age-related, inherent deficiency that contributes to susceptibility to periodontal disease [46]. In a study of data from the NHANES I, Abdellatif and Burt [15] found that the effect of aging on periodontal destruction appears to be negligible compared to the role of plaque as represented by oral hygiene practices [15].

Gender and Periodontal Disease

Gender appeared to be significantly related to periodontal disease in several studies [85,86]. Grossi and colleagues found that males were more likely to exhibit greater severity of bone loss and AL compared to females. One possible explanation for the difference is that being male somehow affects individual's susceptibility to periodontal disease resulting in more prevalent or severe disease at comparable ages. Another possible reason is that females take better care of their teeth and gums than males [90].

Possible Disease Mechanisms

Plausible pathways from stress to certain diseases have been described [93]. Stress may act alone or combine in groups, and may exert effects at different stages of the life course. There have been multiple mechanisms proposed to relate pathogenic properties associated with stress, including:

- **A direct role for psychosocial stress and coping behaviors via the central nervous system.**

Genco et al. offered a schematic model which demonstrates the potential role that psychosocial stressors may play a role in starting a cascade of events in the corticotropin-releasing hormone/hypothalamic-pituitary-adrenal axis (HPA) and the activation of the central nervous system [94]. The physiological consequences of the HPA pathway may lead to immunity depression via depleting secretory IgA, IgG and neutrophil functions, enhancing the likelihood of infection and leading to the establishment of destructive periodontitis. Evidence for this pathway is limited and studies about this subject have been controversial [94]. To evaluate this pathway, more epidemiological studies, both experimental and longitudinal, would need to be conducted.

- **A direct role for psychosocial stress and coping behaviors via the autonomic nervous system.**

Psychosocial stress can generate responses that are transmitted to the autonomic nervous system, stimulating the secretion of catecholamines (epinephrines and norepinephrines) subsequently affecting prostaglandin and proteases which in turn enhances periodontal destruction [95]. Emotional stress results in the release of

noradrenaline generating an altered immune response.

- **An indirect role of psychosocial stress and coping behaviors through behavioral changes.**

Psychosocial stress may have an indirect role in periodontitis exhibition through changes in the health behaviors. Stress may affect at-risk health behaviors such as smoking [96], alcohol consumption, neglect of oral hygiene [50] or poor compliance with dental care.

Methodological Issues

One of the major challenges in the study of the association between stress and periodontitis is the complexity of mechanisms involved in the causation of this disease. Several well known risk factors and risk indicators are associated with periodontitis as well as with stress. Smoking, one of the most important risk factors for periodontitis has also been associated with stress [85,86,90]. Failure to control for the effect confounders or effect modifiers can result in a misleading association between stress and periodontitis.

A specific challenge in this kind of study is the difficulty in distinguishing whether stress affects the initiation, or the progression, or both, of the disease. By lowering the immune system, stress may possibly increase periodontal incidence and/or promote the progression of the disease in susceptible individuals. This situation is not clear in cross-sectional and case control studies. Even in longitudinal studies, methodological issues emerge since there is no uniform definition of stress. Another problem with this measure is the potential confounding of appraisals with various

antecedents of appraisals as well as with the psychological outcomes of interest. For instance personality variables, beliefs, values, cognitive styles and mood state may affect appraisals and may independently influence vulnerability to disease. Studies investigating the links between stress and disease have focused on environmental demands (daily life events and chronic strains), psychological appraisals and emotional responses. Each one of these measures has its own conceptual and methodological issues. Employing one, two or more of these components in a particular study depends on the outcome of interest as well as the specific questions asked. In studies of periodontitis, measure of long-term exposure would be a more valuable measurement and the association of stress with chronic diseases is better captured when stress is measured over long time. The question remains about the accuracy of stress levels measurement when asking questions about stress a year or more ago. Integrating different components of the stress process (environmental demands, psychological appraisal and emotional response) may enhance the potential to answer various important questions about the role of stress in disease. Nevertheless, choosing several measures increases the time and cost of research, and may have an influence on individuals' willingness to participate in the studies.

A further challenge could be possibly due to the clinical attachment level measurement. In fact, CAL measurement as an expression of periodontal status has many limitations. One drawback is that the depth measurement has been shown to be dependent on various factors such as the degree of inflammation, probing force, probe tip thickness, angulation and position of probing and root anatomy [97]. Other factors include intra- and inter-examiner measurement errors, erroneousness recordings and anatomical variations in tooth shape or position. Thus, observed CAL is a function of both the true

level of periodontal support and observational error [16]. Listgarten reviewed many of the problems associated with probing [98]. He indicated that the probing force affects the position of the probe tip and that problems associated with probing include angulation of the probe, shape of the tooth, subgingival calculus, and cooperation of the patient [98]. However, he suggested that the worst error in CAL measurement appears to be no more than 1.5 mm.

Summary

In summary, evidence suggests that stress puts individuals at greater risk for periodontitis [5,6,8]. However, many questions remain to be answered. Stress has been widely regarded as having a deleterious effect on health including autoimmune disease [77], cardiovascular disease [31,99] and infectious diseases [34]. A considerable body of data exists relating stress, distress, and coping with periodontitis [5,6,8], though a number of studies to support this relation are of questionable quality. Thus, the need for further analytic studies with adequate sample sizes to confirm the association is unquestionable.

The study presented in this dissertation will investigate the relationship between periodontal disease and stress in two culturally-different populations. Using the same protocol for assessing the two study populations will allow to control for any residual confounding effects which might affect the outcome. As Schlesselman states: "the comparison of relative risks across different studies should be based on estimates that have been adjusted for the same major risk factors" [100]. Furthermore, this study will assess the relation between coping styles and periodontitis and is designed to study its

role in moderating the periodontitis-stress relationship. This study should, therefore,

provide new information, for few existing studies have examined this relationship.

CHAPTER III

METHODS

This chapter is organized in two main sections, namely the methods used in the pilot study and in the main study.

Pilot Study

A pilot study was conducted to investigate the stability, over a ten-day interval, of the two psychosocial scales, PSS and Brief Cope, that were translated into Arabic for the main study. The main purpose of the pilot study was to assess the validity and reliability of the Arabic version of the perceived stress scale (PSS) and the Brief Cope. Moreover, the pilot study was carried out to assess the feasibility of the study procedures and the flow of questions, presence of sensitive questions, and clarity of wording to the respondent. This study was carried out with a convenience sample of University of Damascus employees, with eligibility based on their knowledge of both Arabic and English. Subjects were selected from all offices in the University. Systematically, every fifth employee was asked to participate in the pilot study after a brief description of the

purpose. Those who agreed to participate in the pilot study were asked to sign an Arabic consent form (see appendix). Some words in the Brief Cope questionnaire were changed based on the findings from the pilot study before starting the main study.

Study Design

This study used a test-retest design, with a 10-day interval (time 1 and 3) between the two administrations. An English version of the PSS and the Brief Cope scale were also administered 5 days after the first translated administration (time 2) to assess the accuracy of the translation. Two additional translated stress scales were administered (at time 2) to assess the validity of the Perceived Stress and the Brief Cope scales. Both questionnaires were translated into Arabic, validated and used in psychosocial research in Syria. An additional copy of the PSS and Brief Cope scales were administered 5 days after the English version (time 3) was administered to assess the test-retest reliability of both scales. The difference in timing was discussed with an assistant professor of psychology at the University of Damascus. The rationale for this choice was that by this time the participants would have forgotten their first answers, while at the same time not much had happened in their lives that would lead to differences in their answers.

Procedures

Participants (n = 26) were recruited from staff members in the University of Damascus. After an informed consent had been explained to them and signed (sees

appendix), participants completed three self-administered questionnaires in Arabic (see appendix). The first questionnaire consisted of basic demographic questions including gender, age, marriage status, and level of education. In addition, each participant received and completed two questionnaires, the PSS measuring questionnaire and the brief Cope questionnaire. To diminish the possibility that participants would easily remember their responses to any particular scale, measures were administered at three different time's intervals. Five days later the English versions of the PSS and the Brief Cope scales were completed by the participants. In addition, the Job Stress Symptoms (JSS) measure and the Coping Responses Inventory (CRI) adult measure [101] were administered in Arabic. Ten days after first questionnaires' administration, an additional copy of the PSS and the Brief Cope were administered in Arabic. Order of measures administration of all the measures was the same for all respondents.

Participants

The sample was a nonrandom, convenience sample of 26 subjects ranging in age from 22 to 54 years (mean = 33.1 ± 9.7 years) with an 89.6% response rate. The recruited participants were employees at the University of Damascus, Syria. The sample included 15 males and 11 females. To be eligible for participating in the study, participants were asked if they had at least a high school diploma and if they knew how to read, write, and comprehend English fluently. Those who were eligible and agreed to participate in the study were asked to sign the consent forms.

Measures

The Perceived Stress Scale (PSS), by Cohen [102] is a 14-item scale designed to measure the degree to which life situations in one's life are appraised as stressful by an individual. Each item is rated on a 5-point answer scale ranging from 0: "never" to 4: "very often". This scale was found to possess good psychometric qualities such as adequate reliability and validity measures [102,103]. Cohen et al. reported that PSS had adequate internal and test retest reliability and was correlated as expected with life-event impact score [102]. The authors reported a coefficient alpha of 0.84 to 0.86. Moreover, PSS scale was reported to have acceptable internal consistency in several different studies [104-109] with coefficient alpha ranging from 0.67 to 0.99 (Table 1).

The Brief Cope, by Carver [110], an abbreviated 28 item scale measures the ways in which individuals attempt to face, reduce, or master the challenges presented by stressful experiences. Instructions for administration in this sample asked participants to indicate how they usually respond to stressors that occur in their lifetime. Response choices ranged from 1: "I didn't do this at all" to 4: "I do this a lot".

Reliability records for the Brief Cope were considerably adequate according to reports from different studies [110-114]. Alpha coefficients in those studies ranged from 0.42 to 0.93 . Table 2 included alpha coefficients and factor analysis of the Brief COPE in different study samples.

Job Stress Symptoms Measure (JSS), was developed by Rajaa Mariam, a Ph.D. in psychology at the department of psychology at the University of Damascus, Syria. It contains 42 questions about symptoms of stress employed individuals face in their daily work. This test is used in psychosocial research in Syria. Each item is answered on a 4-point rating scale from 0: "not at all" to 3: "all the time". The JSS scores are obtained by summing the answers to all 41 items. They range from 0 to 123. Job stress is assessed using the following subsequent scales: Physical symptoms (8 items), awareness symptoms (5 items), psychological symptoms (14 items), occupation symptoms (10 items) and symptoms related to others (6 items). The reliability of the test as a whole was 0.79. The test retest reliabilities of the subsequent scales are between 0.58 and 0.82. Alpha coefficients ranged from 0.86 to 0.97. The face and content validity of this measure were established. The student t-tests between the highest and lowest 15% of the measure were all significant at p-value < 0.005. Cronbach's alpha for the measures ranged from 0.86 to 0.97. All over alpha was 0.90. Pearson's correlation coefficients ranged from 0.58 to 0.82, with an average of r = 0.76. All over coefficient alpha yielded 0.79.

CRI Cope Measure, by Moos [101], a coping measure that assess an individual's approach and avoidance coping skills in response to stressful life circumstances and other challenges. Thus, it identifies and monitors cognitive and behavioral responses uses to cope with a recent problem or stressful situation. Each coping style has four subscales (cognitive and behavioral) and is measured by six items. Respondents select a recent (focal) stressor and rate their dependence on each of the 48 coping items on 4-point

scales from 0: "not at all" to 3: "fairly often". The Approach coping styles are assessed using the following scales: logical analysis, seeking guidance and support, positive reappraisal and problem solving. Avoidance coping styles are evaluated using the subsequent scales: Cognitive Avoidance, Acceptance or Resignation, Seeking Alternative Rewards, and Emotional Discharge. Internal consistencies of the CRI-adult scales range from 0.61 to 0.74 (average alpha = 0.65 for women and 0.67 for men) and are moderately positively correlated (average r = 0.25 for women; and r = 0.29 for men). The scale also has minimal association with sociodemographic characteristics such as age, education, marital status and ethnicity (average r = 0.15) [101].

Statistical Analysis:

The SPSS version 10 program was used to analyze the results. A Pearson's correlation coefficient was used to measure the test-retest reliability of the PSS whereas Spearman's coefficient was used to assess the retest reliability of the Brief Cope correlation. In order to determine the retest reliability of the PSS, the responses to the items were added and the sum scores at time 1 and 3 were used to determine the correlation. The responses for the items in each subscale of the Brief Cope were averaged and the mean score at time 1 and 3 were used to determine the correlation.

In addition to the correlation, Cronbach's alpha were determined to assess the internal consistency of both measures. Validity correlation coefficients between the PSS and the JSS were 0.74 and 0.70 for the Approach and Avoidance coping styles respectively. Reliability coefficients ranged from 0.59 to 0.99.

Main Study

Overview

Chapter III includes information on the design of the study, the data collection procedures, a description of the sample and details on the reliability and validity of the instruments used to measure the variables. As stated in Chapter I, the purpose of the present research was to investigate the relationship between stress, as perceived by dental patients, and periodontal disease. Coping styles were measured to assess their role in mediating the relationship between stress and periodontal disease. The primary research question was: Is there an association between the level of stress perceived by the participants and the extent and severity of periodontal disease?

Research Design for the Main Study

The research was a cross-sectional, correlational design. The data were obtained from 2 distinct groups of individuals from different environment and culture who had various levels of stress and periodontitis. Self-reports of perceived stress and coping styles were examined in relation to periodontal measures as assessed by one dental examiner. Validated scales were used to measure the participants' levels of perceived stress and coping styles.

A case-control design, such as one based on identifying cases of disease compared to non disease cases from a comparable target population who had been

matched on age and gender was considered. This design was not chosen, because it was thought to be more expensive and more time consuming than the selected design.

Respondents

Two samples of 321 patients at the University of Michigan, Ann Arbor, USA, and 311 patients at the University of Damascus, Syria, were included in this study. The sites were chosen, because they provided adequate and convenient samples that fitted the budget and time limitations of the study. The Syrian individuals could not be reached by regular sampling techniques such as random digit dialing or use of census tract. Patients visiting the school clinics for different kinds of dental care such as endodontic treatment, periodontics, and prosthodontics were asked to participate.

A major issue in the design of this study was that this was a two population study with no intent to compare the extent of stress and periodontitis in one population with the conditions in the other population.

The University of Damascus is the only dental clinic that provides free dental treatment for the Syrian population in the Western region of Syria. Most of the patients that attend the clinics are from Damascus (the capital of Syria). The majority are patients who cannot afford to pay for treatment in private clinics. In addition, students' relatives comprise a small percentage of the patients attending the dental clinics.

Similarly, the majority of patients who visit the dental clinics at the University of Michigan dental school are patients who do not have dental insurance and cannot afford the higher cost of treatment in private clinics.

Eligibility criteria

Individuals who fall in the following categories were eligible to participate in the study:

- Age: between 35-75 years (30-75 for the Syrian sample)

- Presence of at least six teeth in the mouth, and

- No need for antibiotic prophylaxis for sub-acute bacterial endocarditic.

Procedures

All data were collected within the dental clinics at both universities. Sample selection varied slightly depending on the method each university used to handle the reception of its patients.

US individuals attending the dental school and seated in the waiting area of Patient Admitting and Emergency Services unit; PAES Clinic (graduate and undergraduate clinics) were all invited to participate in the study. Individuals who agreed to participate in the study were initially screened to determine their eligibility for the study. Confirmed as eligible, a brief description of the procedure and the importance of the study were presented to the participants. Following the agreement, participants read and signed the consent form (see appendix), after which they self-completed the demographic questionnaire (see appendix). It included the following sections: (i) demographic and socioeconomic information; (ii) questions concerning dental habits and dental care utilization; (iii) questions concerning their medical history, diagnosed systemic diseases, and medications taken on a regular basis; (iv) history of tobacco and

alcohol consumption. Subjects were then given two sets of self-administered psychological questionnaires namely the PSS (see appendix) and the Brief Cope (see appendix). Instructions were given and the investigator stood by to answer questions. Illiterate or functionally literate subjects, as well as patients who could not complete the questionnaire by themselves for some other reasons (6%), completed the questionnaires with the assistance of the interviewer. Upon completion of the psychological questionnaires, the periodontal examination was carried out. The participants were examined by the main investigator.

The Syrian sample was selected in the same way as the US participants except that the patients were seated in several different waiting rooms. The Syrian participants were selected from the caries, periodontal, endodentics, orthodontics, prosthodontics, and oral & maxillofacial waiting rooms. The sequence for room selection was altered every day to make sure that patients attending different dental departments were selected evenly.

The participants progressed through the various data collection steps, with the final step always being the periodontal examination. The entire data collection process for an individual subject took approximately 30 to 40 minutes. Age limit for the Syrian sample was reduced to 30 years, because of the larger number of younger individuals attending the Dental School in Damascus.

Materials

Outcome Assessment

The association between stress and periodontitis was assessed with the correlations between the average AL and perceived stress as well as between categorized AL and perceived stress. AL was categorized according to Armitage's classification of periodontal disease [115]. Armitage [115] recommended that severity of periodontitis should be categorized on the basis of the amount of clinical AL as follows: slight (mild) = 1-2 mm, moderate = 3-4 mm and severe (advanced) $\geq$ 5mm of AL. Periodontitis was defined as generalized or localized based on the percentage of sites affected. According to Armitage, periodontitis was said to be generalized if $\geq$ 30% of sites examined were affected with at least 5 mm of AL [115]. The major objective was to avoid misclassification of patients with severe disease, since some AL may be a common feature among individuals who have dental restorations with overhangs (localized periodontitis). The variable created had three levels: (a) severe periodontitis with $\geq$ 30% of sites with AL $\geq$ 5 mm, (b) moderate periodontitis with $\geq$ 30% of sites with 3-4 mm of AL, and (c) mild periodontitis with the majority of sites having 1-2 mm of AL. For the Syrian sample, the mild and moderate levels were combined into one category due to the small number of participants in the mild level (5%).

Intra-Examiner Reliability

Duplicate examinations were conducted during the study in order to ensure measurement reliability. A sub-sample of 16 participants from the US sample and 10 participants from the Syrian study were selected to assess the reliability of the CAL and PD measurements. Individuals who were willing to undertake a second examination were asked to come after a week for another periodontal assessment. Oral examinations for PD and CEJ were replicated within a one week of the original examination. The chance for original measurements recall was insignificant and could not influence the duplicate examination because the large number of sites tested (56 sites for each of PD and CEJ measurements within one patient) would preclude recall of individual measurements. Weighted Kappa levels within ±1 mm were computed using SPSS version 10.

Clinical Measurements:

The assessed outcome was AL. Other clinical examinations included recording the number of teeth and the measurement of the following parameters: pocket depth (PD), gingival recession (REC), bleeding on probing (BOP), plaque, and calculus visible or detectable through tactile sense using a periodontal probe. A North Carolina probe (Hu Friedy UNC 15 from Hu Friedy Mfg. Co., Chicago, IL) was used to measure PD and REC. Gingival recession was measured from the cemento-enamel junction (CEJ) to the gingival margin, with a negative value if there was recession and a positive value in the absence of recession and in the presence of inflammation. CAL was calculated by the

summation of PD and CEJ.

Psychosocial Indicators

Perceived Stress Scale

Perceived stress was measured with the Perceived Stress Scale (PSS) developed by Cohen, Kamarck, and Mermelstein [102]. (see). The PSS was based on Lazarus' stress theory, and was designed to measure the degree to which individuals perceive their lives as unpredictable, uncontrollable, and overwhelming.

The PSS is a 14 item scale that includes questions about participants' stressful thoughts or feelings related to situations in their life within the last month. Each item is rated on a 5-point answer scale ranging from 0: "never" to 4: "very often". The PSS is not a diagnostic instrument, so no cut-off points are provided.

The total PSS scores were computed by reversing the scores on the seven positive items, and then adding the responses to all 14 items for each participant. Questions B4, B5, B6, B7, B9, B10, and B13 were the positively stated items. The PSS is scores can range from 0 to 56.

In this study, we used the 14-item PSS version due to its notable good psychometric properties and the evidence of its validity [102]. Additionally, its questions are easy to understand, and the response alternatives are simple to grasp. It also has the virtues of being widely used, brief, and able to assess a stress response on a continuum from relatively mild to severe. Moreover, the scale items are quite general in nature and

hence relatively free of content specific to any event and subpopulation group.

Brief Cope Scale

The Brief Cope is a self-report measure designed to assess coping responses of adults (see appendix). This measure is a shortened 28-item instrument taken from the originally published Cope inventory by Carver, Scheier, and Weintraub [116]. The Cope is theoretically based on the transactional model of stress [24] and a model of behavioral regulation [116]. Participants were asked to indicate how they would respond if they were faced with difficult or stressful events in their lives. The Brief Cope is comprised of 14 scales, with two items in each scale, for a total of 28 items. Each item has a 4-point rating scale ranging from 1: "I haven't been doing this at all" to 4: "I've been doing this a lot". Scale scores were calculated by adding item scores within each subscale with a possible score range from 2 to 8, with higher scores designating a tendency to use the individual coping style.

Based on the theoretical model of stress, coping styles were also categorized as either problem-focused coping or emotion-focused coping. Problem-focused coping can be described as a coping style which is aimed at solving problems as they arise. People who score high on the problem-focused coping scale generally respond to stressful situations by taking action. On the other hand, emotion-focused coping is aimed at reducing or managing the emotional responses to a stressful encounter.

Seven subscales were created from the Brief Cope. These subscales include Humorous Coping, Substance Use Coping, Religious Coping, Problem Focused Coping,

Negative Emotion Focused Coping, Positive Emotion Focused Coping. Items in each subscale were added to form a subscale score.

Covariates:

The following factors were used as covariates: age, gender, race (only for US sample), education, income, job (yes, no), brushing, flossing, toothpick use, last year dentist visit, medication intake, presence of diabetes, diabetes control (diet and/or pills), smoking status (current, never and past smoker), number of cigarettes smoked per day, and alcohol consumption (for the US sample only) (see appendix).

Diabetes was self reported from a question included in the personal interview: "Have you ever been told by a doctor or a nurse that you had diabetes?" For medication intake, the following question was asked: "Other than for diabetes, do you take any medication on a daily basis?". Reason for medication intake was also recorded for both samples. Smoking was evaluated using two variables: smoking status with yes/no and number of cigarettes smoked per day. Alcohol consumption was evaluated in the US sample by assessing two variables, namely drinking status and number of glasses of alcohol consumed per day. For the US sample, education was categorized into six levels: no high school, high school degree, some college or technical degree (2 years), college degree, bachelor degree and professional degree. Education for the Syrian sample included the levels as illiterates, elementary school, secondary school, high school, college degree (two years only) and bachelor degree and over. Income for the US sample was categorized into six levels starting from less than $20,000 to $80,000 and over per year. For the Syrian sample,

income was used as a continuous variable and categorized later for the data analysis. Race was recorded only for the US sample and it included the categories "white, African-American and other. Oral health behaviors such as brushing, flossing, using toothpicks and dentist visits were also recorded. The question: "How often do you brush/floss your teeth? was used to report the frequency of brushing and flossing.

Statistical Analysis

Data Cleaning:

Clinical data for the Syrian sample, collected by the main investigator, were recorded on a paper form by a person who has a two year undergraduate degree from the University of Damascus. This recorder was trained by the main investigator before starting the investigation. For the US sample, the data were entered by the main investigator on paper. Data for both samples were entered into a laptop computer by the main investigator.

Data collected for each instrument were independently entered for each data point. Print outs of entered data were reviewed and compared with expected ranges to highlight outliers where data may have been entered incorrectly. Further data screening was made to check all variables for missing data, skewness and kurtosis. Data were coded and entered by the principal investigator directly into an SPSS version 10 data file at the end of each week.

Descriptive statistics were calculated for each variable to examine their

distributions, to find data entry errors and to see that missing values had been defined correctly. Descriptive statistics were used for continuous variables and frequencies for categorical variables. Outcome variables were checked for violation of distributional assumptions, and necessary transformations applied to achieve a normal distribution prior to performing the analysis.

Correlational analysis (Pearsons for interval level data and Spearman's for ordinal level data) was also run on all independent and dependent variables to look for issues of multicollinearity. Comparison between the 2 groups were assessed with chi-square analysis for nominal data and t-tests when dichotomous variables were evaluated with respect to interval level variables. Bivariate stratified analysis using possible confounders and effect modifiers were conducted as well.

A binary logistic regression model was used for the Syrian sample because the mild and moderate periodontitis levels were combined into one category due to the small number of subjects in the mild level. A binary and multivariate ordinal regression model was used for the US sample. A logistic regression model was used to assess the association between perceived stress and periodontitis while controlling for other covariates. Any independent variable that had a p-value less than 0.05 in the bivariate analysis was included in the regression analysis. Variables that had a p-value more than 0.05 were removed one at a time from the analysis except for the variables know to confound the relationship between stress and periodontitis. Interaction terms were chosen based on their significance level in the model. Moreover, known confounders were kept in the model even if they were not significant because the objective of the study was not to build the best predictive model but to evaluate the effect of stress on periodontitis. The

association between the three ordinal variables created to describe the extent of

periodontitis was evaluated using ordinal logistic regression. Three level independent

variables were also recoded as dichotomous variables to simplify the interpretation of the

results using logistic regression. All statistical analyses were performed using SPSS

V10.0, a statistical package commonly used in psychosocial research.

CHAPTER IV

RESULTS

Reliability and Validity of Measures

The reliability and validity of the explanatory measures, including the translated Brief Cope and PSS, were tested in a pilot study. A calibration test was performed for the clinical measures for two individuals who were not participants in the study. In addition, the reliability test for the clinical measures, i.e. attachment levels and pocket depths, was included in the main study. In this section, the results for these tests will be given in detail.

Pilot Study

The pilot sample consisted of 26 subjects with an 89.6% response rate. . Their ages ranged from 22 to 54 years (mean = 33.1 ± 9.7 years). The sample included 15 males (57.7%) and 11 females (42.3%). All of the participants were employed and the majority was married (69%).

About 33% of the respondents had a high school diploma, 40% had a college degree, and 27.8% had a bachelor's degree. Table 3 presents an overview of the demographic characteristics of the pilot sample.

Perceived Stress Scale

The mean score on the PSS for the complete pilot sample (males and females) was 24.8 (SD = 8.4) and 25.3 (SD = 8.3) for the Arabic and English versions respectively. The difference between the two means was not significant (p > 0.05). For this sample, the Cronbach's alpha for the PSS were 0.83 and 0.85 for the Arabic and English versions respectively. Pearson's correlation coefficient for the test-retest reliability of the PSS was 0.78 (p < 0.001), which is higher than the r=0.73 reported by Remor et al. [117]. To check the accuracy of the Arabic translation of the total PSS, the correlation between the responses on the English and Arabic versions was calculated. Pearson's correlation coefficient between the two versions was 0.86 (p < 0.001). Regarding the validity test, the Pearson's correlation between the PSS and the Job Stress Symptoms scale was r = 0.72 (p < 0.01).

Brief Cope

Table 4 presents the internal consistency (alpha coefficients) and correlation statistics (Pearson's coefficient) for the pilot sample on the Arabic and English Brief Cope versions. The Cronbach's alphas for the Arabic version were all in the acceptable

range [118] except for Acceptance, Venting and Planning (0.47, 0.47 and 0.49 respectively). However, Cronbach's alpha scores for Acceptance and Venting, 0.45 and 0.42 respectively, in the Arabic version both exceeded the alphas for the English version. Moreover, all other coefficient alphas for the Arabic version exceeded the alphas for the English version with the exception of Planning and Instrumental Support. With respect to the accuracy tests, all item correlations between the Arabic and English versions of Brief Cope exceeded 0.49, and ranged from 0.49 for item 16 to a high of 1.00 for item 11 (not shown). Correlations were also calculated for each of the 14 subscales of the Brief Cope scale. Except for Behavioral Disengagement (r=0.47), Pearson's coefficients ranged from 0.59 for Planning to 0.96 for Substance Use.

Reliability results indicated that only Planning and Acceptance did not have a good correlation coefficient with r = 0.46 and 0.49 respectively. Other subscales had correlations ranging from 0.56 for Positive Reframing to 0.96 for Substance Use. For item correlation, only Cope 14 had r = 0.46, and other items ranged from 0.50 for item 12 to 0.96 for item 13 (results not shown).

Validity of the Brief Cope was assessed by comparing Brief Cope with CRI coping measure. Pearson's coefficient were determined to test the construct validity of the Brief Cope. Pearson's correlation coefficient ranged from 0.66 to 0.83 for Active Coping, Denial, Positive Reframing, Venting, Religion, Acceptance, Instrumental and Emotional Support.

Calibration for Clinical Measures:

For training and calibration on the clinical measures of attachment levels and pocket depths, an experienced examiner in the University of Michigan served as the "gold standard". The exercise employed one block of measurements on two quadrants of two volunteer subjects. The study examiner then performed the same measurements on both subjects twice with a half-hour break between the first and the second examinations. Inter-examiner agreement (validity) was assessed by comparing the "gold standard" results with the measurements of the study examiner. The weighted Kappa statistics (within ± 1 mm) were 0.83 and 0.91 for attachment level and pocket depth measurements respectively.

The intra-examiner reproducibility was evaluated by correlating the two measurements done by the study examiner on the same subjects with a 30 minutes intermission time between the two examinations. The results showed that $r = 0.88$ ($p < 0.001$) for the reliability of pocket depths and $r = 0.89$ ($p < 0.001$) for AL reliability.

In summary, the results suggest that the translation of PSS and Brief Cope was well suited for use in the Syrian population with good test-retest reliability and concurrent validity. Individual items in the Brief Cope had good Pearson correlation coefficients with lower for Acceptance and Venting ($r = 0.47$) and higher for Substance Use ($r = 0.91$). The coefficient for the total PSS score was good ($r = 0.83$). Cronbach's alpha for the individual factors in Brief Cope (subscales that include the items that load in each one) were satisfactory, with values ranging from 0.46 for Planning to 0.91 for both Religion and Substance Use. Regarding the concurrent validity for PSS and Brief Cope,

the correlation coefficients were satisfactory with r = 0.66 to r = 0.83 for Brief Cope and r = 0.72 for PSS. Calibration for clinical results were excellent according to Fleiss coefficients [119].

Main Study

In addition to the repeat examinations carried out in the pilot study (described above), tests for reliability were carried out in both the Syrian and the American samples concurrently with data collection in the main study.

Reliability for Attachment loss and pocket depths in US:

A sub-sample of 16 participants from the US study participants were chosen randomly to measure the reliability of the attachment levels and pocket depths. The test-retest reliability was determined with a 7 days interval between the two examinations. The reliability coefficients were r = 0.88 (p < 0.001) for pocket depth and r = 0.85 (p < 0.001) for attachment level.

Reliability for Attachment Level and Pocket Depths in Syria

Another reliability test was performed in the University of Damascus, Syria. A sub-sample of 10 participants was randomly chosen from the Syrian sample. As in the US

sample, there was a 7-day interval between the test and retest reliability examinations. The retest reliability coefficient for pocket depths was r= 0.87 (p < 0.001) and for AL r= 0.84 (p < 0.001).

Demographic Characteristics of both Syrian and US Samples

Regarding the disparity between the US and Syrian sample, the clearest differences were in education, number of children, marital status (Table 5), oral hygiene practices including brushing and flossing, and medication daily use (Table 6).

About 68% of the Syrian sample had no high school diploma and 14.5% had a college degree or higher. The US sample had only 6.5% with no high school diploma and 33.5% had a college degree or higher. Most of the Syrian respondents were married (89%) whereas about 48% of the US subjects were married.

In addition, flossing (p-value <0.005) and brushing (p < 0.05) were significantly different. About 89% of the Syrian sample did not floss compared to 20% for the US sample. The US respondents also brushed their teeth (67%) more often than the Syrian respondents (30%). Another significant difference between the two samples was the use of daily medication (p < 0.05). The Syrian respondents used medicine less often (23%) than the US respondents (54%). This difference was mostly apparent in the use of depression medications (17.8% for the US sample and zero for the Syrian sample). Hence, depression was included in the bivariate and logistic analysis for the US sample.

Clinical Results

The results are presented in two main sections: (I) analysis of the associations between periodontitis and perceived stress (PS) in the Syrian sample and (II) analysis of the association between periodontitis and perceived stress in the US sample. Each section has a separate description of the characteristics of the population, a bivariate analysis for the association between the outcome, explanatory variable and covariates and followed by the multivariate analysis for the association of perceived stress and the main outcome.

For both samples, a comparison of the respondents' and the nonrespondents' characteristics could not be performed, because the nonrespondents had not given written consent and information about their demographics.

Syrian Sample

Factor Analysis for the PSS and the Brief Cope Measures:

PSS Factor Analysis

An exploratory factor analysis was deployed to compare the relationships among the PSS items, which is thought to indicate the extent to which this instrument actually reflects the same construct within the sample. The internal consistency for the perceived stress responses was measured and Cronbach's alpha was 0.76. A principal component

analysis was performed in which the factors were extracted and rotated by the Varimax method. This analysis yielded 3 factors which together accounted for 48.3% of the response variance. In terms of the original PSS, the rotated two factors explained 53.2% of the variance. Varimax rotation was used when eigenvalues were greater than 1. The determinant was 0.06, Kaiser-Mayer-Olkin (KMO) was adequate (0.8) and Barlette's test was significant.

Seven items loaded highly on the first factor which explained 25.0% (Items 4, 5, 6, 7, 9, 10 and 13) of the variance. The second factor accounted for 15.9% of the variance and seven items highly loaded on it (Items 1, 2, 3, 8, 11, 12 and 14). Item 8 loaded on both the second ($r = 0.426$) and the third ($r = 0.403$) factor accounting for only 6.4% of the variance (Table 7). This item loaded more heavily on the second factor; hence, it was treated as other items in that factor. Examination of the highest loadings for each item indicated that items that were positively worded loaded on the first factor and negatively phrased statements loaded on the second factor. For purposes of measuring perceived stress, the distinction between the two factors was considered inappropriate. Accordingly, scores for the PSS used in the analysis were obtained by summing responses with the negative items reversed.

Brief Cope Factor Analysis

The principal component method was used in the factor analysis of the Brief Cope for the Syrian population. Varimax rotation with Kaiser normalization yielded 7 factors with eigenvalues greater than 1, which together accounted for 51.4% of the variance. The

determinant was 0.001 which is large enough to deduce that multicollinearity was not a problem for the US sample, and that there was no need to consider eliminating any question at this stage. The Kaiser-Meyer- Olkin (KMO) measure of sampling adequacy was 0.68. Barlette's measure was significant (p-value < 0.005).

Active Coping and Planning items significantly loaded on the first factor that was labeled "Positive Cope" with loadings between 0.45 and 0.66. The second factor labeled "Negative Cope" included Denial and Behavioral Disengagement with significant loadings of r = 0.47-0.74. Seeking Emotional and Instrumental Support formed a single factor named "Support" with significant loadings of r = 0.66-0.75. Self-distraction, Positive Reframing and Acceptance comprised the fourth factor labeled "Cognitive Coping" (r = 0.40-70). Two scales formed distinct factors: Religion and Substance Use. Both items from the Self-blame subscale comprised the seventh factor labeled "Blame". The first item from Acceptance loaded on the "Blame" factor as well. Reliability was highest for the Substance Use (r = 0.96) and lowest for the Positive Reframing (r = 0.57). Table 8 also shows the value of Cronbach's alpha for the items included in each of the seven factors across the whole sample. These values were at least acceptable and generally good, indicating internal consistency in these new scales. The discriminant validity of the measures was primarily supported by the relatively low correlation between the subscales (0.01- 0.39).

Descriptive Statistics and Clinical Results for the Syrian Population:

In this section, the characteristics of the population are described, followed by the statistical analysis of the correlation between (a) PSS and AL, and (b) PSS and extent and severity of periodontitis.

Descriptive Characteristics:

There were 514 subjects approached in the Syrian dental school. Only 453 (88.1%) individuals were eligible to participate in the study. The major reason for ineligibility was because of their young age. Of those who were eligible to be in the study, 68.7% agreed to participate (n=311). Of the 311 participants who completed the demographic, PSS, and Brief Cope questionnaires, 299 completed their clinical examination (96.1%). The 311 Syrian participants ranged in age from 30 to 70 years (41.3 ± 9.0 years; mean ± SD). The majority of the population were female (58.2%) with an average age of 39.8. Males comprised of approximately 42% of the participants with mean age of 43.5.

Only 14.5% of the participants had a college degree or higher, and 67.5% did not make it through the secondary level (10-12 grade). Males were more educated than females; about 45% of females did not complete their education beyond elementary level. On the other hand, 44% of the males had a higher education beyond high school. Regarding the family income, the sample mostly comprised lower income families. Mean income was 10,768 ± 7,594 SL (Syrian Lira) per month and the median was 9,850 SL (1

dollar equals 55 SL). This is the equivalent of $2,349 (median = $2,149) per year.

Some 26.3% of Syrian respondents reported an annual income less than $1,500 a year. Approximately 45.4% reported an annual income between $1,501 and $2,500, about 15.5% reported their annual income between $2,501 and $3,500, and slightly more than 12.8% reported an annual income greater than $3,501. In addition to that, this sample had a poverty rate of 38%. This rate was higher than the national poverty rate of 30% reported by the United Nations Development Program (UNDP) [120] suggesting that this sample is poor compared to the Syrian population. These participants also have low educational attainment, and approximately 75.5% have not completed high school. There were 3.5% of the sample participants who were illiterate and at the other end of the scale 14.5% had a college degree or higher.

In order to compare the Syrian sample with the Syrian population, a demographic comparison between the sample and the Syrian population characteristics was made. Comparison shows some similarities in the characteristics between both the Syrian population and the sample for the study. Table 9 presents the demographic, smoking, and diabetes profiles of the Syrian sample obtained through the demographic questionnaire along with comparable statistics from a United Nations 2000 report, HDR, CIA fact sheet and National Tobacco survey [120-124]. This table includes only those categories for which equivalent data were available from both the Syrian sample and the adult Syrian population.

In terms of the dental health perceptions, 9.6% rated there dental health was not at all healthy. About 47% of the respondents reported that they considered their dental health as somewhat healthy. Dental hygiene was not well practiced in this population

when compared to accepted norms [2]. Only 29.8% of the participants reported that they brush their teeth twice or more a day. Those who ever flossed comprised about 10% of the sample population. About 64% of the participants claimed that they had a dental visit at least once during the last year. Participants mostly visited their dentists for caries related reasons (42.1%). Only 4.8% of the participants reported that they visited the dentist for periodontal treatment and 8.4% for cleaning. Table 9 presents the dental health behavior of the Syrian sample.

Regarding health in general, 4.5% had diabetes, with 69.2% and 46.2% of those who had diabetes reported controlling it by pills and diet respectively. For general medication intake, 23% reported taking medications on a regular daily basis. Hypertension was the most common condition reported for daily medication intake (19.7%) followed by heart conditions (14%) and asthma 12.7%.

Bad health behaviors, notably smoking, were more frequent in male than female participants. About 45.7% of the males were current smokers compared to 12.3% for females. For the whole sample, 26.3% reported that they were current smokers (Table 9). Over one third of the participants claimed that they smoked less than 10 cigarettes a day (41.6%), 29.8% smoked 10 to 20 cigarettes per day, and 28.6% smoked 20 or more cigarettes a day.

Water pipe use was not as common in this sample; about 12.7% used the water pipe on a regular basis. About two thirds of those who used the water pipe, 65.7% reported that they did so once per week or less, 17.1% twice per week, and 17.2% three times or more per week.

The Relation between Perceived Stress and Other Covariates

For the Perceived Stress score, the overall mean was 27.4 ± 8.7. Women had a significantly higher rate than males; 28.6 ± 8.8 and 25.7 ± 8.2 respectively. The overall median for the whole sample was 27. Minimum and maximum scores for PSS were 7 and 50 respectively. This sample had higher perceived stress than the US sample with mean of 23.9 ± 8.6 and the scores reported by Cohen et al. for a US probability sample of 2,389 adult participants. The mean reported by Cohen was 19.6 with standard deviation of 7.5 and the score ranges were 0 to 45.

Association between Attachment Loss, Perceived Stress and other Covariates

The first research question was: "What is the difference in the reported level of perceived psychosocial stress among the 3 groups of respondents with different attachment loss? Specifically for respondents with a) mild periodontitis, b) moderate periodontitis and c) severe periodontitis". Mild and moderate periodontitis groups were combined due to the small number of participants in the mild group. This question was answered with multiple regression analysis.

Pearson's correlation was used to examine the bivariate relationship between the outcome represented by mean AL (continuous variable) and the following interval level contributing factors: age, tooth loss, dental visit times, number of children, total PSS, number of cigarettes consumed per day, and number of alcohol glasses consumed per day. A t-test was used to measure the difference in AL means among the dichotomous

antecedent variables (gender, marriage, education, job, dental and general health behavior variables, and medical history variables). The bivariate analyses show that mean AL was higher among individuals who reported higher levels of stress ($r = 0.14$; $p < 0.05$), older age ($r = 0.31$; $p < 0.001$), higher consumption of cigarettes and higher numbers of missing teeth ($r = 0.49$; $p < 0.001$). Males (mean = 3.68) had significantly greater AL than females (mean = 3.11, $p < 0.001$). In addition to that, AL were higher among those who had more children ($r = 0.15$, $p < 0.05$), and were diabetic (mean = 4.51 and 3.29 for diabetics and nondiabetics respectively, $p < 0.005$) and current smokers (mean = 3.84 and 3.18 for smokers and nonsmokers respectively, $p < 0.005$). Table 10 illustrates the results of this analysis.

Perceived stress scores followed a similar pattern of association with the covariates. The correlation between total PSS and AL, age, income and higher consumption of cigarettes were all significant. Other covariates that were significantly associated with total PSS scores included: gender, education, employment, poverty, perceived oral health, diabetes, and medication consumption.

The analysis of the mean AL as a continuous variable was performed to investigate the correlation between total PSS scores and AL. The scatter plot of total PSS and mean AL suggested a weak relation between the two variables. This relation was absent when analyses were run for females only and was more detectable when analysis was run for males only. Figure 2 presents the scatter plot correlation between perceived stress and mean AL in both males and females.

Attachment Loss Regression Results

Statistical data addressing the first research question will be presented in this section. Linear regression was used to test for possible multicollinearity between the independent variables. Correlations did not demonstrate multicollinearity among the independent variables, and none were found. Also, computer-generated tolerance figures for each variable were performed. Tolerance values for independent variables in the regression equations did not indicate any multicollinearity. A binary logistic regression was performed to examine the effects of all of the model's independent variables on AL. The number of cases in this study (311) was large enough for examination of all of the predictor variables used in the regression model. The dependent variable in the binary logistic regression analyses was used on a binary level scale. The predictor variables were measured on both interval and nominal level scales.

Research Question 1:

There will be a significant relationships found between reported perceived stress and periodontal disease as measured by AL.

The initial step in logistic regression analysis involved forced entry of all model variables into the regression. Variables that were significantly related to AL in the bivariate analysis and the variables that were known to confound the relation between stress and periodontal disease were included in the initial model. Variables were subsequently removed to achieve the most parsimonious model with an optimal goodness of fit as indicated by the pseudo R-square (Nagelkerke) and the Pearson goodness of fit. A

significance level of 0.05 was used as the primary criterion for deleting variables. The model that appears the best included the following variables: age, gender, tooth loss, calculus level and total PSS. The smoking variable was not significant, however, it was kept to control for its confounding effect. When diabetes was added to the model, PSS was only marginally significant related to AL with p = 0.56. Table 11 contains the regression statistics from this model. The pseudo R-square for the model (Nagelkerke R Square) was 0.370, indicating that these variables explained about 37% of the variance in AL severity. This model predicts that the odds ratio (OR) for AL related to PSS was 1.05 (CI = 1.01 to 1.09; P < 0.05). Thus, the model predicted that the OR would change by 1.05 for every unit change in perceived stress when all other variables are held constant. This model also predicts that if the subject is a man (gender=1), then the OR= 2.24 (P <0.05). That is, men are 2.24 times more likely to have a greater AL than women. In this model, the results also indicate that age is also a significant predictor. Older age predicts larger AL than younger participants (OR=1.07; 95% CI=1.0, 1.1; P < 0.005). The data also indicated that with a unit change in tooth loss, the OR of having a greater AL is 1.15 (P < 0.005). Results of the binary logistic regression analysis considering perceived stress variable and possible confounding or co-risk factors are shown in Table 11.

Alternative analyses were carried out to find out if the relation between stress and periodontal AL holds using different case definitions of periodontal disease. The association of stress with AL was significant regardless of periodontal case definition used (Table 12). Multiple linear regression analysis was used to assess the relation of stress with the mean AL per person (average across all sites). Results showed that ß=0.018 (p < 0.05) adjusting for age, gender, smoking and diabetes. With mean AL

categorized into five ordered categories: healthy (0 to 1 mm AL), low (1.1 to 2.0 mm), moderate (2.1 to 3.0 mm), high (3.1 to 4.0) and severe (> 4.0 mm), OR was 1.04 (95% CI = 1.02, 1.07; P <0.005).

For established periodontitis (having 2 or more sites with AL $\geq$ 6mm and one site or more with PD $\geq$ 5 mm.) , the OR of the association with stress was 1.06 (95% CI =1.03, 1.10, P <0.005)

Research Question 2:

The second research question: "Do different strategies of coping for stress moderate the relation between stress and AL?" To answer this question, interaction terms for stress and each of the coping styles were entered into the regression analysis simultaneously. Interaction with the highest p-values were removed one at a time from the analysis. None of the stress-coping styles interaction were found to be significant in the regression analysis. Table 13 presents ORs of the interaction terms between stress and periodontitis.

To further evaluate the role of coping strategies, the subjects were stratified according to their coping behavior to assess the risk differential of different disease levels between individuals with "high" and "low" coping behaviors while controlling for age, gender, diabetes and smoking. Table 14 shows that individuals with low Positive Cope and more perceived stress had a higher risk of having more severe AL (OR=1.10, 95% CI = 1.02 - 1.18, p < 0.05). Also those individuals with high Negative and Blame Coping styles and more perceived stress had a higher risk of having more severe AL (OR = 1.07;

95% CI = 1.00 - 1.10) for Negative Cope style and (OR = 1.05; 95% CI = 1.0, 1.1) for

Blame Coping style (Table 14). Scoring high on Substance Use, Religion and Support

had significant results for the relation between stress and AL, though the odds ratios did

not have a significant change.

To further investigate the role of coping behavior as a moderator, total perceived

stress was stratified into two levels according to the median and the binary regression was

run for a categorical variable. Results showed that the odds of having periodontal disease

is 2.7 times greater in participants who perceived high stress than those who reported low

stress. Participants were divided according to their coping strategies. Stress was related to

periodontitis only in those who reported low on the Positive Cope and high on the

Negative Cope. Results are presented in Table 15.

In summary, the results from the Syrian sample showed that the factor analysis

for both PSS and Brief Cope were satisfactory. The participants had a higher education

level and a higher poverty level compared to the national data for Syria population. As

expected, participants with higher perceived stress had greater AL than those with lower

perceived stress. Furthermore, individuals with low positive and high Negative-coping

and more perceived stress had a higher risk of having more severe AL.

US Sample

Factor Analysis for the PSS and the Brief Cope Measures

PSS Measure

The internal consistency for the PSS measure yielded a Cronbach's alpha = 0.86. A principal component analysis with varimax rotation was used in the factor analysis of the PSS scale. The analysis yielded two factors with eigenvalues >1 which together accounted for 49.6% of the variance. The analysis yielded a first factor with an eigenvalue of 5.3 with a sharp drop-off the next factor at 1.7. Positive statements loaded heavily on the first factor named "Positive Perception" and negative items loaded on the second factor named "Negative Perception" (Table 16). As for the Syrian sample, scores for the PSS used in the analysis were obtained by summing responses with the negative items reversed. The determinant was 0.007 which is greater than the necessary value of 0.00001. This means that multicollinearity was not a problem for the US sample and there was no need to consider eliminating any question at this stage.

The Kaiser-Meyer- Olkin (KMO) measure of sampling adequacy was 0.89 (Table 16) which falls in the range of being "almost superb" according to Kaiser Recommendations [125]. So, this finding adds to our confidence that factor analysis is appropriate for these data.

Brief Cope:

A factor analysis with Varimax rotation and Kaiser Normalization of the 28 items of the Brief Cope yielded 7 factors with eigenvalues greater than 1, which together accounted for 61.3% of the response variance. The level of significance for item/factor correlations of $r = 0.40$ was established.

Table 17 presents the items' loadings on each of the seven factors. Planning, Active Coping, Positive Reframing and the first item of Acceptance all had significant loadings ($r = 0.39$-0.76) on the first factor which was labeled "Positive Cope". The second item of Acceptance and the second item of Positive Reframing also loaded on the sixth factor labeled "Humor" ($r = .46$ and $.48$ respectively). Both the Emotional and the Instrumental Support items loaded significantly on the second factor labeled "Support" ($r = .65$-$.81$). The third factor was labeled "Negative Cope" and included Denial, Behavioral Disengagement and Self-distraction. The fourth factor comprised both Humor items. The fifth factor comprised the two items of both Venting and Self-blame ($r = .40$-$.52$). The sixth factor included the Religion items and was named "Religion". The seventh factor included both items from the Substance Use and was named "Substance Use".

Reliability was highest for Religion, Substance Use, Humor and the first items of each of the Emotional and Instrumental Support subscales ($r = 0.80$), and lowest for the Acceptance, Positive Reframing, Self-distraction, and Venting subscales ($r = 0.52$).

Table 17 also presents the value of Cronbach's alpha for the items included in each of the seven factors across the whole sample. These values were at least acceptable and generally good, indicating internal consistency in these new scales. The discriminant validity of the measures was primarily supported by the relatively low correlation

between the subscales (0.01-0.48).

Descriptive Statistics and Clinical Results for the US Population

In this section, the sample characteristics are presented, followed by the statistical analysis of the correlation of perceived stress (PSS) and average of AL and the association between PSS and extent and severity of periodontitis.

Descriptive statistics

Out of the 579 patients approached at the University of Michigan School of Dentistry, 513 (88%) individuals were eligible to participate in the study. The major reason for ineligibility was because of their young age. 321 (62.6%) of these eligible persons agreed to participate in the survey. Reasons given for not participating were mainly lack of time or lack of interest in the study. 278 of these participants (86.6%) completed both the questionnaires and received the periodontal examination.

The 321 participants ranged in age from 35 to 75 years with a mean of 49.7 years. The participants were predominantly white (74.3%) and the majority were female (n = 195; 60.9%). Approximately 48% of the study population was married. Most of the participants (59.2%) had a job and 14.3% were retired. The majority of the sample subjects (93.4%) had a high school degree or more, 36.3% had some college but no degree, and 33.4% had a college or professional degree. Regarding the household income, 42.3% of the participants reported an annual income less than $20,000.

Approximately 27.1% reported an income between $20,000 and $35,000 and about

30.7% reported an annual income greater than $35,000. Results are shown in Table 18.

Only 12.2% of the subjects perceived their oral health as "not at all healthy" and

the majority (about 94%) of them brushed their teeth at least one time a day.

Regarding oral health behavior, 58.4% of the participants reported visiting the

dentist within the last year. The majority reported that they brushed their teeth twice or

more a day (67.3%). In terms of using dental floss, only about 20% reported that they

never floss and about 37% reported that they floss at least once a day. Only 9.5% flossed

their teeth twice or more a day.

Use of tooth picks was less practiced in this sample with 41% of the participants

never using toothpicks and only 23.5% used toothpicks at least once a day.

In terms of general health, only 11.4% had diabetes (74.3% used pills and (57.1%

used diet to control it). About 54% reported that they take some medication regularly

(35% for high blood pressure, 17.8% for depression and 14.3% for cholesterol). About

one third of the population reported that they were current smokers (31.9%) and slightly

more than 38% stated that they consumed alcohol (84.5% consumed one or fewer glasses

per day). Of those who smoked, 40.4% reported that they smoked 10 cigarettes or less a

day, while 48.5% reported a consumption of 11-20 cigarettes per day, and 11.1% smoked

more than 20 cigarettes a day (Table 19).

To compare the US sample to the US and Michigan population, a demographic

(Table 18), dental visits [126], smoking, and diabetes comparison (Table 19) between the

sample, the US and the Michigan population characteristics was made. Some similarities

between the population were evident, as shown in Table 18 and 19, in which the data for

the US and Michigan populations were taken from 2004 Census data [127,128]. These tables include only those categories for which equivalent data were available from both the Syrian sample and the adult Syrian population.

Analysis of the Relation between Perceived Stress and other Covariates

Total perceived stress was significantly correlated with gender, age, marriage, income, medication use, smoking, alcohol consumption, dental visits, oral health perceived, brushing, and flossing. Also, stress was related to the number of cigarettes smoked ($p < 0.001$) and alcohol consumed per day ($p < 0.05$) and the number of visits to the dentist made during the past year ($p < 0.001$). Results are presented in Table 20.

Analysis of Association between Attachment Loss, Perceived Stress and other Covariates:

In assessing the clinical periodontal data, the 278 participants were examined for the presence of plaque, bleeding on probing, calculus, periodontal pocket depth, and clinical AL. Mean AL was significantly more severe among older individuals ($r = 0.15$; $p < 0.05$), males ($p < 0.01$), individuals who are currently smokers ($p < 0.01$) and those who brush more often ($p < 0.05$). In addition to that, subjects who smoked more cigarettes had significantly greater AL than those who consumed less cigarettes per day ($r = 0.170$; $p < 0.05$). Results are shown in Table 20.

Individuals who had fewer teeth in their mouth had significantly higher AL than those who had more teeth in their mouth ($r = 0.33$; $p < 0.001$). AL was also

significantly related to the total perceived stress. Those who perceived themselves to have higher stress had significantly more severe AL than those who perceived themselves to have less stress ($r = .16$; $p < 0.05$). The relationship between AL and total stress remained significant after adjusting for age, gender, medication daily intake and marriage status (Table 20).

The scatter plot of total PSS and mean AL suggested a weak relation between the two variables. This relation was not present when analyses were run for males only and was more evident when analysis was run for females only. The results are shown in Figure 3.

With respect to pocket depths, individuals who reported higher levels of stress had significantly higher mean pocket depths ($r = 0.22$; $p < 0.01$). Variables that were significantly related to periodontitis in the bivariate analysis were included in the regression analysis. In addition to that, factors that have been shown in the literature to confound the relation between stress and periodontitis were also added into the regression analysis.

Attachment Loss Regression Results

Relationships between the independent variables and perceived stress and coping will be represented in this section on the research question analysis. In order to assess the association between perceived stress, coping styles and AL, ordinal logistic model using SPSS procedure LOGISTIC was utilized in the analysis.

According to Armitage's classification of periodontal disease [115], periodontitis was categorized into three levels and analyzed as an ordinal categorical

variable. As mentioned previously in the methods chapter, periodontitis was defined as based on percentage of sites affected by disease. Periodontitis was defined as severe when 30% or more of the sites examined had at least 5 mm of AL. AL of 3-4 mm constituted moderate and 1-2 mm mild level categories.

The mean scores of the total PSS measurements after adjusting for age, gender and smoking for different severities of clinical AL were 22.6, 23.5 and 24.5. A simultaneous regression analysis was calculated to determine the association between total perceived stress and AL. The results of the ordinal logistic regression analysis considering perceived stress and possible confounding or co-risk factors are shown in Table 21. From this analysis it can be seen that an increase in clinical AL was significantly associated with perceived stress (OR = 1.05; CI =1.0, 1.1). All the variables that were significant in the bivariate analysis and the variables that were known to confound the relation between stress and periodontitis were included in the initial model. The least significant factors were consecutively dropped from the analysis. The final model included age, gender, smoking, diabetes, and depression in addition to total perceived stress.

As with the Syrian sample, the US sample was also categorized into two levels of periodontitis and analyzed with a binary logistic regression. Those with AL ≥ 5mm in 30% or more of their teeth sites affected were categorized as the group with severe periodontitis. Those who had ≤ 5mm of AL in 70% or more of their examined sites affected were categorized as the mild/moderate constituted the disease group. The binary logistic results are displayed in Table 22. There was a significant difference in PSS scores among the two groups. The relation was still significant after controlling for age, gender,

smoking, diabetes, and depression (OR = 1.07; p < 0.05). The odds for severe AL in smokers increased with increasing amounts of smoking. This relation was not significant after adjusting for plaque levels, however. Coping styles were added to the regression model simultaneously. The most insignificant coping styles were removed from the regression one at a time (p > 0.05). Similar to the Syrian sample, only Negative Cope style was significantly related to periodontal AL (p < 0.05).

Alternative analyses were carried out to find out if the relation between stress and periodontal AL holds up when using different case definitions of periodontitis are used. The association turned out to be regardless of periodontal case definition used (Table 23). Multiple linear regression analysis was used to assess the relation between stress and the mean AL per person (average across all sites). Results showed that ß=0.04 (p < 0.001) adjusting for age, gender, smoking and diabetes. With mean AL categorized into five ordered categories: healthy (0 to 1 mm AL), low (1.1 to 2.0 mm), moderate (2.1 to 3.0 mm), high (3.1 to 4.0) and severe (> 4.0 mm), OR was 1.06 (p < 0.01). For established periodontitis, the association with stress was not significant with OR = 1.01 (p = 0.46), adjusting for age and gender.

In addition, interaction terms were added to the regression model. As was found in Syria, the interaction between stress and Positive Cope was not significant. Table 24 presents ORs of the interaction terms between stress and periodontitis.

In the same way as for the Syrian sample, the subjects were stratified according to their coping behavior to assess the risk differential of different disease loss between individuals with "High" and "Low" different coping behaviors while controlling for age, gender, diabetes and smoking. Table 25 shows that individuals with low positive-coping

and more perceived stress had a higher risk of having more severe AL (OR=1.17, CI=1.058- 1.29). This relationship remained significant even after adjustments were made for varying levels of previous dental visits and brushing times. Similar results were found among those with low Negative Cope for AL severity (OR=1.12, CI = 1.02, 1.24).

To further investigate the role of coping behavior as a moderator, total perceived stress was stratified into two levels (divided according to the median) and the binary regression was run for a categorical variable. Results (Table 26) shows that the odds of having periodontitis in the participants who reported high scores of perceived stress are 3 times greater than participants who reported a low score on perceived stress (OR = 2.96, p < 0.05). Moreover, the relationship between stress and periodontitis appears to be more evident in those who scored low on Positive Cope style and high on Negative Cope (OR = 9.25; p < 0.005 for the low positive copers, and OR = 10.84; p = 0.005 for the high negative copers). Results are shown in Table 26.

Summing up, US sample findings were in line with the Syrian sample results. Factor analysis for both PSS and Brief Cope was satisfactory. The participants had a higher education level, lower income rate than the US population. Smoking rates were high compared to the rates of smoking in the whole population. As in the Syrian sample, participants with higher perceived stress had greater AL than those with lower perceived stress even with different definitions were applied in the analysis. Further findings suggested that individuals with low positive-coping and individuals with high Negative Cope and more perceived stress had a higher risk of having more severe AL.

CHAPTER V

DISCUSSION

The main purpose of this study was to explore the relation between perceived stress and the severity of periodontitis as measured by AL. A secondary purpose was to investigate the role of coping strategies in moderating this relationship. Two research questions were developed and served as a guide for data analysis. The findings from this study indicated that perceived stress influences the risk of having periodontitis. Results also demonstrated that certain coping behavior styles may moderate this relationship.

Discussion of the results is organized into three main areas: 1) selection of both the Syrian and US samples and their representativeness, 2) selection of stress scales, dental outcome and the use of categorical data, and 3) analysis of results from multilevel models according to the research questions. Finally, strengths and limitations of the investigation are examined

Discussion of Samples

The Syrian and US populations were convenience samples based on availability and accessibility of the subjects. Both samples were by no means representative of the whole population. Looking first at the Syrian sample in this study, it seemed reasonably representative when compared with the demographic characteristics profile of the larger Syrian population. Respondents' characteristics including employment rates, smoking and diabetes were in line with values from the larger population. On the other hand, the individuals in the Syrian sample were more highly educated than the general Syrian adult population. This discrepancy was most likely because individuals who attend the University of Damascus are from the city of Damascus, the capital of Syria, while the census counts people from different cities including smaller urban and rural places. Another reason was possibly because the census data were collected before year 2001, a difference of 5 years results in an increase of 5% in the literacy rates for the year 2006.

A further difference that should be considered when judging the Syrian sample was the income and the poverty levels, i.e., its socioeconomic status. The mean income for the sample was comparable to that of the larger population, though a difference in poverty level was evident. This difference in poverty levels could probably be because the definition of poverty and the threshold at which the people were considered poor in the study sample was not the same as that used for the national population. This latter measure of poverty rate was calculated according to the poverty construct developed by the UNDP [120]. This construct takes into consideration the location and household composition in addition to monthly income. When the UNDP used the higher expenditure

poverty lines, overall poverty in Syria rose from 11.4% to 30.1% of the Syrian population. Using the UNDP construct, though considering only household composition, the poverty rate in the study sample was 37.8% suggesting that this sample is poorer than the rest of the whole population. Taking into consideration the similar rates for mean income, the discrepancy (7.8%) then lies in the values for "number of children" or the "household location" (not measured).

Regarding the participants in the US sample, a considerable disparity in the income rates was noted between the sample and the total US population. The respondents had lower incomes than the larger population. This may be due to the large proportion of respondents aged 65 and older (23%). Also individuals who attend the U-M School of Dentistry clinics for treatment usually do so because they have no dental insurance and the cost for treatment is less than in private clinics.

Another clear difference was seen in the proportion of smokers in the study sample compared to the US whole population. The percentage of subjects who reported that they were current smokers was greater than that reported by the entire US population and the Michigan population. As just discussed, a likely reason could be the generally lower socioeconomic status of the study sample. Several studies have demonstrated that smoking prevalence levels have remained high in low-income, less educated individuals [128] while overall levels have dropped. According to findings from the Behavioral Risk Factor Surveillance System, smoking prevalence among individuals with annual incomes less than $15,000 was 29.4%, compared with 16.9% among individuals with incomes of $50,000 or greater [129]. In addition, an inverse relationship has been shown to exist between income and smoking after adjusting for ethnicity and gender [130].

In light of these major discrepancies in both samples relative to the whole population, particularly for the US sample, the likelihood of the study samples being representative of the whole Syrian and US population is probably quite low.

A significant issue to consider at this point is whether the findings of this study are generalizable, that is whether the results are applicable to other populations. To discuss external validity (generalizability), we have to base our rating on the representativeness of the accessible population with the target population, adequacy of the sampling method, and adequacy of the response rate. As being discussed earlier, these data are not representative of the larger population. Furthermore, subjects were randomly selected from all the individuals attending the dental clinics whenever possible. Nevertheless, sampling of the accessible population was not accomplished as originally planned. Lack of time and funding were the two main reasons for this limitation. On the other hand, response rates were 68% and 62% for both the Syrian and US samples respectively. In general, the percentage of responses necessary would probably differ according to the type of study conducted. According to Babbie et al. 1990 [131] for mail surveys, 60% is usually considered a good response rate, while 70% is considered very good. In addition, desired response rates are thought to be less in studies including clinical exams such as this study. In fact, more people will answer a questionnaire than submit to periodontal exam. The reason that lower response rates are problematic is that people who do not respond may well be different from those who do. If that was the case in this study, a low response can then create sampling bias; the lower the response, the greater the risk of such bias. If the nonresponse is neither due to questionnaire design nor to any particular variable measured within the sample (e.g. gender, age, income), then the

nonrespondents are said to be "missing at random". Major reasons for choosing not to participate, in both samples, were lack of time, pain or inability to be involved in more dental activities. No interest in research was also a primary reason for nonresponse in the Syrian sample. It is also important to mention that stress-perio studies on truly representative populations are extremely unlikely to be conducted. Hence, conclusions in this kind of studies have to be based on less-than-perfect samples as the case in this study.

It was not possible in this study to assess if the nonresponse was non differential. This was because we could not have any data (did not sign the consent form) on those who were eligible for the study but did not want to participate. If participants and eligible individuals who did not participate are very different, then the validity of the study would be compromised. On the other hand, there is no reason to believe that nonparticipation is related in any way to the exposure or to the outcome used in this study.

Consequently, the findings in this study cannot be generalized to the larger populations from which the samples were drawn. However, internal validity is not directly affected by the type of sampling. This research could still provide valuable insights about the relation between stress, coping and periodontitis. The issue here is not whether the study participants are representative but whether the association between stress and periodontitis given by the study participants is likely to apply to other groups. This association could be applied to other individuals, even though its strength might be modified by the relative importance of other factors.

Outcome Measurement

Periodontal index (PI) was the widely used index in early epidemiology studies of periodontal diseases. PI was a composite index that scored periodontitis and gingivitis on the same scale. In light of modern concepts of periodontitis, PI is invalid because it did not measure AL and graded all PD of 3mm or more equally. The Community Periodontal Index of Treatment Needs (CPITN) is another index that has received worldwide use with some promotion from World Health Organization (WHO). Widespread use of CPITN has produced considerable contributions to WHO's Global Oral Data Bank, however, it must be remembered that CPITN is a measure of treatment need rather than a research tool. Currently, researchers and clinicians use a number of measures to assess periodontitis levels [5-8]. These measures include radiographs of bone loss [5], along with clinical measures of AL [5], pocket depth [13], and presence of plaque and calculus [10]. According to Goodson, AL continues to be accepted as the diagnostic -"gold standard"-for periodontitis although it measures scars of past disease rather than current activity [44]. Furthermore, Nunn et al. indicated that alveolar bone loss and clinical AL are the best and most pragmatic measures of periodontal destruction [132].

A more ideal measure could be combining clinical measures of past disease with some measure of current disease. The detection of inflammatory mediators such as cytokines at suspected active disease sites looks promising, but such measures still await further development.

In summary, measuring periodontitis is very hard for the examiner to complete and very uncomfortable for the individuals to tolerate. Thus, it looks like we are at the

end point of clinical research of periodontal disease at least for the next few years. For these reasons, AL remains the standard measure for now, thus for this study, AL was chosen to record the periodontitis outcome.

According to our current knowledge, periodontitis is a site-specific rather than a generalized disease. It is suggested now that chronic periodontitis proceeds through a series of episodic attacks [2], though some loss may be a result of continuous linear loss. Hence, handling the periodontitis measure as a continuous linear process seems inappropriate.

Furthermore, substantial divergence characterizes the threshold values employed to define the periodontal pockets and AL which can be accepted as periodontitis [5,8]. At this time, there is no universally-accepted index for periodontitis. According to Armitage [115], it is recommended that periodontitis severity be categorized on the basis of AL into: Slight = 1-2 mm, Moderate = 3-4 mm, and Severe $\geq$ 5 mm. It has also been recommended that periodontitis is said to be generalized if > 30% of the teeth are affected. Based on these recommendations, the severity of periodontitis (slight, moderate and severe) and the extent of the disease ($\geq$ 30%) were applied in this study. Also, taking into consideration that different subjects had a variable number of remaining teeth, using the percentage of sites affected seemed a practical measure.

Full-mouth examinations for AL, pocket depths, gingival bleeding, plaque, and calculus can take 30-45 minutes per examination. This has urged investigators to try various indexes on a subset of teeth to save time and burden on study participants. As an example, two randomly selected quadrants, one maxillary and one mandibular, were examined in the National Survey of Employed Adults and Seniors in 1985-1986 [19].

Investigators collectively agreed on the reliability and validity of partial-mouth recording to assess plaque and gingivitis, both of which are generalized conditions [119,133]. However, the two-quadrant approach was less satisfactory for assessing site-specific conditions such as periodontitis. It has been shown that the use of this method does underestimate the prevalence of periodontal disease [2]. However, it appears to yield unbiased estimates of full mouth measure when summary measures such as averages and "extent and severity" scores are used. For this study, this method was used as a trade-off between some measurement bias and time and cost limits.

In the absence of a universally-accepted index for periodontitis, three other definitions for periodontitis were applied to examine the association between stress and periodontitis. This application was performed to make certain that the association between stress and periodontitis is not an artifact. The odds of having a greater AL with higher stress were still significant when we used the continuous and the categorized forms of AL analysis. When the definition of "established periodontitis" was used, the association between stress and periodontal AL was insignificant ($p = 0.40$) in the US sample. As stated earlier, this discrepancy could be due to the difference in defining the cutoff points to distinguish disease.

Stress Scales Selection

Stress Selection

PSS is a global appraisal scale designed to measure the degree to which individuals found their lives to be unpredictable, uncontrollable, and overloading. Early studies using the 14-items PSS measure found that it possesses good psychometric qualities such as adequate reliability and predicted associations with other indices of stress [102,103]. In a study by Cohen et al., the authors reported that PSS had adequate internal and test retest reliability and was correlated as expected with life-event impact score than to the number of events occurring within a particular time span [102]. The relations between the PSS and other stress measures, health, health service utilization, health behaviors, life satisfaction, and help seeking were also assessed to provide evidence for construct validity [103]. The authors reported that the study analysis provided evidence that PSS is an adequate scale of measuring appraised stress. Moreover, PSS scale was reported to have acceptable internal consistency in several other studies [104-109] (Table 1).

Moreover, Cohen et al. have addressed the problem of confounding appraisals as measured by the PSS with antecedents and outcomes, by using prospective designs and controlling for other possible predictors of psychological distress. They indicated that scores on the PSS predict different outcomes independent of measures of psychological and physical symptoms evaluated at baseline[134].

An alternative scale to measure stress was the hassles and uplift scale. This

scale included both the occurrence of the even and the individual's response of the event [135]. It was originally designed to be used retrospectively, with subjects rating hassles that occurred over the previous month. Limitations to this scale, however, included the sociological versus psychological content of the scale and the issue of realizing the psychodynamics of the stress process [135]. Lazarus stated, for example, that a more psychological approach to stress content is needed because knowing that work stress is high in some persons compared to others will not inform us about the psychological processes that are involved [135].

In sum, it was good to use multiple scales for measuring stress in order to integrate the most possible features of stress process in each individual [134]. One should bear in mind, though, that using two or more stress scales increase the time needed to complete the questionnaires and the burden laid on the subject.

Brief Cope selection

Where there is stress, there is also coping as a fundamental feature of the adaptational encounter, whether the coping process is effective or ineffective, problem focused, or emotion focused. In brief, it is imperfect to measure stress independent of coping [135]. Lazarus, however, suggested that coping does not operate directly by affecting disease status but by moderating the impact of the stress. It seems reasonable for example that routine coping mechanisms in individuals who have little stress in their life will have little bearing on their disease state as they will not be using it. Coping mechanisms will be important for those individuals dealing with stress as it may relieve

the effect of the stress. This required careful consideration of the statistical analysis of data involving perceived stress and coping mechanisms. In order to detect the moderating effect of a variable, Holmbeck [136] suggested including interaction terms in regression models, or alternatively using Structural Equation Modelling.

Psychometric properties of the Brief COPE in earlier were also acceptable. Reliability records were reported from a non-psychiatric sample of 168 adults in Florida participating in a study of the process of recovery after Hurricane Andrew [102]. The factor structure of this scale was remarkably similar to that reported by the full COPE version. According to Nunnely [118], The internal consistency coefficients of all scales, were acceptable and exceeded the value of 0.50 which is regarded as minimally acceptable. Other studies also reported considerably adequate reliability and validity for the Brief Cope measure [110-114]. Table 2 includes alpha coefficients and factor analysis of the Brief Cope in different study samples.

Reliability and Validity of the Arabic Version of the Stress and the Coping Scales

Reliability tests for the Arabic-translated version for perceived stress were acceptable. These findings were in-line with other translated versions such as the Mexican and Sweden versions [108,117]. The validity test was also satisfactory and similar to the results reported by Remor et al. for concurrent validity with distress and anxiety tests [117].

Considering the reliability tests for the translated version of the Brief Cope, the internal consistencies of the different items were satisfactory except for Acceptance,

Planning and Venting. For these variables, alpha coefficients were 0.47, 0.47 and 0.49 respectively. The internal consistencies for other Brief Cope items ranged from 0.51 to 0.91. These findings were lower than the results found by Perczek et al. [114] in a sample of 148 undergraduates (r = 0.57- 0.94). The alpha coefficient for Venting was in line with the findings of Carver [110] in a convenience sample of 168 participants (r = 0.50). The low internal consistency of these items could be due to several reasons. Perhaps the concepts contained in these items are not as simply expressed in Arabic as in English, causing the translation to be conceptually inaccurate. An alternative possibility is that this concept has different emotional implications in the person's native language versus more recent acquired language. Yet another possibility is that our translation of those items into Arabic was not as accurate as it was intended. However, the only case in which the correlation between the English and Arabic versions of a scale was unacceptably weak was for the Behavioral Disengagement factor. Furthermore, the internal consistencies for Venting and Acceptance in the English version were 0.42 and 0.45 respectively. This may indicate the possibility that the problem was not with the Arabic version of the items but with the English items used in the original development of the instrument. That is, in the factor analysis of the main study, responses to both Acceptance items in the Syrian sample loaded on one factor whereas responses to the items in the US sample loaded on two other factors. Venting items on the other hand loaded on different factors in the Syrian sample on one factor in the US sample. In the main study, a few wording adjustments were made to improve the internal consistency and clarity of these items.

Multivariate Analysis of Results

Psychosocial factors have been suggested by several studies to play a possible role in periodontal disease [6,8,48,49] though the data to support these contentions are sparse. In this study, we investigated the relation between stress and periodontitis in a two-population study design. Furthermore, we examined the moderating effects of coping styles on this relation. A logistic regression was performed in which potential confounders such as age, gender, smoking, general health, dental and general health behaviors were controlled for. As shown in the Results section, findings from the multivariate analysis demonstrated that perceived stress was moderately associated with greater levels of periodontitis assessed as higher levels of clinical AL. This relation was still significant even after adjusting for age, gender, diabetes and smoking. In general, the findings were consistent with reported results in the majority of previous studies. Genco and colleagues [5] in a cross-sectional study (Erie County Risk Factor Study) of 1,426 participants aged 24 to 74, found that psychosocial measures of stress associated with financial strain are significant risk indicators for chronic periodontitis in adults (OR = 1.70). This study controlled for age, gender and smoking variables.

In an exploratory case-control study, Moss et al. selected subjects (71 cases and 77 controls) from the Erie County Risk Factor Study. After adjusting for age, sex and smoking status, they found that role strain was significantly related to more severe periodontitis (OR = 2.84) [8]. Machtei's approach for establishing threshold levels for periodontal AL at a given site was used in this study [17]. The findings were assessed prospectively by examining factors associated with more extensive disease among 71

patients. These researchers reported that there was a significant relation between elevated depression at baseline and more extensive disease.

The associations reported by Genco and Moss were stronger than those found in this study, even when the same periodontal definition was used in the analysis [5,8]. This could be mainly explained by the higher number of subjects that participated in their studies. Another possible reason may well be the large comprehensive set of stress scales used in their study. Also, the kind of criteria used to establish periodontal health status in investigations involving risk indicators may have influenced the results, promoting overestimated or underestimated associations.

In a previous correlational study, Marcenes and Sheiham [48] demonstrated significantly poorer oral health in participants who reported increased work stress and low marital quality. Stress however remained significantly correlated with periodontal disease after adjustment for plaque scores. Marcenes et al. [48] also investigated possible associations between negative life events and self-reported oral symptoms. These authors reported a significant association between marital and family problems and self-reported oral symptoms.

Further studies also investigated the association of stress measured by life events and periodontal disease. Croucher and colleagues [14] reported that periodontitis was associated with the negative impact of life-events after adjusting for oral health behavior and socio-demographic variables. Linden et al. [137] in a retrospective longitudinal study over 6 years, suggested that an increase in loss of periodontal attachment was significantly predicted by increasing age, lower socio-economic status, lower job satisfaction and type "A" personality. In addition to those findings, Green et al. [6]

suggested a relationship between life events stressors and periodontal disease severity.

In a case control study, Pistorius et al. [138] compared 120 patients with chronic periodontitis with a control group, matched for age and gender, with respect to their perceived stressful life events. The authors concluded that life event stress may have an effect on the course of chronic peridontitis. In addition to those findings, Green et al. [6] suggested a relationship between life events stressors and periodontal disease severity.

Vettore and colleagues studied the relation between stress and anxiety with chronic periodontitis in a case control study. In contrast to the findings just described, this group found that cases and controls did not differ with respect to percentage of stress and anxiety [13]. They used pocket depths as a measure of chronic periodontitis. Similarly, Monteiro Da Silva did not find a significant relation between the average of plaque index scores and total perceived stress in a case control study [11].

Discrepancies in results may be due to several factors such as the differences in the variables controlled for, the kinds of stress dimensions investigated, stress level, and the sensitivity of psychometric instruments employed. Other factors are likely to include differences in sampling strategies, study design, age range, criteria for study eligibility and varying case-definitions for periodontitis.

In addition to those issues just described, self reported, personal information is hard to collect. Participants may under-report or over-report their perceived stress for a number of reasons. It is important to keep in mind the limits of the instrumental data used to measure psychosocial stress as well as their accuracy in measuring subjective data. Several factors affect this accuracy such as the precision of measuring subjective data and the respondents' level of education.

Only 37% and 23% of the variance in periodontal disease in the Syrian and US samples, respectively, was explained by psychosocial factors together with other risk factors accounted for in the study. This clearly suggests that there are important factors other than those examined in this study that may account for the remaining variance. For example, there was no information available on bacterial activity, which is a strong determinant of periodontal disease and which may help explain some of the remaining variability.

Depression has been hypothesized to contribute to periodontal progression through an altered immune response [139]. Other postulated causes include neglect of oral hygiene, changes in diet, increase in smoking and other risk behaviors [44], bruxism, alterations in gingival circulation, changes in saliva, or endocrine imbalances [11]. In addition many antidepressant medicines have been shown to cause xerostomia (affecting approximately 18 percent of patients [49]. Because the US sample had a considerable number of participants who used antidepressants regularly, the data were analyzed for those who do not use depression medicine daily (82%). The results revealed that total perceived stress was still a significant risk indicator for periodontal disease after controlling for depression.

Unexpectedly, smoking status was not related to periodontitis in the Syrian sample and in the ordinal regression analysis in the US sample. This was possibly because smoking variable was not collected as pack-year variable. Subjects were not asked how many years they've been smoking; only smoking status and cigarettes per day consumption were collected and analyzed. Another possibility could be that a high proportion of participants were smokers in both samples. It is hard to show relationships

with little variance in smoking factor.

Summing up, the findings in this study were in accord with other studies that reported significant associations between stress and periodontal disease. This is despite the difference in the psychometric instruments used and the diversity of the stress variables examined. Nevertheless, there are a small number of studies that failed to find a significant association between the two variables. This lack of consensus may be due, at least in part, to limitations in periodontal disease classifications. Differences in the results found in this study could be due to several reasons. Several studies that investigated the relationship between psychosocial factors and periodontitis have employed a wide range of methods related to stress and periodontal measures.

Moderating Effect of Coping Strategies

In our study, coping behaviors did not show any direct relation with periodontitis. According to Lazarus, coping does not operate directly by affecting disease status but by moderating the impact of the stress [24]. Thus, it seems reasonable for example that routine coping strategies in individuals who have little or no stress in their life will have little effect on their disease state because they will not be using it. Clearly, coping mechanisms will be important for those individuals facing more stress as it may attenuate its effect.

In order to detect the moderating effect of a variable, it is suggested that including interaction terms in regression models, or alternatively Structural Equation Modeling (SEM) can be used. SEM could not be used in our study as this kind of analysis

needs a substantial sample size. Using the first method, the present study failed to demonstrate an interaction between stress and coping behaviors in participants with periodontitis. Alternatively, the subjects were stratified according to their coping behavior to assess the risk differential of different disease levels between individuals with "high" and "low" different coping behaviors while controlling for age, gender, diabetes and smoking. In the US sample, we found that individuals with low positive-coping and more perceived stress had a higher risk of having more severe AL. We also found that stressed individuals who had a high score on positive/adequate coping behaviors exhibited less periodontitis than those individuals who had a low score. Similar results were found among the low negative-coping individuals for AL severity.

After stratifying total perceived stress into two categories (according to median), the results from the ordinal regression revealed a similar yet stronger association. We found that the relation between stress and periodontitis seems to be more evident in those who scored low on Positive Cope style and high on Negative Cope. These results were consistent for both US and Syrian samples. Only a high score on Blame factor yielded moderating effects between stress and periodontitis in the Syrian sample.

Other coping strategies such as Support, Denial, Humor, Religion or Self-distraction did not have any significance in moderating the relation between stress and periodontitis. Likewise, high positive and low Negative Cope levels did not yield any significance moderating effects.

These findings about Cope strategies were consistent with results reported by other investigators such as Genco, Wimmer, and Hugoson [5,51,65]. Hugoson et al. reported that individuals who had experienced traumatic life events and those who had

poor coping skills had an increased risk for periodontitis [65]. Furthermore, Wimmer et al. in a retrospective case-control study investigated stress-coping modes and found that patients with inadequate stress behavior strategies (defensive coping) were at greater risk for severe periodontitis [51]. Moss and colleagues [8] suggested that the association between social strain and periodontitis was strongest among individuals who were characterized as more frequently using an emotion-focused style of coping.

Study Strengths

This study had various strengths that should be addressed. First, this research took advantage of assessing the relation between stress and periodontitis in two different cultural samples. The relation between risk factors and disease may act differently in diverse societies. Finding significant and consistent results in both samples strengthens the likelihood that the results are valid. Second, there was only one investigator to assess the periodontal outcome in both samples. This removes the problems associated with inter-examiner variation and increases the reliability of the outcome assessment. Third, the analysis for both samples was identical. We adjusted for the same covariates including age, gender, diabetes and smoking.

Our two populations registered two different scores on psychosocial stress. The Syrian sample included individuals with high scores for stress (some subjects at the exhaustion stage of stress) and the US sample showed a lower, more normal score for perceived stress. It is always interesting to investigate relations between disease and risk factors when there are groups of subjects with different levels for both the disease and the

risk factor.

Another issue to mention here is in the difference in coping strategies found in each sample. This discrepancy could be because of the type/nature of stressor (primary) or the stressor appraisal (some people could appraise the same source of stress more seriously than others. The difference also depends on the interests of the individuals (e.g. the elderly care more about health and kids issues and the younger generation care about job related matters).

Study Limitations

As with other studies, there are several limitations that are worthy of discussion. The major weakness of this study is its cross-sectional design, which does not give us information about temporality of stress exposure. The failure to match the temporal courses of the stress measure and the disease is a chronic problem in stress research that can obscure important relationships [9]. Patients' stress responses may reflect recent symptoms, while periodontitis is a chronic illness. Also, taking into consideration that the disease activity was not measured in this study, one cannot be positive about the temporal precedence in the relationship between stress and periodontitis. It is also important to point out that the correlational analyses for this study cannot be used to establish causality. Hence, the results cannot be interpreted to indicate that high perceived stress levels are causally associated with periodontitis.

Another major limitation to consider is the convenience nature of the sample. The most serious impact occurs when the individuals participating vary according to both

exposure and disease. For example, if individuals who both are stressed and have periodontitis are less likely to seek treatment at the university clinics, then selection bias could have been introduced and the value of the odds ratio could be quite different from the population one hopes to estimate. It is also possible that those with higher perceived stress may visit the dentist less frequently, and thus have poorer dental care.

Due to the vulnerability to selection bias, these samples cannot be considered representative of the population from which they were obtained. Studies that are based on nonrandom samples or cross-sectional data collection intensify the gap between the data in a study and the conclusions that their association may seem to suggest. For this reason, the data should be interpreted with caution. Thus, the major disadvantage of this technique is that we have no idea how representative the information collected about the sample is to the population as a whole. However, the information could still provide some fairly significant insights, and be a good source of data in exploratory research.

In addition, the effect of residual confounding due to unmeasured and poorly measured covariates was possibly notable enough to influence the association between stress and periodontitis. This effect would be stronger when the US and the Syrian samples have different residual confounders affecting this relationship. It is important to note however, that there is no known biologic reason to expect that there are confounding factors other than those used would cause a major difference in the relationship between stress and periodontitis.

The complicated nature of stress also makes the interpretation of any association more difficult. Stress and coping scales are self-reported (less accurate) rather than direct observation instruments. Without a biological measure of stress, a limited number of

studies have used proxy measures of stress to study its association with periodontitis.

When this type of instrument is used in research, one should bear in mind that the respondents may supply incorrect information (due to reasons ranging from misunderstanding the question to filling in the answers incorrectly). For example Venting could mean crying (passive) or acting out anger (aggressive). Thus the difference between two individuals could be a misapprehension rather than genuine disparity.

CHAPTER VI

CONCLUSIONS AND RECOMMENDATONS

In conclusion, this study showed a moderate statistically significant association between stress and periodontitis after adjusting for the major risk factors for periodontitis. Furthermore, the relation was consistent using different definitions of periodontitis. We also found that active and Negative Cope strategies play an important role in the relationship between stress and periodontitis.

Causal relation between stress and periodontitis could not be assessed in this cross sectional study. Future studies using biochemistry markers, psychological assessment and multiple measurements of variables should be considered to clarify the role of psychosocial factors and their mechanisms of action in the periodontal tissues. Research might continue to explore this longitudinally with larger sample sizes in order to learn more about how particular thoughts, emotions, and behaviors affect our periodontal health. Treating a group of periodontal patients with a psychological intervention in an experimental study would also provide evidence for potential causal relationships. Ideally, these investigations would include both self-report and relatively more objective measures of stress and more accurate periodontitis assessment.

In addition, this study could not discriminate between the effect of stress on the

initiation of periodontitis and the effect of stress on the progression of periodontitis. Hence, there is a need for studies that specifically address the distinction between factors responsible for the onset of periodontitis *versus* those affecting its progression. It is also important to distinguish between the role that stress plays on host resistance factors and altered behavioral responses that stress may induce.

Finally, it is necessary to establish a standardized case-definition of periodontitis to be used in epidemiologic studies, so that findings from different research studies are readily interpretable.

TABLES

Table 1. Alpha coefficients for PSS

Author	Year	Coefficient alpha
Chang [104]	1998	0.84
Cohen et al. [102]	1983	0.84, 0.85, 0.86*
Cohen et al. [103]	1988	0.75
Culhane et al. [105]	2001	0.77
Dyck et al. [106]	1999	0.99
Ebrecht et al. [107]	2004	0.72, 0.66, 0.49**
Eskin [108]	1996	0.82
Hamarat [109]	2001	0.84-0.86
Remor [117]	2001	0.67

*Three different samples.
**Three different times.

Table 2 . Psychometric properties of the Brief Cope

Author	Year	Factor analysis	Coefficient α
Carver [110]	1997	72.4%	0.50-0.90
Fogel [111]	2004	_	0.42-0.91
Heydecke [112]	2004	69.9%	0.66-0.92
Meyer [113]	2001	_	Adaptive: 0.81
			Maladaptive*: 0.48
			Maladaptive**^{2}: 0.57
Perczek [114]	2003	78%	English: 0.57-0.93
			Spanish: 0.62-0.93

 * All scales included
** 2 scales eliminated (Substance Use & Self-distraction)

Table 3. Demographic characteristics of the respondents in the pilot study

Characteristics	N(%)
Gender	
Male	15 (57.7%)
Female	11 (42.3%)
Education level	
High school	9 (34.6%)
College	11 (42.3%)
Bachelor degree	6 (23.1%)
Marital status	
Single	8 (30.7%)
Married	18 (69%)
	Mean (sd)
Age (years)	33.1 (9.67)

Table 4. Internal consistency and correlation results for the English and Arabic Brief Cope subscales for the pilot study.

Subscales Language	Item no.	Cronbach's α	r_1 (Test-Retest)	r_2 (Arabic-English)
Active coping			0.81	0.73
Arabic	2	0.76		
English	7	0.73		
Planning			0.46	0.59
Arabic	14	0.49		
English	25	0.56		
Positive Reframing			0.56	0.64
Arabic	12	0.70		
English	17	0.67		
Acceptance			0.49	0.64
Arabic	20	0.47		
English	24	0.45		
Humor			0.86	0.87
Arabic	18	0.67		
English	28	0.57		
Religion			0.96	0.90
Arabic	22	0.78		
English	27	0.68		
Emotional Support			0.77	0.76
Arabic	5	0.57		
English	15	0.55		
Instrumental Support			0.76	0.82
Arabic	10	0.62		
English	23	0.74		
Self-distraction			0.87	0.91
Arabic	1	0.79		
English	19	0.65		
Denial			0.83	0.79
Arabic	3	0.51		
English	8	0.50		
Venting			0.75	0.73
Arabic	9	0.47		
English	21	0.42		
Substance Use			0.96	0.96
Arabic	4	0.91		
English	11	0.90		
Behavioral Disengagement			0.60	0.47
Arabic	6	0.63		
English	16	0.57		

r1: Test retest; 10 days interval

r2: Arabic-English versions; 5 days interval

Table 5. Demographic characteristics of the respondents in the Syrian and US samples.

	Syrian sample (%)	US sample (%)	P-value
Age (mean; sd)	41.3 (8.96)	49.7 (12.25)	0.423
Marital Status%			0.029
Single	7.4	27.8	
Married	89.1	47.8	
Widowed	2.9	5.6	
Divorced	0.6	18.8	
Children			0.112
No children	8.4	19.9	
1	3.9	13.7	
2	13.2	23.7	
3	19.0	17.8	
4	19.6	14.3	
5 or more	36.0	10.6	
Gender			
Male	42	39.3	
female	58	60.7	
Education			0.622
No high school	67.5	6.5	
High school degree	18.0	23.7	
Some college		36.1	
College degree	6.8	10.3	
Bachelor degree	7.1	14.0	
Professional degree	0.6	9.3	
Employment			0.178
Yes	46.2	60.9	
No	53.8	39.1	

Table 6. Dental health and health behavior of the respondents in the Syrian and US samples.

	Syrian sample (%)	US sample (%)	P-value
Dental Health%			0.109
"not at all healthy"	9.6	12.3	
"little bit healthy"	20.5	20.4	
"Somehow healthy"	47.1	36.7	
"fairly heathy"	14.4	23.8	
"very healthy"	7.7	6.3	
Brushing%			0.032
Never	11.5	0.6	
<3times a week	17	4.1	
once a day	41.7	28.0	
twice or more a day	29.8	67.3	
Flossing%			0.005
Never	89.1	20.1	
<3times a week	3.2	42.3	
once a day	3.8	27.6	
twice or more a day	3.8	10.0	
Dental visits%			0.237
Yes	64.1	58.5	
No	35.9	41.5	
Diabetes%			0.073
Yes	4.8	11.3	
No	94.6	88.7	
Medication daily use %			0.045
Yes	23.1	54.1	
No	72.8	45.9	
Smoking %			0.126
Yes	26.3	31.8	
No	72.8	68.2	

Table 7. Factor structure matrix of the PSS for the Syrian sample

	Positive perception	Negative perception	Factor 3
PSS 1	.062	**.698**	.090
PSS 2	.152	**.676**	.207
PSS 3	.091	**.706**	.058
PSS 4	**.620**	-.162	.302
PSS 5	**.701**	.014	-.085
PSS 6	**.685**	.108	-.115
PSS 7	**.518**	.331	-.075
PSS 8	-.079	**.426**	**.403**
PSS 9	**.659**	.026	.032
PSS 10	**.623**	.179	.294
PSS 11	.048	**.578**	.306
PSS 12	-.115	**.550**	-.038
PSS 13	**.489**	-.105	.359
PSS 14	.178	**.454**	.389

The highest factor loadings of each item on the scale obtained from the factor analysis given in bold
Extraction method: Principal component analysis
Rotation method: Varimax with Kaiser normalization

Table 8. Factor structure matrix of the Brief Cope for the Syrian sample

Scale	Item no.	Support	Negative Cope	Cognitive Cope	Substance Use	Positive Cope	Blame	Religion
% total variance		**8.50%**	**7.95%**	**7.72%**	**7.31%**	**6.9%**	**6.62%**	**6.38%**
Cronbach's alpha		**0.70**	**0.66**	**0.59**	**0.94**	**0.57**	**0.50**	**0.64**
Emotional	**5**	**.681**	-.025	.177	-.031	.056	.043	.036
Support	**15**	**.701**	.011	.047	.012	.097	.045	.046
Instrumental	**10**	**.750**	.137	.011	-.091	.087	-.032	.042
Support	**23**	**.663**	.042	.056	-.032	.053	.123	.196
Denial	**3**	.057	**.743**	.076	.049	.062	.040	-.040
	8	.021	**.728**	-.002	.025	.126	-.121	-.045
Behavioral	**6**	.112	**.468**	.025	-.059	-.504	.214	.018
Disengagement	**16**	.040	**.595**	.083	.070	-.424	.221	-.001
Positive	**12**	.111	.043	**.565**	.106	.088	.278	.176
Reframing	**17**	.015	-.092	**.396**	-.049	.220	.387	.109
Acceptance	**20**	.092	-.159	**.410**	-.174	-.037	**.472**	.046
	24	.274	-.157	**.435**	-.330	.204	-.019	.053
Self-distraction	**1**	.017	.349	**.573**	-.037	.183	-.184	.071
	19	.077	.129	**.703**	.097	-.074	-.051	-.161
Substance Use	**4**	-.051	.016	.036	**.948**	.056	-.012	-.061
	11	-.021	.044	.009	**.963**	.043	-.021	-.034
Active coping	**2**	.116	.117	.387	-.078	**.469**	.085	.083
	7	.081	.077	.077	.129	**.450**	.124	.232
Planning	**14**	.094	.118	.095	.008	**.605**	.384	.062
	25	.081	-.094	.011	.016	**.655**	.006	-.107
Self-blame	**13**	.023	.096	.098	-.003	.174	**.718**	-.027
	26	.088	.124	-.124	.048	-.037	**.668**	-.052

Continuation Table 8. Factor structure matrix of the Brief Cope for the Syrian sample

Scale	Item no.	Support	Negative Cope	Cognitive Cope	Substance Use	Positive Cope	Blame	Religion
								Component
Religion	**22**	.171	-.009	.230	-.081	-.128	.085	**.689**
	27	.077	.072	-.012	-.024	.125	.005	**.711**
Venting	**9**	.152	**.431**	.174	.001	-.018	.269	.069
	21	**.412**	.130	.111	.057	-.153	.055	.053
Humor	**18**	.163	.078	**.404**	.014	-.024	.129	-.334
	28	-.024	.180	.084	.007	-.008	.052	-.580

Extraction method: Principal component analysis
Rotation method: Varimax with Kaiser normalization
The highest factor loadings of each item on the scale obtained from the factor analysis given in bold

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Table 9. Comparison of demographic characteristics, smoking status, and diabetes for the Syrian sample and the Syrian Population

	% of Syrian study sample	% of Syrian 2001 Adults Syrian Population*
Gender		
Male	41.8	50.3
Female	58.2	49.7 [+]
Education		
Literate	3.5%	3.2%
Primary education (≤6)	29.6%	14%
7-9 grade	34.4%	55.7%
10-12 grade	18%	14.9%
College degree	6.8%	8.7%
University graduates	7.7%	3.5%
Income	2,349	2,449[+]
Poverty	37.8% (below poverty)	20% (below poverty)
Smoking		
Females	12.3%	9.9%**
Males	45.7%	50.6%
Diabetes		
Yes	4.5%	3.9%
No	95.5%	96.1%

*United Nations: World Population Prospects: the 2000 Revision Highlights. February 2001, pp.47-50
[+]UN Statistics Division, Department of Economic and Social Affairs. "World Population Prospects: The 2004 Revision".
[++] HDR 2003 human development report
**Adult and Youth: Smoking determined by the National Tobacco Survey; Reported in Country Profiles on Tobacco Control in the Eastern Mediterranean Region, 1999 [121]

Table 10. Average attachment loss (in MMs) at four sites and PSS scores among individuals 30-70 years old from the Syrian sample.

	Average attachment loss (MM)			Total PSS scores		
	Mean (sd†)	r*	p**	Mean (sd†)	r*	p**
Age (years)		0.314**	<0.001		-0.154	0.009
Children		0.148	0.011		-0.024	0.679
Total PSS		0.141	0.017**			
Tooth loss		0.492	<0.001		0.079	0.184
Income		-0.006	0.920		-0.165	0.005
Dental visit times		-0.094	0.106		0.055	0.350
Cigarettes per day		0.232	0.048		0.266	0.025
Water pipe use per week		-0.52	0.769		0.323	0.062
Gender			<0.001			0.004
Male	3.68 (1.28)			25.65 (8.15)		
Female	3.11 (0.88)			28.58 (8.83)		
Marriage			<0.001			0.099
Married	2.96 (0.37)			30.36 (9.62)		
Not married	3.35 (1.11)			27.19 (8.54)		
Education			0.310			<0.001
Literate	3.86 (1.58)			34.82 (8.99)		
Up to 6th grade	3.47 (1.15)			29.70 (8.84)		
7-9 grade	3.27 (1.05)			27.31 (8.06)		
10-12 grade	3.31 (1.10)			24.31 (8.34)		
College	3.06 (0.90)			23.78 (7.52)		
Bachelor degree & over	3.17 (0.93)			24.41 (7.51)		
Employment			0.559			
Yes	3.51 (1.20)			25.63 (8.14)		0.002
No	3.20 (0.98)			28.78 (8.85)		
Poverty			0.420			0.006
Yes	3.30 (1.10)			26.12 (8.31)		
No	3.41 (1.10)			29.02 (8.91)		
Diabetes			<0.001			0.016
Yes	4.51 (1.58)			32.79 (8.28)		
No	3.29 (1.04)			27.08 (8.61)		
Medication use			0.395			0.009
Yes	3.44 (1.14)			29.75 (8.56)		
No	3.31 (1.08)			26.63 (8.58)		
Smoking			<0.001			0.410
Yes	3.84 (1.49)			28.08 (8.63)		
No	3.18 (0.87)			27.12 (8.68)		

Continuation Table 10. Average attachment loss (in MMs) at four sites and PSS scores among individuals 30-70 years old from the Syrian sample.

	Average attachment loss (MM)			Total PSS scores		
	Mean (sd†)	r*	p**	Mean (sd†)	r*	p**
Water pipe consumption			0.869			0.258
Yes	3.31 (1.33)			28.87 (9.72)		
No	3.35 (1.06)			27.14 (8.50)		
Oral health perceived			<0.001			<0.001
Not at all healthy	4.30 (1.81)			31.48 (9.90)		
Little bit healthy	3.56 (1.19)			30.61 (7.82)		
Somewhat healthy	3.21 (0.83)			25.97 (8.07)		
Fairly healthy	2.85 (0.61)			24.46 (7.93)		
Very healthy	3.31 (1.06)			27.50(10.36)		
Brushing			<0.001			0.181
Never	4.15 (1.58)			29.69 (9.70)		
<3times a week	3.40 (1.01)			28.02 (8.33)		
once a day	3.19 (1.00)			27.36 (8.19)		
Twice or more a day	3.19 (0.89)			26.00 (8.97)		
Floss use			0.003			0.099
Yes	3.38 (1.13)			30.36 (9.62)		
No	2.97 (0.65)			27.19 (8.54)		
Toothpick use			0.302			<0.001
Yes	3.29 (1.14)			34.82 (8.99)		
No	3.42 (1.03)			29.70 (8.84)		
Dental visits			0.869			
Yes	3.35 (1.19)			25.63 (8.14)		0.002
No	3.33 (0.92)			28.78 (8.85)		

  *Pearson correlation analysis was conducted for continuous variables.
 **Independent-samples T tests and One-Way ANOVA were conducted for dichotomous
   and categorical variables respectively.
† standard deviation of mean.

Table 11. Binary Logistic Regression model for the Syrian sample including all significantly related variables with Dependent variable: attachment loss.

Variable	ß	S.E.	Wald	Sig.	Exp (ß)	95% CI for exp (ß)	
						Lower	Upper
Constant	-7.134	1.268	31.629	.000	.001		
Age	.064	.021	9.382	.002	1.066	1.023	1.110
Gender	.806	.391	4.247	.039	2.240	1.040	4.822
Tooth Loss	.138	.036	15.001	.000	1.148	1.071	1.232
Total PSS	.049	.021	5.603	.018	1.050	1.008	1.093
Smoking	.352	.413	.726	.394	1.422	.633	3.192
Calculus	1.107	.353	9.822	.002	3.025	1.514	6.045

Total PSS: continuous
AL: Binary; Severe = 1, mild = 0
Pseudo R square=0.370
Exp (ß) is the odds ratio of the row independent with the dependent (AL). It is the predicted change in odds for a unit increase in the corresponding independent variable.

Table 12. Odds ratios of the association between stress* and periodontitis using different case definitions for the Syrian sample.

Periodontal case definition	Adjusted OR[†] (95%CI)	P Value
30% of sites with AL ≥ 5 mm	1.05 (1.01-1.09)	0.014
Established Periodontitis	1.06 (1.03-1.10)	0.002
Categorized mean AL[++]	1.08 (1.02-1.07)	0.002
Mean AL**	ß = 0.02 (0.01-0.04)	0.002

[+]Established Periodontitis: Having 2 or more sites with AL ≥ 6mm and one site or more with PD ≥ 5 mm

[++]Categorized mean AL: Mean AL categorized into five ordered categories: healthy (0 to 1 mm AL), low (1.1 to 2.0 mm), moderate (2.1 to 3.0 mm), high (3.1 to 4.0) and severe (> 4.0 mm), OR was 1.04 (95% CI = 1.02, 1.07; P <0.005).

[†] Age, gender, smoking, and diabetes

* Stress: Continuous data

** Mean AL: Continuous data

Table 13. Odds ratios of the association between stress* and periodontitis**with interaction terms included for the Syrian sample

	OR†	p-value
PSS	**1.02**	**.143**
PSS*Positive Cope	**1.00**	**.452**
PSS*Negative Cope	**1.03**	**.853**

*Stress (PSS): continuous data
** AL: Binary; Severe = 1, mild = 0.
†Adjusted for Age, gender, smoking, and diabetes

Table 14. ORs of the association between stress and periodontitis using continuous stress variable in high and low coping style levels (Syrian sample).

	0dds ratios[†]	p-value	95% confidence interval	
			Lower bound	**Upper bound**
All cases	1.05	.018	1.01	1.09
High Positive Cope	1.03	.244	0.98	1.08
Low Positive Cope	1.10	.031	1.02	1.18
High Negative Cope	1.07	.018	1.00	1.10
Low Negative Cope	1.03	.399	0.96	1.10

[†] Adjusted for age, gender, smoking, diabetes, and depression variables
*Stress: continuous

Table 15. ORs of the association between stress and periodontitis using categorical stress variable in high and low coping style levels (Syrian sample).

	0dds ratios[†]	p-value	95% confidence interval	
			Lower bound	Upper bound
All cases	2.70	.026	1.01	14.86
High Positive Cope	2.56	.175	1.19	12.96
Low Positive Cope	2.94	.031	1.03	18.84
High Negative Cope	5.34	.018	1.02	20.79
Low Negative Cope	1.91	.186	1.20	6.73

[†]Adjusting for age, gender, diabetes and smoking variables
Stress categorized at median

Table 16. Factor structure matrix of the PSS for the US sample

	Positive perception	Negative perception
PSS 1	-.020	**.757**
PSS 2	-.127	**.785**
PSS 3	.008	**.812**
PSS 4	**.763**	.021
PSS 5	**.777**	-.126
PSS 6	**.504**	-.393
PSS 7	**.415**	-.294
PSS 8	-.053	**.593**
PSS 9	**.448**	-.372
PSS 10	**.492**	-.263
PSS 11	-.084	**.679**
PSS 12	-.355	**-.489**
PSS 13	**.557**	-.343
PSS 14	-.245	**.706**

The highest factor loadings of each item on the scale obtained from the factor analysis given in bold
Extraction method: Principal component analysis
Rotation method: Varimax with Kaiser normalization

Table 17. Factor structure matrix of the Brief Cope for the US sample

Scale	Item no.	Positive Cope	Support	Negative Cope	Humor	Blame	Religion	Substance Use
% total variance		11.80%	9.91%	9.50%	8.21%	7.80%	7.24%	6.71%
Cronbach's alpha		0.81	0.82	0.70	0.81	0.67	0.88	0.89
Active coping	2	**.734**	.074	.042	.057	.101	.191	.038
	7	**.716**	.173	-.053	.128	-.117	.083	.001
Acceptance	20	**.464**	.096	-.245	.383	.049	.170	-.183
	24	.293	.097	.018	**.456**	.035	.219	-.139
Planning	14	**.738**	.146	.155	.042	.224	-.109	.036
	25	**.755**	.227	-.098	.061	.167	.090	-.078
Positive	12	**.482**	.275	.244	.255	-.088	.241	-.023
Reframing	17	**.391**	.060	.038	**.479**	-.321	.317	-.012
Emotional	5	.095	**.805**	-.006	.016	.112	.040	.053
Support	15	.191	**.785**	-.025	.136	.045	.058	.071
Instrumental	10	.131	**.808**	.134	.078	.101	.022	-.014
Support	23	.275	**.654**	.058	.039	.138	.178	.018
Denial	3	.085	.062	**.728**	-.022	.002	.009	.186
	8	.039	-.074	**.717**	-.172	.112	-.017	.171
Behavioral	6	-.246	-.050	**.634**	-.006	.368	.065	-.014
disengagement	16	-.187	-.038	**.624**	.023	**.412**	-.167	-.111
Self-distraction	1	.276	.243	**.408**	.097	.051	-.039	-.037
	19	.140	.201	**.497**	.344	.148	-.039	.104
Humor	18	.059	.072	.024	**.868**	.106	-.015	.097
	28	.064	.052	-.015	**.781**	.135	-.038	.145

The highest factor loadings of each item on the scale obtained from the factor analysis given in bold
Extraction method: Principal component analysis
Rotation method: Varimax with Kaiser normalization

Continuation Table 17. Factor structure matrix of the Brief Cope for the US sample

Scale	Item no.	Component						
		Adequate Coping	Support Coping	Inadequate Coping	Humor	Blame	Religion	Substance Use
Self-blame	**13**	.082	.125	.117	.030	**.765**	-.027	.191
	26	.110	.055	.213	.005	**.753**	-.052	.087
Venting	**9**	-.045	.155	.338	.175	**.401**	.069	.076
	21	.194	.179	.097	.170	**.516**	.053	-.116
Religion	**22**	.161	.102	-.074	.033	.022	**.902**	-.021
	27	.129	.109	-.007	.069	-.032	**.911**	.007
Substance Use	**4**	-.051	.047	.135	.071	.076	.002	**.895**
	11	-.015	.064	.146	.074	.097	-.019	**.908**

The highest factor loadings of each item on the scale obtained from the factor analysis given in bold
Extraction method: Principal component analysis
Rotation method: Varimax with Kaiser normalization

Table 18.Comparison of demographic characteristics of US sample and of 2004 US population

	% of US study sample	% of 2004 Michigan** Census Adults Population	% of 2004 US Census Adults Population
Age			
35-44	37.8	12.8	14.8(30-39)
45-54	30.3	15.1	12.3(40-49)
55-59	7.3	5.8	11.4(50-64)
60-64	10.1	4.5	
65 & over	23.2	12	8.1
Gender			
Male	39.1	49.1	49.2
Female	60.9	50.9	50.8
Marital Status			
Single	27.9	28.3	15.8
Married	47.6	53.7	61.4
Widowed	5.6	6.1	7.4
Divorced	18.8	11.9	11.5
Race			
White	74.3	78.1	67.4
Black	16.0	14.3	12.8
Other	9.7	6.5	19.5
Education			
No High school	6.6	13.1	14.8
High school graduate	23.8	31.4	32.0
Some college	36.3	23.2	17
College degree	10.3	7.6	8.4
Bachelor's degree	13.8	15.1	18.1
Professional degree	9.4	9.5	9.6
Employment			
Yes	59.2	60.8	59.3
No	40.78	3.7	5.6

Continuation Table 18.Comparison of demographic characteristics of sample and of 2004 US population

	% of US study sample	% of 2004 Michigan** Census Adults Population	% of 2004 US Census Adults Population
Income			
	35,000 (median)	46,291 (median)	43,318 (median)
	38,000 (mean)	57,976 (mean)	
Less than $20,000	42.3	14.3(<15)	
$20,000-34,999	27.1	12.4(15-24,99)	
$35,000-49,999	14.2	12.7(25-35)	
$50,000-64,999	6.1	15.2(35-50)	
$65,000-79,999	3.9	19.9(50-75)	
$80,000 & over	6.5	11.4(75-100)	

Note: table includes only those categories for which equivalent data were available from both the census and US sample.
** 2002 Michigan Behavioral Risk Factor Survey (BRFS) [128]

Table 19.Comparison of dental visits, smoking, and diabetes of US sample and of 2004 US Population

study	% of US sample	% of 2004 Michigan** Census Adults Population	% of 2004 US Census Adults Population
Dental visits	58.4	76.1	64.5
Yes	41.6	23.9	35.5
No			
Smoking			
Yes	31.9	24.1 (18 and	20.9
No	68.1	older)**	79.1
Diabetes			
Yes	11.4	8.1	10.5
No	88.6	91.9	89.5

Note: table includes only those categories for which equivalent data were available from both the census and US sample.
** 2002 Michigan Behavioral Risk Factor Survey (BRFS) [128]

Table 20. Average attachment loss at four sites and PSS scores among individuals 35-75 years old from the US sample.

	Average attachment level (MM)			Total PSS scores		
	Mean (sd†)	r*	p**	Mean (sd†)	r*	p**
Age (years)		0.150	0.037		-0.241	<0.001
Children		0.085	0.263		0.023	0.690
Total PSS		0.155	0.030		-	-
Tooth loss		0.327	0.001		0.123	0.087
Dental visit times		-0.102	0.156		-0.232	<0.000
Cigarettes per day		0.170	0.018		0.208	<0.000
Alcohol per day		0.140	0.053		-0.119	0.038
Gender			0.008			<0.001
Male	3.55 (0.36)			21.47 (8.49)		
Female	3.06 (1.03)			25.56 (8.33)		
Race			0.632			0.861
White	3.21 (1.13)			23.97 (8.99)		
Black	3.42 (1.34)			23.65 (8.09)		
Other	3.19 (1.39)			24.45 (8.63)		
Marriage			0.546			0.030
Single	3.39 (1.41)			25.04 (8.81)		
Married	3.13 (1.09)			22.78 (7.96)		
Widowed	3.34 (0.99)			21.83 (8.09)		
Divorced/ separated	3.37 (1.15)			26.16 (9.65)		
Education			0.682			0.104
No highschool	3.41 (1.52)			27.05 (7.84)		
Highschool degree	3.16 (1.21)			24.94 (8.06)		
Some college/ Technical degree	3.39 (1.30)			24.09 (9.44)		
College degree	2.89 (0.57)			24.09 (8.29)		
Bachelor degree	3.20 (1.03)			22.66 (8.08)		
Professional degree	3.06 (0.92)			20.54 (7.54)		
Job			0.052			0.082
Yes	3.09 (1.09)			23.15 (8.26)		
No	3.42 (1.27)			24.87 (8.95)		

Cont. Table 20. Average attachment loss at four sites and PSS scores among individuals 35-75 years old from the US sample.

	Average attachment loss (MM)		Total PSS scores	
	Mean (sd[†])	p**	Mean (sd[†])	p**
Income		0.407		0.004
< $20,000	3.4 (1.30)		26.0 (8.72)	
$20,000-$34,999	3.2 (1.09)		23.6 (8.41)	
$35,000-$49,999	3.1 (1.25)		21.1 (6.72)	
$50,000-$64,999	3.3 (1.14)		23.6 (8.22)	
$65,000-$79,000	3.3 (0.73)		19.0 (7.95)	
$80,000 and over	2.6 (0.61)		21.0 (11.14)	
Diabetes		0.704		0.724
Yes	3.2 (0.80)		24.5 (8.48)	
No	3.3 (1.23)		23.9 (8.70)	
Medication use		0.689		0.019
Yes	3.3 (1.18)		25.0 (9.24)	
No	3.2 (1.21)		22.7 (7.74)	
Depression		0.691		0.000
Yes	3.4 (1.46)		30.9 (8.20)	
No	3.3 (1.89)		23.7 (8.11)	0.003
Smoking		0.004		
Yes	3.6 (1.33)		26.1 (8.59)	
No	2.8 (1.07)		23.0 (8.51)	
Alcohol consumption		0.062		0.026
Yes	3.5 (1.34)		22.6 (8.15)	
No	3.1 (1.05)		24.9 (8.83)	
Oral health perceived		0.032		0.000
Not at all healthy	3.8 (1.24)		27.0 (9.19)	
Little bit healthy	3.5 (1.50)		26.3 (8.20)	
Somewhat healthy	3.2 (1.15)		24.5 (8.13)	
Fairly healthy	3.0 (0.97)		21.7 (7.97)	
Very healthy	2.8 (0.95)		16.3 (7.99)	
Brushing		0.014		0.001
Never	5.4 (0.21)		41.5 (6.36)	
<3times a week	3.2 (0.35)		27.7 (9.26)	
once a day	3.4 (1.29)		25.4 (8.17)	
Twice or more a day	3.1 (1.07)		22.9 (8.48)	
Floss use		0.583		0.005
Never	3.3 (1.02)		25.8 (9.87)	
<3times a week	3.3 (1.17)		25.0 (7.90)	
once a day	3.3 (1.37)		22.5 (8.50)	
Twice or more a day	2.9 (0.91)		20.3 (7.94)	

Continuation Table 20. Average attachment loss at four sites and PSS scores among individuals 35-75 years old from the US sample.

	Average attachment loss (MM)		Total PSS scores	
	Mean (sd[†])	p**	Mean (sd[†])	p**
Toothpick use		0.229		0.954
Never	3.0 (1.07)		24.2 (8.92)	
<3times a week	3.3 (1.17)		23.7 (9.02)	
once a day	3.5 (1.74)		24.4 (6.92)	
Twice or more a day	3.4 (1.02)		23.8 (7.78)	
Dental visits		0.179		0.000
Yes	3.15 (1.13)		22.25 (8.68)	
No	3.38 (1.26)		26.40 (7.98)	

*Pearson correlation analysis was conducted for continuous variables.

**Independent-samples T tests and One-Way ANOVA were conducted for dichotomous and categorical variables respectively.

† Standard deviation of mean.

Table 21. Ordinal logistic regression model including all significantly related variables with dependent variable: attachment loss for the US sample.

Variable	ß	S.E.	Wald	Sig.	Exp (ß)	95% CI for exp ß)	
						Lower bound	Upper bound
Age	0.0543	0.015	13.864	.000	1.056	1.026	1.087
Gender	0.830	0.355	5.466	.019	2.293	1.143	4.595
Smoking	0.501	0.377	1.764	0.184	1.650	0.788	3.459
Diabetes	0.677	0.535	1.605	0.205	1.070	0.178	1.449
Depression	0.875	0.608	2.070	0.150	2.399	0.728	7.893
Total PSS	0.047	0.021	5.190	.023	1.048	1.007	1.092

Total PSS: continuous
AL: ordinal; 3 levels with sever = 3, moderate = 2, and mild = 1
Depression: dichotomized; yes = 1, no = 0
Pseudo R square=0.139
Exp (ß) is the odds ratio of the row independent with the dependent (AL). It is the predicted change in odds for a unit increase in the corresponding independent variable.

Table 22. Binary logistic regression model for the US sample including all significantly related variables with dependent variable: attachment loss.

	B	S.E.	Wald	Sig.	Exp(ß)	95% CI for exp (ß)	
						Lower	Upper
Age	0.08	0.02	16.42	0.00	1.08	1.04	1.12
Gender	1.15	0.43	7.09	0.01	3.14	1.35	7.30
Total PSS	0.05	0.03	4.63	0.03	1.06	1.01	1.11
Smoking	0.97	0.47	4.23	0.04	2.64	1.05	6.67
Diabetes	0.84	0.68	1.51	0.22	2.32	0.61	8.84
Depression	0.76	0.77	0.97	0.33	2.14	0.47	9.75

Total PSS: Continuous
AL: Binary; Severe = 1, mild = 0
Depression: dichotomized, yes =1, no = 0
Pseudo R square=0.225
Exp (ß) is the odds ratio of the row independent with the dependent (attachment loss). It is the predicted change in odds for a unit increase in the corresponding independent variable.

Table 23. Odds ratios of the association between stress* and periodontitis using different case definitions for the US sample.

Periodontal case definition	Adjusted OR[†] (95%CI)	P Value
30% of sites with AL $\geq$ 5 mm	1.06 (1.01-1.11)	0.032
Established Periodontitis[+]	0.02 (0.98-1.06)	0.40
Categorized mean AL[++]	1.13 (1.03-1.20)	0.002
Mean AL**	ß = 0.03 (0.02-0.06)	0.001

[+]Established Periodontitis: Having 2 or more sites with AL $\geq$ 6mm and one site or more with PD $\geq$ 5 mm

[++]Categorized mean AL: Mean AL categorized into five ordered categories: healthy (0 to 1 mm AL), low (1.1 to 2.0 mm), moderate (2.1 to 3.0 mm), high (3.1 to 4.0) and severe (> 4.0 mm), OR was 1.04 (95% CI = 1.02, 1.07; P <0.005).

[†] Age, gender, smoking, and diabetes

* Stress: Continuous data

** Mean AL: Continuous data

Table 24. Odds ratios of the association between stress* and periodontitis** with interaction terms included for the US sample

	OR†	p-value
PSS	**1.06**	**.265**
PSS*Positive Cope	**1.01**	**.442**
PSS*Negative Cope	**1.07**	**.732**

*Stress (PSS): continuous data
** AL: Binary; Severe = 1, mild = 0.
†Adjusted for Age, gender, smoking, diabetes, and depression

Table 25. ORs of the association between stress and periodontitis using continuous stress variable in high and low coping style levels (US sample).

	0dds ratios[†]	p-value	95% confidence interval	
			Lower bound	**Upper bound**
All cases	1.06	0.03	1.01	1.11
High Positive Cope	0.99	0.778	0.904	1.07
Low Positive Cope	1.17	0.031	1.058	1.29
High Negative Cope	1.12	0.018	1.02	1.24
Low Negative Cope	1.02	0.742	0.92	1.13

[†]Adjusted for age, gender, smoking, diabetes, and depression variables
Stress: continuous

Table 26. Odds ratios of the association between stress and periodontitis using categorical stress variable in high and low coping style levels (US sample).

	0dds ratios[†]	p-value	95% confidence interval	
			Lower bound	Upper bound
All cases	2.96	.016	1.23	7.13
High Positive Cope	0.85	.811	0.23	3.12
Low Positive Cope	9.25	.002	2.30	37.19
High Negative Cope	10.84	.005	2.07	56.77
Low Negative Cope	2.45	.285	0.47	12.63

[†]Adjusting for age, gender, diabetes and smoking variables
Stress categorized at median

FIGURES

Fig. 1. Model of the indirect impact of perceived stress on periodontitis
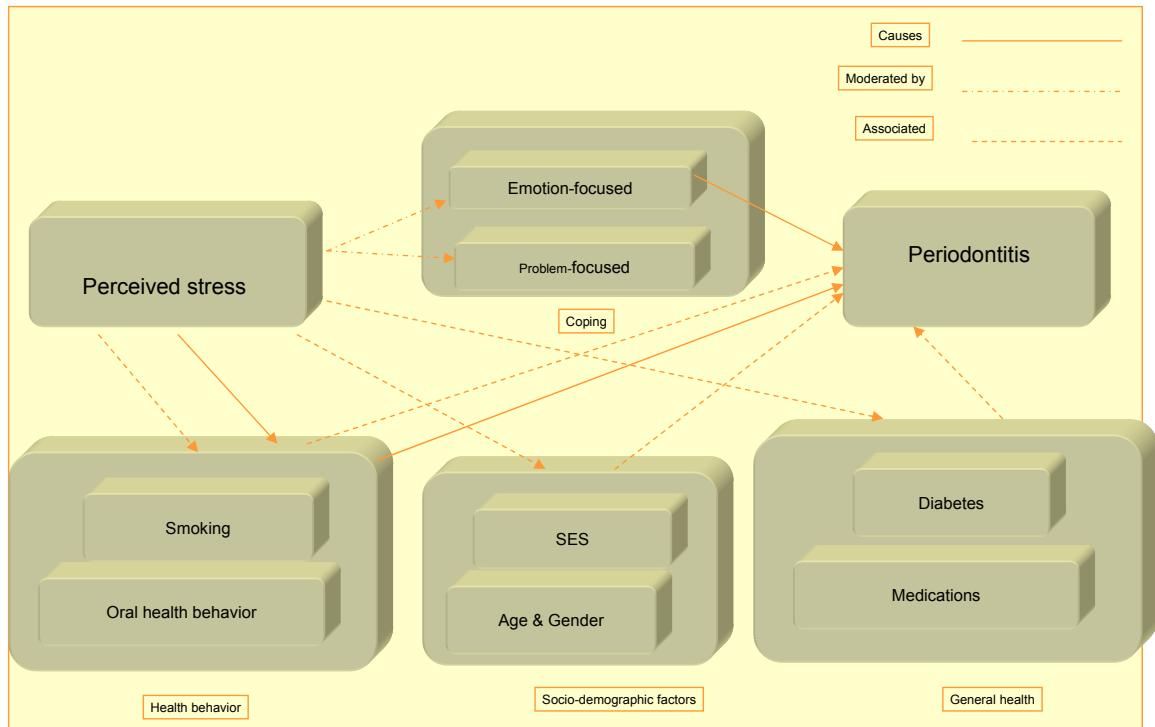
Figure 2. Scatter plot of total PSS and mean attachment loss relation among Syrian sample.
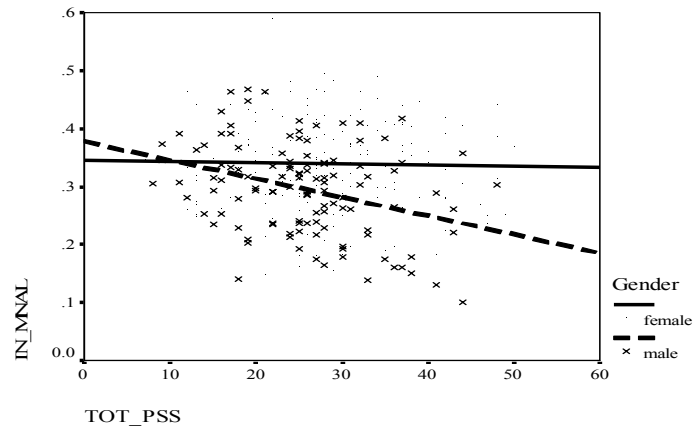
Figure 2. Correlation between average attachment loss at four sites and PSS scores among individuals from 30 to 70 years old from the Syrian population sample for males and females independently.

Figure 3. Scatter plot of total PSS and mean attachment loss relation among US sample.
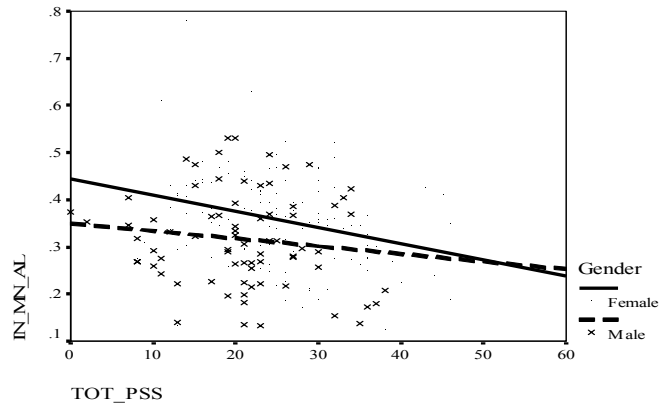
Figure 3. Correlation between average attachment loss at four sites and PSS scores among individuals from 35 to 75 years old from the US population for males and females independently.

APPENDICES

Appendix A. English Consent Form

Thank you for participating in this study. This study has been designed to examine the relation between stress and periodontitis. Your participation will be of the great help in gathering of this valuable information. Your participation will take about 45 min. including an interview and a clinical exam.

Your participation in this study is completely voluntary. You are free to discontinue the study at any time and/or decline to answer any particular question; by agreeing to participate you also agree to give thoughtful, honest responses to questions you do answer. As a participant you will agree to be given a dental exam performed by the researcher.

Please know that your responses will remain confidential. Your name will not be placed on the questionnaire. Only members of the research team will see the responses, and they will keep them completely confidential.

Physical risks of a periodontal examination are minimal. In the unlikely event of physical injury resulting from research procedures, the University will provide first aid medical treatment or emergency care. Additional medical care will be provided if the University determines that it is responsible to provide such treatment. By signing this form, you do not give up your right to seek additional compensation if you are harmed as a result of participation in this study.

There will be no clinical or any other benefits from your participating in this study and your decision to participate or not will have no impact on clinical care.

You will receive one token gift at the end of the periodontal exam. If you decide to withdraw from participation before the research ends, you will receive a cheaper token gift.

If you have any questions or concerns regarding this study, please contact Dr. Brian Burt (734) 764-5478 . Additionally, you can also receive information about this study from Ms. Kate Keever, IRB Health and Behavioral Sciences, 540 E. Liberty Street, Suite 202B, Ann Arbor, MI 48104-2210,
(734) 936-0933,
FAX (734) 998-9171,
email: irbhsbs@umich.edu

I have read the information above. I understand the meaning of this information. Dr. Khayat has offered to answer any questions I may have containing the study. I hereby consent to participate in the study.

Participant Name-printed:‗‗‗

Participant signature:‗‗‗‗‗‗‗‗‗‗‗‗‗‗‗‗‗‗‗‗‗‗‗‗‗‗Date:‗‗‗‗‗‗‗‗‗‗‗‗‗‗‗‗‗

Appendix B. Arabic Consent Form

شكرا لقبولكم المشاركة في هذا البحث. هذا البحث مصمم لدراسة العلاقة بين الضغط النفسي ومرض ما حول اللثة. مشاركتكم سوف يكون لها أثرا كبيرا في هذا المجال.

هذه المشاركة سوف تستغرق حوالي 45 دقيقة متضمنة مقابلة و فحص لثوي.

مشاركتكم في هذا البحث طوعية ولديك كامل الحرية لإيقاف البحث أوعدم الرد على اي سؤال لا ترغبون بالإجابة عليه. قبولكم المشاركة يعني الموافقة على اعطاء اجابات صريحة و دقيقة للاسئلة التي ستطرح عليك و الموافقة على الفحص اللثوي الذي ستنجزه الباحثة.

أود أيضا أن أعلمك بأنه لا يمكن لأي شخص الإطلاع على إجاباتك. إسمك لن يكتب على ورقة الإجابة وليس هناك أية وسيلةلربط الإسم مع الأجوبة. المسؤولون عن البحث هم فقط الذين يستطيعون الإضطلاع على الأجوبة وسيتعاملون معها بسرية تامة.

لن تكون هناك أية مسؤولية مترتبة عليك بسبب المشاركة في هذا البحث. كما أنه لن تترتب عليك أية تكاليف و لن يكون هناك أية مدفوعات نقدية لحسابك من قبل المسؤولين عن البحث. غير أنه هناك هدية رمزية لكل شخص مشارك في هذا البحث.

إذا كان لديك أي إستفسار، يمكنك الإتصال بالدكتور أسامة ابراهيم.

لقد قرأت المعلومات السابقة وفهمت ماذا تعني. الدكتورة رزينة الخياط قدمت الإجابة على كل أسئلتي بشأن هذا البحث. وبناء عليه أود المشاركة في هذا البحث.

إسم المشترك: ـــ

إمضاء المشترك: ـــــــــــــــــــــــــــــــــــ   التاريخ: ـــــــــــــــــــــــــــــــــ

Appendix C. Socio-demographic Survey

This is a self report questionnaire. The investigator will hand in the questionnaire when the individual sign the consent form. The respondent will answer the questions by themselves.

Q1. Please indicate your sex:
- ❏ Male
- ❏ Female - Go to Q3

Q2. Are you pregnant?
- ❏ Yes
- ❏ No
- ❏ Don't know/not sure

Q3. How old are you?
- I am _____ years old.
- ❏ Don't know/not sure

Q4. What race do you consider yourself?
- ❏ White
- ❏ African American
- ❏ Other _____
- ❏ Don't know/not sure

Q5. What is your marital status?
- ❏ Single
- ❏ Married
- ❏ Widowed
- ❏ Divorced/separated
- ❏ Other

Q6. How many children do you have?
- I have _____ children.

Q7. What is the highest grade of school you completed?
- ❏ Not completed high school
- ❏ High school only

❑ Some college/ technical degree
❑ College degree/ 2 to 4 years
❑ Bachelor degree
❑ Professional degree
❑ Don't know/not sure

Q8. Are you currently working at a paying job?
❑ Yes
❑ No

Q9. Which of these income groups represents your own income?
❑ Less than $20,000
❑ $20,000 - $35,000
❑ $35,000 - $50,000
❑ $50,000 - $65,000
❑ $65,000 - $80,000
❑ $80,000 or more
❑ Don't know/not sure

The following questions are concerned with how you think about your dental health behaviors.

Q10. On a scale from 1 not at all healthy to 5 very healthy, how healthy do you think your teeth and gums are?
❑ Not at all
❑ Somehow not healthy
❑ A little bit healthy
❑ Somehow healthy
❑ Very healthy
❑ Don't know/not sure

Q11. How often do you brush your teeth?
❑ Never
❑ Less than 3 times a week
❑ Once/day
❑ Twice or more/day
❑ Don't know/not sure

Q12. How often do you floss
❑ Never
❑ Less than 3 times a week
❑ Once/day
❑ Twice or more/day
❑ Don't know/not sure

Q13. How often do you use toothpicks?
- ❑ Never
- ❑ Less than 3 times a week
- ❑ Once/day
- ❑ Twice or more/day
- ❑ Don't know/not sure

Q14. Did you visit your dentist last year?
- ❑ Yes
- ❑ No -Go to Q16
- ❑ Don't know/not sure

Q15. How many times did you visit the dentist last year?

_____ times.
- ❑ Don't know/not sure

Q16.   What is the reason for your visit today?

_____.
- ❑ Don't know/not sure

The following questions are related to your general health.

Q17. Have you ever been told by a doctor or a nurse that you had diabetes, high blood sugar,or sugar in your urine?
- ❑ Yes
- ❑ No -Go to Q20
- ❑ Don't know/not sure

Q18. Are you currently taking insulin or pills to control it?
- ❑ Yes
- ❑ No
- ❑ Don't know/not sure

Q19. Are you on a special diet to control it?
- ❑ Yes
- ❑ No
- ❑ Don't know/not sure

Q20. Other than for diabetes, are you taking any medication on a regular basis now?
- ❑ Yes
- ❑ No -Go to Q22
- ❑ Don't know/not sure

Q21. For what reason are you taking the regular medication?

_____ .
- ❑ Don't know/not sure

The following questions are related to your health behaviors in general.

Q22. Do you smoke?
- ❑ Yes
- ❑ No -Go to Q24

Q23. On average, how many cigarettes do you usually smoke per day?
_____ cigarettes.
- ❑ Don't know/not sure

Q24. Do you drink alcohol?
- ❑ Yes
- ❑ No -End

Q25. On average, how many glasses of wine do you drink per day?
_____ glasses.
- ❑ Don't know/not sure

Appendix D. English Perceived Stress Scale

The questions in this scale ask about the respondents' feelings and thoughts during the last month. In each case, he/she will be asked to indicate how often you felt or thought a certain way. Although some of the questions are similar, there are differences between them and the respondent should treat each one as a separate question. The respondent should not try to count up the number of times he/she felt a particular way, but rather indicate the alternative that seems like a reasonable estimate. The best approach is to answer each question fairly quickly.

0=Never
1=Almost Never
2=Sometimes
3=Fairly Often
4=Very Often

In the last month:

	Never				**very often**
1. How often have you been upset because of something that happened unexpectedly?	❏0	❏1	❏2	❏3	❏4
2. How often have you felt that you were unable to control the important things in your life?	❏0	❏1	❏2	❏3	❏4
3. How often have you felt nervous and "stressed"?	❏0	❏1	❏2	❏3	❏4
4. How often have you dealt successfully with irritating life hassles?	❏0	❏1	❏2	❏3	❏4
5. How often have you felt that you were effectively coping with important changes that were occurring in your life?	❏0	❏1	❏2	❏3	❏4
6. How confident about your ability to handle your personal problems?	❏0	❏1	❏2	❏3	❏4
7. How often have you felt that things were going your way?	❏0	❏1	❏2	❏3	❏4

8. How often have you found that you could not cope with all the things you had to do? ❑0 ❑1 ❑2 ❑3 ❑4

9. How often have you been able to control irritations in your life? ❑0 ❑1 ❑2 ❑3 ❑4

10. How often have you felt that your were on top of things? ❑0 ❑1 ❑2 ❑3 ❑4

11. How often have you been angered because of things that were outside of your control? ❑0 ❑1 ❑2 ❑3 ❑4

12. How often have you found yourself thinking about things that you have to accomplish? ❑0 ❑1 ❑2 ❑3 ❑4

13. How often have you been able to control the way you spend your time? ❑0 ❑1 ❑2 ❑3 ❑4

14. How often have you felt difficulties were piling up so high that you could not overcome them? ❑0 ❑1 ❑2 ❑3 ❑4

Appendix E. Arabic Perceived Stress Scale

اختبار لفهم الضغط النفسي الاجتماعي:

تتعلق الأسئلة التالية بمشاعرك وأفكارك **خلال الشهر الماضي**. يرجى منك الإشارة إلى عدد المرات التي شعرت أو فكرت فيها بالطريقة المذكورة. يرجى منك أخذ كل سؤال بعين الاعتبار على الرغم من تشابه بعض الأسئلة، لأنها لا تحمل نفس المضمون. الحل الأفضل لذلك هو أن تختار الإجابة المعقولة أكثر حسب تقديرك بشكل سريع دون عد المرات.

1. كم مرة خلال الشهر الماضي شعرت بالانزعاج بسبب حدوث أشياء غير متوقعه؟
   - 0= لم يحدث على الإطلاق
   - 1= تقريبا لم يحدث على الإطلاق
   - 2= متكرر قليلا
   - 3= متكرر إلى حد ما
   - 4=متكرر كثيرا

2. كم مرة خلال الشهر الماضي شعرت بعدم قدرتك على التحكم بالأمور الهامة في حياتك؟
   - 0= لم يحدث على الإطلاق
   - 1= تقريبا لم يحدث على الإطلاق
   - 2= متكرر قليلا
   - 3= متكرر إلى حد ما
   - 4=متكرر كثيرا

3. كم مرة خلال الشهر الماضي شعرت بأنك متوتر ومضطرب؟
   - 0= لم يحدث على الإطلاق
   - 1= تقريبا لم يحدث على الإطلاق
   - 2= متكرر قليلا
   - 3= متكرر إلى حد ما
   - 4=متكرر كثيرا

4. كم مرة خلال الشهر الماضي تعاملت بنجاح مع مشاحنات الحياة اليومية المزعجة؟
   - 0= لم يحدث على الإطلاق
   - 1= تقريبا لم يحدث على الإطلاق
   - 2= متكرر قليلا
   - 3= متكرر إلى حد ما
   - 4=متكرر كثيرا

5. كم مرة خلال الشهر الماضي شعرت بأنك قادر على التأقلم مع التغيرات المهمة الطارئة على حياتك؟

0=لم يحدث على الإطلاق

1= تقريبا لم يحدث على الإطلاق

2= متكرر قليلا

3= متكرر إلى حد ما

4=متكرر كثيراا

6. كم مرة خلال الشهر الماضي شعرت بالثقة وبقدرتك على تدبير مشاكلك الشخصية؟

0=لم يحدث على الإطلاق

1= تقريبا لم يحدث على الإطلاق

2= متكرر قليلا

3= متكرر إلى حد ما

4=متكرر كثيرا

7. كم مرة خلال الشهر الماضي شعرت بأن الأمور تسير إلى صالحك؟

0=لم يحدث على الإطلاق

1= تقريبا لم يحدث على الإطلاق

2= متكرر قليلا

3= متكرر إلى حد ما

4=متكرر كثيرا

8. كم مرة خلال الشهر الماضي أدركت بأنك غير قادر على تدبير كل ما يتوجب عليك فعله؟

0=لم يحدث على الإطلاق

1= تقريبا لم يحدث على الإطلاق

2= متكرر قليلا

3= متكرر إلى حد ما

4=متكرر كثيرا

9. كم مرة خلال الشهر الماضي كنت فيها قادرا على السيطرة على المنغصات في حياتك؟

0=لم يحدث على الإطلاق

1= تقريبا لم يحدث على الإطلاق

2= متكرر قليلا

3= متكرر إلى حد ما

4=متكرر كثيرا

10. كم مرة خلال الشهر الماضي شعرت بأنك متحكم بكل أمورك؟

0=لم يحدث على الإطلاق

1= تقريبا لم يحدث على الإطلاق

2= متكرر قليلا

3= متكرر إلى حد ما

4=متكرر كثيرا

11. كم مرة خلال الشهر الماضي كنت فيها غاضبا بسبب بعض الأمور التي كانت خارج نطاق سيطرتك؟

0=لم يحدث على الإطلاق

1= تقريبا لم يحدث على الإطلاق

2= متكرر قليلا

3= متكرر إلى حد ما

4=متكرر كثيرا

12. كم مرة خلال الشهر الماضي وجدت نفسك فيها مشغولا بالتفكير بأشياء يتوجب عليك القيام بها؟

0= لم يحدث على الإطلاق

1= تقريبا لم يحدث على الإطلاق

2= متكرر قليلا

3= متكرر إلى حد ما

4=متكرر كثيرا

13. كم مرة خلال الشهر الماضي كنت فيها قادرا على التحكم بكيفية قضاء وقتك؟

0= لم يحدث على الإطلاق

1= تقريبا لم يحدث على الإطلاق

2= متكرر قليلا

3= متكرر إلى حد ما

4=متكرر كثيرا

14. كم مرة خلال الشهر الماضي شعرت فيها بتراكم الصعوبات لدرجة أنك لم تعد قادرا على التغلب عليها؟

0= لم يحدث على الإطلاق

1= تقريبا لم يحدث على الإطلاق

2= متكرر قليلا

3= متكرر إلى حد ما

4=متكرر كثيرا

Appendix F. Brief Cope

These items deal with ways the respondent have been coping with the stress in his/her whole life. There are many ways to try to deal with problems. Obviously, different people deal with things in different ways, but we're interested in how the respondent has tried to deal with his/her problems. Each item says something about a particular way of coping. We want to know to what extent (how much or how frequently) the respondent has been doing what the item says. The respondent should not answer on the basis of whether it seems to be working or not—just whether or not he/she is doing it. The respondent should use the following response choices and try to rate each item separately in his/her mind from the others.

1 = I haven't been doing this at all
2 = I've been doing this a little bit
3 = I've been doing this a medium amount
4 = I've been doing this a lot

	not at all	little bit	medium	a lot
1. I've been turning to work or other activities to take my mind off things.	❏1	❏2	❏3	❏4
2. I've been concentrating my efforts on doing something about the situation I'm in.	❏1	❏2	❏3	❏4
3. I've been saying to myself "this isn't real."	❏1	❏2	❏3	❏4
4. I've been using alcohol or other drugs to make myself feel better.	❏1	❏2	❏3	❏4
5. I've been getting emotional support from others.	❏1	❏2	❏3	❏4
6. I've been giving up trying to deal with it.	❏1	❏2	❏3	❏4
7. I've been taking action to try to make the situation better.	❏1	❏2	❏3	❏4
8. I've been refusing to believe that it has happened	❏1	❏2	❏3	❏4
9. I've been saying things to let my unpleasant feelings escape.	❏1	❏2	❏3	❏4

10. I've been getting help and advice from other people. ❑1 ❑2 ❑3 ❑4

11. I've been using alcohol or other drugs to help me get through it. ❑1 ❑2 ❑3 ❑4

12. I've been trying to see it in a different light, to make it seem more positive. ❑1 ❑2 ❑3 ❑4

13. I've been criticizing myself. ❑1 ❑2 ❑3 ❑4

14. I've been trying to come up with a strategy about what to do. ❑1 ❑2 ❑3 ❑4

15. I've been getting comfort and understanding from someone. ❑1 ❑2 ❑3 ❑4

16. I've been giving up the attempt to cope. ❑1 ❑2 ❑3 ❑4

17. I've been looking for something good in what is happening. ❑1 ❑2 ❑3 ❑4

18. I've been making jokes about it. ❑1 ❑2 ❑3 ❑4

19. I've been doing something to think about it less, such as going to movies, watching TV, reading, daydreaming, sleeping, or shopping. ❑1 ❑2 ❑3 ❑4

20. I've been accepting the reality of the fact that it has happened. ❑1 ❑2 ❑3 ❑4

21. I've been expressing my negative feelings. ❑1 ❑2 ❑3 ❑4

22. I've been trying to find comfort in my religion or spiritual beliefs. ❑1 ❑2 ❑3 ❑4

23. I've been trying to get advice or help from other people about what to do. ❑1 ❑2 ❑3 ❑4

24. I've been learning to live with it. ❑1 ❑2 ❑3 ❑4

25. I've been thinking hard about what steps to take. ❑1 ❑2 ❑3 ❑4

26. I've been blaming myself for things that happened. ❑1 ❑2 ❑3 ❑4

27. I've been praying or meditating. ❑1 ❑2 ❑3 ❑4

28. I've been making fun of the situation. ❏1 ❏2 ❏3 ❏4

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