PSYCHOSOCIAL FACTORS IN PERIODONTAL DISEASE AND TOOTH WEAR
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ABSTRACT

This thesis investigates some putative relationships between relevant psychosocial factors (PSFs) and two types of dental disorder, namely, inflammatory periodontal diseases and tooth wear. The first study investigated possible associations between a number of PSFs and adult onset rapidly progressive periodontitis (RPP). It was shown that there was a significant relationship between the combined PSFs and the three periodontal diagnoses of RPP, routine chronic adult periodontitis (RCAP) and no significant periodontal destruction (control group). The RPP group presented significantly more depression and loneliness than the RCAP and control groups. The second study investigated whether a number of PSFs could predict dental plaque levels in a group of patients with two forms of chronic periodontitis (CP): RPP and RCAP. Because gender, smoking and education have been associated with neglect of oral hygiene, their role as predictors of plaque was also examined. In addition, this study investigated whether RPP and RCAP patients differ significantly on plaque and smoking, before their periodontal treatment. It was found that the PSFs were not significant predictors of plaque, and that only gender contributed significantly to the prediction of plaque. Females had significantly less plaque than males, and the RPP and RCAP patients did not differ significantly on plaque. However, RPP patients smoked significantly more than RCAP patients, and there was a marginally significant correlation between depression and smoking. The third study investigated putative associations between a number of PSFs and tooth wear with a significant component of attrition. The results suggested that attrition-tooth-wear patients differed significantly from controls only on trait anxiety. Overall, it was concluded that the PSFs are not equally associated with different forms of CP, they may be of importance to periodontal destruction via a mechanism other than neglect of oral hygiene, and trait anxiety might worsen attrition. Suggestions were made for further research.
ACKNOWLEDGEMENTS

This is a multidisciplinary work and I am grateful to many people for their assistance. First, I would like to thank my two supervisors: Dr. David Arthur Oakley, on the psychological side, and Professor Hubert Neil Newman, on the dental side, for their constant guidance, encouragement and enthusiasm throughout this research.

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Finally, my warm thanks to the women and men who were the subjects of the research described here, revealing their private thoughts, feelings and sorrows because they often believed that in this way they could advance understanding of disease and therefore reduce future suffering. This is the ultimate aim of this work.
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Throughout:
histologic = histological
anatomic = anatomical
physiologic = physiological
immunologic = immunological
epidemiologic = epidemiological

p 21, Figure 8, line 6 - subdivided
p 22, para 1, line 1 - Proceedings
p 64, para 3, line 1 - circumstances
p 78, para 1, line 14 - cardiovascular
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p 102, para 1, line 9 - assessment
            para 3, line 1 - unexplained
p 151, para 2, line 3 - being = been
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Figure 1. The periodontium (Jenkins et al. 1988).

Figure 2. Anatomical relationships of normal gingiva (Löe et al. 1990).
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Chapter 1 - Inflammatory periodontal diseases

If an individual presents only with chronic gingivitis, this does not necessarily imply that the life of the dentition is endangered. Sometimes, however, chronic gingivitis develops into chronic periodontitis. It is important to note, however, that gingivitis does not inevitably progress to periodontitis. On the other hand, although periodontitis is generally preceded by the clinical features of gingivitis, this also is not invariable (Palmer, 1990). The term periodontitis describes a group of inflammatory diseases which cause loss of dental attachment. Periodontitis is identified when periodontal ligament attachment and alveolar bone support of the tooth have begun to be lost. This is associated with apical migration (in the direction of the root apex) of the junctional epithelium onto the root surface, producing spaces (periodontal pockets) adjacent to the CEJ which can be detected by probing (see Figure 5d). Therefore, by definition, periodontitis occurs when the junctional epithelium migrates apically to the CEJ (Genco 1990a). The final result of periodontitis may be the loss of teeth.

These common periodontal diseases - chronic gingivitis and chronic periodontitis - are microbial infections associated with local accumulation of dental plaque (i.e., the deposit that collects around the teeth and is composed mainly of bacteria and their breakdown products), and especially with overgrowth of some of its constituent species, mainly Gram-negative anaerobes. It is worth pointing out here that there are other diseases of the gingiva and periodontal attachment apparatus which are not infections but are caused, for example, by traumatic, cystic, granulomatous, neoplastic, or degenerative processes (Genco 1990a).

Although the inflammatory periodontal diseases, gingivitis and periodontitis, are of local origin, they may be significantly affected by systemic conditions of the patient. Systemic disorders such as diabetes mellitus, leukaemia, agranulocytosis, and acquired immune deficiency syndrome (AIDS), have been shown on occasion to increase the
severity of plaque-induced periodontal diseases (Schluger et al. 1990, Wilton 1991). In addition, preliminary epidemiologic studies suggest that there is a significant association between cardiovascular disease and periodontal disease (Loesche 1994).

**Figure 5. The development of chronic gingivitis and periodontitis** (Jenkins et al. 1988).

a) A healthy gingival sulcus with early supragingival plaque formation.
b) Established chronic gingivitis with minor inflammatory enlargement.
c) Long-standing chronic gingivitis with subgingival plaque extension in a gingival pocket.
d) Chronic periodontitis with destruction of periodontal ligament and alveolar bone and apical migration of epithelial attachment.

Before considering classification of the inflammatory periodontal diseases, it will be helpful to describe their clinical and radiographic features.

Bleeding upon probing between tooth and gingiva is widely accepted as a clinical
sign of gingival/periodontal inflammation (Carranza 1990a). Histological studies have verified the presence of significantly more inflammation in tissues which bleed after stimulation compared to non-bleeding sites (Proceedings of the World Workshop in Clinical Periodontics 1989). However, visibly inflamed sites do not always bleed. Cessation of bleeding on probing has been used for many years to check the effects of periodontal therapy directed towards reduction of inflammation. There is evidence that cessation of gingival bleeding is related to significant reduction in gingival inflammation, repair of gingival connective tissues, pocket depth reduction and sometimes gain in clinical probing attachment (Proceedings of the World Workshop in Clinical Periodontics 1989).

Visual signs such as redness and swelling are also accepted clinical signs of gingival inflammation and have been taken into consideration for evaluating periodontal status. Histological studies have shown that these visual signs of gingival inflammation correspond to a significant inflammatory lesion in the gingival tissues. In summary, bleeding on probing and other visual signs of inflammation are reliable clinical features for determining the presence or absence of inflammatory lesions within the periodontium (Proceedings of the World Workshop in Clinical Periodontics 1989). The importance of these variables in periodontal diagnosis and evaluation of the effects of therapy is well established. However, the associations between them and periodontitis activity, that is, the stage of periodontitis characterized by loss of connective tissue attachment and supporting bone, appear to be weak (Haffajee et al. 1983, Badersten et al. 1987). It will be necessary, therefore, to develop alternative methods and technology for detecting chronic inflammatory periodontal disease activity (Newman & Sanz 1990). Although it is not possible to detect chronic inflammatory periodontal disease activity, it is possible to measure the destruction caused by such activity in the past.

Because periodontitis is associated with the development of periodontal pockets
and attachment loss apical to the CEJ, periodontal probes are used, in addition to evaluation of bleeding on probing, to measure probing pocket depth and probing attachment level. Probing pocket depth is the distance between the gingival margin and the apical limit of periodontal probe tip penetration (Figure 6). Probing attachment level is the distance between the CEJ and the apical limit of periodontal probe tip penetration (Proceedings of the World Workshop in Clinical Periodontics 1989).

**Figure 6. Probing a healthy sulcus** (Jenkins et al. 1988).

These measurements, which estimate these two important consequences of periodontitis, represent an historical record of past chronic inflammatory periodontal disease activity. Until recently pocket formation and loss of connective tissue attachment were thought to be continuous and slowly progressive in routine chronic adult periodontitis, a form of periodontitis which is described later in this chapter. Consequently, when significant pocketing and attachment loss were present, along with clinical signs of inflammation, these probing measurements used to be interpreted as indicating an on-going periodontitis.
However, recent reports on the episodic nature of periodontal destruction have challenged this position (Carranza 1990b), and the diagnostic and prognostic significance of probing measurements is under debate. It is currently assumed that single measurements give a history of past disease activity, but do not distinguish between sites which are quiescent (the lesion is present in its stable form) and active (an on-going destructive process of supporting tissues is present). The distinction between quiescent and active sites can only be determined by longitudinal measurements; however, errors in probing methodology dictate that large differences must occur (2 to 3mm) before a site can be reliably labeled as active (Proceedings of the World Workshop in Clinical Periodontics 1989).

It is important to take into consideration that probing pocket depth and probing attachment loss are measurements which are subject to error. According to the Proceedings of the World Workshop in Clinical Periodontics (1989), the degree of probe tip penetration might be related to thickness of the probe, pressure applied, contour of the tooth, degree of inflammatory cell infiltration, and accompanying loss of collagen fibres. Variability in reports of probe penetration into the pocket and the realization that this was possibly due to uncontrolled probing forces led to the development of controlled force probes. In addition, controlled force probes are becoming automated for measurement and recording of probing pocket depth and probing attachment level, reducing error and subjectivity inherent in manual probing techniques.

Conventional radiographs give a history of bone loss - which is one of the features of periodontitis - but are not able to provide information on periodontitis activity (Carranza 1990c). In addition, although radiographs are used to estimate the severity and pattern of bone loss, they are of no assistance in diagnosis of gingivitis and early periodontitis, as no significant bone changes are present under these conditions.
A. The interdental septum is less than 2mm wide: horizontal bone loss could arise from apical extension of plaque on one or both roots. B. Bone loss on coronal half of tooth 3 where interdental septum is less than 2mm wide could be due to apical extension of plaque on tooth 3 and tooth 4 or tooth 4 alone. Angular defect on mesial of tooth 4 signifies more rapid disease progress tooth 4 than on tooth 3. C. Broad interdental septum mesial of tooth 5 is not affected by periodontitis. D, E. Very wide interdental bone allowing two separate angular defects. F, G. Interdental septum broad enough apically to allow separate angular defects after narrower crestal bone totally destroyed. H. Very wide bone defect. Resorbed surface outside radius of action of tooth-associate plaque, but could be caused either by subsequent mesial drift or bacterial invasion on pocket wall.

From radiographs periodontologists have described two patterns of bone loss (Genco 1990a): i) generalized, horizontal, or even, if the bone loss involves most of the teeth at the same rate; ii) vertical, angular, or uneven, if alveolar bone loss progresses more rapidly in one site than in another (Figure 7). Bone loss can also be seen between roots in furcations, the areas between roots in multi-rooted teeth. In patients with advanced periodontitis, bone loss can extend to the apex (the pointed end of the root) of the tooth which can also exhibit mobility and migration. Under these circumstances the prognosis is frequently poor with the final result being loss of the tooth.

Because there is a lack of a method to measure disease activity, controversies exist as to the nature of the progression of periodontitis. According to the Proceedings of the
World Workshop in Clinical Periodontics (1989), three models have been used to explain destruction of the periodontal supporting tissues: i) continuous paradigm, ii) random burst theory, and iii) asynchronous multiple burst hypothesis. The continuous paradigm suggests that the destruction is slow, constant and progressive. Cross-sectional studies have supported this model. The random burst theory proposes that short periods of destruction, followed by periods of quiescence, occur randomly in relation to time and at random sites within an individual. Longitudinal monitoring of patients has shown that specific sites within individuals may lose several millimeters of probing attachment and significant bone support within several months, while other sites may apparently gain attachment or remain quiescent. According to the asynchronous multiple burst hypothesis, destruction occurs during a specific period of life and the disease then goes into remission. Many sites would show bursts of activity over a limited period of time, followed by an indefinite period of quiescence, most periodontal destruction happening over a period of only a few years. This is what seems to occur with some patients with Localized Juvenile Periodontitis, a form of chronic periodontitis. In summary, there are data to support all three models of periodontal destruction, and it is possible that each of them manifest in different individuals and sites depending on the form of periodontitis present.

Classification and description of inflammatory periodontal diseases have evolved as more information relevant to aetiology, pathogenesis, and host factors has emerged (Genco 1990a). Therefore, present classifications reflect current knowledge and are likely to be supplanted by more precise classifications. This will be a continuing trend until our understanding of the diseases becomes more complete.

According to the American Academy of Periodontology (1986) gingivitis without systemic involvement can be divided into: i) marginal gingivitis, and ii) acute necrotizing ulcerative gingivitis. Marginal gingivitis occurs when sufficient plaque accumulates at the
gingival margin to cause inflammation. It can be characterized clinically by redness, gingival bleeding on probing, oedema or enlargement, and gingival tenderness.

Acute Necrotizing Ulcerative Gingivitis (ANUG) has been known by other names such as trench mouth, Vincent's gingivitis, acute fusospirochaetal gingivitis and acute ulcero-membranous gingivitis (Jenkins et al. 1988). Undoubtedly, microorganisms play an important role in ANUG, as demonstrated by the dramatic response of this disease to antibiotic therapy. This periodontal infection has been associated with fusiform bacilli and spirochaetes, indigenous, normally nonpathogenic, oral bacteria. These microorganisms may appear in large numbers during the disease course and even invade the gingival tissues (Cogen et al. 1983). Although it is generally accepted that ANUG is caused by bacteria, some underlying tissue changes are also necessary to promote the pathogenic bacterial mechanisms. Stress is often implicated as a modifying factor in the onset of the disease (Cogen et al. 1983). It is one of the few painful conditions of the gingiva and is also characterized by a sudden onset. In addition, there is a "foetor oris" or characteristic unpleasant mouth odour, ulceration, and the gingivae become red, shiny and bleed easily. As the name suggests, ulceration is the most characteristic feature of ANUG (Jenkins et al., 1988). Usually the ulcers appear first on the interdental papillae. If severity increases, they will spread to involve the marginal gingiva and, finally, in some untreated cases, the attached gingiva. The ulcers are painful and covered with a white pseudomembrane. ANUG has a noticeable tendency to recur. Multiple episodes may affect the periodontal attachment apparatus and exhibit a characteristic form of periodontitis called necrotizing ulcerative periodontitis.

According to the Proceedings of the World Workshop in Clinical Periodontics (1989) there are four major forms of periodontitis: adult, rapidly progressive, juvenile, and prepubertal (Figure 8). In addition, rapidly progressive periodontitis has been
subclassified as type A and type B, and juvenile periodontitis appears to have both
generalized and localized patterns of destruction; and refractory forms of periodontitis are
also recognized

**Figure 8: The four major forms of periodontitis**

<table>
<thead>
<tr>
<th>1. Adult periodontitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Also called routine chronic adult periodontitis, it is a slowly progressing periodontitis of adults, and the most common form of periodontitis.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Rapidly progressive periodontitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Also referred to as adult onset rapidly progressive periodontitis.</td>
</tr>
<tr>
<td>This form may be subdivided into types A and B, and presents a rapid clinical course with adult onset.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Periodontitis in juveniles</th>
</tr>
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<tbody>
<tr>
<td>It is subdivided into:</td>
</tr>
<tr>
<td>i) localized juvenile periodontitis, a rapidly progressive localized periodontitis in young persons;</td>
</tr>
<tr>
<td>ii) generalized juvenile periodontitis, characterized by rapid severe periodontal destruction around most of the teeth, occurring in a slightly older population than that of the localized form.</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>4. Pre-pubertal periodontitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is a rare and very rapidly progressive periodontitis of the deciduous dentition, and occurs as a generalized or localized disease.</td>
</tr>
</tbody>
</table>

Routine chronic adult periodontitis generally occurs in adults over 35 years of age, and there appears to be no predilection for either sex (Genco 1990a). The rate of pathogenesis of chronic adult periodontitis usually takes years and even decades to progress (Suzuki 1988). The presence of this form of periodontitis and its severity have been directly related to accumulations of plaque and calculus (Suzuki 1988). Dental calculus, mineralized deposits preceded by dental plaque, results from precipitation of calcium-phosphate salts within the organic matrix provided by bacterial plaque, consisting of 70-80% inorganic, mainly crystalline salts (Leung & Jensen 1958). Routine chronic adult periodontitis patients' neutrophil and lymphocyte function seem to be normal (Suzuki 1988). Bacteria associated with routine chronic adult periodontitis vary depending on the
Rapidly progressive periodontitis commonly occurs in young adults, before 35 years of age (Suzuki 1988). As its name implies, it is a form of periodontitis displaying relatively rapid loss of clinical attachment and alveolar bone. Lesions are generalised, affecting most of the teeth, and without a consistent pattern of distribution (Schluger et al. 1990). Establishing this disease as a distinct clinical entity, Page et al. (1983) reported that during the active phase, the gingival tissues are extremely inflamed and there is haemorrhage, proliferation of the marginal gingiva, and exudation. They also reported that this phase may be accompanied by general malaise, weight loss, and depression, although these symptoms are not observed in all patients. Rapidly progressive periodontitis may be subclassified as type A and type B. Rapidly progressive periodontitis type A occurs in young adults, and characteristically in the early twenties through mid-thirties (Proceedings of the World Workshop in Clinical Periodontics 1989). The disease is characterized by severe gingival inflammation and rapid loss of connective tissue attachment and alveolar bone support. Approximately 66% of affected persons have a depressed neutrophil chemotaxis response (reduced migration of neutrophils to a chemotatic agent) or a depressed Autologous Mixed Lymphocyte Response (AMLR) (Proceedings of the World Workshop in Clinical Periodontics 1989). Although not well understood, the AMLR is a proliferative response of normal T cells when stimulated in vitro by autologous non-T cells. The AMLR is taken to be an in vitro correlate of immunoregulation. Consequently, it is possible that the AMLR may detect systemic immunoregulatory phenomena in chronic inflammatory periodontal disease and that aberration in the AMLR may be a manifestation of the disease, reflecting disease activity (Seymour et al., 1986). It is probable that there are genetic predisposing factors associated
with type A rapidly progressive periodontitis (Suzuki 1988). Type B rapidly progressive periodontitis is found in a slightly older age group, 26 to 35 years, and it may be related to significant plaque and calculus (Suzuki 1988, Proceedings of the World Workshop in Clinical Periodontics 1989). Immune and genetic factors have not been significantly investigated.

Routine chronic adult periodontitis and its severity have been directly related to accumulations of plaque (Suzuki 1988). On the other hand, the extension and severity of periodontal destruction in adult onset rapidly progressive periodontitis is not commensurate with observed plaque levels, that is, the amount of destruction is greater than would be expected on the basis of the present plaque levels (Carranza 1996). However, it appears that no study has examined whether there is a statistically significant difference between patients with adult onset rapidly progressive periodontitis and patients with routine chronic adult periodontitis concerning level of accumulation of plaque. This question will be considered later in chapter 3.

Juvenile periodontitis with localized patterns of destruction usually becomes evident around puberty and is characterized by severe angular bony defects, typically in relation to the first permanent molars and, sometimes, incisors (Proceedings of the World Workshop in Clinical Periodontics 1989). Localised juvenile periodontitis is characterized by a high prevalence of the gram negative bacterium *Actinobacillus actinomycetemcomitans* (Van Dyke & Vaikuntam 1994). The amount and severity of destruction are inconsistent with the relatively sparse plaque and lack of clinical signs of severe gingival inflammation (Genco 1990a). In general, lesions are bilaterally symmetrical (Genco et al. 1986). The rate of attachment loss is three to five times more than in adults (Proceedings of the World Workshop in Clinical Periodontics 1989). Numerous studies have pointed out the familial tendency of the disease (Genco 1990a), which appears to
have a genetic basis, and patients often present depressed neutrophil chemotaxis (reduced migration of neutrophils to a chemotactic agent) and phagocytosis (engulfment of foreign matter) which do not disappear after successful treatment (Proceedings of the World Workshop in Clinical Periodontics 1989).

As its subclassification indicates, juvenile periodontitis with generalized patterns of destruction is characterized by rapid severe periodontal destruction around most of the teeth, and usually presents between ages 12 to 30 years (Proceedings of the World Workshop in Clinical Periodontics 1989). The mean age of generalized juvenile periodontitis patients is slightly greater than that of localized juvenile periodontitis patients. According to Genco (1990a), it may involve two or more types of periodontal diseases, including patients who have early-onset adult periodontitis and others who have had localized juvenile periodontitis that has progressed to a generalized form. In general patients present severe gingival inflammation with extensive plaque and calculus formation (Genco 1990a). This severe gingival inflammation differentiates it from localized juvenile periodontitis. Moreover, generalized juvenile periodontitis is associated with a neutrophil chemotactic disorder (Proceedings of the World Workshop in Clinical Periodontics 1989).

Prepubertal periodontitis is not a common condition and occurs as a generalized or localized disease. Generalized prepubertal periodontitis affects primary and secondary teeth and starts at the same time as eruption of primary teeth (Proceedings of the World Workshop in Clinical Periodontics 1989). It is characterized by severe gingival inflammation, rapid bone loss, mobility, and ultimately tooth loss. Patients usually present polymorphonuclear and mononuclear defects, and they may also be subject to other infections such as otitis media and upper respiratory tract infections (Proceedings of the World Workshop in Clinical Periodontics 1989). On the other hand, localized prepubertal periodontitis affects only some of the primary teeth, is less aggressive, and may be related
to defective polymorphonuclear or mononuclear leukocytes, but not both at the same time (Proceedings of the World Workshop in Clinical Periodontics 1989).

Finally, some cases of the four major forms of periodontitis above described may be classified as refractory periodontitis, which is characterised by multiple sites with disease in patients who continue to demonstrate attachment loss after apparently adequate therapy (Proceedings of the World Workshop in Clinical Periodontics 1989).
CHAPTER 2:
PSYCHOSOCIAL FACTORS IN INFLAMMATORY PERIODONTAL DISEASES

2.1 Introduction

Having previously considered the current description and classification of inflammatory periodontal diseases, the present chapter initially focuses on the complex aetiology of these diseases and the putative importance of psychosocial factors. This is followed by a review of human studies, laboratory animal studies and possible mechanisms of action of psychosocial factors on periodontal tissues.

2.2 Aetiology of Inflammatory Periodontal Diseases: The Putative Role of Psychosocial Factors

The aetiology of inflammatory periodontal diseases is complex. There are many processes at work, and no single one of these appears to be sufficient as the causative factor in all cases (Moulton et al. 1952, Gupta 1966, Meyer 1989).

Although there is irrefutable evidence that the presence of bacterial plaque is a necessary condition for the development of inflammatory periodontal diseases (Genco 1990b), the view that everyone will respond in the same way to dental plaque is overly simplistic. For instance, in some individuals gross deposits of plaque may not be associated with significant periodontal destruction, while in others low accumulation of plaque is accompanied by severe destruction, which may be either generalized or highly localized. It is important to take into consideration the fact that inflammatory periodontal diseases result from the interaction of the host defence mechanisms with the microorganisms (Seymour 1991).

Workers in the field have demonstrated the aetiological significance in inflammatory
periodontal diseases of biological and behavioural risk factors, including systemic conditions, smoking, oral cleanliness, and age. However, a significant proportion of the variation in disease severity cannot be explained taking only these factors into consideration (Marcenes & Sheiham 1992). The remaining variance, at least in part, may be explained by important psychosocial factors.

Seymour (1991) presents a model of chronic inflammatory periodontal disease in which genetic factors, such as those underlying immune responses, divide the population into two groups, non-susceptible and susceptible. In general the periodontal tissues of susceptible individuals are in balance with their oral flora, and any lesion of the periodontium is present in its stable form. Progressive disease results when this balance is disrupted, and this may involve a depression of immune responsiveness as a result of factors such as physical and mental stress (Ballieux 1991).

Several workers in the field have pointed out a possible association between psychological factors and inflammatory periodontal diseases on the basis of their clinical observations (De Marco 1976, Lowental 1981, Davies et al. 1985, Newman 1993).

2.3 Human Studies

In addition to clinical observations, periodontologists have conducted studies which have generally yielded positive correlative findings between psychosocial factors and inflammatory periodontal diseases. Most of these have used clinical populations.

In an early study Moulton et al. (1952) investigated patients who presented with particularly severe periodontal disorders - six cases of ANUG and sixteen cases of chronic periodontitis - to see whether there were associations between the degree of periodontal breakdown and personality variables. They described these patients as "oral dependents", characterized as less helpful, more demanding, and in need of counselling. The cases of
ANUG occurred in the youngest patients and in all cases symptoms were preceded by acute anxiety arising from a conflict about dependency and/or sexual needs. According to the investigators, local factors and oral habits were of minimum aetiological influence. The chronic periodontitis cases presented a background of longstanding, less acute conflict, mainly related to dependency needs. There was significant marital conflict and many psychosomatic symptoms involving the head, neck, and gastric areas. Furthermore bleeding gums were often observed at times of greatest anxiety, and bruxism was a frequent habit among these patients.

Baker et al. (1961) undertook a study to clarify the role of psychosocial factors in the periodontal disease process. A total number of 102 subjects participated: forty normals, 26 psychotics and 36 psychoneurotics. All were examined by a periodontologist, and two periodontal disease measures were used: bone resorption and probing pocket depth. The subjects were also given the Minnesota Multiphasic Personality Inventory (Hathaway and McKinley 1951) and were rated on thirty-five objective, personal history, and personality variables. The results indicated that there were significant correlations between a compound periodontal disease measure (average amount of bone resorption and average depth of pocket) and age, broken home, marital adjustment, somatization and hysteria scores. The two component parts of this "periodontal score" were correlated separately with each of the personality factors which presented significant relationships with the combined measure. They found that the estimates of bone resorption yielded, on average, much higher correlations with personality factors than did average depth of pocket alone.

Belting and Gupta (1961) tested the hypothesis that psychiatric disturbances predispose to the development of inflammatory periodontal disease. The experimental group consisted of 104 patients who were receiving psychiatric treatment at the outpatient clinic of the Veterans Administration West Side Hospital in Chicago. The control group
Chapter 2 - Psychosocial factors in inflammatory

consisted of 122 patients who were receiving treatment for conditions other than psychiatric disturbances at the same clinic. Patients' age ranged from 20 to 65 years. Patients having less than six teeth were excluded from the study. No attempt was made to control for the effects of systemic disorders which may worsen periodontal conditions. Using Russell's (1956) method, a periodontologist scored the periodontal status of each subject as follows: 0 = negative (healthy), 1 = papillary gingivitis, 2 = marginal gingivitis, 4 = radiographic evidence of alveolar bone resorption (not used in this study), 6 = gingivitis with pocket formation, 8 = advanced alveolar destruction with mobility. The sum of the numerical values for all teeth in the mouth was divided by the number of teeth present to obtain the Russell's score for each subject. The results indicated that the experimental group of psychiatric patients presented statistically significant higher levels of periodontal disease than the control group up to 50 years of age. The authors report that over 50 years the difference was in the same direction but was not significant, possibly due to the small number of patients over 50 years. The nature of the association between psychiatric disturbances and periodontal disease was evaluated by analysing the differences between the two groups on the following factors: brushing frequency, degree of calculus, bruxism, and degree of anxiety. The results showed a tendency for the severity of periodontal disease to decrease as brushing frequency increased, although the decrease was not statistically significant in either group. When they compared subjects having the same daily brushing frequency from the two groups, they found that the psychiatric group presented significantly higher periodontal scores than the control group. The percentage of patients reporting the same brushing frequency was about the same in both groups. Consequently, brushing frequency could not explain the difference in periodontal disease severity between the two groups. The severity of periodontal disease increased significantly in both groups as the degree of calculus increased. They also found more "moderate" and "heavy" calculus in the
psychiatric group than in the control group. According to the authors, this latter finding suggested that differences in the amount of calculus might be producing higher periodontal scores. In order to evaluate this possibility the average periodontal scores in both groups were compared while maintaining constant the degree of calculus and brushing frequency. Under these conditions the psychiatric group continued to show significantly higher scores than the control group, suggesting that some factor other than calculus and brushing frequency was producing the higher periodontal scores in the psychiatric group. Bruxism was found to be more prevalent among the psychiatric than the control subjects. Surprisingly, however, there was no significant difference in the severity of periodontal disease between subjects who bruxed and those who did not. There continued to be no significant difference when calculus and brushing frequency were held constant. Looking at more general factors, the severity of periodontal disease was found to decrease significantly in both groups as educational level increased. However, the correlation between income level and severity of periodontal disease was not significant. In attempting to explain the association between educational level and the severity of periodontal disease, the average brushing frequencies at different educational levels were compared. A highly significant difference in brushing frequency was found between grade 8 and college levels. According to the authors, this finding suggests that increased brushing frequency played an important role in decreasing the severity of periodontal disease at the higher educational levels. An assessment of the degree of anxiety manifested by each psychiatric patient was carried out by the psychiatrist based upon his knowledge of the case history of the patient. This information was not obtained for the control patients. When calculus and brushing frequency were held constant, the severity of periodontal disease increased significantly as the degree of anxiety increased. In conclusion, this study's results indicate that mental disturbances and periodontal disease are associated. Moreover, this association appears to
be due to some, as yet unknown factors, other than poor oral hygiene habits, excessive calculus or bruxism. The authors suggested that the periodontal changes seen in the psychiatric patients are mediated through one or more processes related to anxiety, and under the control of the autonomic nervous system.

Davis and Jenkins (1962) conducted a study to determine possible correlations between what they called "psychological measures of stress" and periodontal disease. Subjects were patients recently admitted to the wards of the Psychiatric Center of the North Carolina Memorial Hospital. According to the authors, these patients were selected because they had not been subject to an institutional environment for more than a few weeks, and were known to be experiencing various degrees and kinds of psychological disturbance. Subjects were given the Minnesota Multiphasic Personality Inventory, MMPI (Hathway and McKinley 1951). For the purposes of this study, emotional stress was operationally defined in terms of the scales of the MMPI. The following scales of this personality inventory were selected as being representative measures of emotional stress and the defences against it: depression, hysteria, mania, schizophrenia, repression, and anxiety. All subjects were given a dental examination, and Russell's (1956) periodontal index (described above) was used to measure periodontal status. Eighty-nine subjects were used in the analysis of data. Their ages ranged from seventeen to sixty-eight years, with a median of thirty-six years. Statistically significant relationships were found between the periodontal index and anxiety, schizophrenia, depression, and mania. Since the schizophrenia score and the anxiety score were highly correlated (0.78), the authors controlled for the effect of the schizophrenia score by a partial correlation, but the remaining correlation between periodontal index and anxiety was 0.45, still highly significant. According to the authors, this suggested that discomfort and inner turmoil or anxiety is associated with periodontal disease even when the disorganization and the
deterioration of psychosis, as measured by the MMPI schizophrenia scale, is an excluded factor. When the anxiety score effect was controlled by the same method, the correlation between schizophrenia score and periodontal index was reduced to -0.05. So, the authors concluded that the schizophrenic component is not the fundamental element in these relationships. Anxiety, then, remained as a contributing factor to consider in the aetiology of inflammatory periodontal disease. The authors also considered the likelihood that there were elements of anxiety present in both manic and depressive conditions. When anxiety was controlled through partial correlation, the statistical relationships between periodontal index and mania score and between periodontal index and depression were reduced to insignificant levels. In summary, only anxiety remained significantly correlated with periodontal index. The authors speculated that anxiety alters concentrations of adrenal corticoids and other hormones which might adversely affect the periodontium.

Vogel et al. (1977) evaluated the relationship of neuroticism and introversion to periodontal disease and plaque scores. Fifty subjects, registering for treatment at a dental school clinic, were initially selected for this study. For each patient the authors collected the: name, age, sex, and medical and dental history. Patients with systemic disease or taking any drug which could affect the periodontium were excluded. In addition, all subjects were above the age of 21 years and had at least five teeth in each quadrant of the oral cavity. For each subject a full-mouth series of radiographs was taken. The degree of periodontal disease was evaluated using Ramfjord's (1959) periodontal index on the following teeth: maxillary right first molar, left central incisor and first premolar, and the mandibular left first molar, right central incisor and first premolar. Ramfjord's periodontal disease index - as Russell's (1956) periodontal index used in the two last described studies - is a composite measure, making use of both reversible and irreversible signs of periodontal disease. Therefore, in this study as in the previous two, gingivitis and periodontitis were not
evaluated separately, which would have been desirable since they are distinct clinical entities. After recording the periodontal index score, the same examiner derived a plaque index score (Podchadley & Hogley 1968) utilizing the same six teeth. In addition, radiographs were analysed to determine bone loss. For each of the teeth clinically evaluated, a radiographic score ranging from 0 to 3 was given by one examiner. A score of zero indicated no bone loss. A score of one was given when there was crestal bone loss of less than one third of the total osseous support of the tooth. A score of two indicated that bone loss was between one third and two thirds of the root length, and a score of three showed that more than two thirds of the osseous support was lost. Each subject was also evaluated for extroversion-introversion and neuroticism-stability using the Eysenck Personality Inventory (Eysenck & Eysenck 1968). All data were subjected to statistical analysis by a two-tailed coefficient of correlation test. Statistically significant correlations were found between clinical and radiographic measures of periodontal disease, as well as between these two variables and age and plaque. Statistically significant correlations were also found between introversion and plaque, and between introversion and periodontal disease as measured both clinically and radiographically. Significant correlations were not found between neuroticism and plaque or between neuroticism and clinical measures of periodontal disease. However, there was a significant correlation between neuroticism and radiographic measures of periodontal disease, as well as between neuroticism and age. In conclusion, this study seems to corroborate previous findings which have demonstrated that both age and plaque are significantly associated with periodontal disease. Since a highly significant correlation was found between plaque and introversion, it was not surprising to find a similar relationship between introversion and periodontal disease. These findings appear to indicate that the relationship between introversion and periodontal disease may well be explained by introverts having greater amounts of plaque.
Ludenia and Donham (1983) examined the relationship between health locus of control and the following variables: age, depression, trait anger, trait anxiety, and dental ratings of oral hygiene and inflammatory periodontal disease. Locus of control has been defined as the degree to which individuals perceive events in their lives as being a consequence of their own actions, and thereby controllable (internal control or internality), or as being the result of forces beyond their control, and therefore due to chance, fate, or powerful others (external control or externality) (Lefcourt 1976). Subjects were 101 male outpatients at a Veterans Administration Medical Centre. Patients being treated by Psychiatry Service were excluded from this sample. Each subject was tested individually with the following psychological instruments: The Multidimensional Health Locus of Control Scale (Wallston and Wallston, 1978), Beck Depression Inventory (Beck, 1967), the Trait Anger and the Trait Anxiety Subscales of the State-Trait Personality Inventory (Spielberger et al., 1979). [Psychological trait variables refer to an inherited or acquired characteristic which is relatively consistent, persistent and stable (Wolman 1989). State variables, on the other hand, are conceptualized as transitory states or conditions which may vary in intensity and fluctuate over time.] Before filling out the psychological instruments, each subject was rated by one of the dentists on a four-point scale that indicated status of oral hygiene and presence of periodontal disease. Unfortunately, the authors did not describe the criteria used to rate subjects on the four-point scale. The study found that trait anxiety, depression and trait anger were correlated negatively and significantly to health internality. Trait anxiety was related positively and significantly to both health externality and powerful others externality. Moreover, there was a significant positive correlation between age and powerful others externality, which suggests that older dental patients tended to place greater reliance on health professionals for dental health. Contrary to the authors' prediction, status of oral hygiene and degree of periodontal disease were not
correlated to either health internality or health externality.

As maintenance of oral care - specifically, continuing to keep regular appointments with a periodontologist - may be crucial in terms of sustaining periodontal health, Becker et al. (1988) conducted a study to determine whether personality differences exist between patients who have had periodontal therapy and showed maintenance of care compared to those who had periodontal therapy, but did not display maintenance. They used the adjective check list to evaluate patients' personality differences, and the results indicated a tendency (p=0.06) to personality differences between the two groups. The maintained care group tended to have higher achievement, endurance, affiliation and positive image scores than did the patients not showing maintenance.

Possibly because of its very nature (acute painful onset, short duration, ease of diagnosis, and multiple predisposing factors), acute necrotizing ulcerative gingivitis (ANUG) is the most studied periodontal disorder in relation to psychosocial predisposing factors.

On examining 9,577 men in the Danish defence forces during the years 1945 to 1948, Pindborg (1951) concluded that after some months of service there was a considerable increase in the number of ANUG cases. In a study with the objective of circumscribing ANUG symptomatology and finding a more efficient method of treatment, Grupe and Wilder (1956) reported that ANUG was present in 2.2% (58 ANUG cases among 2,622 examined) of a newly inducted army personnel population. This, plus the coincidence of ANUG with nail biting suggested a psychosomatic aetiological factor. Giddon et al. (1963), in an epidemiological study of a university population, reported that the monthly prevalence of ANUG appeared to have some relation to situational factors such as academic examinations or vacation periods. Reviewing the literature, Goldhaber and Giddon (1964) concluded that the most conspicuous ANUG predisposing factors were
smoking, gingivitis, or local trauma, in association with acute psychological disturbance precipitating the disease in susceptible individuals.

Evidence for the relationship between emotional conditions and acute necrotizing ulcerative gingivitis also comes from quasi-experimental studies in which individuals were assessed over time while exposed to naturally occurring stressful situations. Formicola et al. (1970) compared some personality traits of two groups of student naval aviators. All subjects were experiencing a situation presumed to be stressful: the indoctrination phase of preflight training. Group 1 consisted of 41 preflight students with ANUG. Group 2 also consisted of 41 preflight students; however, they were randomly selected as a control group at the time of dental examination. The control group subjects were chosen on the basis that they had healthy gingiva with no present or past history of ANUG. The ANUG group was scored on the basis of the severity and extent of the disease. All 82 subjects completed the Edwards Personal Preference Profile. This inventory examines 15 individual personality traits such as achievement, dominance and heterosexuality. The results indicated that two personality traits, dominance and abasement, correlated significantly with the severity and the extent of ANUG. The correlation between dominance and ANUG was positive while, perhaps not surprisingly, the correlation between abasement and ANUG was negative. The investigators suggested that suppression of dominance during military training could create emotional disturbance and a subsequent increase in ANUG incidence, since a dominant type of individual would not be able to argue a point of view or exhibit leadership during this training period.

Another military personnel study by Shields (1977) evaluated the significance of possible explanatory factors by comparing ANUG patients with a random sample of dental patients of the same age group. The explanatory factors evaluated, using a patient questionnaire, were stress, smoking and oral hygiene. ANUG patients believed themselves
to be under more emotional stress than the control group. A greater percentage of ANUG patients felt that they were debilitated in some way, such as being subject to colds, sore throats, etc. More patients with ANUG smoked than did patients in the control group. They also appeared to smoke more cigarettes daily than the random sample of controls.

Shannon et al. (1969) investigated the putative relationship between stress, as measured by urinary steroid excretion rate, and ANUG. Subjects were 474 males ranging in age from 17 to 22 years. Each subject received a medical examination and was considered suitable for military duty. All subjects had to collect urine at 10:00 pm on the previous night. They also collected all urine voided during the night as well as the urine force-voided at 6:00 am the next morning. All urine samples were treated with beta-glucuronidase and analysed for 17-hydroxy-corticosteroid (17-OHCS) content. Subjects received oral evaluation and were divided into six groups according to gingival and periodontal status: slight gingivitis, moderate gingivitis, severe gingivitis, periodontitis, necrotizing ulcerative gingivitis, and normal. Although the mean excretion rate of 17-OHCS for the ANUG group was considerably higher than the normal group as well as groups with gingivitis or periodontitis, there were no significant differences between the means of any of the groups. It is important to note that the authors did not describe the criteria used to divide the subjects into those six groups. In addition, they did not reveal the number of subjects in each group. According to the investigators the lack of significant differences between the means of any of the groups can be attributed to the large variance in the 17-OHCS measurements and to the small number of subjects with ANUG.

The normal range of 17-OHCS in males is 3 to 16mg/24 hours. Because of this wide normal variation, an extremely large sample population would be necessary to show a statistically significant difference. To cope with this problem, Maupin and Bell (1975) designed a study using each patient as an experimental subject during the course of ANUG
and as his own control after the resolution of the disease. At the initial visit each patient who wanted to take part in the study was asked to collect a 24-hour urine sample to be analysed for 17-OHCS. When the ANUG was resolved, a second 24-hour urine sample was collected. All of the eleven subjects presented higher 17-OHCS levels during the course of ANUG than after resolution of the disease. During ANUG, the average 17-OHCS rate was 10.5 mg/24 hours with a range from 6.7 to 16.3. After resolution, the average 17-OHCS level was 8.1 mg/24 hours with a range from 4.4 to 13.9. A paired t-test showed that the reduction in 17-OHCS was statistically significant. Furthermore, all subjects were questioned about any stressful situation or personal problems. Most of them, nine subjects, could identify stressful events or personal problems that they felt were of special concern. However, the authors did not clarify whether these events preceded or occurred during the ANUG episode.

Cohen-Cole et al. (1983) conducted a study to clarify the postulated role of stress and immunodepression in ANUG. Psychosocial, endocrine, and immune variables were measured. Although the data on immune function were reported elsewhere (Cogen et al. 1983), the complete results of this investigation will be reported here. Initially, 35 patients showing ANUG and 35 controls, matched for age, sex, and dental hygiene, filled out rating instruments, gave blood, and collected overnight and spot urines. Rating instruments and urine collections were repeated two weeks later, after resolution of ANUG. Because of funding limitations, blood tests of immune and endocrine function were not repeated. The following psychosocial instruments were used: The Spielberger State and Trait Anxiety Inventory (Spielberger et al. 1970); the General Health Questionnaire (Goldberg 1978); the Center for Epidemiological Studies Depression Screening Test (Comstock & Helsing 1976); the Minnesota Multiphasic Personality Inventory (Dahlstrom & Welsh 1960) which was only used after the resolution of ANUG; Dohrenwends' 102-item Life Events Scale
Because of clinicians' anecdotal reports that ANUG frequently appears to be precipitated by very recent traumatic events, an open-ended very recent life events instrument was developed to be used in this study. The immunologic assays included white blood cell count, polymorphonuclear leukocyte responsiveness to chemotaxis and phagocytosis, and lymphocyte responsiveness to stimulation by nonspecific mitogens (concanavalin A, purified protein derivative from tubercle bacilli and phytohaemagglutinin).

Several endocrine variables that have been reported to be related with stress were measured: overnight urine free cortisol, spot urine free catecholamines, and serum cortisol, growth hormone, and prolactin. Results revealed that compared to controls ANUG patients presented the following significant differences: i) more state anxiety before disease resolution, while trait anxiety was higher both during ANUG and after its resolution; ii) higher scores on the depression and psychopathic deviation scales of the MMPI; iii) a greater magnitude of recent stressful events; iv) more life events during the previous year, more overall distress and readjustment related to these events, and also more negative life events; v) higher scores in the emotionally disordered range on the General Health Questionnaire and in the depressed range on the Center for Epidemiological Studies Depression Screening Test, before and after disease resolution; vi) elevated serum cortisol levels before ANUG resolution, and elevated overnight urine-free cortisol before and after disease resolution; vii) depressed lymphocyte proliferation as measured after a mitogen (Concanavalin A) stimulation; and viii) depressed PMN leukotaxis and phagocytosis. These findings provide preliminary support for the hypothesis that stress is a predisposing factor for ANUG, and that endocrine and immune alterations may mediate the relationship between psychosocial factors and ANUG. According to the authors, the significant associations of psychosocial, endocrine and immune variables that emerged from this study provide a basis for a plausible causal hypothesis which can be adequately tested in
prospective research designs. They also suggest further prospective investigation into the relationship between personality traits, as measured by the MMPI, and subsequent development of ANUG in high-risk populations, proposing the following model: psychological disturbance (for instance, trait anxiety, depression, and/or psychopathic deviance) - impact of life events (stress) - increased cortisol - depressed immunity - ANUG.

Although earlier studies focused on the relationship between stressful life situations and ANUG scores, the first study systematically to relate self-reported measures of stressful life events and periodontal disease generally (gingivitis and periodontitis) in humans appears to have been that reported by Green et al. (1986). Subjects were fifty male veterans. Oral evaluations were carried out to quantify the degree of gingival and periodontal pathology, without evaluating separately gingivitis and periodontitis. Evidence of somatic symptomatology was assessed with the Somatization Subscale of the Brief Symptom Inventory, which is an abbreviated version of the SCL-90-R (Derogatis et al. 1976). Somatic symptomatology reflects distress arising from perceptions of bodily dysfunction, e.g., headaches, faintness and pain in the heart or chest. Stressful life events were quantified with the Life Experiences Survey (Sarason et al. 1978). Age, highest educational grade completed, smoking status and oral cleanliness were controlled statistically through the use of partial correlations. The results indicated a significant association between stressful life events and periodontal disease status. Moreover, a subset of the subjects was identified for whom the relation between life events and periodontal disease was particularly conspicuous. These individuals obtained high scores on the Somatization Subscale of the Brief Symptom Inventory. Similarly, Marcenes et al. (1993) investigated the association between eight specific negative life-events and self-reported oral symptoms (toothache or trouble with the gums). After the authors adjusted for the other variables studied, marital or family problems was the only variable which remained
More recently, Marcenes and Sheiham (1992) undertook a correlational study to establish whether oral health status is associated with work stress. They studied three work characteristics related to stress: work mental demand, work control and work variety. Since oral health is strongly related to age this variable was standardized, and the subjects were equally distributed over four socio-economic groups. A clinical examination recorded the number of decayed, missing and filled tooth surfaces, periodontal pockets and the presence of gingival bleeding on probing. Questionnaires were used to measure psychosocial factors (work demand, work variety, work control, and marital quality) and the following behavioural risk data: frequency of dental attendance, toothbrushing frequency, sugar consumption and type of toothpaste. Both of these sets of variables were considered, along with age and socio-economic status, in the statistical analysis. The authors did not find significant association between dental caries status and any of the work stress variables. However, a significant association was found between periodontal health status and work related mental demand and marital quality. In addition, the relationship between work mental demand and periodontal status was independent of the risk-related behaviours. Possible alternative mechanisms suggested by the authors to explain how psychosocial factors may affect periodontal tissues included alterations in saliva flow and immune system suppression.

2.4 Laboratory Animal Studies

There are a few laboratory animal studies that might suggest a causal relationship between stress and inflammatory periodontal disease. Making use of a variety of stressors, most of these experiments were based on Selye's concept of the general adaptation syndrome (Selye 1946, 1948, 1975). Selye's stress model is described in the next chapter.
Ratcliff (1956), for instance, stressed rats by adhesive tape immobilization and withholding of food for 68 hours. The histologic observations revealed the following pathologic alterations in the periodontium of the experimental animals compared to controls: i) a marked sloughing of the keratinized layers of the free gingival epithelium, ii) a definite split in the gingival crevicular epithelium, iii) degeneration of the connective tissue of the periodontal ligament, and iv) reductions in the numbers of osteoblasts and cementoblasts. However, these changes could have been the result of food deprivation rather than emotional stress.

Fedi (1958) produced stress in Syrian hamsters with cold, water bath exposure and violent physical exercise, and 10 percent formalin injections, each for a two-week period. The experimental animals presented a stress reaction which included irregular arrangements of periodontal ligament principal fibres, osteoblasts and new bone formation. It is important to note that in this and other animal experiments the effects of emotional and physical stress cannot be distinguished.

Stress induction in rats and hamsters with an intermittent ringing of bells and exposure to bright lights was carried out during a twelve-week investigation by Gupta et al. (1960). They found that the differences in the number and extent of calcified tissue lesions between the control and experimental hamsters were of moderate statistical significance. The findings suggest that the hamsters were more susceptible than the rats to the effects of stress in the periodontium. Histologic examination in the stressed animals indicated that the most pronounced changes were in the alveolar bone, with endosteal osteoporosis in the interradicular septi and osteoclastic activity at the alveolar crest.

Studying the effect of repeated pregnancies and subcutaneous injections of ACTH upon rat periodontium, Karren and Ingle (1964) found a statistically significant greater
severity of inflammatory response of the papillae of the experimental subjects as compared
with the same area of the controls. Furthermore, a statistically significant difference was
also observed in the more apical level of the epithelial attachment of the experimental
animals. However, it is important to take into consideration that pregnancy has many
specific body effects and therefore these results may not be exclusively attributable to
stress.

Shklar and Glickman (1953) observed no gross or microscopic alterations in the
periodontal tissues of rats stressed with injections of 4 percent formaldehyde in the groin
(four injections within forty-eight hours). Because they considered that the forty-eight hour
period of stress used in this experiment was insufficient to produce changes in the
periodontium, the authors went on to study the periodontal tissues in rats subjected to
stress, in this case cold, for longer periods of time: two weeks, one month, and four months
(Shklar & Glickman 1959). After two weeks the experimental rats exposed to cold showed
evidence of alveolar bone osteoporosis and some periodontal ligament changes. However,
after the four-month experimental period, the periodontium of the experimental animals was
essentially normal. The authors concluded that adaptation occurred minimizing the initial
harmful effects.

Studying gingival injury healing processes in rats under stress (injections of 0.5 ml
of turpentine into the hind leg) Stahl (1961) found that the injured-stressed animals showed
a delay in the organization of the connective tissue in wound areas, and a striking reduction
in osseous regeneration of the alveolar ridge as compared to the wounds of non-stressed
rats.

Cohen et al. (1969) subjected 150 mice to three different stressor agents. Mice
receiving daily injections of cortisone demonstrated changes in the periodontium
characterized by apical proliferation of epithelial attachment, periodontal pocket formation,
calculus deposition, inflammation and alveolar bone loss. Mice subjected to cold stress (2 degrees Celsius) from one to four weeks presented minor changes characterized by decreased osteoblastic activity. No changes of the periodontium were found in mice receiving 0.05 mg. of adrenalin daily for one month.

2.5 Possible Mechanisms of Action of Psychosocial Factors on Periodontal Tissues

Although few studies have been performed, workers in the field have since the middle of this century proposed mechanisms which could mediate the putative relationship between psychosocial conditions and inflammatory periodontal diseases (Miller and Firestone 1947, Corby 1947, Gilbert 1947, Moulton et al. 1952, Bricken 1953, Zaidens 1954, Moulton 1955, Davis & Jenkins 1962, O'Leary et al. 1962, Rubin 1963, Gupta 1966, Ringsdorf & Cheraskin 1969, Manhold et al. 1971, Clarke et al. 1981, Meyer 1989).

The mechanisms offered include neglect of oral hygiene, changes in diet, increase in smoking and other pathogenic oral behaviours, bruxism, alterations in gingival circulation, changes in saliva, endocrine imbalances, and lowered host resistance. By examining these mechanisms it is evident that some may involve psychologically-related changes in behaviour which enhance vulnerability to periodontal breakdown. For instance, intensity of oral health behaviour, such as toothbrushing and other home dental care, may decrease during periods of psychological distress, while rates of oral pathogenic behaviour such as bruxism, smoking, other drug use or adverse dietary practices can increase (McGlynn et al. 1990). On the other hand, there are mechanisms involving physiologic pathways through which psychosocial factors may influence periodontal tissues: alterations in saliva, changes in gingival circulation, endocrine imbalances, and lowered host resistance. Each of these hypothesized mechanisms will now be considered briefly.
Many authors have reported that psychological disturbances can lead patients to neglect oral hygiene and that the resultant accumulation of plaque and calculus is detrimental to the periodontal tissues (Miller & Firestone 1947, Moulton et al. 1952, Gupta 1966, Ringsdorf & Cheraskin 1969, Meyer 1989). Belting and Gupta (1961), comparing psychiatric patients with controls found that the severity of inflammatory periodontal disease increased significantly in both groups as the level of calculus increased. They also found more moderate and heavy calculus in the psychiatric group than in the control group.

Emotional conditions are thought to modify dietary intake, thus indirectly affecting periodontal status (Miller and Firestone 1947, Moulton et al. 1952, Zaidens 1954, Gupta 1966, Ringsdorf & Cheraskin 1969, Meyer 1989). This can involve, for instance, excessive quantities of refined carbohydrates and softer diets, requiring less vigorous mastication and therefore predisposing to plaque accumulation at the approximal risk site (Newman 1974).

Among the many harmful oral habits which are believed to be induced by emotional disturbances, smoking is possibly the most important in relation to worsened periodontal conditions (Rivera-Hidalgo 1986, Haber 1994). The following effects of circulating nicotine have been mentioned: i) vasoconstriction, produced by the release of adrenaline and noradrenaline, which is supposed (Manhold 1956) to result in a lack of nutrients for the periodontal tissues; ii) suppression of in vitro secondary antibody responses (Roszman & Rogers 1973).

Bruxism, which is thought to be due to stress (McGlynn et al. 1990), has been considered of aetiological importance in chronic inflammatory periodontal disease (Goldberg 1973, Meyer 1989). However, it is difficult to find scientific evidence to substantiate this claim, which seems to be basically supported only by clinical observations.

Manhold (1956), taking into consideration that emotional conditions provoke an increase in sympathetic outflow resulting in release of neurotransmitters (such as adrenaline
and noradrenaline) causing vasoconstriction of the peripheral vasculature, hypothesized that long continued or extreme emotions could affect periodontal tissues by a physical mechanism. The constant constriction of the blood vessels would produce a lack of oxygen and nutrient materials for the periodontal tissues. In two subsequent experiments Manhold et al. (1971) found a lower ability by the tissues of those animals under stress to utilize oxygen. However, according to Rugh et al. (1984), this proposed mechanism remains obscure because Manhold and colleagues did not perform a detailed metabolic analysis. Furthermore, smoking, which is related to depression and stress, has been implicated in vasoconstriction reducing nutrients for periodontal tissues (Kardachi & Clarke 1974).

It is assumed that both increase and decrease of saliva in the oral cavity, induced by emotional disturbance, may affect the periodontium adversely (Gupta 1966). Moreover, emotional distress may also produce changes in saliva pH and chemical composition (Ringsdorf & Cheraskin 1969, Fournier and Mascre 1988). It remains to be proved, however, that these emotion-induced changes in saliva worsen periodontal conditions.

Stress has been found to affect the endocrine system. Selye (1975), for instance, emphasizes the importance of the hypothalamus-pituitary-adrenal-cortical axis in the nonspecific stress response. Although the interactions between stress-endocrine-periodontal changes are not yet well understood, some hypotheses have been proposed. Davis and Jenkins (1962) suspected that periodontal status is related to alterations in the concentration of adrenal corticoids and other hormones involved in the general adaptation syndrome, as reported by Selye (1946). Moulton et al. (1952) hypothesized that stress can alter pituitary function and subsequently influence carbohydrate and calcium metabolism resulting in consequent effects on the state of the mouth. There are some studies which indicate that glucocorticoids, released under stress, may have some role in the pathogenesis of ANUG by altering the response of oral tissue to bacterial toxins (Shannon et al. 1969, Maupin &
Bell 1975). Cogen et al. (1983), comparing ANUG patients with controls, reported data suggesting that elevated cortisol might be important in mediating the effects of stress upon leukocyte function. Furthermore, stress induced hormones in the gingival crevicular fluid could provide a nutrient that favours the subgingival growth of pathogenic microbial populations (McGlynn et al. 1990).

As outlined previously, stress and its biochemical mediators may modify the immune response to microbial challenge. The release of adrenaline and noradrenaline under stress conditions may not only induce a decrease in blood flow, but possibly also in those blood elements necessary for maintaining resistance to invading microbes. It may be that glucocorticoids released during stress act further to prolong this vascular response (Meyer 1989). Clarke et al. (1981) hypothesized that this depression in the host's defences may induce selective influences on the oral flora, allowing certain microbes to overgrow others and consequently affect compromised tissues. Cogen et al. (1983) not only suggested that the elevated level of cortisol presented by their ANUG subjects may be important in mediating the effects of stress upon leukocyte function, but also found that ANUG patients compared to controls presented: i) depressed polymorphonuclear leukocyte responsiveness in both chemotaxis and phagocytosis; and ii) reduced proliferation of lymphocytes upon stimulation by a nonspecific mitogen. Cogen and co-workers' data indicate that depression of some host defence mechanisms, under stress conditions, may be important in the pathogenesis of ANUG. Furthermore, the increased severity of inflammatory periodontal diseases in patients showing disease states which involve depression in numbers and/or functions of leukocytes, such as Down's Syndrome, Chediak-Higashi Syndrome and insulin-dependent diabetes, has indicated that depression in host defence mechanisms plays a relevant role in the rate of onset and progression of inflammatory periodontal diseases.
2.6 Conclusions

The available scientific evidence for a possible relationship between psychosocial factors and inflammatory periodontal diseases may be summarised as follows.


On the other hand, taking into consideration that studies concerning the relationship between psychosocial factors and periodontitis in humans have yielded only correlative findings and furthermore have for the most part used a periodontal index which included both gingivitis and periodontitis features (Belting and Gupta 1961, Davis and Jenkins 1962, Vogel et al. 1977, Green et al. 1986, Marcenes & Sheiham, 1992), it is not clear that the scientific evidence is sufficient to substantiate the hypothesis that psychosocial factors are of aetiological importance in periodontitis. Moreover, there are different forms of periodontitis, and these may not be equally associated with psychosocial factors. For instance, while some periodontologists, on the basis of clinical observations, have suggested the possible role of psychological factors such as stress, depression and anxiety in relation to the onset and progression of rapidly progressive periodontitis (Davies et al. 1985, Newman 1993), routine chronic adult periodontitis might not be significantly affected by psychological conditions. Therefore, future investigations should attempt to establish the likelihood, or otherwise, of the aetiological importance of psychosocial factors in relation to all diseases which are generally known as periodontitis. Because psychosocial factors to date clearly relate only to one form of (acute) gingivitis and not to periodontitis, these studies need to include the measurement of periodontitis features independently of those descriptive of gingivitis.
On the basis of the few experimental studies concerning the effects of stress in the periodontium in animals, it may be concluded that the findings do not definitively support the hypothesis that emotional stress significantly affects the soft and calcified tissues of the periodontium because: i) some studies (Ratcliff 1956, Karren & Ingle 1964) which found alterations in the periodontium used stressors with significant specific effects such as pregnancy and food deprivation, making the interpretation of results as an effect of emotional stress doubtful; ii) other studies did not find any significant effects on the periodontium of a short period of stress (Shklar & Glickman 1953) or only found effects for one of two animal species studied (Gupta et al. 1960); and iii) as some studies indicated (Shklar & Glickman 1959, Cohen et al. 1969), the changes in the periodontium caused by some stressors may be either not significant or transitory. Consequently, new experimental studies controlling period of stress, type of stressor, and different animal species and strains, are necessary to elucidate the effects of stress on animal periodontal tissues. Moreover, it is not possible to separate the effects of physical from emotional stress in such animal studies. In human beings, with their highly developed nervous system, psychosocial stress might play a more important role in producing pathologic alterations and illnesses. For instance, stressful psychosocial events such as bereavement and divorce are associated with immune suppression, which is thought to increase vulnerability to disease (Bartrop et al., 1977; Kiecolt-Glaser et al., 1987).

The mechanisms which may mediate possible relationships between psychosocial conditions and inflammatory periodontal diseases remain a fertile area for research. There appears to be no study which has shown that stress has induced changes in behaviour which, in turn, have worsened periodontal conditions. In relation to the physiologic pathways through which psychosocial factors could influence periodontal breakdown, the following proposed mechanisms remain to be tested by future research: alterations in
salivary flow and composition, changes in gingival circulation, endocrine imbalances and lowered host defence. Among them the last is potentially particularly interesting, given that studies in the emerging field of psychoneuroimmunology have been presenting evidence that psychosocial factors can produce immunosuppression, which is presumed to increase vulnerability to a range of diseases (Ballieux 1991, Dorian & Garfinkel 1987, Kiecolt-Glaser & Glaser 1992, Kaplan 1991, Monteiro da Silva et al. 1995).
CHAPTER 3:
PSYCHOSOCIAL FACTORS OF POSSIBLE IMPORTANCE IN CHRONIC PERIODONTITIS

3.1 INTRODUCTION

On the basis of the clinical observations and the findings of correlational studies, presented in the previous chapter, a number of relevant psychosocial factors were selected for use in this thesis in order to examine their possible associations with different forms of chronic periodontitis. The chosen psychosocial factors were stress, depression, anxiety and somatization. In addition, two other psychosocial factors, social support and loneliness, which appear not to have been directly explored in relation to chronic periodontitis, were also included because of strong evidence linking interpersonal relationship variables and health (Pilisuk 1982, Cohen & Syme 1985, Cohen & Wills 1985, House et al., 1988).

This section aims to review current knowledge concerning these psychosocial factors, particularly as regards their mutual relationships, biological changes that are thought to occur as a direct or indirect consequence of them, and their possible associations with a range of illnesses, principally infections.

3.1 STRESS

Reviewing the literature concerning psychosocial factors and chronic inflammatory periodontal diseases, stress appears to be the most important psychosocial influence relating to periodontal breakdown (Rugh et al. 1984, Monteiro da Silva et al. 1995).

Stress has become a very popular concept for explaining a wide variety of health outcomes, mostly negative, that otherwise seem to defy explanation (Baum et al. 1984).
An analysis of the use of the term by theorists and researchers however reveals a lack of agreement regarding the definition of stress (Paterson and Neufeld 1989). Breznitz and Goldberger (1982) caution against prematurely defining the boundaries of the domain of stress by using strict definitions. In fact, Lazarus (1966) suggested that stress should be treated as an organizing concept for understanding a wide range of phenomena of relevance in human and animal adaptation. Consequently, from this viewpoint stress would not be considered a variable but a rubric consisting of many variables and processes. This approach implies a systematic theoretical framework for examining the concept at multiple levels of analysis within which to specify antecedents, processes, and outcomes that are relevant to stress phenomena. However, there is a problem about the tendency to expand the concept of stress to all the activities normally considered under the rubric of adaptation. Much that people do to adapt goes on routinely and automatically through cognitive processes and specific actions and styles of living that do not necessarily involve stress (Lazarus & Folkman 1984). Therefore, if stress is to be regarded as a generic concept, it is essential to delimit clearly its sphere of meaning. Otherwise the concept of stress will mean anything and everything which is already included in the concept of adaptation. Taking this into consideration, modern concepts of stress suggest that it involves complex processes by which an organism responds to certain environmental or psychological events, called stressors, that pose challenge or danger to the organism. Such modern concepts emphasize the role that the organism’s interpretation of these stressors plays in determining the stress response. Therefore, it is important to clarify the circumstances in which a stimulus will create a stress reaction. With that in mind it is helpful first to consider some of the more important models of stress which have been proposed.

3.2.1 MODELS OF STRESS
Models of stress may be divided into those that conceptualize the phenomenon: i) as stimulus-based, ii) as response-based, and iii) as an interaction between the two.

Stress stimuli are most commonly thought of in terms of events impinging on the person. According to Lazarus and Cohen (1977), there are three types of environmental events typically cited as stress stimuli or stressors: i) major changes, often cataclysmic and affecting large numbers of persons (e.g., war); ii) major changes affecting one or a few persons (e.g., loss of a job and death of a loved one); and iii) daily hassles (e.g., having an argument with a spouse).

Holmes and Masuda (1974) maintain that any change, evaluated as positive (e.g., getting married) or negative (e.g., contracting an incapacitating disease), can have a stressful impact. It is also possible to identify a number of properties of situations in addition to their positive or negative valence that could affect their stressfulness, for instance: i) Chronic versus acute demands, ii) the magnitude of adjustative demands, iii) the kind of adjustment called for, and iv) the extent an individual has control over the event or can predict it.

Although certain situations, as illustrated above, are considered normatively stressful, it is necessary to take into consideration individual differences in vulnerability to such stressors. To develop a taxonomy of stressful situations it is necessary to examine the patterns of stress responses. Once patterns are taken into account, the properties of individuals that give stimulus situations potency and meaning must be considered, and the definition of stress is no longer only stimulus-bound but becomes relational (Lazarus & Folkman 1984).

In biology and medicine stress is generally defined with emphasis on response terms as in the work of Hans Selye (1946, 1948), for instance. When the stress response of a person or animal is emphasized, it involves the use of expressions such as, a state of stress,
an organism reacting with stress, being under stress, being disrupted or distressed.

If stress is only defined by the response, there is no systematic way of identifying prospectively what will be a stressor and what will not. In addition, many physiological responses can be taken to indicate stress when such is not the case. Patkai (1971) showed that increased output of the "stress hormones" epinephrine and norepinephrine is associated not only with aversive events but also with pleasant but uncontrollable events.

In summary, all models of stress that conceptualize the phenomenon as stimulus-based or as response-based are inadequate. There are always the crucial questions of what it is about the stimulus that produces a particular stress response, and what is it about the response that indicates a particular stressor. Therefore, it is the stimulus-response relationship, not stimulus or response by itself, that provides the best way to conceptualize stress. Those who adopt such an interactional model (e.g., Lazarus 1966, Lazarus & Folkman 1984) emphasize that stress is neither an external situation (stimulus) nor an internal state (response), but proceeds entirely from a complex interaction between environmental demands, perceptions of these demands, the perceived ability to meet or alter them, and the organism's response to them.

3.2.1.1 Early Conceptions of Stress

Although the scientific study of stress is relatively recent, stress has been of concern to physicians for centuries. For instance, Hippocrates separated suffering caused by disease (pathos) from the pressure involved in resisting and fighting it (ponos) (Gatchel et al. 1989). By doing so, he proposed a stressful aspect of illness, the energy and wear caused by attempts to combat disease. Since then, other similar concepts have appeared. However, it was not until the beginning of the twentieth century that the concept of stress became more widely recognized through the work of Walter Cannon.
Cannon (1914, 1935) was among the first to use the term stress and clearly suggested that it involves both physiological and psychological components. He considered stress a disturbance of homoeostasis under conditions such as cold, lack of oxygen, and so on. He considered stress a potential cause of health problems and that emotional stress could cause disturbances of a physiological nature. He provided a simple description of the function of the sympathetic nervous system: a threatened organism prepares itself for "fight or flight" by producing a heightened arousal state. In his portrayal of voodoo death (Cannon 1942, 1963), he concluded that the phenomenon was due to a heightened and prolonged exposure to the emotional stress of believing one was under the witch doctor's spell. The actual physiological cause was an over-activation of the sympathetic nervous system.

Cannon's work is considered, in some ways, a precursor of Selye's work on biologic stress. However, Cannon's insistence on psychological aspects of stress makes his position more compatible with more recent perspectives of stress.

3.2.1.2 Selye's Physiological Stress Model

In the 1930s, Hans Selye began his studies of stress that provided much of the impetus for current stress investigation. In studying sex hormones, Selye found that injections into rats of extracts of ovary tissue caused a triad of responses: enlargement of the adrenals, shrinkage of the thymus, and production of ulcers. Eventually he found the same nonspecific responses to be a consequence of such dissimilar events as injection of insulin, application of heat or cold, exercise, exposure to X-rays, and so on. The response was nonspecific in the sense that it appeared to be caused by any noxious or aversive event. Whereas the primary aim of diagnosis has been to identify unique symptoms, Selye concentrated on the common symptoms and defined the stress syndrome as consisting of all of the nonspecific changes induced by a noxious agent.
Selye (1946) suggested that the body's response to a noxious or stressful stimulus occurs in three stages which he called the general adaptation syndrome (GAS). The first stage is the alarm reaction. Here the organism prepares to resist the stressor. Adrenal activity, cardiovascular and respiratory functions increase and the body is made ready to respond. Once reserves are ready and circulating levels of corticosteroids have increased, the organism enters a stage of resistance. In this second stage the body tries to return to a state of equilibrium. During this stage there is a relatively constant resistance to the stressor, but there is a decrease in resistance to other stimuli. If these stress reactions are repeated many times or are prolonged, the organism may be placed at risk of irreversible physiological damage. This is the result of the third stage of the GAS, which Selye called exhaustion. The consequences of exhaustion may be the onset of illnesses such as kidney disease, arthritis, and cardiovascular disease. For instance, cardiovascular damage and arthritis may be made likely by prolonged elevated levels of catecholamines, and high concentrations of inflammatory corticosteroids may figure in the onset of arthritis (Gatchel et al. 1989).

3.2.1.3 Psychological Stress Model

Lazarus and associates (Speisman et al. 1964, Lazarus et al. 1965, Lazarus & Folkman 1984) have added a psychological dimension to the stress concept. Their notion that the stress process can be initiated or influenced by psychological events is not inconsistent with the physiological models previously described. However, historically the research traditions have developed independently of each other. Only recently have researchers been working to integrate physiological and psychological research (Gatchel et al. 1989). Lazarus' perspective is almost as exclusively psychological as Selye's is physiological, yet they show compatibility.
Psychological stress is a particular relationship between the person and the environment that is appraised by the person as taxing or exceeding her or his resources and endangering his or her well-being (Lazarus & Folkman 1984). According to this model, two critical processes mediate the person-environment relationship: cognitive appraisal and coping. Cognitive appraisal is an evaluative process that determines why and to what extent a particular transaction or series of transactions between the person and the environment is stressful. On the other hand, coping is the process through which the individual deals with the demands of the person-environment relationship that are appraised as stressful and the emotions they produce.

Lazarus and colleagues argue that in order for an event to be a stressor, it must be appraised at least in part as threatening. That is, pressures appraised to be threatening evoke the stress response. A series of studies conducted by Lazarus and associates during the 1960s provided support for this perspective. For instance, Lazarus et al. (1965) exposed subjects to a stressful film depicting woodshop accidents such as a worker cutting off a finger and a worker being killed by a wooden plank driven through his body. Subjects were told either that the events had been staged and no one was really being hurt or that the events were real but the film would help improve safety in such settings. A third group of subjects were given no explanation. Both sets of instruction were effective in reducing arousal during the film, presumably because they allowed appraisal of the film in a less threatening way. These results are similar to those of an earlier study by Speisman et al. (1964), in which subjects were shown a film depicting primitive initiation rites that involved very unpleasant genital surgery. Subjects saw the film with one of three soundtracks. One group heard narration emphasizing pain, mutilation, and possible disease consequences (trauma condition). Another group heard a script in which the pain and consequences were denied and the participants in the rites were described as willing and happy (denial...
condition). The third group heard a detached narrative of the rites from an anthropological perspective (intellectualization condition). The results indicated that stress responses were reduced for subjects in the denial and intellectualization conditions, compared to subjects in the trauma group. It was presumed that instructions in the second and third conditions allowed subjects to appraise the situation as less threatening, while the instructions given to trauma subjects emphasized those aspects of the film that were more likely to be perceived as stressful.

These and other studies conducted by Lazarus and associates (Lazarus & Alfert 1964, Nomikos et al. 1968, Koriat et al. 1972) provide convincing evidence that stress cannot be properly understood on the basis of environmental factors alone. The films seen by different groups of subjects were the same, and the settings in which they saw them were comparable. However, by controlling the interpretations people made while viewing the films, Lazarus and colleagues were able to observe different stress reactions.

Some of these studies indicated another source of variance in stress reactions: personality dispositions or tendencies to appraise events in particular ways. For example, in the study of response to the film showing genital surgery, Speisman et al. (1964) found that subjects predisposed to use denial as a way of coping with aversive events showed more stress in response to the detached intellectualization soundtrack than to the denial soundtrack. The opposite was true of those who tended to cope by intellectualizing a threat.

Once the role of appraisal processes in the stress process had been extensively demonstrated, research started to focus on long term coping and on the types of appraisals that can be made. Lazarus and Folkman (1984) distinguish between primary and secondary appraisal. The first stage in the perception of stress is the primary appraisal of threat. If a situation is judged to be threatening and stressful, then secondary appraisals will follow. While in the primary appraisal the person is concerned with assessment of danger, in the
secondary appraisals the attention is directed to the dangers or benefits of different modes of coping with perceived threats. The perception of danger motivates a search for coping responses that will reduce this threat. Three types of primary appraisal were identified by Lazarus and Launier (1978): i) irrelevant, an encounter with the environment which carries no implication for a person's well-being; ii) benign-positive, the event preserves or enhances well-being, or promises to do so (completely benign events, however, are rare); iii) stressful, this type of appraisal includes harm/loss, threat, and/or challenge. In harm/loss appraisal some damage to the person has already happened, as in incapacitating illness, damage to self or social esteem, or loss of a beloved person. Threat involves harms or losses that have not yet taken place but are anticipated. Even when a harm or a loss has occurred, it is always combined with threat because every loss/harm also carries negative implications for the future. However, differently from harm or loss, threat permits anticipatory coping. The third type of stress appraisal, challenge, is similar to threat in that it too mobilizes coping efforts. The difference is that challenge appraisals focus on the potential for gain or development inherent in an encounter, and they are characterized by pleasurable emotions such as excitement and exhilaration, while threat focuses on the potential harms/losses and is characterized by negative emotions such as fear, anxiety and anger. Therefore, individuals who are disposed or encouraged by circumstances to feel challenged probably have advantages over easily threatened individuals in morale, quality of functioning and health (Lazarus & Folkman 1984).

It is important to mention that a number of factors including environmental, social, cultural and psychological variables, affect the way we interpret stressors. In addition, although appraisal is often taken to be a conscious, rational and deliberate process, this is not always the case. An individual may be unaware of any or all elements of appraisal (Lazarus 1966, 1982, 1984). This lack of awareness can result from the operation of
defence mechanisms, or it can be based on nondefensive attentional processes (Lazarus & Folkman 1984).

3.2.2 MEDIATING FACTORS

One interesting issue in stress research relates to an understanding of the factors that make some individuals likely to react to stressors in a disturbed fashion whereas others, exposed to the same stimuli, seem to cope without undue difficulty.

A number of social and personal characteristics such as social support, dispositional variables and perceived control have been considered as possible mediators of stress, rendering some individuals relatively immune to stress and others relatively susceptible. While social support will be presented as a separate psychosocial factor in the next part of this discussion, other mediators will be considered here.

3.2.2.1 Perceived Control

Perceived control has been regarded as a powerful mediator of stress. If persons perceive that outcomes are within their own control, it follows that they should be active and effortful copers. Because effortful coping increases the likelihood of successful coping, feelings of control are presumed to operate as a stress buffer (Lefcourt 1985, Wheaton 1982). Glass and Singer (1972) considered the effects of perceived controllability and predictability in their studies of stress due to noise. The perception that the noise could be precisely anticipated, or even turned off if desired, facilitated adaptation with minimal aftereffects. Being able to predict when stressful events are about to occur can significantly reduce the emotional response to these events. When children are told, for example, what a dentist is doing and what to expect, they report less anxiety and physical discomfort (Siegel & Peterson 1980).
There is evidence that animals exposed to an aversive situation where they have no control may develop a feeling that no matter what happened they would not be able to do anything about their circumstances. This "learned helplessness" phenomenon may occur in humans too (Peterson & Seligman 1984). In fact, Seligman (1975) argues that learned helplessness can result from any situation where persons think that they have no control over events. It does not matter whether there is a solution to their difficulty or not, as long as they perceive the situation as hopeless they will cease to seek a way out. Individuals who perceive events to be beyond their control will learn to become helpless. In the hospital environment perceived control has been shown to influence stress factors. For instance, Volicer et al. (1977) asked medical and surgical patients to rate hospital practices in terms of perceived stressfulness. The events rated as most stressful were, not surprisingly, thinking they might have cancer, losing their sight and knowing they had a serious illness. However, other events rated highly included not being told the nature of the diagnosis, not knowing the results of or reasons for treatment and having questions ignored. The stress associated with the latter group of events can be easily reduced by communicating more effectively with the patient.

The potential of perceived control to reduce stress can be effectively used by health professionals, who can help patients to realise that they have a certain degree of control over their circumstances. The psychological and physical benefits of obtaining a sense of control over events may be observed in the dentist's surgery as well as in an individual patient's fight to master cancer (Taylor 1984).

3.2.2.2 Dispositional Factors

Research has indicated that there may be differences in the way we respond to stress. A meta-analysis of studies of acute stress responses, for instance, has suggested that
men may respond more strenuously to stressors than women, especially in terms of changes in systolic blood pressure (Stoney et al. 1987). Concerning stress hormones such as catecholamines, there is evidence that men exhibit a greater epinephrine response during stress but show norepinephrine and cortisol responses comparable to those of women (Frankenhaeuser 1983).

The existence of "high stress" or "high risk" personalities, or of other personal variables that affect the appraisal of stressors, has been considered in many studies. Grinker and Spiegel (1945) reported that only a relatively small number of air combat crews serving during World War II developed severe stress-related disorders, and that some of these had previously established neuroses that made them more susceptible to the stress of war. More recently the concept of vulnerability has been used to provide an explanation for selective onset of schizophrenia (Zubin & Spring 1977), illness (Kobasa 1979), stress-induced immunosuppression (Kaplan 1991), and other stress-related disturbances (Kasl & Cobb 1970, Cobb 1976).

Different coping styles or behaviour patterns have also been considered to be relevant stress mediators as they appear to affect the ways in which events are appraised. Studies on a number of dimensions (repression-sensitization, arousal seeking, screening, and denial) have indicated that people differing along these dimensions may not interpret situations in the same way (Byrne 1964, Zuckerman 1971, Mehrabian 1977). For instance, a study by Baum et al. (1982) indicated that individuals who handle social overload by screening and prioritizing demands are less susceptible to the effects of stress than those who do not cope in this way.

There are other stress-relevant coping styles. For instance, individuals who manifest a type A behaviour pattern tend to respond to stress as if it were control-threatening and interpret most threats to control as stressful. Type A behaviour is characterized by
excessive competitive drive, impatience, hostility, and accelerated speech and motor movements, while the type B pattern is defined as the relative absence of these characteristics (Friedman & Rosenman 1959, Glass 1977, Matthews 1982). Epidemiologic studies have shown that type A individuals are more likely than type B individuals to develop coronary heart disease (Cohen & Edwards 1989). Type A individuals' appraisal of events is particularly sensitive to anything that might reduce their control over a situation. The time urgency, competitiveness, and hostility that accompany this response, together with the increased likelihood of experiencing stress and physiological concomitants of that stress, may explain type A individuals' higher risk for coronary heart disease.

3.2.3 PHYSIOLOGICAL ASPECTS OF STRESS

As previously mentioned, stress cannot be defined without reference to the response made by the organism. These physiological, cognitive, affective and behavioural reactions to stressors are important aspects of stress processes.

Physiological and biochemical measurements of stress allow inferences about emotional states and provide markers of those bodily responses most affected by stress. Catecholamines and corticosteroids, secreted by the adrenal medulla and cortex respectively, are involved in stress responding (Cannon 1929, Frankenhaeuser 1973, Glass et al. 1980). Refinement of measurement techniques allows estimates of their levels to be drawn from urine and blood samples (Nagatsu 1973). Catecholamine secretion also reflects sympathetic arousal, as the adrenal medulla is innervated by the sympathetic nervous system, and secretion of epinephrine and norepinephrine appears to be part of sympathetic arousal. Therefore, secretion of catecholamines is also associated with systemic reactions (Gatchel et al. 1989). Increases in cardiovascular reactivity (faster heart rate, higher blood pressure), changes in muscle potential, and measures of skin conductance have also been
used to show the effects of stress. As stated by Selye (1946), at this physiological level the stress response seems to be fairly nonspecific. Physiological arousal and related somatic changes are similar for most stressors, although some research has suggested patterning of endocrine responses to different situations. In general, however, most stressors appear to provoke the same kind of general physiological response.

These somatic consequences of stress are important for a number of reasons. First, increased catecholamine and corticosteroid secretion is associated with a wide range of other physiological responses such as the above mentioned changes in heart rate, blood pressure, breathing, muscle potential, inflammation, and other functions. Prolonged or sudden elevation of circulating catecholamines may damage body tissue, as is suggested for the pathogenesis of atherosclerosis (Schneiderman 1983). Catecholamines also appear to affect cognitive and emotional functioning, and changes in level of epinephrine or norepinephrine in the blood may affect mood and behaviour (Gatchel et al. 1989). For instance, elevations in catecholamine levels have been associated with emotional states of threat and challenge (Lazarus & Folkman 1984).

However, under some circumstances, these physiological aspects of stress can be of benefit. Cannon (1929) suggested that epinephrine has a salutary effect on adaptation. By arousing the organism, epinephrine provides a biological advantage, enabling the organism to respond more rapidly to danger. Therefore, stress-related increases in catecholamines may sometimes facilitate adaptative behaviour. In fact, studies have shown superior performance on some tasks among subjects injected with epinephrine (Frankenhaeuser et al. 1961), and also among individuals who produce larger amounts of catecholamines in the face of challenge (Frankenhaeuser 1971). On the other hand, arousal has also been associated with impaired performance on complex tasks (Evans 1978).

Although there may be cognitive benefits of stress, it is evident that the "fight or
flight" model, derivable from Cannon's work, is not always adequate for predicting response to danger in modern complex society. Most of the research that supports the view that stress can be facilitating has involved acute stressful situations in which adjustment can soon lead to a decrease in stress. The consequences of unabated, chronic stress or repeated exposure to stress have only recently been subjected to investigation. Among these consequences are decrements in the ability to cope with subsequent stress, and, in some cases, physiological dysfunction, tissue damage, or death.

In summary, physiological responses to stressors may be both specific and nonspecific and may be chronic or acute. The responses that are short-lived, either because adaptation is achieved soon or because the stressor was brief, are similar to Cannon's mobilization response. However, when stress-induced physiological responses are repeated or prolonged, the alarm reaction is no longer functional. If adaptation is not achieved, prolonged arousal can lead to tissue damage and diseases of exhaustion (Selye 1976).

Other biological changes occur as a direct or indirect consequence of stress. The extent to which they are part of the adaptive response itself or consequences of these responses is sometimes unclear. Immune system changes in response to stress do not seem to be adaptive (Gatchel et al. 1989). Although suppression of immune system activity could reflect a conservation of energy, it may instead be a product of neural and hormonal changes that are part of the stress response.

3.2.4 STRESS AND ILLNESS

Traditionally, illness has been regarded as a biomedical phenomenon. Germs or some internal malfunction tended to be considered as the only causes of sickness. However, a marked development of interdisciplinary thought has occurred, and with it an increasing emphasis on relations among systems and the importance of the context in which
phenomena occur. Recently, the belief in exclusively external causes of disease has given way to a newer concept of illness: that a pathogen must be combined with a susceptible organism (Lazarus & Folkman 1984). The characteristics of the system under attack (for instance, a person) are as important as the external noxious agent. Therefore, a person becomes ill as a consequence of being vulnerable to those agents. Such a perspective has encouraged the exploration of the links between stress, other psychosocial factors and illness.

The links between psychosocial factors and illness may be classified into three basic mechanisms: direct psychophysiological effects, health-impairing habits, and reactions to illness (Krantz et al. 1981).

The first mechanism is consistent with notions of stress, involving all direct alterations of bodily processes and tissues by psychosocial events. Events such as stressors, therefore, can produce neural and endocrine changes that alter the normal functioning of the organism (for instance, changing cardiovascular reactivity or immune system functioning). These physiological changes, in turn, may increase vulnerability to illnesses ranging from coronary heart disease to gastrointestinal disorders, cancer and infections (Gatchel et al. 1989).

The evidence for the second mechanism, the effects of habits and lifestyles, is also relevant. People who experience high levels of stress tend to perform behaviours that increase their chance of becoming ill or injured (Wiebe & McCallum 1986). For instance, they consume more alcohol, cigarettes, and coffee than those who experience less stress (Conway et al. 1981, Baer et al. 1987). Consumption of these substances has been associated with the development of various illnesses (Sarafino 1990).

The third mechanism is concerned with the reaction of the individual to the stressful influences of illness and its treatment. For instance, reactions to illness such as one's
motivation to seek medical care or report symptoms can affect the course of an illness. If one fails to report noticeable changes in bodily function or delays reporting these changes, the likelihood of an illness progressing to a point where it is more difficult to treat will increase. In addition, response following diagnosis of an illness is also relevant. Emotional distress, failure in following treatment regimens or inability to change lifestyle appropriately can retard recovery.

In practice, the three mechanisms are not independent and are difficult to completely separate. For instance, stress and its accompanying physiological effects may be exacerbated or moderated by one's individual characteristic reaction to being ill.

Although the study of links between psychosocial factors and disease is relatively new, research has already identified a number of relationships. Early research on stress found that Londoners showed increased blood pressure during the initial phase of the mass bombing of London during World War II (Gatchel et al. 1989). The stress associated with incarceration in German concentration camps and prisoner-of-war camps was also investigated. For instance, concentration camp survivors have shown a greater incidence of premature death in the years following their release compared to people of their age who were not prisoners (Cohen 1953, Bettelheim 1960).

Most evidence of a stress-illness link has been provided by the study of life changes or stressful life events. The idea that life changes could predispose to illness is not new. However, the study of life events is a relatively recent phenomenon, which started with the use of Holmes and Rahe's (1967) Schedule of Recent Experiences. This scale provided an extensive list of events and changes (for example, death of a close family member, personal injury or illness, loss of job). Initially, respondents only checked those events that had occurred in their lives in a given period of time, and the number of events experienced was used as an index of life change for that period. However, there were problems with such
a gross scoring method. Persons reporting the same number of stressors may vary in the
amount of stress experienced, either due to the nature of the stressors experienced or
mediators of stress such as personal dispositions or social resources. Despite the fact that
gross summation measures did show some relationships to illness, numerous changes have
been made in order to increase the accuracy of measurement. In some studies, weights, or
relative degrees of life change caused by each event, were generated by panel ratings; other
studies asked subjects to assign their own weights (Holmes & Rahe 1967, Rahe 1975, Rahe
et al. 1980).

Initial research using these scales was generally retrospective (Gatchel et al. 1989).
Subjects reviewed their experiences over a past time period, and these recollections were
transformed into life-change scores. Some studies reported a consistent increase or
clustering of life events causing change and requiring adjustment during the year preceding
diagnosis of illnesses such as infectious disease, metabolic disturbance, and heart disease
(Jacobs et al. 1970, Rahe 1975, Garrity & Marx 1979). In a prospective study, Rahe et
al. (1970) reported a significant relationship between life change and illness rate among
enlisted men during six-month cruises aboard U.S. navy ships.

Other studies have suggested that life change is associated with a wide range of
behavioural and health outcomes, including accidents, academic performance,
cardiovascular risk, drug use, and illness (Bruns & Geist 1984, Garrity & Ries 1985, Rahe
1987).

In summary, there is abundant evidence that stressful life events such as death of a
loved one, divorce, or loss of a job, especially when they accumulate over a brief period in
one's life, are related to a variety of physical and mental illnesses, for instance, heart
disease, fractures, childhood leukemia, schizophrenic episodes, and depressive reactions
(Dohrenwend & Dohrenwend 1974, Dohrenwend et al. 1984). However, relations between
life events and such adverse health changes have tended to be weak, the average relationship being perhaps as low as 0.12 (Rabkin & Struening 1976). This fact has led researchers to focus on a variety of other environmental aspects of life stress and on personal dispositions, and possible mediating factors, that may augment or reduce the impact of the events. For instance, Pilkonis et al. (1985) reported a study that used both life events checklists and interviews to identify the characteristics of life events that are most important. They found three relevant general factors: desirability of an event, control, and required readjustment.

In the measurement of stressful life events, there are problems associated with recall ability, memory biases, reliability of measurement, and the frequent causal relationships among stressful life events that should be considered (Hudgens 1974).

Serious criticisms have been raised about life-events measures, especially as developed by Holmes and Rahe (1967). Most relevant is the suggestion that a substantial portion of the events on the Holmes and Rahe list could be symptoms of physical or mental illness, thus confounding the measurement of stress with the measurement of health outcomes (Brown 1974, Dohrenwend 1974, Hudgens 1974). For instance, Hudgens (1974) suggested that 29 of the 43 events on Holmes's Social Readjustment Rating Scale are events that are often the symptoms or consequences of illness. The confounding of symptoms with life events is especially relevant in results based on cross-sectional surveys and retrospective studies, but also occurs in prospective study because the onset of many physical and mental disorders is insidious (Dohrenwend et al. 1984).

As the investigation of stress and its relationship to the development of psychological and physical symptomatology has progressed, two general models of stress have emerged. The first, described above, with a long and comprehensive history, focuses on the role of major life events (family relocation, divorce, death of a loved one, etc.) in
relationship to symptom development and maintenance (Wagner et al. 1988). An alternative model has focused on smaller, more chronic stressors as precipitants of symptoms. These ongoing stresses of daily living have been conceptualized as "daily hassles" (Lazarus 1984), "unpleasant events" (Lewinson & Talkington 1979), "chronic role strains" (Pearlin 1983), "severe daily events" (Stone & Neale 1982), "minor negative events" (Monroe 1983), and "microstressors" (McLean 1976). Although these various conceptualizations are not identical, they all address stress as immediately experienced in day-to-day life. By contrast, a major life event is often less psychologically immediate.

Studies have compared daily stressors with major events as predictors of symptoms among adults, and have found daily stressors to be the superior predictor (Kanner et al. 1981, DeLongis et al. 1982, Monroe 1983, Holahan et al. 1984, Wagner et al. 1988). In addition, there have been some suggestions as to ways in which major and daily events might operate in a mediational fashion. Kanner et al. (1981) postulate that a major life event, for example divorce, could have an impact on symptoms via the increased hassles that it produces (having to make one's own meals, keeping house, increased child care duties, handling the finances, finding companionship, etc.). Pearlin et al. (1981) suggested that major life events may change the meaning of pre-existing daily events, so that previously minor annoyances may suddenly become overwhelmingly frustrating. From this perspective, hassles might serve as a direct indication as to how a person's routine is being affected by major life events and, therefore, be a better predictor of health outcomes. However, by and large these hypotheses have remained untested. An exception is the study by Wagner et al. (1988) which has shown that major events led to an increase in daily stress which, in turn, led to increased psychological symptoms.

Apart from the impact of life events, many hassles have their origin in the person's characteristic style, routine environment, or their interaction. As such, hassles might predict
health outcomes quite independently of life events.

The measurement of hassles also presents some of the problems which occur in the measurement of life events. For instance, it is important to know whether the impact of a hassle depends merely on its cumulative impact or on its content and meaning in the person's life (Kanner et al. 1981). In addition, there are indications that problems of confounded measurement, items in the measures being symptoms or consequences of illness, are also present in measures of hassles (Dohrenwend et al. 1984).

In conclusion, though there is evidence that life events are associated with illness, such events have not been shown to be strong predictors of illness. Consequently, researchers have started to investigate the importance of a number of potential mediators (social support, perceived control, type A behaviour, etc.) in the relationship between stress and symptomatology. In addition, an alternative stress model which focuses on daily hassles has been developed, and evidence has emerged that hassles are better predictors of symptoms than major life events. However, measures of hassles, similarly to measures of life events, either have shortcomings or have not been sufficiently tested (Sarafino 1990). As stated previously, stress is a very difficult concept to define, and it is perhaps even more difficult to measure.

On the basis of the evidence so far stress appears to have a consistent but small to moderate relationship to illness, being one of many factors that may contribute to its development and progression.

Stress has been linked to a number of physical symptoms or illnesses such as ulcers (Wolf & Wolf 1947, Weiss 1984), asthma (Cluss & Fireman 1985, Eiser 1985, Werry 1986), chronic headache (Andrasik et al. 1986, Levor et al 1986, Gannon et al. 1987), rheumatoid arthritis (Moos & Solomon 1964, Hendrie et al. 1971, Baker 1982, Genest 1989), dysmenorrhoea (Calhoun & Burnette 1983), skin disorders (Grossbart 1982),

The relationship of stress to infections is the most relevant of these for present purposes. It is also arguably the area in which recent literature has documented the most convincing role of psychosocial factors. For instance, there is substantial evidence that stressful conditions may make animals more vulnerable to experimentally induced infection (Broadbent et al. 1984). There is some evidence from studies in humans that psychological stress may increase the risk of verified acute infectious respiratory illness (Boyce et al. 1977, Graham 1986). Jemmott et al. (1983) and Dorian et al. (1986) noted an increase in respiratory infections in subjects who responded to an examination stressor with high levels of distress. Although possible evidence from experimental exposure to infection in humans is much harder to obtain for ethical reasons, a few experiments have been conducted. Totman et al. (1980) exposed volunteers to rhinovirus while living in relative isolation. They found that the severity of the resulting colds was related to the degree of introversion of the individual, and to the amount of recent change in subjects' general level of activity. Developing the approach of Totman et al., Broadbent et al. (1984) exposed volunteers to various rhinovirus and influenza virus challenges, confirming a higher degree of infection by rhinovirus in introverts compared to extroverts. However, the influenza trials did not show such an effect. In addition, subjects with higher scores on a self-report inventory of mild psychoneurotic symptoms tended to show increased nasal secretion after infection by either type of virus. Again experimentally exposing subjects to respiratory viruses, Cohen et al. (1991) found that psychological stress was associated in a dose-
response manner with an increased risk of acute infectious respiratory illness, and that this risk was attributable to increased rates of infection rather than to an increase in frequency of symptoms after infection.

Cellular immune control of latent Epstein-Barr virus (EBV), which is responsible for infectious mononucleosis (glandular fever), has been shown to be influenced by psychosocial stressors (Glaser et al. 1987, 1990) and stress responses (Esterling et al. 1990) in healthy individuals. In addition, Glaser et al. (1991), using an examination stress model, found evidence for incomplete reactivation of latent EBV, with only partial expression of the latent viral genome.

Herpes simplex virus (HSV), which produces herpes labialis (cold sores) and genital herpes, is presumed to be reactivated by a number of factors including colds, sunburns, fevers and menstruation. Psychosocial stressors have been presumed to precipitate a recurrence of cold sores. Luborsky et al. (1976) have demonstrated that recurrence of cold sores in student nurses could be associated with unhappiness. Goldmeir & Johnson (1982) reported that the presence of non-psychotic psychiatric disturbance was predictive of recurrences of genital herpes. Kemeny et al. (1989), in a prospective study, used genital herpes as a model for assessing relationships among stress, mood, immunological change and disease course. The results suggested that both stressful experience and negative mood are associated with levels of T cell subsets in the peripheral blood of patients with recurrent genital herpes. Stressful experiences (including major life changes, daily hassles, concern related to having herpes, residual distress from past events, and distress in anticipation of future negative events) were associated with helper-inducer and suppressor-cytotoxic T cell levels. Negative moods (depression, anxiety, hostility) appeared to be associated with suppressor-cytotoxic T cell levels only. Among the factors investigated as possible predictors of herpes recurrence (including stressful life experience, depression, anxiety and
hostility, fatigue, infections and menstrual cycle), only depressive mood level over the six-month study period was associated with the number of herpes recurrences. Suppressor-cytotoxic T cell levels, depression and HSV recurrence rate over the six-month period were all intercorrelated, indicating that suppressor-cytotoxic T cell levels or other associated immunological factors may mediate the relationship between depression and herpes recurrence. The data from this interesting study raise two important issues concerning the possible effects of stress. First, aspects of stressful experience other than major life events and daily hassles (residual stress and anticipated negative events) were associated with quantitative aspects of immunity. Second, stress is presumed to be an activator of herpes recurrences. However, stressful experience, measured broadly, did not predict who would have more recurrences or when they would occur. These findings suggest that exposure to stressful experiences alone may be not enough to trigger a recurrence. Therefore, stress mediators such as social support, methods of coping, past experience and personality may determine whether individuals respond to stressful experiences with negative affective changes that, in turn, may produce immunological vulnerability to HSV recurrence. Perhaps a tendency to experience depressive affect, or unhappy mood, independently of stressful experiences, may create the necessary vulnerability to lesion formation.

Although available evidence concerning the role of stress and other psychosocial factors in infectious diseases is promising, much remains to be done. It is crucial for future studies examining possible relationships between psychosocial factors, immune changes and specific infectious diseases to be prospective and where practical to include multiple measurements of psychosocial factors, immune alterations and specific illness symptoms and signs. As Kemeny et al. (1989) indicate, it is important to include multiple aspects of stressful experiences (such as major life events, daily hassles, residual stress from major life events, stress associated with the disease, anticipated future stressors) as well as stress
mediators (including social support, methods of coping, personal control and so on). These studies also need to measure various aspects of the immune system simultaneously, and to control for health behaviours such as sleep, smoking, physical activity, current health status, etc. These behaviours may have immunological consequences. Besides, many of them seem to be affected by stress and other psychosocial factors, and they can influence disease onset and course via a mechanism other than a reduction in immunocompetence. Finally, the underlying psychoneuroimmunological mechanisms linking stress and other psychosocial factors to infectious diseases remain a fertile area for future research.

3.3 INTERPERSONAL RELATIONSHIP FACTORS: SOCIAL SUPPORT AND LONELINESS

Recent scientific work reveals both a theoretical basis and solid empirical evidence for the influence of social relationship factors on health. The data suggest that social relationships do not have a correlational relationship to health, but really have a causal impact: i) prospective studies that have controlled for baseline health status have reliably shown greater mortality among individuals with fewer relationships; and ii) experimental and quasi-experimental studies with humans and animals have indicated that social isolation is a significant risk factor for mortality from various causes (House et al. 1988).

In this section, two relevant relationship factors, social support and loneliness, will be examined.

3.3.1 SOCIAL SUPPORT

Social support refers to the perceived comfort, caring, esteem, or help a person receives from somebody else or groups (Cobb 1976, Wallston et al. 1983, Gentry & Kobasa 1984). This support may come from different sources: the person's spouse or partner,
family, friends, coworkers, health professionals or community organizations. According to Cobb (1976) someone with high social support feels loved and cared for, esteemed and valued, and part of a social network, such as family or community organization, that can provide goods, services and mutual defence in times of need or danger.

The fact that social support can be measured in a number of different ways makes research difficult to interpret and integrate. For instance, as a simple index of social support, the number of people an individual sees on a regular basis can be directly observed or estimated (Berkman & Syme 1979). A broader definition of social support can involve estimates of the number of people one considers to be friends, the types of nonfriend contacts, such as clergy or family, and the importance of each (Caplan et al. 1975). Other measures include evaluations of broad social networks at home and at work, the perceived relevance of social ties in general, and the degree to which these relationships satisfy various needs (Pilisuk & Parks 1980). Perhaps, the most important distinction to be made, in terms of social support variables assessed by different instruments, is between the number of relationships a person has and the person's perception of the supportive value of social interactions. The former is usually referred to as the social network; the latter, as perceived social support. The benefits of social relationships are assumed, not measured, in instruments using the social network concept. On the other hand, instruments using the concept of perceived social support reflect an effort to assess the person's evaluation of the supportive quality of a relationship. Almost all measures of social support are based on self-assessment and are therefore susceptible to self-report bias. Furthermore, the more objective measures involving the social network concept, such as counting number of friends, do not provide information about the quality and relevance of relationships.

Another factor that complicates the investigation of social support involves the various types of support that can be provided to a person, and researchers have attempted
to classify various types of support based on the function served by each (Cobb 1976, Schaefer et al. 1981, Wills 1985). In general, four basic types of support have been identified: esteem support, informational support, instrumental support, and emotional support (Sarafino 1990). Esteem support occurs through other peoples' expression of positive regard for the person, encouragement or agreement with the individual's ideas or feelings, and positive comparison of the person with others. This type of support serves to build the person's feeling of self-worth, competence, and of being valued. Informational support includes giving advice, directions, suggestions, or other necessary information (for example, a person who is ill gets information from a physician concerning the treatment of the illness). Instrumental support refers to the physical aid or direct assistance a person can get from others (for instance, the family of a man who has lost his job may help with money, which reduces the demands on his finances). Emotional support includes intimacy, the expression of empathy, caring, concern toward the person. All of which contribute to the feeling that one is loved or cared about. The importance of distinguishing and assessing different types of social support lies in the possibility that they may have independent effects on health and psychological functioning, depending on the degree to which they meet the needs of a specific individual and situation.

Several reviews (Pilisuk 1982, Cohen & Syme 1985, Cohen & Wills 1985) confirm that social support has two types of effect on health outcomes: indirect/buffering and direct/main. The "buffering model" postulates that support protects individuals from potentially pathogenic effects of stressful events. The "main effect model" proposes that social support directly improves well-being by fulfilling basic social needs and social integration. The main effect is considered as being a primary preventive function and is explained in part by the social-inoculation theory (Stewart 1990).

The social-inoculation theory claims that social support influences vulnerability to
some infections, and to some aspects of humoral and cell-mediated immune responses (Pilisuk 1982). Stressful life events can create major rents in social networks, which may in turn suppress the immune response (Gottlieb 1988). On the other hand, integration in a social network could be related to positive health outcomes via emotionally induced effects on neuroendocrine and immune-system functioning. In fact, the social support literature, although acknowledging direct effects of support on health, has only recently begun to consider the potential relationship between social support and immunity to disease. However, immune dysfunction is not the only putative mechanism that could link social support to illness. It is also possible that a relationship between social support and physical illness may be mediated by the effects of support on health behaviours. In addition, there is now a range of converging evidence implicating the absence of supportive social ties in cardiovascular disease (Sheffield & Carroll 1994). One way in which social support might be ameliorative for cardiovascular disease is by attenuating cardiovascular reactions to stressful events, and there is some evidence that social support attenuates cardiovascular reactions to laboratory stressors (Kammarck et al. 1990, Edens et al. 1992, Sheffield & Carroll 1994).

Adaptation to chronic health problems appears to be enhanced by having an effective system of social support (Wallston et al. 1983). For instance, Solomon & Temoshok (1987) conducted a long-term follow-up study of patients who completed questionnaires to assess a variety of psychosocial factors soon after being diagnosed with acquired immune deficiency syndrome (AIDS) or AIDS-related complex (a number of recurrent symptoms such as spiking fever, night sweats, diarrhoea, fatigue, and swollen lymph glands, which occur between the time of infection and the AIDS diagnosis). Longer survival was associated with higher scores on measures of personal control, problem-focused coping, and social support. In a study by Cain et al. (1986), cancer patients in a
support group received counselling sessions, training in relaxation, and information about diet, exercise, and their illness. Subsequent comparisons with controls revealed that those in the support group were less depressed and anxious, had fewer sexual problems, and participated more in leisure activities.

However, there is some evidence that social support may not always benefit health. Given the incomplete state of knowledge, and the fact that interpersonal relationships may function as a source of support or stress, Revenson et al. (1983) examined the effects of support provided by friends and family on patients' psychological adjustment to cancer. They found that social support was related to poorer adjustment (increased negative mood and decreased self-perceptions of worth, mastery, acceptance of the patient role, and acceptance of death) for patients not undergoing chemotherapy or radiation treatments, or for those with many limitations on physical functioning. These findings suggest that supportive behaviours can provide not only elements of "true" support but may also pose threats to autonomy and self worth. For a variety of reasons (such as physical repulsion and fear fostered by a serious disease, mixed feelings of sadness, anger and resentment in relation to a seriously ill person, etc.) people who are physically ill may find that their social relationships not only fail to protect against the stress of the illness, but constitute an additional source of distress. Another study by Schaefer et al. (1981) revealed that neither social support nor stressful life events were associated with physical health.

In summary, it is important that researchers in the area should refine their hypotheses and theories beyond global statements that social support somehow protects against psychological and physical health problems. Perhaps, the greatest problem with most studies is the use of inadequate measures of social support (Berkman 1985). It is necessary to make use of the more sophisticated measures currently available, which allow the measurement of specific network and support characteristics (Berkman 1985). Another
issue is the extent to which life events and the social network overlap making it difficult to assess their relative impacts on health. For instance, many life events such as death of a spouse or divorce and loss of job, are actually losses or involve breaks in social ties; others may not be real life events but a consequence of ongoing poor or deteriorating social relationships. The available evidence indicates the existence of both main and buffer effects, and it may be the case that some network or support characteristics have buffer effects whereas others have main effects. Overall, it is clear that a great deal more work needs to be done on the various forms of support, their functions, and how they serve to increase or decrease levels of distress and to facilitate or impair physical health.

3.3.2 LONELINESS

Loneliness is a phenomenon that has only recently started to be investigated scientifically. Social transitions are a basic fact of life in our modern society, and so is loneliness. However, for most people, intense feelings of loneliness do not last long; for others, loneliness is a constant characteristic of daily life.

A variety of definitions of loneliness have been developed by social scientists. Despite their differences, there appear to be three very important points of consensus (Peplau & Perlman 1982): i) loneliness is a consequence of deficiencies in an individual's social relationships; ii) loneliness is a subjective experience, and is not equal to objective social isolation; iii) the experience of loneliness is unpleasant and distressing. Different definitions of loneliness reflect differences in theoretical orientations. Different theoretical perspectives concentrate particularly on the nature of the social deficiency experienced by lonely individuals. One perspective emphasizes inherent human needs for intimacy. Sullivan (1953), for example, defines loneliness as the exceedingly unpleasant and driving experience connected with inadequate discharge of the need for intimacy. A second way of
conceptualizing loneliness emphasizes cognitive processes concerning people's perception and evaluation of their social relationships. According to this perspective, loneliness results from perceived dissatisfaction with one's relationships. For instance, Peplau & Perlman (1979) suggest that loneliness (the unpleasant experience that occurs when one's network of social relations is quantitatively and/or qualitatively deficient) may be seen as one end point of a continuum for evaluating social relationships. A third approach to loneliness proposes that insufficient social reinforcement is the main deficiency experienced by lonely persons. Social relationships are considered as a particular class of reinforcement. In which case it may be assumed that a person's reinforcement history determines the quantity and type of contact a person finds satisfying.

While the "needs" approach to loneliness emphasizes the affective aspects of loneliness, cognitive approaches emphasize the perception and evaluation of social relationships and social deficits. In addition, theorists of the "needs" approach have suggested that individuals can experience loneliness without explicitly defining themselves as lonely or consciously recognizing the nature of their suffering. On the other hand, cognitive theorists underline the person's perceptions and reports of relational inadequacies, and direct attention to those who report themselves as lonely.

According to Peplau & Perlman (1982), the causes of loneliness fall into two different classes. The first involves events or changes that precipitate the onset of loneliness. Events such as death of a loved one, divorce, and moving to a new community, that may create loneliness. In addition to changes in actual social relationships, loneliness can also be caused by changes in the person's social needs. Life-cycle changes in a person's desires for social relations may produce loneliness if they are not accompanied by corresponding changes in actual relations. For instance, for many successful professional people, midlife may bring an increased desire to have a richer set of social relations in addition to work.
A second category of causes of loneliness involves personal and situational factors that increase an individual's susceptibility to become lonely or to persist in remaining lonely. A number of personal characteristics have been shown to be linked to loneliness: shyness, introversion, reluctance to take social risks, low self-esteem, and inadequate social skills (Peplau & Perlman 1982). In addition, cultural and situational factors may also affect loneliness. For instance, by stimulating unrealistic expectations about relationships, the mass media may also intensify feelings of social inadequacy and loneliness.

In terms of affective manifestations loneliness has been consistently linked to depression (Russell et al. 1980, Weeks et al. 1980, Blatt et al. 1995). However, depression is perhaps a broader phenomenon than loneliness. People can be depressed for a variety of reasons, and depressed people are not always lonely. Equally, people who feel lonely are not necessarily depressed. Russell et al. (1980) demonstrated that loneliness, as measured by the revised UCLA loneliness scale, may be distinguished from measures of other conceptually related constructs such as depression, lack of affiliative motivation, and low social risk taking. Lonely people frequently describe themselves as feeling anxious, tense, restless, and bored (Louks 1974, Perlman et al. 1978). There is also some evidence that lonely individuals may feel angry and hostile toward others (Louks 1974, Russell et al. 1978).

Some studies have focused on the impact of cognitive processes of attention on loneliness. Several studies indicate that lonely individuals are highly self-conscious or self focused (Jones et al. 1981). This heightened self-focus may be reflected in subtle characteristics of interpersonal behaviour, such as asking fewer questions about others (Peplau & Perlman 1982). The type of causal attributions that lonely individuals make may have significant influence on their optimism about the future, their affective reactions to loneliness, their self-esteem, and their coping behaviour. For instance, individuals who have
recently moved to a new community may feel more hopeful about improving their social life if they attribute their loneliness to temporary social conditions rather than to unchangeable aspects of their own personality. It has also been suggested that attributions may influence, to some degree, whether or not a lonely person becomes depressed. Beliefs that one's loneliness is caused by stable features of one's personality may be especially likely to produce depression (Peplau & Perlman 1982).

Loneliness has been associated with a variety of individual and social problems such as alcoholism (Farragher et al. 1994), suicide (Wenz 1977, Draper 1995), physical illness and overutilization of health care services (Lynch 1977).

Studies in the field of psychoneuroimmunology have indicated an association between loneliness and immune dysfunction. Lonelier medical students, for example, have been found to have significantly lower levels of natural killer (NK) cell activity than students who described themselves as less lonely (Kiecolt-Glaser et al. 1984a). Lonelier students also had higher antibody titres to Epstein-Barr virus (EBV) virus capsid antigen (VCA) (Glaser et al. 1985), which suggested immune suppression. Furthermore, lonelier psychiatric patients had significantly lower levels of NK cell activity than less lonely patients, a poorer T-cell proliferative response to the mitogen phytohaemagglutinin, and higher levels of stress-related urinary cortisol (Kiecolt-Glaser et al. 1984b). Studying women awaiting mammograms and diagnosis at a breast clinic, Fox et al. (1994) found that women in the new cancer group reported significantly more loneliness than the women in the fibrocystic and normal groups. The newly diagnosed cancer group also included a higher number of women who had suffered the death of a spouse or close familiar member within the previous two years compared to the other groups. One interpretation of this is that loneliness may contribute to the onset and progression of illness. In addition, some chronic illnesses, for example, those which increase physical disability, such as rheumatoid arthritis,
may render the person more lonely which, in turn, might result in disease progression. For instance, Fitzpatrick et al. (1991) found that friendship was affected by rheumatoid arthritis. Further research is indicated to clarify whether loneliness plays a role in the onset and progression of specific illnesses.

3.4 DEPRESSION

The term depression may be used to indicate two different phenomena: i) an experience of low mood; or ii) a serious disorder that disrupts the previous level of functioning of the individual.

Mood refers to a person's relatively sustained emotional state, which differs from the brief fluctuations in emotions that happen throughout the day (Stein et al. 1991). Everyone at some point in their life can experience low moods (Rosenham & Seligman 1984). For instance, it is to be expected that tragic events such as loss of a loved one will be accompanied by significant depressed mood.

Nevertheless, the presence of depressed mood alone is not sufficient to make a diagnosis of a clinical depressive syndrome, as in major depressive disorder (MDD) or major depression (MD). MDD (Spitzer et al. 1978) and MD [Diagnostic and Statistical Manual of Mental Disorders (DSM III), American Psychiatric Association, 1980; DSM III-Revised (DSM III-R), American Psychiatric Association, 1987] are two essentially equivalent diagnoses. There is considerable overlap between the two sets of diagnostic criteria, although some differences exist (Stein et al. 1991).

MDD and MD refer to clinical syndromes which comprise not only a persistent depressed mood or loss of interest or pleasure, but also the concomitant appearance of a series of associated symptoms which can disrupt all areas of a person's life. In addition to a persistent
depressed mood or loss of interest or pleasure, some or all of the following symptoms are involved (Stein et al. 1991, Champion 1992): i) sleep disturbance (usually insomnia), ii) appetite disturbance (usually poor appetite and/or loss of weight), iii) fatigue or loss of energy, iv) psychomotor agitation or retardation, v) feelings of self-reproach or excessive guilt, vi) diminished ability to think or concentrate, vii) feelings of self-condemnation, viii) recurrent thoughts of death or suicide.

It is important to make clear that depression can best be viewed on a continuum of severity (Champion 1992). For instance, in the milder type of depression thinking will be negative, but individuals will still be able to think about their situation and communicate it in a reasonable way. It is also possible to make contact and form a relationship with such individuals who are, therefore, suitable for psychological treatment. On the contrary, the severely depressed person is generally inaccessible to attempts at communication, and may need somatic antidepressant treatment before being able to respond to psychological intervention. Individuals during a single episode of MD/MDD may belong to a very heterogeneous group (Stein et al. 1991). For instance, a depressed patient may have predominantly vegetative, rather than psychological, symptoms; may experience coexisting anxiety or hostility; may or may not be severely depressed; may be labelled "endogenous" or "melancholic", may be hospitalized and may be psychotic. Endogenous and melancholic patients are those who show a particular symptom profile including symptoms such as lack of reactivity to the environment, a pervasive loss of interest in all or almost all activities, significant weight loss, diurnal variation in mood, and early morning awakening. In addition they tend to have a positive response to somatic antidepressant therapy.

Another source of variation among depressive patients concerns the longitudinal course of the depression: the length of the current episode of depression, the number of previous episodes, a family history of depression, and a past history of mania or
hypomania. Mania is the opposite of depression, including symptoms of elation, grandiosity, decreased need to sleep, and increased activity. Hypomania is a less pronounced form of mania. Depression accompanied by manic or hypomaniac episodes is described as bipolar to distinguish it from simple, unipolar, depression. The distinction between bipolar and unipolar depression may be relevant because there is evidence suggesting that the biological changes found in these conditions may be different (Roy et al. 1985, 1986).

There are different models or approaches to understanding the causes of depression and its treatment: psychodynamic, cognitive, behavioural, learned helplessness, social, and biochemical models (see Champion 1992).

As an approach to depression psychoanalysis presents a number of different theories (Wetzel 1984). Common features of these theories are the emphasis on unconscious factors, and the relationship between early development and vulnerability to depression in adult life.

Cognitive models of depression are a relatively recent but significant development in the area from a psychological perspective (Champion 1992). The work of Aaron Beck is of major relevance (Beck 1972, Beck et al. 1979). This approach emphasizes that in depression a negative cognitive set is primary and that alteration in affect is secondary. Beck regards the depressed person as having constellations of negative perceptions of the self, the world, and the future, which are reflected in "negative automatic thoughts" and which determine motivational, emotional, and behavioural changes. These errors in thinking are called characteristic sets, predisposing the depressed individual to interpret events within a schema of self-depreciation and self-blame. This assessment of self appears as truth to the depressed person, even though clearly it is a distortion when balanced against the perceptions of others.
In the behavioural approach, depression is considered to be a learned response, the consequence of a "low rate of response-contingent reinforcement", in behavioural terms, inadequate or insufficient gratification in connection with the depressed person's behaviour. Conjecture as to how that deprivation happens may focus on the environment or on the depressed persons themselves, depending on the theorist (Wetzel 1984).

The learned helplessness theory is the result of extensive work by Seligman and his associates (Seligman 1975) in both humans and other animals. Learned helplessness is a psychological state resulting from repeated instances of noncontingency between behaviour and outcome. The individual learns that events are not controllable, and this belief generalizes to other situations. Depression has been associated with learned helplessness. Seligman argues that the kinds of events that produce depression are similar to those that cause helplessness, and therefore, that the two phenomena may be linked. Both are characterized by passive behaviour, negative expectations, and hopelessness. Seligman presumes that helplessness may, in fact be a basis for depression. In general, depressed individuals have failed on a number of occasions (lost a job, experienced rejection, or lost control over their lives). This kind of life history, it is argued, can result in learned helplessness and depressed mood. Although links between helplessness and depression appear to exist, the relationship is much more complex than initially thought. A number of studies by Seligman (1975) and others (Cohen & Tennen 1985, Peterson et al. 1985, Beck 1976) have indicated some degree of relatedness, and a number of reformulations of helplessness theory have been developed to incorporate some of the known cognitive determinants of depression (Gatchel et al. 1989).

Authors who adopt a social approach to depression, share the assumption that the disorder is largely a social phenomenon and must be understood in its social context (Brown 1985, Coyne 1985). It is relevant here that the rates of depression, excluding
bipolar disorders, differ between certain social groups. For instance, women are about
twice as likely as men to be diagnosed as having a clinical depressive syndrome (Weisman
& Klerman 1985, Cochrane 1983). In order to explain this dramatic sex difference
according to social theorists, it is necessary to look at social explanations such as: sex
discrimination, the early role socialisation of girls to be more helpless and powerless than
boys, the greater acceptability for women in our society to express depression compared
to men (Champion 1992). In addition, women are expected to fulfill social roles such as the
carer of young children, cleaner, housewife, which are thought to make them vulnerable to
depression (Gove & Tudor 1973). The work these roles require is not highly valued in our
society, it is frequently not paid or poorly paid, there are no fixed hours and generally very
poor conditions of service. For many women, especially for those who have few material
or social resources, the experience may produce feelings of being trapped and helpless that
are common in depression. One of the most influential social approaches to depression was
developed by Brown and colleagues (Brown 1989, Brown & Harris 1978). In summary,
social models of depression have much to say about the contribution of social factors in the
environment of the depressed person, or about the broad influences of sex, class, culture
and life stage.

Biochemical theories claim that depression is caused by an imbalance of chemicals
in the brain. It is not clear whether this imbalance is a result of gene transmission, or
abnormalities in brain chemistry that predispose a person to a vulnerability to depression.
A biochemical interpretation may also include depression as secondary affective disorder.
In such a perspective, depression is considered a secondary symptom resulting from another
major physiological or psychological problem (Wetzel 1984). Specific biochemical theories
have been reviewed by Willner (1985) and Gilbert (1984).

There is evidence that depressive disorders are associated with increased morbidity
Persky et al. (1987) examined the relationship of depression to the incidence and mortality from cancer in a group of 2,000 middle-aged men over a 20-year period. A significant correlation between depression and incidence of cancer was found for the first 10 years of follow-up and with mortality for the total 20 years of follow-up. The relationship was significant even after adjusting for age, smoking, alcohol consumption, occupational status, and family history of cancer. In another study by Kerr et al. (1969), a group of patients aged 40 years and over with the primary diagnosis of depression, who were followed for up to four years, exhibited a significantly higher number of deaths than expected. The relationship between depression and cancer is complex and may be related to a number of factors. For instance, depression may be a manifestation of cerebral metastasis that has not produced any physical symptom, or may be a nonmetastatic symptom of an undetected cancer.

Another possibility is that the association between depression, morbidity and mortality may be related to changes in immune function. Some studies have suggested that the severity of depressive symptoms accompanying bereavement may be related to decreased mitogen proliferative responses (Linn et al. 1984), reduced NK cell activity, and reduced T-suppressor cell numbers (Irwin et al. 1987a, b). In addition, it was found that plasma adrenocorticotropic responses to infusions of corticotropin-releasing hormone in individuals with bereavement accompanied by a major depressive episode were similar to those of patients with a major depressive disorder (Roy et al. 1988). This response pattern was not observed in bereaved subjects without a depressive disorder. It is possible that among bereaved individuals with depression there may be neurobiological alterations which alter immune responses.

Reviewing the literature on depressive disorders and immune function Stein et al. (1991) concluded that studies investigating the number of immune cells in the peripheral
blood of individuals with MD/MDD have reported no consistent results for any of the cell types or subsets. Concerning studies that used functional immune assays (namely, lymphocyte proliferative response to mitogens and NK cell activity), Stein et al. (1991) also concluded that no consistent alterations have been reported in MD/MDD patients. The failure to confirm quantitative and functional immune alterations was considered by these authors to be a possible consequence of a number of potential confounds in experimental design and a variety of methodological faults (including diagnostic heterogeneity, sample size, control group composition, assay technique).

Schleifer et al. (1989), in a well designed study to control these potential confounds and methodological faults, investigated immune parameters in 91 rigorously diagnosed patients with unipolar MDD compared with 91 age- and sex-matched controls. The analysis revealed significant age-related differences between the depressed patients and controls in relation to mitogen responses and T4 lymphocyte numbers. The depressed subjects did not show increased lymphocyte mitogen response with advancing age compared to controls. Similar age differences were found between the two groups for T4 lymphocytes. Severity of depression was also associated with the mitogen proliferative responses. These findings indicate that alterations in immune responses in MD/MDD do not seem to be a specific biological correlate of this depressive disorder, although they may occur in subgroups of depressed patients such as the elderly and the severely depressed.

Finally it is important to mention that the clinical relevance of any of the immune alterations that have been reported to be linked to depression is not known. These changes could be primarily adaptative in nature or could influence the onset and progression of illness. Taking into consideration conceptual and methodological limitations, the evidence so far indicates that there may be subgroups of depressed subjects (for instance, the severely depressed, the elderly) who may present immune alterations. Stein et al. (1991) suggest that
a more promising approach may be to investigate possible reciprocal interactions between
the central nervous system and the immune system in depression. Alterations in the immune
system appear to be secondary to neurobiological changes linked to depression. Similar to
pituitary cells, immune cells have recently been shown to have the capability of secreting
thyroid-stimulating hormone (TSH) in response to thyrotropin-releasing hormone (TRH),
and adrenocorticotropic hormone (ACTH) in response to corticotropin-releasing hormone
(CRH) (Harbour et al. 1987, 1988). Given that pituitary function is critical to
neuroendocrine function and possibly neuroendocrine dysfunction in depression, Harbour
et al. (1988) reported a preliminary use of immune cells as peripheral models of
neuroendocrine function in the depressive disorders. Isolated mononuclear leucocytes from
10 depressive and 9 control subjects were incubated with TRH, and TSH production was
assessed. The number of cells positive for TSH and the amount of TSH produced was
significantly reduced in cell cultures from the depressed group compared to the control
group. Because decreased responsiveness of the hypothalamo-pituitary-thyroid axis to
exogenous TRH has been observed in certain depressed patients, the evidence of similar
reduced TRH responsivity at the level of the immune cell is interesting and potentially
useful in further examining the molecular mechanisms that may be involved.

3.5 ANXIETY

Emotions such as depression and anxiety can be part of the stress process or can
occur independently (Gatchel et al. 1989). The anxiety response is not unlike the stress
response. Both may involve similar physiologic, experiential, and behavioural components.
For instance, a person encountering a final examination as a stressor may react with anxiety,
presenting increased cardiovascular reactivity, a subjective experience of being threatened,
and may attempt to escape from the examination room.

As illustrated above anxiety and other emotions involve physiologic, experiential, and behavioural components. However, there may be discordance between these three systems of expressing anxiety. For instance, an individual who dreads entering a given situation may nevertheless force her/himself to do so (Akiskal 1985).

Anxiety may be defined as a generalised condition of fear and apprehension. One issue that needs to be raised at the outset is at what point anxiety should be considered pathological. Akiskal (1985) suggests that the threshold for clinical anxiety is reached when: i) the emotion is recurrent or persistent; ii) it is out of proportion to the situation eliciting it, or happens in the absence of any ostensible danger; iii) the person is paralyzed with a sense of helplessness, or unable to take adequate action to stop the anxiety-provoking situations; and iv) psychological or physiological functioning is impaired.

Physiological symptoms of anxiety, reflective of heightened autonomic nervous system arousal, include elevated heart rate and blood pressure, sweating, intestinal distress, and muscular tension and weakness. Anxious individuals also report symptoms such as insomnia, worry, forgetfulness, difficulty in concentrating, irritability, and frequently, mild depression. Anxiety disorders are distinguished by diffuse and often severe "free floating" anxiety that may not be related to any one immediate situation or threat object. In addition to their clinically high levels of anxiety, these persons can experience acute episodes of panic.

There are two widely used systems for classifying anxiety conditions: the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (DSM) and the World Health Organisation's International Classification of Diseases (ICD). The more recent version of both, DSM-IV and ICD-10, show remarkable similarity in the criteria used to define the major anxiety disorders: panic disorder, specific phobias, obsessive-compulsive
disorder, generalized anxiety disorder.

Panic disorder is described in both of these systems as recurrent, abrupt, unexpected, or unpredictable attacks of fear or discomfort, peaking in minutes and accompanied by symptoms such as palpitations, breathlessness, chest pain or discomfort, feelings of unreality, dizziness or unsteadiness, hot or cold flushes, sweating, faintness, shaking, fear of dying, going mad, and a sudden need to use the toilet. Recurring attacks may lead to the phobic avoidance of situations believed to trigger attacks, which may explain the common coexistence of panic disorder and agoraphobia (Priest & Baldwin 1992).

Specific phobias are defined as an excessive or unreasonable fear of specific objects or situations. DSM-IV also requires that the phobia interfere with one's life or activities. Social phobia is defined as an excessive and unreasonable fear and avoidance of scrutiny or of being the focus of attention in social situations one thinks will result in being humiliated, criticized or embarrassed. ICD-10 requires that specific symptoms be present, while in DSM-IV a level of handicap is required (Andrews et al. 1994).

Obsessive-compulsive disorder is defined as obsessions (intrusive thoughts, commonly fear of contamination and of perpetrating aggression) or compulsions (repetitive unwanted acts); both being repetitive, unable to be resisted, and excessive and inappropriate, and which distress or handicap by occupying time.

Generalized anxiety disorder is defined as more than six months of anxiety and worry over everyday events or problems, accompanied by somatic symptoms of anxiety (motor tremors, urinary frequency, loss of appetite, rapid eyeblinks, restlessness and other symptoms of increased activity of the sympathetic nervous system). Because the anxiety persists the affected individual is usually handicapped in interpersonal relationships and other aspects of life (Powell & Enright 1993).
There are four major theoretical approaches to anxiety: i) biological, ii) psychoanalytic, iii) behavioural, and iv) cognitive. These approaches will be briefly characterized below.

Although the existence of a biological process associated with anxiety is not disputed, pure biological theories claim that biological processes are of primary importance in the underlying aetiology. For those who adopt this approach, individuals' differing experiences of anxiety reflect their different genetic make-up, biochemical make-up, and brain function.

It is presumed that anxiety disorders are related to disorders in different neurotransmission systems: the benzodiazepine-GABA-system, the noradrenergic system and the serotonergic system. Although it appears that these systems fulfil an important role in regulating anxiety (Hoehn-Saric & McLeod 1988, Wamboldt & Insel 1988), there is not conclusive evidence confirming any causal relationships.

There has been little research concerning the possible role of genetic factors in the development of anxiety disorders. Two studies on monozygotic and dizygotic twins are relevant concerning social phobia. Torgersen (1979) and Rose & Dilto (1983) found a limited genetic contribution to the onset of social anxiety. Some investigations have been carried out into a possibly hereditary component of obsessive-compulsive disorder. However, the available evidence does not permit any firm conclusions concerning the contribution of genetic factors to the disorder (Emmelkamp et al. 1992). On the basis of the available evidence, it is plausible to assume that there is no genetic contribution present in the onset of generalized anxiety disorder, or in connection with most forms of simple phobia (Emmelkamp et al. 1992). Although there are indications of genetic contributions to the onset of panic disorder and agoraphobia (Torgersen 1988), the methodological shortcomings of the studies do not permit more definitive conclusions (Emmelkamp et al.)
Some researchers, though they would not endorse a solely biological model, have offered further evidence for biological involvement. For instance, H. J. Eysenck (1967) has suggested that individual differences in the experience of anxiety may occur as a result of the inheritance of a particular genetic make-up that predisposes one to react with greater or lesser intensity to stimuli which might cause distress. He also suggests that certain individuals are predisposed toward forming strong conditioned responses. By doing so, he combines biological and behavioral theories.

There are various psychoanalytic theories of anxiety (Fischer 1979) and all of them emphasize the role of childhood experience and unconscious factors in the development of pathological anxiety. Freud, the founder of psychoanalysis, distinguished between three different types of anxiety: i) reality, ii) moral, and iii) neurotic. Reality anxiety is the anxiety of everyday life with which all of us are familiar. It refers to certain objects in the real external world and is essentially synonymous with what is generally called fear. This anxiety is both rational and proportional to the fear stimulus, and has the adaptative function of preparing the person faced with danger. Moral anxiety, which is usually experienced by the ego as guilt or shame, develops through the perception of danger coming from the superego, especially that portion known as conscience. As an internalized agent of parental authority, the conscience threatens to punish the ego for either doing or thinking something that transgresses upon the perfectionistic aims of the ego-ideal. The third type, neurotic anxiety, is caused by the perception of danger from the id instincts. It is a result of the threat of the id to overwhelm the ego, with the consequent socially unacceptable expression of pleasure-seeking or aggressive behaviour.

In the behavioural approach to anxiety different forms of learning (such as classical conditioning, instrumental conditioning, and vicarious experience) are used to explain the
development of anxiety.

By demonstrating that a phobia can be acquired through a process of classical conditioning, Watson & Rayner (1920) pioneered research into a behavioural theory of phobias. Mowrer (1947) expanded the behavioural approach by suggesting a two-factor theory for the development and maintenance of phobia. At first, fear develops through classical conditioning and subsequently the individual learns to reduce this fear by avoidance. This second form of learning is called instrumental conditioning and the response of avoidance is acquired and maintained because it reduces anxiety and is therefore reinforced.

Bandura (1969) has proposed four mechanisms for the development of anxiety. First, he considers that anxiety can be learned by classical conditioning. Second, he suggests that vicarious experience (observing someone else undergo punishment, pain or discomfort as a consequence of her/his behaviour) may be of relevance. Third, symbolic instruction refers to learning through education, reading or being told that certain things are terrifying, painful or taboo. Fourth, Bandura considers symbolic logic as potentially important in the development of anxiety. A person may deduce correctly or not that something is dangerous. Therefore, Bandura's perspective combines learning principles together with the role of individual reasoning in the development of anxiety disorders.

The relevant cognitive theories were developed largely as an explanation and treatment approach for depression (Powell & Enright 1993). Later they began to be applied to the field of anxiety. Although different theorists offer slightly different emphases, cognitive theories usually state that anxiety is maintained by the dysfunctional appraisal of a situation leading to a perception of danger. Cognitive theorists believe that it is not events which cause anxiety but rather it is the person's interpretation of these events that may lead to the development of anxiety. For instance, Beck (1976) suggests that pathological anxiety
comes from the repeated overestimation of danger along one or more of four dimensions:
i) overestimating the chances of a feared event occurring, ii) overestimating the severity of
the feared event, iii) underestimating one's ability to cope, iv) underestimating the likelihood
that someone else will be able to help.

A more academic perspective of anxiety has been developed by Spielberger and co­
workers (1966, 1970), who have distinguished between two different anxiety concepts:
state anxiety (A-State) and trait anxiety (A-Trait). A-State refers to a transitory emotional
state that can vary in intensity, fluctuates over time, and is characterized by subjective
feelings of tension and apprehension and heightened autonomic nervous system activity. A-
Trait is defined as relatively stable individual differences in anxiety proneness, that is,
differences in the disposition to respond to situations perceived as threatening with
elevations in the intensity of A-State.

According to Spielberger et al. (1970), it is expected that those who are high in A-
Trait tend to show A-State elevations more frequently than low A-Trait persons given that
the former tend to react to a wider range of situations as dangerous or threatening.

As stated above, anxiety may be part of the stress process. In fact, among all
psychosocial concepts related to stress, anxiety appears to be the closest. For instance,
both stress and anxiety responses involve heightened sympathetic arousal and sensations
in the viscera. In addition, both of them usually motivate people to try to dispel, avoid or
overcome the source of emotional arousal. Therefore, it is possible that anxiety could have
played a relevant role in the above reviewed studies linking stressful life events to illness.
However, in this section, only studies that have specifically assessed anxiety will be reviewed.

Rees (1964) considered anxiety, depression and other emotional reactions, among
other factors, to be responsible for the precipitation of asthmatic attacks. Anxiety
management and assertiveness training have been shown to reduce pain and need for medication among patients with ulcers (Brooks & Richardson 1980). In the long term, ulcer patients given these skills were far less likely to experience recurrence of symptoms. Although the available evidence is not conclusive, it suggests that anxiety and stress are of primary relevance to ulcer formation (Gatchel et al. 1989).

Regarding the association between anxiety and immune function, in a study of patients with recurrent genital herpes simplex virus it was observed that subjects with high levels of anxiety, depressive mood or hostility had a lower proportion of suppressor-cytotoxic T cells. (Kemeny et al. 1989). In studies of AIDS spectrum disorders, measures of anxiety, mood state, and hopelessness were positively correlated with total white blood cell count and with numbers of polymorphonuclear leukocytes and lymphocytes on differential counts (Temoshok 1988). Levy (1988) reported inverse relationships between natural killer cell activity and indicators of state anxiety, tension, depression and fatigue. The occurrence of acute necrotizing ulcerative gingivitis was linked by Cohen-Cole et al. (1983) to anxiety, negative life events and depression.

In the studies above described anxiety was only one among several factors whose putative associations with immune dysfunction were examined. However, in a study especially designed to investigate the possible link between anxiety and immune suppression, Esterling et al. (1993) found that subjects reporting high and middle levels of anxiety had higher antibody titres to Epstein-Barr virus, suggesting poorer immune control over the latent virus, as compared with the low-anxious group. Studying women undergoing adjuvant chemotherapy for breast cancer, Fredrikson et al. (1993) found that subjects with high compared to low trait anxiety evidenced immune changes. Total number of monocytes was reduced in patients with high compared to low trait anxiety and natural killer cell activity tended to be compromised in the high anxiety group. In addition,
helper/inducer T-cells isolated from blood samples were lower in patients with high as compared to the low trait anxiety group. LaPerriere et al. (1990) investigated the impact of aerobic exercise training as a buffer of the affective distress and immune decrements which accompany the notification of HIV-1 antibody status in an AIDS risk group. They found that seropositive controls (who did not receive the aerobic exercise training) showed significantly greater increases in anxiety and depression, as well as decrements in natural killer number following notification compared to the exercise group.

In summary, it appears that anxiety may have adverse effects on immunocompetence. However, it is necessary to investigate whether anxiety-induced immune alterations are of relevance to the onset and progression of specific illnesses.

3.6 SOMATIZATION

Somatization can be defined as a tendency to experience and display somatic distress and symptoms unaccounted for by pathological findings, to attribute them to physical illness, and to seek medical help for them (Lipowski 1988). Lipowski (1988) makes the important point that somatization does not imply that the patient may not have a concurrent physical illness. On the contrary, in some cases somatization may actually coexist with, mask, and be facilitated by such an illness.

Somatization is a common problem in health care. Patients presenting with symptoms lacking an adequate medical basis are ubiquitous in all medical care settings. The somatic expression of psychological distress occurs in a significant proportion of primary care patients. It is associated with substantial distress and impairment and with increased health care utilization. In a UK study of somatization in primary care almost 20% of
patients who presented to their doctors with new episodes of illness fulfilled research criteria for somatization (Goldberg & Bridges 1988), as do a substantial proportion of the patients referred to psychiatrists in general hospitals. Thomas (1983) estimated that they are responsible for 30% of the referrals to a British liaison psychiatry service.

A number of psychosocial and cultural factors are presumed to contribute to somatization (Bass 1990). It is hypothesized that increased awareness of bodily sensations can result in more intense emotion which can in turn increase somatic symptoms. High traits of anxiety and hypochondriasis might lead some individuals to report somatic sensations at a relatively low level of emotional stimulation. An inability to verbalize distressing emotions, alexithymia, is thought to predispose to somatization. In a study that reported the impact of specific life events on an individual's capacity to respond using appropriate affective language, Andrews & House (1989) found an excess of events relating to conflicts over speaking out before the onset of functional dysphonia. In an interesting series of studies, Pennebaker & Susman (1988) suggested that inability to disclose traumatic childhood events may lead to adverse health outcomes. They presumed that inhibition of thoughts, feelings and behaviours is associated with psychological processes, which may be manifest in the short term by increases in autonomic nervous activity. In addition, explanations borrowed from cognitive psychology have made an important contribution to the understanding of somatization. In particular, the patient's attributions of causality can determine not only how symptoms are perceived but also what treatments are sought. The patient's focus in somatic symptoms prevents her/his psychological understanding of the situation and obscures the need for personal change. It has also been suggested that somatization plays an adaptative function for the patient by avoiding the stigma of mental illness. It may also lessen the patient's responsibility for her/his condition. Family and health professionals may show more sympathy and consideration for patients with a physical
illness than for those with psychological problems. Those with psychological problems may be considered responsible for their condition, while those, for example, with an infection may be perceived as having fallen victim to a disease. Complaints of sadness, loneliness and anxiety may not be taken seriously, whereas headaches, abdominal discomfort and fatigue may receive more attention.

The term somatoform disorders was introduced in the third edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-III) (American Psychiatric Association, 1980) to describe a new class of psychiatric syndromes whose essential characteristic is: physical symptoms indicating physical disorder for which there are no demonstrable organic findings or known physiological mechanisms and for which there is evidence, or a strong presumption, that the symptoms are linked to psychological factors or conflicts.

There are six conditions classified as somatoform disorders in DSM-III-R: i) body dysmorphic disorder, ii) conversion disorder, iii) hypochondriasis, iv) somatization disorder, v) somatoform pain disorder, and vi) undifferentiated somatoform disorder.

Body dysmorphic disorder was introduced as a separate category in the 1987 revised edition of the DSM-III. It is defined as a preoccupation with some imagined defect in appearance in a normal-appearing person. The most common complaints involve facial flaws such as wrinkles, spots on the skin, shape of nose, jaw, etc. The criteria exclude cases in which the complaint is delusional and when it arises in the course of anorexia nervosa or transsexualism. There are obvious problems with this definition. For instance, judgments about a person's appearance are not medical but aesthetic and are likely to vary between doctors.

There is an essential difference between conversion disorder and other somatoform disorders, that is an alteration or loss of physical functioning is required for the diagnosis, which is not made on the basis of symptom complaints alone. Therefore, pain is not
classified as a conversion symptom. Most typical examples of conversion suggest neurological disease, for instance, paralysis, seizures, or anaesthesia. However, The DSM-III-R also gives pseudocyesis (phantom pregnancy) and vomiting as examples of conversion. Unlike other somatoform disorders an episode of conversion is usually of short duration with sudden onset and resolution, although it can be recurrent. Several studies have shown the unreliability of an initial diagnosis of conversion (Murphy 1990). Sources of error in the medical assessment of a patient with undiagnosed neurological disease that may lead to a mistaken diagnosis of conversion include: natural variations in the disease process, limitations in medical knowledge and methods of assessment, and a tendency for distressed patients to exaggerate their complaints.

The DSM-III-R and ICD-10 concepts of hypochondriasis emphasize the patient's preoccupation with having a physical disorder far in excess of what is justified, as well as disease conviction that shows an indifference to the opinion of others, and lack of responsiveness to persuasion. The symptoms are not just those of panic attacks, and the duration of the disturbance should be at least six months.

The criteria for somatization disorder include a history of multiple unexplained physical complaints or a belief that one is sickly, beginning before the age of 30 and persisting for several years. In addition, the patient must have at least 13 physical symptoms from a list of 35 in the DSM-III-R. These symptoms are listed in six groups: pain, gastrointestinal, cardiopulmonary, conversion (pseudoneurological), sexual and female reproductive symptoms. For a symptom to count towards the diagnosis it has to satisfy three criteria: i) there is no pathophysiological mechanism to account for the symptom; ii) it has not occurred only during during a panic attack; and iii) it has led the person to see a doctor, take medicine, or alter life style.

In the DSM-III-R the criteria used to diagnose somatoform pain disorder include
preoccupation with pain for at least six months. In addition, the first or second of the following criteria must be satisfied: i) appropriate evaluation uncovers no organic pathology or pathophysiological mechanisms to account for the pain; ii) when there is related organic pathology, the complaint of pain or resulting social or occupational impairment is grossly in excess of what would be expected on the basis of the physical findings. These criteria do not require any judgement about the aetiological role of psychological factors. In addition, pain is usually involved in somatization disorder and hypochondriasis, being an insufficient symptom for the diagnosis of conversion disorder. There are also difficulties with the classification of regional pain syndromes (for example, atypical facial pain) for which there are competing physical and psychological aetiological theories. Because of these problems somatoform pain disorder is thought to reflect a diagnostic problem rather than a discrete syndrome (Murphy 1990).

Undifferentiated somatoform disorder is defined as a residual category to somatization disorder in the DSM-III-R. It is diagnosed in cases that do not meet the full symptom picture of somatization disorder. Its diagnostic criteria are: one or more physical complaints that cannot be explained by organic pathology or pathophysiological mechanisms, or are grossly in excess of what would be expected from organic findings; duration of more than six months; and occurrence not exclusively during the course of another disorder. Because more patients can be classified in this category than in any of the other somatoform categories, clinicians and researchers seem reluctant to use a residual category to classify a common type of clinical problem.

A number of criticisms of the concept of somatoform disorder, which may apply to psychiatric diagnosis in general, have been made. Such criticisms have been along the following lines (Murphy 1990): i) division of patients on the basis of presenting symptoms is superficial, and classification should be based on something deeper than physical
symptoms; ii) the individual disorders are not qualitatively distinct but rather merge into each other, most patients, therefore, have features from different diagnostic categories; iii) many of the concepts, including medical help-seeking behaviour, number of symptoms and hypochondriacal attitudes are better described in dimensional rather than categorical terms; iv) the clinical descriptions of the specific disorders are derived from hospital-based experience and are not representative of the large population of somatizing patients in community and primary care settings; v) making such a diagnosis could result in stigma for patients, giving the spurious impression of understanding and leading to naive assumptions about disease entities; vi) the diagnostic criteria for somatization disorder are too restrictive for clinical use, and as a consequence most cases end up in a residual category (undifferentiated somatoform disorder).

The relationship between somatization and physical illness may be different from the relationships between other psychosocial factors and physical disorders, in the sense that somatization can mimic physical diseases. On the other hand, psychosocial factors such as stress and anxiety, for instance, may be of relevance to the onset and/or progression of a range of genuine illnesses such as ulcers, coronary heart disease, stroke, malignancy and infections. In addition to the inconvenience caused by the experienced symptoms, the somatizer's affliction may be aggravated given that a legitimate illness is not acknowledged. It is known that in certain cases, however, somatization may coexist with a physical illness. In such cases, somatization could increase the patient's distress, and perhaps play a role in the course of the illness.

Concerning chronic inflammatory periodontal diseases, Moulton et al. (1952) reported that patients with severe chronic periodontitis presented with many psychosomatic symptoms involving the head, neck, and gastric areas. Baker et al. (1961) found a significant correlation between somatization and periodontal status. More recently, Green
et al. (1986) reported a particularly conspicuous relation between stressful life events and periodontal disease for individuals who scored high on somatization.

Somatization has also been linked to other physical disorders. For instance, somatization is presumed to be associated with gastrointestinal illness (Drossman et al. 1995). Baker et al. (1995) reported that patients with gastroesophageal reflux disease compared to controls show higher somatization, depression, anxiety, and intensity of reporting symptom distress. Reviewing research on chronic fatigue syndrome (CFS), Wessely (1991) concludes that most patients fulfill criteria for psychological disorders. Depression was considered the most common diagnosis, followed by anxiety disorders and somatization disorders. The aetiology of CFS is obscure and no simple explanation can be found (White 1990). Although psychosocial factors are definitely linked with the disorder, a biological aetiology for CFS-associated physical and affective signs cannot be excluded (Antoni et al. 1994). CFS is characterized by a constellation of signs and symptoms that brings about severe limitations in the lifestyle and vocational activities of previously vital and productive individuals. Symptoms are numerous and include debilitating fatigue, mild fever, sore throat, lymph node pain and tenderness, myalgias, arthralgias, cognitive difficulties, and mood changes. Objective physical signs include low-grade fever, non-exudative pharyngitis and palpable cervical or axillary lymph nodes (White 1990). Like somatization, this syndrome appears to defy the tendency to simplify phenomena. Both CFS and somatization question dichotomized categories such as mind versus body and organic versus psychogenic.

In summary, although somatization has been linked with some physical conditions, it appears that there is no strong evidence of its influence in the course of such physical disorders.
3.7 CONCLUSIONS

Among all the psychosocial factors presented in this section stress is the broadest. Anxiety and depression may be experienced as a reaction to stressors impinging on the person, or may occur independently of environmental events. Given the occurrence of a stressor, an individual may react with dysphoria presenting higher state anxiety. On the other hand, individuals with high levels of trait anxiety may be considered more vulnerable to stressors, tending to respond to situations perceived as threatening with higher levels of state anxiety. In the case of depression, it appears that not all major life events increase the risk for depression. Only the most severe and typically those involving loss seem to be relevant. During a stressful period in their lives, as a consequence of experiencing a higher level of dysphoria, people may also present more somatization. In addition, somatization is most often associated with depressive and anxiety disorders.

Among the mediators of stress, social support is of great importance given that social support has been shown to protect individuals from pathogenic effects of stressful events, such as increased anxiety, depression and immune suppression. Loneliness, the other interpersonal relationship factor, may be related to social support. For instance, an individual with a low frequency and/or intensity of social contacts, feeling subjectively lonely, is also likely to experience decreased social support. For many individuals loneliness occurs in response to disruptive life events such as widowhood, divorce, and moving home. Loneliness has also been shown to be associated with depression and anxiety. Anxiety and depression frequently occur together, and such mixed syndromes are the commonest psychiatric disorders in the general population (Priest & Baldwin 1992). However, despite the association between them, it has been argued that depression and anxiety are conceptually and empirically distinguishable on the basis of course, relative severity of each

In summary, the psychosocial factors presented here are conceptually and empirically related. Their most important mutual relationships were mentioned above. However, there may be indirect associations between them not mentioned in the literature. For instance, loneliness and somatization may occur together, which could involve the mediation of depression. A lonely individual who is experiencing a high level of depression may in turn complain of physical symptoms which lack demonstrable organic bases. Such associations may not be of statistical significance, although they may be important in clinical practice.

It has been shown that stress and the other psychosocial factors presented in this chapter have been linked to a number of physical symptoms or illnesses. Although most of the evidence is only clinical or correlational, some well designed experimental or non-experimental prospective studies have suggested a causal influence of these psychosocial factors in the onset and progression of illness (Totman et al. 1980, Broadbent et al. 1984, Kemeny et al 1989, Cohen et al. 1991). Furthermore, it appears that it is in the area of infection that recent literature has documented the most convincing causal role for psychosocial factors.

The periodontal conditions of most interest in the present research work, different forms of chronic periodontitis, are infections, and perhaps a significant proportion of their variation in terms of occurrence and severity might be explained by relevant psychosocial factors via a number of putative mechanisms including induced immunosuppression. Previous studies concerning the relationship between psychosocial factors and periodontitis in humans generally have yielded positive correlative findings, although they have for the most part not assessed periodontitis features independently of those descriptive of gingivitis.
It would be of relevance, therefore, to investigate the aetiological importance of psychosocial factors specifically to those diseases which are classified as forms of periodontitis. Study 1, which is described in the next chapter, addresses this question with respect to adult onset rapidly progressive periodontitis. The psychosocial factors used were those discussed in this chapter: stress, depression, anxiety, somatization, social support and loneliness.
CHAPTER 4:
STUDY 1: PSYCHOSOCIAL FACTORS AND ADULT ONSET RAPIDLY PROGRESSIVE PERIODONTITIS

4.1 INTRODUCTION

Most studies in humans have found significant associations between psychosocial factors and chronic inflammatory periodontal disease (Moulton et al. 1952, Baker et al. 1961, Belting & Gupta 1961, Davis & Jenkins 1962, Vogel et al. 1977, Green et al. 1986, Marcenes and Sheiham 1992). These studies have yielded correlative findings, and have for the most part used a periodontal index which included both chronic gingivitis and chronic periodontitis (CP) features. Although a preliminary prospective study, with a sample of 18 subjects (Freeman & Goss 1993), has indicated that an increase in pocket depth was significantly predicted by psychological factors such as occupational stress and type-A behaviour pattern, the evidence at present does not definitively support a causal relationship between psychosocial factors and CP (Monteiro da Silva et al. 1995). In addition, CP can differ with respect to bacterial aetiology, host response and rate of progression, and psychosocial factors may not be equally associated with the different forms of CP (McGlynn et al. 1990, Monteiro da Silva et al. 1995).

Adult onset rapidly progressive periodontitis (RPP) is more frequently suggested to be associated with psychosocial factors than other current forms of CP. For instance, establishing RPP as a distinct clinical entity, Page et al. (1983) reported that the active phase of the disease was often associated with depression. Davies et al. (1985) noted that, for some RPP patients, the disease appeared to be associated with stress and/or depression, and Newman (1993) suggested the possible importance of stress in relation to the time of onset and rate of progression of idiopathic RPP. The present study therefore investigated
possible associations between a number of relevant psychosocial variables (number of life events during the previous year, total perceived stress, average perceived stress, total social support, average social support, depression, loneliness, state anxiety, trait anxiety and somatization) and RPP.

In the present study the significance of the psychosocial variables was assessed by comparing three groups: i) patients with RPP, ii) patients with routine chronic adult periodontitis (RCAP), and iii) patients without significant periodontal destruction (controls).

RCAP presents slow onset, after 35 years, even or horizontal bone loss, and no gross inflammation. Severity increases with age and progress of the disease is generally slow (Genco 1990a). Host-response factors such as neutrophil and lymphocyte function seem to be normal (Suzuki 1988). In contrast, RPP is of earlier onset and a more destructive form of CP than RCAP. It occurs in young adults, before 35 years, and has the following characteristics: rapid onset, uneven or vertical bone loss, without a symmetrical pattern, and gross inflammation and pus during the active phase (Page et al. 1983, Genco 1990a). A large percentage of affected persons display a depressed neutrophil chemotaxis response and autologous mixed lymphocyte response (Suzuki 1988). In addition, Gutierrez et al. (1991) found that peripheral blood polymorphonuclear neutrophils of RPP patients showed alterations in their adhesive and phagocytic capacities. Because the course of RCAP is presumed to extend over years and even decades, it seems likely that the putative effects of psychosocial factors on the progress of periodontal destruction would be more evident in patients with RPP. Consequently, it is possible that psychosocial factors may play a more important role in the onset and progression of RPP than RCAP via a number of proposed mechanisms, including neglect of oral hygiene, changes in diet, increase in smoking and other pathogenic oral behaviour, bruxism, alterations in gingival circulation,
changes in saliva, endocrine imbalances, and lowered host resistance (Monteiro da Silva et al. 1995). It is also possible that RPP itself, being a more severe condition than RCAP, may produce more psychosocial maladjustment than RCAP. Compared to RCAP, RPP patients are at greater risk of losing teeth and have to cope with a more distressing disease condition.

Taking into consideration the clinical observations linking psychosocial factors to RPP, and differences between the two forms of CP, it was anticipated therefore that RPP patients would show higher levels of psychosocial maladjustment compared to RCAP and control patients.

4.2 MATERIAL AND METHODS

This study protocol was reviewed and approved by the Joint Research and Ethics Committee of the Eastman Dental Hospital and Institute.

4.2.1 Subjects

Subjects comprised 150 patients from the Eastman Dental Hospital and Institute: 50 with RPP, 50 with RCAP and 50 controls. Subjects with RPP and RCAP had been under treatment in the Department of Periodontology for at least six months. The controls were patients attending for other conditions in the Conservative Dentistry Department. The majority of the latter had endodontic problems. Patients were excluded if they presented systemic conditions such as diabetes mellitus, HIV infections, neutropenias, Papillon-Lefèvre syndrome, and cardiovascular disease, which have been shown to have a significant association with CP. Patients using anticonvulsive, immunosuppressive, and calcium-channel block medications were also excluded because of their relationship with gingival inflammation. In addition, patients with radiographic and clinical evidence of previous
Discuss in more detail inclusion criteria.
Who made the diagnosis?
What of a 38yr old w/meane bone loss?
juvenile periodontitis were excluded. The three groups were matched exactly for sex (66% were females and 34% males), and as closely as possible for ethnicity (overall 88% were White Europeans, 8% Asians and 4% Africans). Because age is an important criterion in distinguishing RPP from RCAP patients, the three groups could not be matched for age. The means and standard deviations of age for RPP, RCAP and control groups were 37.8 (±5.24), 45.2 (±6.36), and 38.8 (±8.83), respectively.

4.2.2 Procedure

The following criteria were used to identify and select the RPP patients: diagnosis of chronic periodontitis before 35 years; gross inflammation and pus; advanced bone loss affecting most teeth; multiple vertical osseous defects. The inclusion criteria for RCAP patients were: diagnosis of chronic periodontitis after 35 years of age; even or horizontal bone loss; no gross inflammation or pus. Controls with no significant periodontal destruction were selected to have: no radiographic evidence of bone loss; probing pocket depths no greater than 4mm. These criteria do not exclude patients with chronic gingivitis from this group.

Once patients were confirmed as meeting the above mentioned pre-arranged criteria, they were invited to take part in the study. After voluntary written informed consent to participate in the study had been obtained, subjects completed the measures.

4.2.3 Psychosocial Measures

The psychosocial instruments used in the present study are described below and are reproduced in Appendix 1. Previous studies concerning the reliability and validity of these measures are summarized in Appendix 2.

The Somatization Symptom Dimension of the Hopkins Symptom Checklist

Somatization was assessed with the somatization symptom dimension of the Hopkins Symptom Checklist (Derogatis et al. 1974). The 12 items concerned reflect
distress arising from perceptions of bodily dysfunctions. Complaints focused on cardiovascular, gastrointestinal, respiratory, and other systems with marked autonomic mediation are included. Headaches, pain and discomfort localized in the gross musculature and other somatic equivalents of anxiety are also represented. Each item is followed by a five-point scale (0=not at all, 4=extremely). The total score, obtained by adding all items, potentially varies from 0 to 48.

The Modifiers and Perceived Stress Scale

A slightly amended version of The Modifiers and Perceived Stress Scale (Linn 1986) was used to measure number of stressful life events during the previous year, total and average perceived stress in relation to these events, as well as total and average social support received from family and friends to cope with the stressful events. The number of stressful events and the total perceived stress score provide measures of objective and subjective stress within the person's environment over a given time. The total social support reflects a subject's perceived amount of support received to cope with the events that happened in the previous year. On the other hand, the average score is presumed to reflect a person's usual way of perceiving stress or the tendency to obtain social support (Linn 1986). The instrument contains 28 life events applicable to adults. In addition, subjects were also asked to report any other event(s) not included in the list that had happened in the previous year. For each identified event, the number of months since occurrence was recorded. Subjects also estimated on a 10 point scale (0=none, 9=extreme or very much) the degree to which the event was perceived as stressful and the amount of support received from family and friends in coping with the event. The scale was scored by totalling the number of life events, the amounts of perceived stress, and social support. In addition, the average of perceived stress and social support was also calculated.

The modified version of the scale used in the present study differed from the original
mainly in not requesting the subject to estimate the degree to which the event was anticipated, and the degree of responsibility in bringing the event about.

*The State-Trait Anxiety Inventory*

State and trait anxiety were measured using the Spielberger et al. (1970) State-Trait Anxiety Inventory (STAI). This is one of the most widely used instruments and includes two separate self-report scales for measuring the two aspects of anxiety. The STAI A-Trait scale consists of 20 statements that ask people to describe how they generally feel. The A-State scale also contains 20 statements, but the instructions require subjects to indicate how they feel at a particular moment in time. The range of possible scores varies from a minimum score of 20 to a maximum score of 80 on both A-State and A-Trait scales. Subjects respond to each STAI item by rating themselves on a four-point (1-4) scale. The total score is obtained by adding all items, after reversing the items on which a high rating indicates low anxiety. Higher total scores reflect higher levels of anxiety for both scales.

*The Depression Subscale of The Hospital Anxiety and Depression Scale*

Depression was quantified with the depression subscale of the Hospital Anxiety and Depression Scale (Zigmond & Snaith 1983), which has been used for assessing states of depression in the setting of a hospital outpatient clinic. The seven items composing this subscale were largely based on the anhedonic state (a state characterized by loss of pleasure and interest) since it is presumed to be the central psychopathological feature of that form of depression which responds well to antidepressant drug treatment (Zigmond & Snaith 1983). The items are followed by four-point scales. In the present study the four-point scales varied from 1 to 4. The total score was obtained by adding all items, after reversing items 3, 4 and 5, and it varied from a minimum of 7 to a maximum of 28.

*The Revised UCLA Loneliness Scale*

The Revised UCLA Loneliness Scale (Russell et al. 1980) was included to provide
a brief subjective measure of loneliness, which reflects the adequacy of interpersonal contacts. The Revised UCLA Loneliness scale contains 20 items, 10 positively and 10 negatively worded, followed by a four-point (1-4) scale. The total score, which may vary from 20 to 80, is the sum of all 20 items, after reversing the positively worded items. Therefore, higher scores indicate higher experience of loneliness.

4.2.4 Control Measures

Potential confounds including age, smoking status, drinking habits, oral hygiene and educational background, which are known to correlate with periodontitis, were also assessed by questionnaire (see Appendix 1). Subjects who were smokers answered questions about the number of cigarettes smoked per day, and/or the number of cigars smoked per week, and/or ounces of tobacco used each week for hand-rolled cigarettes or in smoking a pipe. Subjects answered a six-point scale to assess frequency of intake of alcoholic drinks, ranging from twice a day or more to never in the past 12 months. Patients completed a questionnaire concerning oral hygiene habits during the previous year including such features as toothbrushing frequency, frequency of dental floss use, and frequency of use of mouthwash. Relevant demographic data, for instance, sex, and ethnic background were also recorded.

4.2.5 Statistical Analysis

Statistical analyses consisted of: i) between subjects multivariate analyses of covariance, ii) univariate analyses of covariance, iii) comparisons on pairs of groups by the use of simple contrasts, iv) a one-way analysis of variance. Differences at the 5% level were accepted as significant.

By the use of a commercial statistical program, SPSS-MANOVA (Norušis 1992),
A between-groups multivariate analysis of covariance was performed on the psychosocial variables (number of life events during the previous year, total perceived stress, average perceived stress, total social support, average social support, depression, loneliness, state anxiety, trait anxiety and somatization) using periodontal diagnosis (RPP, RCAP and no significant periodontal destruction) as the between-groups factor. Adjustments were made for the following covariates: smoking status, drinking habits, oral hygiene, educational background and age.

In the process of checking the assumption of multivariate normality, some psychosocial variables (number of life events during the previous year, total perceived stress, total social support, loneliness and somatization) which were not normally distributed were effectively normalised by the use of square root transformation. After transformation, assumptions of normality, homogeneity of variance-covariance matrices, linearity, and multicollinearity were satisfied.

After a distribution is normalized by transformation, the mean is equal to the median. The transformation affects the mean but not the median because the median depends only on rank order of cases. Consequently, conclusions about means of transformed distributions apply to medians of untransformed distributions (Tabachnick & Fidell 1989).

4.3 RESULTS

Table 4.1 shows the medians and the values for the 5th and 95th percentiles for the non-transformed psychosocial variables for RPP, RCAP and control groups.
Table 4.1: Medians and values for the 5th and 95th percentiles for the psychosocial factors for the three groups

<table>
<thead>
<tr>
<th>Psychosocial factors</th>
<th>RPP median, central 90%, range (lower/upper)</th>
<th>RCAP median, central 90%, range (lower/upper)</th>
<th>Control median, central 90%, range (lower/upper)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of life events</td>
<td>4.00 (1.00, 9.90)</td>
<td>4.00 (1.00, 10.45)</td>
<td>4.00 (1.00, 10.45)</td>
</tr>
<tr>
<td>Total perceived stress</td>
<td>20.00 (3.10, 56.60)</td>
<td>18.50 (3.00, 60.35)</td>
<td>17.50 (1.00, 74.35)</td>
</tr>
<tr>
<td>Average perceived stress</td>
<td>5.00 (1.40, 9.00)</td>
<td>4.73 (1.28, 8.59)</td>
<td>4.94 (1.00, 7.70)</td>
</tr>
<tr>
<td>Total social support</td>
<td>22.50 (1.65, 65.00)</td>
<td>26.50 (3.00, 68.25)</td>
<td>21.00 (2.55, 45.70)</td>
</tr>
<tr>
<td>Average social support</td>
<td>5.66 (0.36, 9.00)</td>
<td>6.24 (1.18, 9.00)</td>
<td>5.77 (1.06, 9.00)</td>
</tr>
<tr>
<td>Depression</td>
<td>11.00 (7.55, 15.00)</td>
<td>9.00 (7.55, 14.00)</td>
<td>9.00 (7.00, 14.00)</td>
</tr>
<tr>
<td>Loneliness</td>
<td>38.50 (24.55, 56.45)</td>
<td>31.50 (21.00, 49.45)</td>
<td>32.00 (20.00, 52.45)</td>
</tr>
<tr>
<td>State anxiety</td>
<td>38.50 (23.55, 55.35)</td>
<td>35.50 (22.00, 49.80)</td>
<td>34.50 (22.65, 52.80)</td>
</tr>
<tr>
<td>Trait anxiety</td>
<td>40.00 (26.55, 58.90)</td>
<td>36.00 (25.55, 55.25)</td>
<td>37.00 (22.00, 55.70)</td>
</tr>
<tr>
<td>Somatization</td>
<td>3.00 (0.00, 15.45)</td>
<td>3.00 (0.00, 12.00)</td>
<td>3.00 (0.00, 13.00)</td>
</tr>
</tbody>
</table>

Covariates were judged to be adequately reliable for covariance analysis as the slopes of the regression lines for the three groups were not significantly different for each psychosocial variable regressed on each covariate. With the use of Wilks' criterion, one of the most commonly used criteria for evaluating multivariate differences (Olsen 1974), the combined psychosocial variables were shown to be significantly related to the combined covariates, approximate $F(50, 609) = 1.43, p = 0.032$.

Again with the use of Wilks' criterion, it was shown that the combined psychosocial variables were significantly related to the periodontal diagnosis of RPP, RCAP and no significant periodontal destruction, approximate $F(20, 266) = 2.22, p = 0.002$. Univariate
analysis of covariance showed that the three periodontal-diagnosis groups differed significantly on depression and loneliness, $F(2,142) = 5.54$, $p = 0.005$ and $F(2,142) = 7.52$, $p = 0.001$ respectively. No other differences between the three groups were statistically significant at the 5% level (see Table 4.2).

Table 4.2: Psychosocial variables, respective approximate univariate F and significance of F

<table>
<thead>
<tr>
<th>psychosocial variables</th>
<th>approximate F</th>
<th>significance of F ($p$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>square root of number of life events</td>
<td>1.47</td>
<td>0.23</td>
</tr>
<tr>
<td>square root of total perceived stress</td>
<td>0.39</td>
<td>0.68</td>
</tr>
<tr>
<td>average perceived stress</td>
<td>0.07</td>
<td>0.92</td>
</tr>
<tr>
<td>square root of total social support</td>
<td>2.91</td>
<td>0.06</td>
</tr>
<tr>
<td>average social support</td>
<td>1.49</td>
<td>0.23</td>
</tr>
<tr>
<td>depression</td>
<td>5.54</td>
<td>0.005</td>
</tr>
<tr>
<td>square root of loneliness</td>
<td>7.51</td>
<td>0.001</td>
</tr>
<tr>
<td>state anxiety</td>
<td>0.85</td>
<td>0.43</td>
</tr>
<tr>
<td>trait anxiety</td>
<td>1.65</td>
<td>0.20</td>
</tr>
<tr>
<td>square root of somatization</td>
<td>1.12</td>
<td>0.33</td>
</tr>
</tbody>
</table>

In summary, there was a significant difference in the combined psychosocial variables between the three periodontal diagnoses of RPP, RCAP and no significant periodontal destruction, after adjusting for the covariates. In addition, two psychosocial variables, depression and loneliness, were significant in distinguishing between groups. Therefore, comparisons on every pair of groups on depression and loneliness were performed between RPP, RCAP and control groups by the use of simple contrasts in the
SPSS MANOVA command. The RPP group presented significantly increased depression when compared to the RCAP and control groups, t(148) = 2.30, p = 0.003 and t(148) = 2.47, p = 0.02, respectively. In addition, the RPP group reported significantly more loneliness than the RCAP and control groups, t(148) = 3.35, p = 0.001 and t(148) = 3.06, p = 0.003, respectively. No other comparison on depression and loneliness was statistically significant at the 5% level.

Although RPP patients smoked more than RCAP and control patients (see Table 4.3), an univariate analysis of variance showed that there was not a significant difference in amount smoked between the three groups (F = 1.11, p = 0.33).

Table 4.3: Means and standard deviations for smoking (grammes/week) for the three groups

<table>
<thead>
<tr>
<th>groups</th>
<th>mean</th>
<th>standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPP</td>
<td>26.57</td>
<td>43.00</td>
</tr>
<tr>
<td>RCAP</td>
<td>20.44</td>
<td>51.86</td>
</tr>
<tr>
<td>control</td>
<td>13.52</td>
<td>35.30</td>
</tr>
</tbody>
</table>

Although the RPP patients presented significantly more depression and loneliness than the RCAP and control patients, a question remains concerning the relative importance of these two psychosocial factors in distinguishing between the three groups. To establish whether loneliness and depression were or were not equally important to the relationship between the combined psychosocial factors and the three periodontal diagnoses of RPP, RCAP and no significant periodontal destruction two additional multivariate analyses of covariance were performed on the psychosocial variables using the three periodontal diagnoses as the between-groups factor, but first adding loneliness and then depression to the covariates. The first between-subjects analysis of covariance was performed on number of life events, total perceived stress, average perceived stress, total social support, average
social support, depression, state anxiety, trait anxiety and somatization, using the three periodontal diagnoses as the between-groups factor. As previously described here, some of the psychosocial factors were entered into the analysis as transformed variables. Loneliness, smoking, drinking habits, oral hygiene, education background and age were entered into the equation as covariates. With the use of Wilks' criterion it was shown that at the 5% level the combined psychosocial variables were not significantly related to the three periodontal diagnoses of RPP, RCAP and no significant periodontal destruction, approximate $F(18,266) = 1.62$, $p = 0.06$. The second between-groups analysis of covariance was performed on the same psychosocial variables above listed after removing depression but including loneliness. Adjustments were made for the following covariates: depression, smoking, drinking habits, oral hygiene, education background and age. Using the Wilks' criterion, it was found that the combined psychosocial variables were significantly related to the three periodontal diagnoses (approximate $F(18,266) = 1.83$, $p = 0.02$). In addition, the Pearson correlation coefficient between depression and loneliness was significant ($r = 0.62$, $p < 0.0001$).

4.4 DISCUSSION

The results of this study show that, even controlling for the covariates (smoking, drinking habits, oral hygiene, educational background, and age), the three periodontal diagnoses of RPP, RCAP and no significant periodontal destruction differed significantly on the combined psychosocial factors. The RPP patients presented significantly increased depression and loneliness, when compared to RCAP and control patients. These findings suggest that different forms of CP are not equally associated with psychosocial factors (McGlynn et al. 1990, Monteiro da Silva et al. 1995) and support clinical observations.
linking RPP to psychosocial factors (Page et al. 1983, Davies et al. 1985, Newman 1993). It is interesting to note that Page et al. (1983) also reported an association between depression and RPP, and there has been some speculation about the processes involved when depression is found to be associated with infections. Reviewing the literature concerning depression and the immune system, Stein et al. (1991) for example identified three possible processes involved in depression, occurring in the context of HIV-1 infection. According to them, depression may result from: i) a psychological response to knowledge of the diagnosis, prognosis, and difficulties of dealing with evolving symptoms and debilitations; ii) a direct neurotropic effect of the virus; and/or iii) an indirect central nervous system effect secondary to viral activation of the immune system.

Similarly, the psychosocial differences between RPP, RCAP and control patients reported here may or may not be a psychological response to the diagnosis and prognosis of the rapidly progressive form of the disease. They also may or may not have existed before the rapidly progressive form of CP appeared. RPP, being of earlier onset and a more destructive form of periodontitis than RCAP, might itself have produced these psychosocial differences. On the other hand, previous psychosocial characteristics, such as those reported here, might render some individuals more susceptible to RPP. Moreover, neither of these alternatives excludes the possibility that these psychosocial differences might be of importance to the progression of RPP. Even the possibility that these psychosocial differences resulted from a direct or indirect effect of microorganisms on the CNS cannot be definitely excluded. A significant proportion of RPP patients show immunological deficiencies, and RPP has been sometimes associated with general malaise, weight loss, depression, and loss of appetite which have been suggested to reflect the existence of a fulminant gingival infection (Page & Schroeder 1982, Page et al. 1983).

Although there was a tendency for the RPP patients to smoke more than the RCAP
and control patients, the results of the analysis of variance indicated that there was not a significant difference between the three groups on smoking.

The results reported here are consistent with the hypothesis that psychosocial factors are of importance to the onset and progression of RPP (Davies et al. 1985, Newman 1993). However, a study of the present design does not permit strong conclusions to be drawn concerning causal relationships, and cannot provide direct evidence that psychosocial factors are of significant influence in establishing RPP. While the putative effects of psychosocial factors on progress of periodontal destruction would be more evident in RPP than RCAP patients, considerably more time than the previous year (the most prolonged retrospective time covered by the psychosocial measures employed in the present study) would be necessary for the RPP patients to show evident clinical signs. In summary, although the findings reported here do not provide definitive proof, they are compatible with a putative causal relationship between psychosocial factors and the onset and progression of RPP.

Concerning the question whether loneliness and depression are equally important to the relationship between the three periodontal diagnoses of RPP, RCAP and no significant periodontal destruction, the results indicated that the multivariate F was significant when depression was entered into the equation as one of the covariates but not significant when loneliness was included as one of the covariates. It appears, therefore, that loneliness is more important than depression in terms of the association with the periodontal diagnoses. As previously mentioned in chapter 3, loneliness and depression have been shown to be consistent and significantly associated. This is confirmed by the highly significant Pearson correlation coefficient between depression and loneliness found in the present study.

Among the proposed mechanisms which could mediate possible relationships
between psychosocial factors and inflammatory periodontal disease, immunological pathways are of special interest. Recently PNI studies have been providing evidence to support the premise that psychosocial factors can alter host defences and increase vulnerability to a range of illnesses, especially those intimately associated with immunologic mechanisms, such as infection, autoimmune disease and malignancy (Kiecolt-Glaser et al. 1984 a, b, Glaser et al. 1985, Dorian & Garfinkel 1987, Kaplan 1991, Kiecolt-Glaser and Glaser 1991). In fact, immunoregulatory control, either at a systemic or local level, is probably an important factor in the control of CP, and may explain, at least in part, individual variation among patients concerning periodontal destruction, as well as cyclical or other periodontal breakdown (Seymour et al. 1986). It is possible, therefore, that psychosocial factors are of importance in the onset and progression of RPP via depression of immune function (Ballieux 1991, Monteiro da Silva et al. 1995). It remains for further studies to clarify the interactions between psychosocial factors and RPP. Based on an "X-Y-Z" model (Elliot & Eisdorfer 1982) such prospective studies could include multiple measurements of: i) psychosocial factors as potential activators, ii) physiological responses such as hormonal and immunological parameters, and iii) periodontal tissues variables, such as loss of attachment and probing pocket depth.

Another possible mechanism involves neglect of oral hygiene induced by psychosocial conditions (Miller & Firestone 1947, Moulton et al. 1952, Gupta 1966, Ringsdorf & Cheraskin 1969, Meyer 1989), and this will be examined in the next chapter.
5.1 INTRODUCTION

Study 1 has provided evidence of an association between loneliness, depression and RPP. As noted earlier, one of the basic mechanisms linking psychosocial factors to illness involves health-impairing behaviours (Krantz et al. 1981). Individuals who experience high levels of distress, for example, tend to behave in ways that increase their chance of becoming ill (Wiebe & McCallum 1986). In particular, neglect of oral hygiene was identified as one of the mechanisms which could mediate the putative relationship between psychosocial factors and chronic inflammatory periodontal diseases. It has been presumed that psychological disturbances, such as those related to depression and loneliness, can lead patients to neglect oral hygiene and that the resultant accumulation of dental plaque is detrimental to the periodontal tissues, given that plaque plays a major aetiological role in chronic inflammatory periodontal diseases (Miller & Firestone 1947, Moulton et al. 1952, Gupta 1966, Ringsdorf & Cheraskin 1969, Meyer 1989, Monteiro da Silva et al. 1995). Neglect of oral hygiene can also result in dental calculus, which is mineralized bacterial plaque permeated with various calcium phosphates (Ånerud et al. 1991). Such hard deposits, preceded by plaque, may form on the tooth crowns above, or on the root surfaces below, the gum line and are called, respectively, supragingival or subgingival calculus. Both supra- and subgingival calculus are covered by a vital, non-mineralised bacterial plaque. Although there is strong evidence that chronic inflammatory periodontal diseases result from the overgrowth of certain Gram-negative bacteria in the subgingival plaque, calculus is thought to be a contributing factor in its progression or persistence.
While supragingival calculus may contribute to gingival inflammation, there is some support for the view that subgingival calculus increases the chronicity and progression of periodontitis (Mandel & Gaffar 1986).

Depression, anxiety or rebellion against authority have been suggested as factors leading to neglect of oral hygiene (Moulton et al. 1952, Rubin 1963, Gupta 1966). From a theoretical perspective, depression is perhaps the most interesting of these factors given that its associated symptoms (fatigue or loss of energy, loss of interest, psychomotor agitation or retardation, and diminished ability to concentrate) would seem particularly likely to interfere with oral hygiene behaviour. Working with patients with mental disorders, Preston (1941) observed that depressed patients accumulated calculus more quickly than other classes of patients. He offered two possible explanations for this phenomenon: i) depression may reduce patients' willingness to perform physical activities, leading them to pay less attention to their mouths; or ii) depression may cause a chemical change in the secretions that bathe the mouth, which in turn would increase calculus formation.

Anxious individuals also present symptoms which may interfere with their oral hygiene behaviour (for instance, forgetfulness and difficulty in concentrating). In addition, they frequently report a mild depression (Gatchel et al. 1989). Consequently, anxiety may also be of relevance to neglect of oral hygiene.

More recently, as stress has become a popular concept, it has also been thought to be associated with neglect of oral hygiene (Meyer 1989). As described in chapter 3, stress is a complex term covering many variables and processes such as number of life events during the previous year, and total and average perceived stress in relation to these events. In addition, stress can involve depression and anxiety as reactions to stressors impinging on individuals.

Despite what appears to be a reasonable theoretical basis, surprisingly few studies
have examined whether psychosocial factors such as depression, anxiety and stress are significantly associated with dental plaque or calculus accumulation.

Belting & Gupta (1961) found that the severity of chronic inflammatory periodontal disease increased as the level of calculus increased in both psychiatric patients and controls. They also found more calculus in the psychiatric group than in the control group, confirming Preston's (1941) report. Because brushing frequency was about the same in both groups, Belting & Gupta hypothesized that calculus formation was related to a higher salivary pH in the psychiatric group. Gupta (1966) went on to elaborate possible mechanisms involving changes of saliva secretion and composition to explain the relationship between psychosocial factors and periodontal status. Emotional factors, it was argued, affect the autonomic nervous system which in turn influences the dilation or contraction of secretory ducts. He mentioned examples of chronic stress causing elevated salivary flow and possibly a greater deposition of saliva-derived calculus. In some individuals he reported a decreased salivary flow under similar stress conditions. He argued that decreased salivary flow may lead to an increased deposition of plaque, since cleansing action is decreased. He also suggested that changes in the chemical composition of saliva (decrease in salivary calcium content, and increased acidity of saliva) induced by adverse mental stimuli or emotional tension could affect the periodontium. It should be noted, however, that a difference in the efficacy of toothbrushing between psychiatric patients and controls could also explain the greater calculus formation in the psychiatric group without postulating differences in saliva.

It appears that only two studies, which were reported after the present study commenced, have directly investigated the association between psychosocial factors and dental plaque. Croucher et al. (1995) showed that patients with at least one site with a probing pocket depth of 5.5 mm had higher dental plaque levels compared to controls with
no periodontal pockets. They also found that subjects reporting higher numbers of negative life events had significantly higher levels of dental plaque. Kurer et al. (1995) found that depression scores, assessed with the depression subscale of the Hospital Anxiety and Depression Scale (Zigmond & Snaith 1983), were positively and significantly associated with dental plaque in general dental patients. However, it appears that no study has investigated the association between psychosocial factors and level of dental plaque in patients with different forms of chronic periodontitis such as adult onset rapidly progressive periodontitis (RPP) and routine chronic adult periodontitis (RCAP). It appears also that the psychosocial factors examined so far have included only negative major life events (Croucher et al. 1995), state anxiety and depression (Kurer et al. 1995).

Reviewing the broader literature, it is evident that factors such as educational background, social class, sex, and smoking are linked to neglect of oral hygiene. For instance, Belting and Gupta (1961) found a highly significant difference in brushing frequency between subjects with "Grade 8" and "College" education levels. According to the authors, this finding suggested that increased brushing frequency played an important role in decreasing the severity of chronic inflammatory periodontal disease at the higher educational levels. Schou & Wight (1994) found that only children from non-deprived schools responded to a dental health programme by showing a statistically significant reduction in plaque scores. Addy et al. (1990) investigated the relationship between a number of factors (toothbrushing frequency, toothbrushing hand, sex and social class) and the incidence of plaque and periodontal disease in a group of 720 adolescents examined at ages 11-12 years and again at 15-16 years. At both examinations, the boys had higher plaque, bleeding and pocketing scores than did the girls. In addition, at 11-12 years children from social class I (the highest level of a social class classification based on the occupation of the head of the household) were less likely to brush once per day or less and more likely
to brush twice daily than those from social class V (the lowest level of the above mentioned social class classification). At 15-16 years of age, plaque and bleeding scores for both sexes showed an overall trend to increase from social class I through to social class V. The authors concluded that their results demonstrated the influence of social class and sex on oral hygiene and gingival health. However, they used a large number of statistical tests and some caution must be exercised in the interpretation of differences significant at the 5 percent level.

In an attempt to delineate potential risk indicators for periodontal disease, Grossi et al. (1995) examined the association of a number of explanatory variables with periodontal destruction, as measured by alveolar bone loss. Their study population consisted of 696 females and 665 males between the ages of 25 and 74. Among the significant risk factors that emerged were poor education and male gender.

Concerning the relationship between smoking and dental plaque the findings until recently were inconsistent. Earlier investigators found either an increase (Sheiham 1971, Preber & Kant 1973, Bergstrom & Floredus-Myrhed 1983) or no difference (MacGregor et al. 1985, Preber & Bergstrom 1986a, Bergstrom 1990) in the amounts of plaque in smokers compared to non-smokers. Recent studies, however, have been more consistent in showing that smokers, compared to non-smokers, have the same levels of dental plaque accumulation (Bolin et al. 1986, Bergstrom & Preber 1994, Grossi et al. 1994, 1995). Although these more recent data have indicated that smokers do not have increased plaque levels, cross-sectional studies on large groups of patients (Bergstrom & Eliasson 1987, Bergstrom 1989, 1990, Linden & Mullaly 1994, Grossi et al. 1995) and longitudinal studies (Bolin et al. 1986, Ah et al. 1994) have shown that smokers, again compared to non-smokers, have greater bone loss, increased number of deep pockets, and increased calculus formation. This evidence from recent clinical and epidemiological studies thus
indicates that smoking and other tobacco use does affect the prevalence and progression of chronic inflammatory periodontal diseases (Ryder 1996). Furthermore, smokers appear to respond less well to various forms of periodontal therapy such as surgical treatment (Preber & Bergstrom 1990, Ah et al. 1994), scaling and curettage (Preber & Bergstrom 1986b).

In the light of the above evidence the present study aimed to investigate whether a number of psychosocial factors (depression, state anxiety, trait anxiety, total perceived stress, average perceived stress and loneliness) could predict dental plaque levels in a group of patients with two different forms of chronic periodontitis (CP): RPP and RCAP.

It is relevant to mention again that the two previous studies which have directly investigated the association between psychosocial factors and dental plaque (Croucher et al. 1995, Kurer et al. 1995) were published after the data collection of the present study had been initiated. Therefore, the findings of Croucher et al. (1995) and Kurer et al. (1995) could not be taken into consideration in the process of selecting the psychosocial variables included in the present study.

As previously stated, neglect of oral hygiene has been thought to be associated with depression, anxiety and stress (Moulton et al. 1952, Gupta 1966, Ringsdorf & Cheraskin 1969, Meyer 1989). Therefore, it was decided to include in the present study variables of stress, anxiety and depression. Concerning depression, its associated symptoms seem to be particularly likely to interfere with oral hygiene behaviour. Furthermore, the findings of the first study reported in this thesis indicated a significant association between depression and RPP. By chance, state of depression was assessed by the same instrument in both the present study and the one conducted by Kurer et al. (1995). It was decided to include two stress variables in the present study, total perceived stress and average perceived stress. Although number of major life events was assessed, it was not included in the present
study, because it was previously found to be significantly and highly correlated with total perceived stress, and both variables loaded together on one factor (Linn 1986). While number of major life events provides an objective measure of stress, total perceived stress and average perceived stress are subjective measures of stress taking into account the individual's perception concerning the stressfulness of life events. Two aspects of anxiety, state anxiety and trait anxiety, were included in order to examine whether they are equally important to prediction of dental plaque level. Another psychosocial factor not previously explored in relation to neglect of oral hygiene, loneliness, was included given that it is a distressing experience consistently linked to depression (Russell et al. 1980, Weeks et al. 1980, Blatt et al. 1995), anxiety (Louks 1974, Perlman et al. 1978) and physical illness (Lynch 1977, House et al. 1988). In addition, the findings of the first study reported in this thesis suggested that loneliness was significantly related to one form of CP, RPP.

Because factors such as sex, smoking, and educational background have been associated with neglect of oral hygiene, their role as predictors of dental plaque accumulation was also examined here. The present study also aimed to examine whether patients diagnosed as having RPP and RCAP differ on dental plaque levels and smoking, before they start to receive periodontal treatment. RCAP and its severity have been directly related to accumulations of plaque (Suzuki 1988), while the extension and severity of periodontal destruction in RPP is greater than would be expected on the basis of the observed plaque levels (Carranza 1996). It could be assumed, therefore, that if there would be a statistically significant difference in plaque accumulation between these two forms of CP, RPP patients would show lower levels of plaque than RCAP patients. However, from a psychosocial view, it could be presumed that RPP patients would have higher levels of plaque than RCAP patients given that the findings of the first study reported in this thesis indicated that RPP patients presented significantly more depression and loneliness than
RCAP patients. Because the periodontal and psychosocial perspectives indicated diverse directions, no prediction was made in terms of difference between RPP and RCAP patients on dental plaque levels. In order to investigate plaque levels before periodontal treatment had commenced the patients for this study were selected from those attending the Periodontal Diagnostic Clinic for the first time.

5.2 MATERIAL AND METHODS

This study was reviewed and approved by the Joint Research and Ethics Committee of the Eastman Dental Hospital and Institute.

5.2.1 Subjects

Subjects comprised 80 patients from the Eastman Dental Hospital attending the Diagnostic Clinic in the Department of Periodontology. In the sessions of the Diagnostic Clinic, patients, usually referred by their general dental practitioners, are examined clinically and radiographically and a periodontal diagnosis is then made. Most patients diagnosed as having one of the current forms of CP are treated at the Eastman Dental Hospital in the Department of Periodontology and at the School of Oral Hygiene. In the present study, subjects were 40 patients with RPP and 40 with RCAP, and 60% of them were females and 40% males. The percentages of females and males with RPP or RCAP did not differ. Patients' age ranged from 23 to 58 years with a mean of 39.2 (SD ± 7.94). In terms of ethnicity, 72.50% of subjects were White Europeans, 12.50% Africans, 10% Asians, and the remaining 5% described their ethnic background as being a combination of the ones previously mentioned.
Patients were excluded if they had been treated by a periodontist in the previous three months. In addition, patients were excluded if they presented relevant systemic conditions, including diabetes mellitus, HIV infections, neutropenias, Papillon-Lefèvre syndrome, and cardiovascular disease, which have shown a significant association with periodontal destruction. Patients making use of anticonvulsive, immunosuppressive, and calcium-channel block medications were also excluded because of their relationship with gingival inflammation.

5.2.2 Procedure

The following criteria were used to select the RPP patients: diagnosis of chronic periodontitis before 35 years, gross inflammation with/without pus, advanced bone loss affecting most teeth, and multiple vertical osseous defects. The selection criteria for RCAP patients were: diagnosis of chronic periodontitis over 35 years of age, even or horizontal bone loss, and no gross inflammation or pus.

Patients meeting the above mentioned pre-arranged criteria were invited to take part in the study. After voluntary written informed consent to participate in the study had been obtained, a clinician scored dental plaque in a sample of six teeth according to the procedure described by Silness and Løe (1964). Afterwards each subject completed the measures.

5.2.3 Silness & Løe (1964) Plaque Index System

The teeth examined to assess dental plaque levels were: maxillary right first molar, maxillary right lateral incisor, maxillary left first premolar, mandibular left first molar, mandibular left lateral incisor, mandibular right first premolar (16, 12, 24, 36, 32, 44). Missing teeth were not substituted. Eight patients were so affected: five RPP and three
RCAP patients. Assessment of plaque was made according to the following scores and respective criteria.

<table>
<thead>
<tr>
<th>Scores</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No plaque.</td>
</tr>
<tr>
<td>1</td>
<td>A film of plaque adhering to the free gingival margin and adjacent area of the tooth. The plaque may be seen <em>in situ</em> only after application of disclosing solution or by using the probe on the tooth surface.</td>
</tr>
<tr>
<td>2</td>
<td>Moderate accumulation of soft deposits within the gingival pocket, or on the tooth and gingival margin which can be seen with the naked eye.</td>
</tr>
<tr>
<td>3</td>
<td>Abundance of soft matter within the gingival pocket and/or on the tooth and gingival margin.</td>
</tr>
</tbody>
</table>

The buccal, lingual, mesial and distal surfaces of each sampled tooth were given a score varying from zero to three. The scores from the four surfaces of the tooth were then added and divided by four in order to obtain the plaque index for the tooth. The plaque index for the patient was the mean of the plaque indices for all the sampled teeth. In the present study the assessment of plaque involved the use of an explorer along the surfaces of the teeth both supra- and subgingivally, instead of the use of disclosing solution.

The three clinicians who assessed plaque were previously trained to achieve a high level of reproducibility. Before data collection commenced random re-examinations of patients, who did not then take part in this study, were performed by the clinicians until a minimal level of repeatability for measuring plaque (75%) was achieved by each of them. Patients were allocated to the clinicians at random.

5.2.4 Psychosocial Measures

The psychosocial factors investigated in the present study, depression, state anxiety, trait anxiety, total perceived stress, average perceived stress, and loneliness, were quantified with the measures previously described in chapter 4. However, there was a minor change concerning the depression subscale of the Hospital Anxiety and Depression Scale (HADS).
In the first study, reported in chapter 4, the items of this subscale were followed by four-point scales varying from 1 to 4. In the present study, it was decided to conform with the values previously adopted by Zigmond & Snaith (1983), and, therefore, the items of the depression subscale of the HADS were followed by four-point scales varying from 0 to 3. Consequently, the total score of the depression subscale varied from 0 to 21 in the present study.

5.2.5 Measures of Demographics, Medical Variables and Smoking

Demographic variables previously associated with dental plaque accumulation, namely, sex and educational background were also assessed by questionnaire. Subjects were asked to describe themselves as being female or male. Educational background was measured by an ordinal scale and assumed three values: i) left school at 16 or earlier; ii) left school at 18; and iii) went on to College, Polytechnic or University (see Appendix 1).

Other relevant demographic variables such as age, present or most recent occupation, ethnic background and marital status were also recorded by questionnaire (see Appendix 1).

Although the medical history of the patients was systematically assessed and recorded in the patients' notes by the clinicians who were examining and diagnosing, a questionnaire item asked the subjects to write the names of any medicines they were currently taking (see Appendix 1).

Concerning the smoking variable, if subjects reported to be currently smokers they answered questions about the number of cigarettes smoked per day, and/or the number of cigars smoked per week, and/or ounces of tobacco used each week for hand-rolled cigarettes or in smoking a pipe. The number of manufactured cigarettes smoked per day, small, medium and big cigars smoked per week, and ounces of tobacco used each week for
hand-rolled cigarettes or in smoking a pipe were all finally transformed into grammes approximate estimates of weight of tobacco consumed per week. Subjects who were not currently smokers reported if they had or had not smoked in the past.

5.2.6 Statistical Analysis

A standard multiple regression was performed between dental plaque accumulation as the dependent variable and depression, state anxiety, trait anxiety, total perceived stress, average perceived stress, loneliness, sex, educational background, form of chronic periodontitis and smoking as independent variables. Analysis was performed using SPSS 6.1 LINEAR REGRESSION (Norusis 1995). In addition, again by the use of SPSS 6.1, t-tests were performed in order to confirm some results. Differences at the 5% level were accepted as significant.

5.3 RESULTS

The mean values and standard deviations for the psychosocial variables used in the analyses are depicted in Table 5.1. The mean and standard deviation of plaque scores were respectively $1.24 \pm 0.57$.

The simple correlation analyses showed that the correlations between dental plaque accumulation and the psychosocial factors were not significant (see Table 5.2).

Investigation of the assumptions of the multiple linear regression led to transformation of one variable to improve linearity. A logarithmic transformation (base 10 logarithm) was used on smoking. There were no cases with missing data, $N = 80$. 
Table 5.1: Psychosocial variables, means, standard deviations, observed minimum and maximum values for \( N = 80 \)

<table>
<thead>
<tr>
<th>psychosocial variable</th>
<th>mean</th>
<th>standard deviation</th>
<th>minimum</th>
<th>maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>depression</td>
<td>3.80</td>
<td>2.94</td>
<td>0.00</td>
<td>12.00</td>
</tr>
<tr>
<td>state anxiety</td>
<td>40.50</td>
<td>13.03</td>
<td>21.00</td>
<td>73.00</td>
</tr>
<tr>
<td>trait anxiety</td>
<td>39.44</td>
<td>9.83</td>
<td>20.00</td>
<td>67.00</td>
</tr>
<tr>
<td>total perceived stress</td>
<td>22.48</td>
<td>20.03</td>
<td>0.00</td>
<td>81.00</td>
</tr>
<tr>
<td>average perceived stress</td>
<td>5.00</td>
<td>2.50</td>
<td>0.00</td>
<td>9.00</td>
</tr>
<tr>
<td>loneliness</td>
<td>36.40</td>
<td>10.80</td>
<td>20</td>
<td>71</td>
</tr>
</tbody>
</table>

Table 5.2: Correlation coefficients between dental plaque accumulation and the psychosocial factors used in the multiple regression analysis with respective levels of significance

<table>
<thead>
<tr>
<th>psychosocial factor</th>
<th>plaque</th>
<th>level of sig. (p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>depression</td>
<td>0.01</td>
<td>0.47</td>
</tr>
<tr>
<td>state anxiety</td>
<td>0.01</td>
<td>0.46</td>
</tr>
<tr>
<td>trait anxiety</td>
<td>-0.03</td>
<td>0.41</td>
</tr>
<tr>
<td>total perceived stress</td>
<td>-0.02</td>
<td>0.44</td>
</tr>
<tr>
<td>average perceived stress</td>
<td>-0.004</td>
<td>0.48</td>
</tr>
<tr>
<td>loneliness</td>
<td>0.002</td>
<td>0.49</td>
</tr>
</tbody>
</table>
The result of the analysis of variance testing the null hypothesis that all the coefficients of the independent variables are equal to zero was not significant, $F(10, 69) = 1.17, p = 0.324$. Furthermore, $R^2$, the square of the adjusted multiple correlation coefficient, was 0.02 indicating that only 2% of the total variation of dental plaque level could be explained by its relationship with the predictors. In spite of this result, one of the independent variables, sex, contributed significantly to prediction of level of dental plaque, $t = -2.70, p = 0.0086$. The partial regression coefficient for sex was estimated as $-0.37$ (95% confidence limits were -0.6412 to -0.0968) indicating that on average, dental plaque was 0.37 lower for females compared to males, after adjusting for the other predictor variables (see Table 5.3). The other independent variables, including form of chronic periodontitis (RPP or RCAP), did not contribute significantly to prediction of level of dental plaque (see Table 5.3). Subsequent univariate t-tests confirmed these results. In particular, the mean level of plaque for males (1.43, SE = 0.10) was significantly higher than the mean level of plaque for females (1.11, SE = 0.08), $t(78) = 2.54, p = 0.013$. RPP and RCAP patients did not differ significantly on level of dental plaque, $t(69.99) = 0.65, p = 0.13$.

In addition, in the multiple regression output, there was a marginally significant correlation between depression and smoking, $r = 0.16, p = 0.07$. Furthermore, an univariate t-test indicated that RPP patients smoked significantly more (Mean = 42.40, SE = 8.60) than RCAP patients (Mean = 37.99, SE = 6.01), $t(69.72) = 2.36, p = 0.02$. 
Table 5.3: Predictor variables in the multiple regression equation
their range of values, partial regression coefficients, 95%
confidence interval, value of t and significance of t

<table>
<thead>
<tr>
<th>variable</th>
<th>possible values</th>
<th>partial regression coefficient</th>
<th>95% confidence Interval</th>
<th>value of t</th>
<th>sig.of t (p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>sex</td>
<td>1=male, 2=female</td>
<td>-0.37</td>
<td>-0.64</td>
<td>-0.10</td>
<td>-2.70</td>
</tr>
<tr>
<td>education</td>
<td>1=left school at 16, 2=18, 3=college</td>
<td>-0.12</td>
<td>-0.27</td>
<td>0.04</td>
<td>-1.52</td>
</tr>
<tr>
<td>depression</td>
<td>0 to 21</td>
<td>0.02</td>
<td>-0.04</td>
<td>0.09</td>
<td>0.73</td>
</tr>
<tr>
<td>state anxiety</td>
<td>20 to 80</td>
<td>0.01</td>
<td>-0.01</td>
<td>0.03</td>
<td>0.98</td>
</tr>
<tr>
<td>trait anxiety</td>
<td>20 to 80</td>
<td>-0.01</td>
<td>-0.04</td>
<td>0.02</td>
<td>-0.86</td>
</tr>
<tr>
<td>total perceived stress</td>
<td>0 to 81</td>
<td>-3.16</td>
<td>-0.01</td>
<td>0.01</td>
<td>-0.08</td>
</tr>
<tr>
<td>average perceived stress</td>
<td>0 to 9</td>
<td>-0.003</td>
<td>-0.07</td>
<td>0.06</td>
<td>-0.10</td>
</tr>
<tr>
<td>loneliness</td>
<td>20 to 80</td>
<td>-1.24</td>
<td>-0.02</td>
<td>0.02</td>
<td>-0.02</td>
</tr>
<tr>
<td>form of CP</td>
<td>1=RPP, 2=RCAP</td>
<td>-0.13</td>
<td>-0.40</td>
<td>0.15</td>
<td>-0.91</td>
</tr>
<tr>
<td>smoking</td>
<td>grammes per week</td>
<td>-0.07</td>
<td>-0.18</td>
<td>0.03</td>
<td>-1.39</td>
</tr>
<tr>
<td>constant</td>
<td>---</td>
<td>2.30</td>
<td>1.38</td>
<td>3.21</td>
<td>5.01</td>
</tr>
</tbody>
</table>

5.4 DISCUSSION

The results of the present study showed that depression, state anxiety, trait anxiety,
total perceived stress, average perceived stress and loneliness did not predict significantly
dental plaque accumulation. The present findings differ from those obtained by Kurer et al. (1995) who reported a low but significant Spearman correlation coefficient between depression and dental plaque levels \((r = 0.28, p < 0.05)\), and suggested that this finding might be of more significance in a population subjected to greater levels of depression and periodontal disease. It may be noted that both the present study and the one conducted by Kurer et al. (1995) measured depression using the same instrument, the subscale of the Hospital Anxiety and Depression Scale (Zigmond & Snaith 1983). In addition, the number of subjects in the present study and in Kurer et al. (1995) were 80 and 47, respectively. Therefore, the difference between these study findings cannot be attributed to diverse operational definitions of depression or to a smaller number of subjects in the present study, which would increase the chance of making a type II error in the null hypothesis test. Whereas Type I errors deal with the problem of "finding" a difference or association that is not there, Type II errors concern the equally serious problem of not finding a difference or association that is actually present. It is known that one of the factors that increases the chance of making a type II error is small sample size. However, this would not seem relevant here, given that Kurer et al. (1995) found a significant association between depression and dental plaque accumulation in a smaller number of subjects.

Kurer et al. (1995) reported that none of their subjects reached a depression score of 11 or more in the depression subscale of the Hospital Anxiety and Depression Scale, which would suggest clinically significant depression disrupting subjects' previous level of functioning (Zigmond & Snaith 1983). In the present study three subjects had a score of 11 and one got a score of 12 for depression, and there was no significant association between depression and dental plaque levels, even trying the same statistical analysis used by Kurer et al. (1995), Spearman correlation coefficient \((r = 0.005, p = 0.97)\). In addition, a one-way analysis of variance was performed after dividing the subjects into three groups:
low, middle and high depression. By the use of the 33rd and 66th percentiles, the subjects were classified as having: i) low depression if they had a depression score below the 33rd percentile, ii) middle depression if they got a depression score below the 66th percentile but not lower than the 33rd percentile, and iii) high depression if their depression scores were equal to or greater than the 66th percentile. Again, the results of the analysis of variance confirmed that there was not a significant association between the three levels of depression and dental plaque accumulation, as the mean plaque levels did not differ on the three depression groups \((F = 0.36, p = 0.70)\).

While in the present study plaque was assessed by the index of Silness & Løe (1964), Kurer et al. (1995) disclosed and scored plaque according to the method described by Turesky et al. (1970), which varies from 0 (no plaque) to 5 (plaque covering two-thirds or more of the crown of the tooth). Perhaps the different findings of the two studies could be a consequence of inconsistencies in the scoring methods of plaque. There are similar discrepancies elsewhere in the literature. Some studies, for example, have shown an increase and others no difference in the amounts of plaque in smokers versus non-smokers (Ryder 1996).

The fact that a significant association between depression and dental plaque accumulation was not found in the present study does not preclude the possibility that it may occur in the case of more severely depressed patients. After noting that depressed patients accumulated calculus more rapidly than other classes of patients, Preston (1941) speculated that depression may increase patients' difficulty in performing oral hygiene behaviour, or may cause a chemical change in mouth secretions which, in turn, might increase calculus formation. Although it appears that no study has investigated whether depression can induce chemical changes in the oral cavity which would produce more calculus, recent observation has linked a clinically depressed state with decreased oral
hygiene behaviour. Friedlander & West (1991) report that major depression may be associated with a disinterest in performing appropriate preventive oral hygiene techniques, diminished salivary flow, and advanced periodontal disease. Furthermore, tricyclic and heterocyclic antidepressants worsen the problem of decreased salivary flow by blocking parasympathetic stimulation of the salivary glands (Handelman et al. 1986, Clemmesen 1988).

In summary, the present study results indicate that there is no significant association between depression and dental plaque accumulation in CP patients with RPP and RCAP. Because Kurer et al. (1995) did find a low but significant correlation between depression and dental plaque levels in a group of regular attenders with no probing depths greater than 5mm at the dental facility of a large UK company, future research is needed to clarify the contradictory findings. However, it appears that the association between depression and dental plaque levels, whether statistically significant or not, is low in patients who are not severely depressed.

Although the present study results indicate that two stress variables, total perceived stress and average perceived stress, cannot predict dental plaque accumulation, Croucher et al. (1995) found that subjects reporting higher numbers of negative life events had significantly higher levels of dental plaque. Croucher et al. (1995) asked their subjects to classify the major life events that happened in the previous year as negative, neutral or positive. The discrepancy between the results of the present study and those of Croucher et al. (1995) with respect to a significant association between a stress variable and levels of plaque may be explained by the diverse nature of the stress variables in the two studies. Future studies are needed to clarify the different study findings.

The present study results indicated that gender contributed significantly to prediction of dental plaque accumulation. Dental plaque was lower for females compared
to males. Similarly, Addy et al. (1990) found that at two examinations boys had higher plaque, bleeding and pocketing scores than did the girls. This gender difference on plaque might be of clinical significance. In an effort to identify risk indicators for periodontal destruction, Grossi et al. (1995) found that males were more likely to exhibit greater severity of bone loss and attachment loss compared to females. Their finding is consistent with previous reports of gender differences in periodontal disease severity (Miller et al. 1987). The reason for this gender difference in periodontal destruction is not known. However, there are at least two possible explanations: i) biological differences between women and men could make the latter more susceptible to periodontal destruction, or ii) there may be gender difference of clinical significance on some health behaviours such as utilization of dental care and oral hygiene. Therefore, the gender difference on plaque accumulation found in the present study may, at least in part, explain the greater severity of periodontal destruction in males. It appears that differences on sex-role norms lead females, compared to males, to value health more (Kristiansen 1990), engage in more health-protective behaviours (Lonnquist et al. 1992), and avoid more risk-taking health behaviours (Antonucci et al. 1990).

The results of the multiple regression indicated that educational background did not significantly predict dental plaque accumulation in the present study (Table 3.3). In addition, a one-way analysis of variance was performed on dental plaque levels after dividing the subjects into three groups: i) left school at 16 years of age, left school at 18 years of age, and iii) went on to college, polytechnic or university. Again, the results of the analysis of variance confirmed that there was not a significant association between educational background and dental plaque accumulation as the mean plaque levels did not differ significantly on the three education groups ($F = 1.38, p = 0.26$). However, dental plaque accumulation tended to decrease as level of education increased. The dental plaque
means and standard deviations for subjects that left school at 16 years, 18 years, or went on to college were 1.33 ± 0.56, 1.27 ± 0.60, and 1.09 ± 0.54, respectively. This is consistent with previous findings indicating that increased brushing frequency plays an important role in decreasing the severity of inflammatory periodontal disease in more highly educated subjects (Belting & Gupta 1961). In addition, Grossi et al. (1995) reported that education was significantly associated with bone loss and attachment loss.

The fact that smoking was found to be a non-significant predictor of dental plaque in the present study is consistent with recent findings suggesting that smokers and non-smokers do not differ on levels of plaque accumulation (Bergstrom & Eliasson 1987, Bergstrom 1989, Linden & Mullaly 1994, Ryder 1996). Although not statistically significant, the association between smoking and dental plaque was negative in the present study; as smoking increased dental plaque tended to decrease. Similarly, Feldman et al. (1983, 1987) found that the mean plaque accumulation level was significantly higher for non-smokers than smokers. Concerning this finding Feldman et al. (1987) commented that higher mean levels of plaque for non-smokers appears to be an anomaly, although it might be due to the smokers feeling the need for more tooth brushing because of their smoking habit. Interestingly, when it was noticed that the correlation between smoking and plaque was negative in the present study, the explanations which first came to mind for this unexpected association were on the same line as those of Feldman et al. (1987). Social pressure on smokers has been increasing in recent years. Smoking has been banished from work places, airline flights, and social events. Smoking has also been restricted to some areas in public places such as restaurants and airports. In addition, there is more awareness concerning the deleterious effects of smoking on general and oral health. Therefore, it is possible that smokers are trying to compensate for their harmful habit by increasing positive health behaviours such as oral hygiene.
Although RCAP is associated with the presence of plaque (Suzuki 1988), and periodontal destruction in RPP is not commensurate with observed plaque levels (Carranza 1996), the RPP and RCAP patients in the present study did not differ significantly on mean levels of dental plaque, before they started periodontal treatment at the Eastman Dental Hospital. Because RPP and RCAP patients were secondary referrals from general dental practitioners, it is not possible to know whether they originally differed on dental plaque accumulation. However, presuming that RPP and RCAP patients are originally equals in terms of plaque accumulation, RPP patients would still continue to show more severe periodontal destruction, which would not be in proportion to observed plaque levels. In other words, although RPP and RCAP patients may have comparable levels of plaque, RPP patients are more susceptible to periodontal destruction, showing a more drastic reaction to accumulation of plaque.

An interesting finding that emerged from this study concerns the quantitative difference in smoking between RPP and RCAP patients. It was found that RPP patients smoked significantly more than RCAP patients, before receiving periodontal treatment. As mentioned previously, there is current evidence that smoking is a major risk factor and smokers are a high risk group for CP (Bolin et al. 1986, Bergstrom & Eliasson 1987, Feldman et al. 1987, Bergstrom 1989, Linden & Mullaly 1994, Grossi et al. 1994, 1995). Although the pathogenesis of periodontitis in smokers is incompletely understood, the data indicate a direct effect of smoking on the periodontal tissues. Potential mechanisms by which smoking may have an adverse effect on periodontitis include immunosuppression, impaired soft-tissue-cell function, and impaired bone-cell function (Haber 1994). There is evidence that smoking has both systemic and local effects. Reports that smokers with CP have less gingival bleeding (Bergstrom & Floderus-Myrhed 1983, Preber & Bergstrom 1985) and inflammation (Feldman et al. 1983, Preber & Bergstrom 1986a) suggest that
smoking also exerts local effects. Tobacco smoke contains cytotoxic and vasoactive substances which may mediate these local effects (Raulin et al. 1989). In addition, smokers have proportionately more periodontal pocketing in the anterior segments than do those who never smoked, a finding suggestive of local effects (Haber & Kent 1992, Haber et al. 1993). The systemic effects of smoking include inhibition of peripheral blood and oral neutrophil function (Eichel & Shahrik 1969, Noble & Penny 1975, Kenney et al. 1977), reduced antibody production (Finklfeia et al. 1971, Bennet & Read 1982), and alteration of peripheral blood immunoregulatory T-cell subset ratios (Ginns et al. 1982, Costabel et al. 1986). Smoking is also known to be associated with a reduction in skeletal bone mineral content (Rundgren & Mellstrom 1984).

Smoking is associated with high periodontitis susceptibility, more severe disease, onset of disease in young adults, disease progression, and treatment failure (Haber 1994, Ryder 1996). The reported associations of smoking with more severe disease and onset of disease in young adults are confirmed by the present study results. RPP is a more severe condition than RCAP, and the RPP patients who were younger adults smoked significantly more than RCAP patients.

Another finding that emerged from this study was a marginally significant correlation between depression and smoking. This is not surprising given that increased depression has been consistently associated with increases in smoking (Hall et al. 1993, Glassman 1993, Breslau et al. 1993, Wang et al. 1994, Tamburrino et al. 1994, Beckham et al. 1995, Whitlock et al. 1995, Sheahan & Latimer 1995). Depression whether defined as a trait, symptom, or as a diagnosable disorder, is overrepresented among smokers (Hall et al. 1993). Pharmacologic and physiologic effects of nicotine include relief of depression or anxiety, pleasure, arousal and enhanced vigilance, improved task performance, decreased hunger, and body weight reduction (McDonald & Olson 1994). In the present study, the
finding of an association between depression and smoking in CP patients is consistent with the hypothesis that emotional disturbances can induce smoking thus indirectly affecting the periodontal tissues (Meyer 1989, Monteiro da Silva et al. 1995).

The available evidence recommends smoking status to be considered in the clinical management of CP. Smoking cessation appears to be essential for the successful treatment of periodontitis. Therefore, smokers with CP, principally RPP patients who smoke more than RCAP, may receive significant benefits from psychosocial interventions designed to help them achieve and maintain smoking cessation. Due to the multifaceted nature of smoking behaviour and the impressive but temporary effects of many interventions, reviewers have long emphasized the need for interventions to involve a variety of components or techniques, focusing on obtaining as well as maintaining abstinence (Bernstein 1969, Hunt & Matarazzo 1970, Blaney 1985). There is evidence that multicomponent interventions, to be possibly used with periodontal therapies, are effective in helping individuals to obtain and maintain abstinence (Delahunt & Curran 1976, Lando 1977, Solberg et al. 1990, Stevens et al. 1993). Psychosocial interventions could provide skills and cues to action to quit smoking and to maintain that behaviour. In addition, patients could learn alternative ways to cope with distress that do not involve increased consumption of cigarettes or other health-damaging behaviours.
CHAPTER 6:
STUDY 3: PSYCHOSOCIAL FACTORS AND TOOTH WEAR WITH A SIGNIFICANT COMPONENT OF ATTRITION

6.1 INTRODUCTION

The opportunity for conducting the present study arose when controls for the first study were being selected. It was considered at that time that some patients presenting tooth wear or loss of tooth surfaces associated with bruxism were not suitable as controls, given that this parafunctional activity is thought to be influenced by stress and other psychosocial factors. Consequently, it was decided not to include such patients in the control group of the first study, but to plan a new study to investigate putative relationships between psychosocial factors and tooth wear associated with bruxism.

Physiological tooth wear manifests as loss of hard tissue from the surfaces of teeth as a natural consequence of ageing where the loss is not attributable to trauma or the presence of plaque. However, various conditions may render wear pathological when the loss is excessive and likely to affect the function or appearance of the dentition, or to cause discomfort or pain (Eccles, 1982). Kidd and Smith (1993) pointed out that a diagnosis of pathological tooth wear at a given age implies a prediction as to whether the teeth will survive that rate of wear in a functional state and with reasonable aesthetic appearance until the end of the patient's life. Although other terms such as "tooth surface loss" (Eccles 1982) can be adopted to identify the disorder, it was decided to conform with the increasing majority of authors (Smith & Knight 1984a, b, Kidd & Smith 1993, Bishop et al. 1994) and use the term tooth wear in this chapter.

It has been found that both the prevalence and the degree of tooth wear increase with age (Hugoson et al. 1988, Seligman et al. 1988, Ekfeldt et al. 1990). It is natural for
the degree of tooth wear to be proportional to the time of exposure of the teeth to the oral cavity. In aboriginals the degree of tooth wear has been found to be more generalized and strongly correlated with age, possibly as a consequence of consumption of abrasive foods and the use of their teeth as tools (Beyron 1964, Dahl et al. 1993). In addition, the degree of tooth wear has been claimed to be more extensive in men than in women (Seligman et al. 1988, Salonen et al. 1990, Ekfeldt et al. 1990) though some studies have not found significant sex differences in tooth wear indices (Dahl et al. 1989, Johansson et al. 1991). Wear of teeth also seems to take place intermittently; that is, there are active and inactive periods (Carlsson et al. 1985, Williams 1987, Dahl et al. 1993).

Tooth wear, the surface loss of dental hard tissue without involving caries or trauma, occurs as a result of abrasion, erosion, and attrition. Generally more than one of these processes are at work and it is often difficult to specify the part played by each of them or to identify the principal agent. Consequently, the general term tooth wear is currently in use to describe the loss of tooth tissue, rather than the more specific terms, namely, erosion, attrition and abrasion (Bishop et al., 1994). However, if one or more of the aetiological factors can be identified on the basis of the patient's examination and medical history, they will be used to qualify the term tooth wear (e.g., tooth wear: dietary erosion/attrition), given that the identified aetiological agents will have implications for the management of the condition.

Abrasion occurs when agents introduced into the mouth remove tooth tissue by physical wear (Eccles 1982, Lee & Eakle 1995). That is, abrasion is defined as physical wear by objects other than another tooth. It tends to be most obvious at the neck of teeth where it produces a rounded V-shaped groove between the gingivae and the enamel of the crown (Eccles, 1982). Abrasion affects teeth which are prominent in the arch (e.g., canines), and teeth adjacent to edentulous areas. If abrasion occurs in the enamel, the result
is a smooth shiny surface where the natural contour has been flattened. It is often the result of a vigorous toothbrushing technique, hard toothbrushes, and abrasive toothpastes. Other physical agents, such as pipe stems, may occasionally cause such tooth wear. Furthermore, it is hypothesized that when occlusion is not ideal, lateral forces cause the teeth to bend, which in turn could disrupt tooth structure and predispose to abrasion (Lee & Eakle 1984).

Erosion is a chemical process whereby tooth surface is removed in the absence of dental plaque (Eccles 1982, Lee & Eakle 1995). Usually the agent is an acid which reaches the mouth from an external or internal source. The most cited external source in the literature is dietary (Eccles & Jenkins 1974, Smith & Knight 1984a, b, Kidd & Smith 1993, Dahl et al. 1993, Bishop et al. 1994). Dietary erosion is caused by an excessive intake of food and drink with a low pH. It commonly affects the labial surfaces of the upper anterior teeth but can affect any tooth surface. According to Kidd and Smith (1993), food and drink with a low pH include: i) citrus fruits and juices, fruit berries; ii) food and drink containing vinegar; iii) carbonated drinks; iv) vitamin C tablets and drinks; v) alcoholic beverages such as lager, dry wine and all carbonated "mixer" drinks to go with spirits; vi) herbal tea; vii) acid sweets; viii) yoghurt; and ix) curry and spicy foods. The lesions produced in erosion tend to be smooth, rounded and polished (Eccles 1982). Industrial erosion, more rarely seen nowadays as a consequence of a greater emphasis on safety at work and improvement of industrial practice, is caused by industrial processes which produce acid fumes or droplets (Bruggen 1968). It can affect those parts of the teeth which are exposed when the lips are at rest or during speech, commonly the labial surfaces of the upper anterior teeth (Kidd and Smith, 1993).

The internal source of acid which can produce erosion is gastric secretion which may be regurgitated into the mouth or reach the mouth through frequent vomiting. This is a common feature in cases of hiatus hernia, gastritis in gastric ulcers, anorexia nervosa,
bulimia nervosa, voluntary regurgitation, and chronic alcoholism (Dahl et al. 1993). Anorexia and bulimia nervosa are two related psychiatric disorders which affect the regulation of food intake in sufferers. It has been frequently reported that bulimic or vomiting anorectic patients present erosive lesions localized to the palatal aspect of the maxillary anterior teeth (Hust et al. 1977, Stege et al. 1982, Robb et al. 1995). Although alcohol is not significantly erosive, it may produce a chronic gastritis which may cause erosion (Kidd & Smith 1993). Gastric secretion generally affects the palatal surfaces of upper anterior teeth and the occlusal and buccal surfaces of lower posterior teeth (Kidd and Smith, 1993).

Attrition is a process by which tooth surface is removed through the movement of teeth against one another (Eccles 1982, Lee & Eakle 1995). Tooth wear as a result of attrition usually affects the occlusal surfaces of the posterior teeth, the incisal surfaces of the lower anterior teeth, and the palatal surfaces of the upper anterior teeth. The teeth are worn in the shape of flat facets and these can be related to movements of the dentition. Attrition has been associated with a lack of posterior stability, other occlusal conditions, and bruxism (Eccles 1982).

A lack of posterior stability is the term given to the situation when a number of premolar and molar teeth in the dentition have been lost and the occlusal load is taken by a reduced number of teeth. Most clinicians assume that a lack of posterior stability produces attrition (for instance, Eccles 1982, Dahl et al. 1993). However, this hypothesis appears not to be scientifically proven (Kayser, 1981).

Attrition is presumed to be common where premature contacts occur, for instance in those dentitions where there is an edge-to-edge occlusion anteriorly but the patient habitually postures her/his mandible so as to obtain maximum intercuspation posteriorly (Eccles 1982).
Attrition has also been associated with bruxism (Eccles 1982, Attanasio 1991, Pingitore et al. 1991, Leung & Robson 1991, Bishop et al. 1994, Lee & Eakle 1995). Bruxism has in general being defined as the clenching or grinding of the dentition during nonfunctional movements of the masticatory system, therefore being regarded as a mandibular parafunctional behaviour (Attanasio 1991, Pingitore et al. 1991). The phenomenon has been observed in animals as well as humans (Harvey 1961). While tooth grinding, or eccentric bruxism, is characterized by forceful, rhythmic contact of the occlusal tooth surfaces with mandibular movement, tooth clenching, or central bruxism, involves repetitive, prolonged, and forceful contact of the teeth without mandibular movement (Leung & Robson 1991). Tooth grinding appears to be more frequently associated with tooth wear (Dahl et al. 1975, Bishop et al. 1994). Bruxism can occur when the individual is sleeping or awake. When this phenomenon occurs during sleep, it is termed nocturnal bruxism. There is disagreement as to whether nocturnal and daytime bruxism are separate domains of behaviour with different aetiologies (Hicks and Conti 1989).

The reported prevalence of bruxism varies from 5% to 81% (Leung & Robson 1991). This wide discrepancy is possibly a consequence of different methodologies, operational criteria, population samples, and definitions used in numerous investigations (McGlynn et al. 1990, Attanasio 1991). Although most individuals show signs of bruxism, only 5% to 20% of the general population are aware that they perform this mandibular parafunctional activity (Attanasio 1991).

Although the bruxist forces can be transmitted to the structures of the masticatory system, some of these forces can be absorbed with no subsequent negative effects whereas others can create disturbances of varying degrees. The host resistance of tooth structure combined with the duration, frequency, and intensity of the bruxist activity are of especial importance in determining the resulting effects (Attanasio 1991). Among numerous
possible effects of bruxism, such as thermal hypersensitivity, tooth hypermobility, injury to the periodontium, fractured cusps, painful masticatory musculature, hypertrophy of the masseter muscle, and complaints of muscle tension headache pain, tooth wear appears to be one of the most commonly observed (Pingitore et al. 1991, Attanasio 1991).

In spite of its negative effects as mentioned above, bruxism may alternatively be viewed as representing a functional behaviour, aspects of which have biological advantage in terms of whetting, sharpening, or honing teeth (Scally et al. 1991). Although it appears to be more difficult to find aspects of bruxism having biological advantage for individuals living in modern societies, it is perhaps important to mention that most individuals show signs of bruxism and have probably bruxed at some periods of their lives without manifesting negative consequences.

The aetiology of bruxism remains debatable. Various aetiologic perspectives have been developed, and they generally fall into the following categories: occlusion-related, psychological, or origin within the central nervous system (Attanasio 1991). To many researchers, malocclusion, occlusal discrepancies, and faulty restorations are thought to be the precipitating factors for bruxism (Pingitore et al. 1991). The assumption is that the individual makes a subconscious attempt at performing a self-equilibration or adjustment of her/his dentition to remove the occlusal interference. However, studies investigating the role of occlusal factors in bruxist activity have yielded conflicting and at times opposing results (Pingitore et al. 1991). For instance, more recently it has become apparent that there is no relationship between nocturnal bruxism and interferences with an individual's occlusion (Kardachi et al. 1978, Egermark-Eriksson et al. 1981, Rugh et al. 1984). Consequently, occlusal irregularities may not be the precipitating factor for nocturnal bruxism, although they may play a role in bruxist activity. One possibility is that the tolerance level to occlusal interferences may be altered by psychological stress affecting the
tonus activity in the jaw muscles (Ramfjord 1961). In addition, the clinician should still consider occlusal schemes for the redistribution of forces generated by the parafunctional behaviour (Attanasio 1991).

The notion that both daytime and sleep-related bruxism are due to psychosocial factors such as stress, anxiety, anger, and frustration has received some support (Funch & Gale 1980, McGlynn et al. 1990, Leung & Robson 1991). For instance, a clearly different response to stress was demonstrated by Rao & Glaros (1979) when they compared the masseter electromyographs of eight daytime bruxists and eight non-bruxist subjects during several stressful tasks. Rugh & Solberg (1976) and Funch & Gale (1980) found that bruxism was significantly associated with experienced and anticipated life stress. In addition, personality characteristics, which may act as stress mediators, such as type A behaviour pattern (characterized by excessive competitive drive, impatience, hostility, and accelerated speech and motor movements) have been associated with bruxism. Moreover, Pingitore et al. (1991) found that the combination of type A behaviour and stress was more predictive of bruxism than either of the individual variables alone. Hicks & Conti (1991) found that bruxers reported experiencing more stress-related symptoms than their nonbruxing peers. However, they also observed that a number of bruxers (29.2%) reported either only one or no stress-related symptoms, they concluded, therefore, that stress-related factors should be viewed as relevant in the aetiology of bruxism in some individuals but not the cause of this parafunctional behaviour.

A growing body of evidence suggests that nocturnal bruxism appears to be induced within the central nervous system and is associated with the phenomenon of arousal reactions during sleep (Broughton 1968, Vilmann et al. 1989).

Most probably the aetiology of bruxism is multifactorial and overlapping, which may create difficulty for the comprehensive and effective management of this parafunctional

Given that attrition is frequently associated with bruxism and that this behaviour appears to be influenced by psychosocial factors such as stress and anxiety, it is possible that these psychosocial factors may play a role in the pathological tooth wear when attrition is clinically significant. However, it appears that no study has yet looked at possible relationships between psychosocial factors and tooth wear with a significant component of attrition.

The present study investigates possible associations between a number of psychosocial factors, total perceived stress, average perceived stress, state anxiety and trait anxiety, and tooth wear with a significant component of attrition. The relevance of these psychosocial factors was assessed by comparing a group of patients with a significant component of attrition contributing to their tooth wear with another group of control patients.

6.2 MATERIAL AND METHODS

This study protocol was approved by the Joint Research and Ethics Committee of the Eastman Dental Hospital and Institute.

6.2.1 Subjects

Subjects comprised 90 patients from the Eastman Dental Hospital. Forty-five of them were attending a diagnostic clinic in the Conservative Dentistry Department. They had been referred to the Eastman Dental Hospital by their general dental practitioner in order to receive specialised evaluation and/or treatment for pathological tooth wear. In addition, for all of them attrition was considered to be a clinically significant aetiological component of the tooth wear. The other 45 patients were controls attending for other conditions in the
Conservative Dentistry Department. Most of them had restorative or endodontic problems. Because psychosocial factors may be associated with chronic inflammatory periodontal disease (Monteiro da Silva et al. 1996), patients were excluded if they had pocket depths greater than 4mm or presented radiographic evidence of bone loss. The two groups were matched exactly for sex (57.78% were females and 42.22% males) and as closely as possible for age. The means and standard deviations for age, in years, for the experimental and control groups were 39.58 (±10.70), and 39.49 (±10.73), respectively.

6.2.2 Procedure

Patients were diagnosed as having tooth wear with a clinically significant component of attrition if they had the occlusal surfaces of the opposing teeth worn in the shape of flat facets which were related to excursive movements of the mandible. In addition, all these patients were instructed by the specialist to use an occlusal splint to protect against nocturnal bruxism. Patients were selected as controls if they did not have significant tooth wear.

Patients meeting the above mentioned pre-arranged criteria were invited to take part in the study. After voluntary written informed consent to participate in the study had been obtained, subjects completed the measures specified below.

6.2.3 Psychosocial, control and demographic measures

Two psychosocial measures, The Modifiers and Perceived Stress Scale (Linn 1986) and the State-Trait Anxiety Inventory (Spielberger et al. 1970) were used in this study. While The Modified and Perceived Stress Scale was employed to measure total perceived stress and average perceived stress, the State-Trait Anxiety Inventory was used to assess state anxiety and trait anxiety. Both instruments were described in chapter 4.

Age and sex which are potential confounders were also assessed by questionnaire
(see Appendix 1). In addition, demographic data of possible relevance such as ethnic background, present or most recent occupation and educational background were also recorded (see Appendix 1).

6.2.4 Statistical Analysis

A between-groups multivariate analysis of variance was performed on the psychosocial factors, total perceived stress, average perceived stress, state anxiety and trait anxiety, using tooth wear diagnosis (pathological tooth wear with a significant component of attrition and no significant tooth wear) as the between-groups factor. Differences at the 5% level were considered statistically significant.

6.3 RESULTS

Apart from other assumptions, significance tests for multivariate analysis of variance are based on multivariate normality, which implies that each dependent variable (that is, the psychosocial factors in this study) and all linear combination of these variables are normally distributed (Norusis 1992). Another assumption, homogeneity of variance-covariance matrices, requires that the dependent variables have the same variance-covariance matrix in each group. A variance-covariance matrix, as its name indicates, is a square arrangement of elements with the variances of the variables on the diagonal, and the covariances of pairs of variables off the diagonal (Norusis 1992).

In the present study, investigation of the assumptions of the multivariate analysis of variance led to transformation of two psychosocial variables to improve normality and homogeneity of variance-covariance matrices. A root-square transformation was used on
total perceived stress and state anxiety. After transformation, assumptions of normality, homogeneity of variance-covariance matrices, linearity, and multicollinearity were satisfied.

Given that conclusions about means of transformed distributions apply to medians of untransformed distributions (Tabachnick & Fidell 1989), Table 6.1 depicts the medians and the values for the 5th and 95th percentiles for the psychosocial variables for both groups, patients with tooth wear with a significant component of attrition and controls.

Table 6.1: The medians and the values for the 5th and 95th percentiles for the psychosocial variables for the two groups

<table>
<thead>
<tr>
<th>psychosocial factors</th>
<th>toothwear patients with a significant component of attrition</th>
<th>control patients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>median, (5th/95th)percentiles</td>
<td>median, (5th/95th)percentiles</td>
</tr>
<tr>
<td>total perceived stress</td>
<td>16.00 (1.60, 56.00)</td>
<td>17.00 (1.90, 66.20)</td>
</tr>
<tr>
<td>average perceived stress</td>
<td>4.86 (1.30, 7.97)</td>
<td>5.00 (1.00, 7.97)</td>
</tr>
<tr>
<td>state anxiety</td>
<td>37.00 (23.60, 60.40)</td>
<td>34.00 (21.00, 53.10)</td>
</tr>
<tr>
<td>trait anxiety</td>
<td>41.00 (27.60, 59.70)</td>
<td>38.00 (22.60, 57.20)</td>
</tr>
</tbody>
</table>

With the use of Wilks' criterion, one of the criteria most used for evaluating multivariate differences (Olsen 1974), the combined psychosocial variables were shown not to be significantly related to the diagnosis of pathological tooth wear with a significant component of attrition or nonsignificant tooth wear, approximate multivariate $F (4, 85) = 1.16, p = 0.33$. In spite of this result, univariate F-tests showed that one of the psychosocial factors, trait anxiety, differed significantly between the two groups (see Table 6.2). Patients with tooth wear with a significant component of attrition presented significantly more trait anxiety than control patients, approximate univariate $F (1, 88) = 4.15, p = 0.045$. 
Table 6.2: Psychosocial factors, respective approximate univariate F and significance of F

<table>
<thead>
<tr>
<th>psychosocial factors</th>
<th>approximate F</th>
<th>significance of F (p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>square root of total perceived stress</td>
<td>0.27</td>
<td>0.601</td>
</tr>
<tr>
<td>average perceived stress</td>
<td>1.23</td>
<td>0.271</td>
</tr>
<tr>
<td>square root of state anxiety</td>
<td>1.67</td>
<td>0.199</td>
</tr>
<tr>
<td>trait anxiety</td>
<td>4.15</td>
<td>0.045</td>
</tr>
</tbody>
</table>

In addition, a logistic regression analysis involving a backward stepwise variable selection was performed. In backward stepwise selection all predictors are entered and the least significant variable is removed; this process repeats until all remaining variables are significant. The backward stepwise logistic regression analysis showed that only trait anxiety was a marginally significant predictor of the outcome of presenting or not presenting tooth wear with a significant component of attrition. The exponential of the partial regression coefficient for trait anxiety yielded an estimated relative risk of 1.05 (p = 0.049), indicating a very slightly increased risk of tooth wear with a significant component of attrition for higher trait anxiety subjects.

6.4 DISCUSSION

The results of the present study showed that tooth-wear patients with a significant component of attrition do not differ from control patients on the combined psychosocial factors. Although the multivariate F was not significant, there was a significant univariate F for one of the psychosocial factors, trait anxiety. In addition, these results were confirmed by logistic regression analysis. Although it appears that no previous study has investigated
possible associations between psychosocial factors and tooth wear with a significant component of attrition, the process of attrition has been linked to bruxism (Eccles 1982, Attanasio 1991, Pingitore et al. 1991, Leung & Robson 1991, Bishop et al. 1994, Lee & Eakle 1995), and other research has documented significant associations between stress variables and bruxism (Rugh & Solberg 1976, Funch & Gale 1980, Hicks & Conti 1991). It is important to mention that in the present study it was not possible to determine whether a patient was currently suffering from tooth wear due to attrition, or whether this problem had occurred in the past and the condition was currently stable. Only a long term study requiring construction of accurate study casts to conduct multiple measurements of tooth wear would show whether the condition was stabilized or progressing. It is possible that in the present study, therefore, a significant proportion of patients in the experimental group were not currently experiencing tooth wear as they were not going through a stressful or anxious period in their lives. The present study results indicated that the experimental and control groups differed significantly only on trait anxiety. Trait anxiety is defined as relatively stable individual differences in anxiety proneness, that is, differences in the disposition to respond to situations perceived as threatening with elevations in the intensity of state anxiety (Spielberger et al. 1970). Therefore, a tentative interpretation of the present study results can be made. Although the tooth-wear patients with a significant component of attrition did not appear to be going through a specially stressful or anxious period in their lives, their higher trait anxiety would predispose them to react with more anxiety and stress in such situations, increasing their bruxist behaviour and tooth wear. Further long term studies involving multiple assessment of psychosocial factors and tooth wear are indicated to test this hypothesis.

The association between stress and bruxism appears to be complex. For instance, studying 125 dental patients who were classified as bruxers or nonbruxers by a dentist,
Pingitore et al. (1991) found that type A behaviour and physical abnormalities (several types of malocclusion, signs and symptoms of temporomandibular joint disorders) were significant predictors of bruxism in a stepwise analysis, while stress was not. They also found that stress was significant only in conjunction with type A behaviour. This study by Pingitore et al. (1991) indicated the possible importance of a dispositional variable, type A behaviour, as a mediator of the relationship between stress and bruxism, given that stress was significant only in combination with type A behaviour. Since other research has documented significant effects of stress on bruxism, Pingitore et al. (1991) pointed out the need for a clearer understanding of the effect of this factor. Hicks & Conti (1991) asked 511 undergraduates to respond to a questionnaire that included critical items to identify nocturnal bruxers and nonbruxers and a check-list to measure the number of stress-linked physical symptoms. Ninety-six of the students identified themselves as bruxers and the remaining 415 were nonbruxers. The bruxers reported experiencing significantly more stress-related symptoms than their nonbruxing peers. However, Hicks & Conti (1991) also observed that 29.2% of bruxers reported either only one or no stress-related symptoms, and suggested that stress variables should be regarded as one of the various aetiological factors of bruxism in some individuals but not the sole cause of this behaviour. Therefore, it appears that the aetiology of bruxism is multifactorial in character including both biological and psychosocial factors (McGlynn et al. 1990, Attanasio 1991). As Leung & Robson (1991) have pointed out, bruxism involves many possible aetiological factors and they are not mutually exclusive.

It is probable that the aetiological role of psychosocial factors and bruxism in tooth wear may vary between individual patients. It is presumed that the host resistance of tooth structure combined with the duration, frequency and intensity of bruxist activity are of importance in determining the consequences of bruxism. For instance, individuals with poor
mineralization of the enamel or dentine (for example, with amelogenesis imperfecta, hereditary enamel defects unassociated with systemic abnormality or disease, or dentinogenesis imperfecta, a rare anomaly of dentine formation determined by an autosomal dominant gene) present with significant tooth wear even though they do not necessarily brux frequently and intensively and are not going through a stressful or anxious period in their lives. On the other hand, individuals who brux frequently, given a greater resistance of their teeth, may suffer other consequences of bruxism but not tooth wear.

In conclusion, given the multifactorial aetiology of attrition and bruxism future research needs to involve multivariate tactics incorporating measures of psychosocial factors such as stress factors, stress mediators such as trait anxiety and type A behaviour and occlusal factors. Unfortunately, it is not currently possible to make a clinical assessment of resistance of tooth structure to tooth wear. Future studies should also involve multiple measurements of tooth wear, of the psychosocial factors and the other possible aetiological factors listed above. Perhaps, sleep-related bruxing could be assessed electromyographically. Tooth wear could be quantified by longitudinal measurement of accurate study casts. Although occlusal splint therapy is usually advised to prevent further tooth wear, not all patients are compliant with this treatment. It would be possible, therefore, to assess the effectiveness of occlusal splint therapy and/or the progression of tooth wear.
CHAPTER 7:
CONCLUSIONS AND FURTHER RESEARCH

The results of the first study reported in this thesis (psychosocial factors and adult onset rapidly progressive periodontitis) indicated a significant relation between the combined psychosocial factors (number of life events, total perceived stress, average perceived stress, total social support, average social support, depression, loneliness, state anxiety, trait anxiety and somatization) and the periodontal diagnoses of RPP, RCAP and no significant periodontal destruction (controls). In particular, the RPP patients presented significantly more depression and loneliness than the RCAP and control patients. However, this raised one further question: whether loneliness and depression were equally important in distinguishing between the three groups. It is well established that loneliness and depression are conceptually related constructs and have been shown to be consistently and significantly associated (Russell et al. 1980, Weeks et al. 1980, Blatt et al. 1995). In the first study of this thesis the Pearson correlation coefficient between depression and loneliness was highly significant, confirming previous findings. To establish whether or not loneliness and depression were equally important to the relationship between the combined psychosocial factors and the three periodontal diagnoses two additional between-subjects multivariate analyses of covariance were performed on the psychosocial variables using the three periodontal diagnosis as the between-groups factor, but including firstly loneliness and then depression as one of the covariates.

Because the multivariate F was significant when depression was entered into the equation as one of the covariates, but not significant when loneliness was included as one of the covariates, it appears that loneliness is more important than depression in terms of the association with the periodontal diagnosis of RPP, RCAP or no significant periodontal destruction.
The consistent and significant relationship between loneliness and depression may be explained in several different ways which are not mutually exclusive. Although in some cases depression can lead to deficits in social relationships which result in loneliness, depression may in other instances be a consequence of feeling lonely. Furthermore, loneliness and depression appear to some extent to result from dispositional factors (for instance, shyness and low self-esteem). It is also possible that exposure to certain situations and events may cause both loneliness and depression. This might have happened with the RPP patients. RPP is of earlier onset and a more destructive form of CP than RCAP and so for these reasons might itself have produced more loneliness and depression. Compared to RCAP, RPP patients are at greater risk of losing teeth and have to cope with a more severe and distressing condition. In addition, RPP is more likely to disrupt personal relationships as RPP patients more than RCAP patients may lose the confidence to initiate and maintain physical proximity and contact with others. Patients with RPP might anticipate possible social rejection associated with disease symptoms such as bleeding and swollen gums, recession of the gums, tooth mobility, spacing and drifting, and halitosis, which could render them more susceptible to loneliness and depression. For instance, one male RPP patient in the first study spontaneously reported that he suffered from halitosis and that he had difficulties with his sexual partners, who used to complain about the halitosis.

On the other hand, the significantly increased loneliness and depression reported by RPP patients, compared to RCAP and control patients, could reflect more enduring personal dispositions that existed before the rapidly progressive form of CP appeared. If so, it might be argued that these personal dispositions could have rendered some individuals more susceptible to RPP. It has been proposed that for some individuals loneliness resembles an enduring personality trait, whereas for others it is a time-limited state (Rook 1986). Similarly, depression can also reflect a relatively stable personality trait. Future
research from a clinical psychological perspective could be designed to explore the time course of these psychosocial differences between RPP, RCAP and control patients.

The findings of the first study suggest that psychosocial factors are not equally associated with different forms of CP and in particular are compatible with a putative causal relationship between psychosocial factors and the onset and progression of RPP. Future investigations intending to provide further evidence concerning the existence of causal relationships between psychosocial factors and CP should: i) consider the putative role of psychosocial factors in relation to the different forms of CP, which can differ with respect to bacterial aetiology, host response and rate of progression; ii) include measurements of periodontitis independently of those of gingivitis, given that they are different clinical entities; iii) involve multiple measurements of both psychosocial factors and periodontitis markers over prolonged periods of time. As noted previously in chapter 3, it is important to assess stress broadly going beyond the major life events approach, and including other aspects of stress and stress mediators that may have a significant effect on physiological processes and health. Thus, any future prospective studies should also include a range of stressful experiences (e.g., major life events, daily hassles, residual stress from major life events, stress associated with CP and anticipated future stressors), as well as stress mediators such as social support and personal control.

Because immunological pathways are of special interest as a mechanism which could mediate the putative relationship between psychosocial factors and different forms of CP, future research could include immune response variables based on an "X-Y-Z" model (Elliot & Eisdorfer 1982). In this model "X" refers to potential activators such as psychosocial factors, "Y" refers to physiological responses such as immunological parameters, and "Z" refers to health consequences, in this case progression of periodontitis involving assessment of periodontal tissue variables such as probing attachment loss and
probing pocket depth. Therefore, future research should not be restricted to examination of "X-Z" links, but also investigate all three "X-Y-Z" links simultaneously, principally including immune parameters under "Y". Although Cogen et al. (1983) have found significant associations between psychosocial factors, endocrine alteration, immunosuppression and acute necrotizing ulcerative gingivitis, there appears to be no research which has systematically investigated whether psychosocially-induced immunosuppression can play a significant role in CP progression.

Some relevant immunological parameters such as autologous mixed lymphocyte response (AMLR), polymorphonuclear neutrophil (PMN) deficiencies and alterations in salivary immunoglobulin A (IgA), presumed to be implicated in the pathogenesis of CP, could be included in future studies.

Some studies aiming to detect individuals susceptible to CP have used the AMLR. For instance, Ranney et al. (1981) and Tew et al. (1983) reported a suppressed AMLR in young patients with severe periodontitis, and Suzuki et al. (1984) found a suppressed AMLR in patients with generalized juvenile periodontitis compared to healthy controls and patients with localized juvenile periodontitis (LJP). In addition, there are reports that the AMLR returned to normal limits after periodontal treatment (Osterberger et al. 1983, Tew et al. 1983, Suzuki et al. 1984). This finding could indicate that local periodontal factors may have a systemic effect on immune regulation which can be detected as a suppressed AMLR (Seymour 1991). Should this view be true, and it needs to be clarified by further studies, the depressed AMLR could be seen as a manifestation of the disease instead of a cause. Consistent with this view, it may be noted that not all individuals with severe periodontitis present with a depressed AMLR (Tew et al. 1983, Boyatzis & Seymour 1986).

The role of PMNs in chronic inflammatory periodontal disease may be considered
a controversial issue. Although their function is thought to be essentially protective in nature, recent studies have found that PMNs are capable of provoking destruction of local tissue through release of potent lysosomal enzymes and oxygen radicals which can damage the periodontal soft tissues (Van Dyke & Vaikuntam 1994). PMN protective function in the pathophysiology of CP is suggested by the finding of severe periodontitis in patients with quantitative or qualitative neutrophil deficiencies. Gingival inflammation, severe loss of alveolar bone and ulceration of the gingivae and oral mucosa are frequently observed in individuals suffering from conditions involving neutrophil deficiencies, such as agranulocytosis, Chediak-Higashi syndrome, diabetes mellitus and cyclic neutropenia. Altered neutrophil function has been associated with the pathogenesis of early onset CP. About 70% of patients with LJP show an altered neutrophil chemotactic response (Van Dyke & Vaikuntam 1994). Schenkein et al. (1991) found that PMN chemotaxis in periodontitis-affected patients is significantly decreased when compared to periodontally healthy controls. The phagocytic ability of crevicular fluid PMNs was found to be significantly depressed in patients with RPP, LJP and post-juvenile periodontitis (Sigusch et al. 1992). Although post-juvenile periodontitis patients are older (26 or more years of age), they display similar clinical and radiographic features (severe angular bony defects typically in relation to the first molars/incisors) as juvenile periodontitis patients (Suzuki 1988). Kimura et al. (1992) reported a reduction in PMN-mediated phagocytosis in patients with LJP and generalized juvenile periodontitis, although a comparatively low percentage of RCAP patients exhibited any impairment. Gutierrez et al. (1991) found that PMNs of RPP patients presented significant reductions in their adhesive and phagocytic capacities.

Secretory IgA in saliva is thought to reduce bacterial colonization of the teeth (Brandtzaeg 1988) and also to reduce the antigen load on the crevicular epithelium.
Robertson et al. (1980) did not observe any attachment loss in IgA-deficient individuals or in a control group. However, the mean age of their subjects was 11 years and, therefore, their risk with regard to CP was not known. Intense physical exertion has been shown to reduce salivary IgA levels (Simon 1991). These decreases in salivary IgA may account, at least in part, for the increased incidence of upper respiratory tract infections observed following competition (Seymour 1991). However, the consequence of stress-induced alteration in IgA to the periodontium is not known.

Another immunological parameter, responsiveness of peripheral blood lymphocytes to mitogens, which appears not to have been clearly implicated in the pathogenesis of CP, could also be included in future investigations. Early functional studies demonstrated the ability of periodontopathic bacteria to depress the response of peripheral blood lymphocytes to plant mitogens (Shenker et al. 1982, Shenker & Dirienzo 1984). In addition, Cohen-Cole et al. (1983) and Cogen et al. (1983) found that patients with ANUG were significantly more stressed and had depressed lymphocyte proliferation after mitogen stimulation compared to controls.

Impairment in the above-mentioned immunological parameters in patients with different forms of CP could reflect a genetic predisposition. However, psychosocial factors, via immunosuppression, may also be of importance, as they may serve to disrupt the balance between the periodontal tissues of susceptible individuals and their oral flora, thereby leading to disease progression (Seymour 1991).

Future studies intending to investigate whether psychosocially-induced immunosuppression plays a role in CP progression need to control for health behaviours such as smoking, oral hygiene, sleep and physical activity. These behaviours may have immunological consequences, and some of them can be affected by psychosocial factors and could thereby influence CP progression via a mechanism other than a direct reduction
Another research alternative to provide evidence concerning possible causal relationships between psychosocial factors and CP would involve evaluation of the efficacy of psychosocial intervention in the treatment of patients with RPP and other forms of CP. Such studies could investigate whether psychosocial interventions have a significant adjunctive effect to routine periodontal therapy in reducing plaque accumulation, probing pocket depth and probing attachment loss. Psychosocial interventions to inhibit further periodontitis progression could, for instance, include components such as: i) spoken and written information about the nature of chronic diseases in general and principally CP, ii) behavioural/cognitive techniques to achieve and maintain a high level of oral hygiene, iii) relaxation or other stress management techniques.

The provision of information about CP and chronic disease in general is suggested for inclusion in an intervention because heightened awareness and knowledge of health risks and possible protective health actions are important preconditions for positive self-directed change in health behaviour (Bandura 1989).

The achievement and maintenance of a high level of oral hygiene is a fundamental step in the process of controlling periodontal destruction and behavioural/cognitive techniques could be used to give patients the necessary means and resources to change their health behaviour. A number of techniques such as positive reinforcement, successive approximations and modelling could be used to facilitate or improve performance of the relevant behaviour (e.g, toothbrushing with ordinary and interdental brushes, dental floss use) and, therefore, increase patients' perceived self-efficacy (one's belief that one can perform a specific behaviour or task in the future; Lorig et al. 1989) in accomplishing a high level of oral hygiene.

The active use of relaxation or other stress management techniques may help
patients to deal with the stress of CP and protect from potential harmful consequences of other stressors. In particular, relaxation and hypnosis might have positive consequences for immune system activity, by reducing subjects' dysphoric responses and vulnerability to stressors (Walker et al. 1993, Monteiro da Silva et al. 1995, Johnson et al. 1996). Once patients have been trained in relaxation, they can use this skill in any situation that evokes stress or anxiety (Goldfried & Trier 1974).

A psychosocial intervention including components such as those suggested above may be effective in inhibiting progression of different forms of CP including RPP. Although the first study showed that RPP patients presented significantly more depression and loneliness than RCAP and control patients, no patient from the RPP or the other two groups obtained a score in the depression subscale of the Hospital Anxiety and Depression Scale that indicated a definite case of clinical depression. On the basis of findings reported by Zigmond & Snaith (1983), a score of 18 or more would be required for such a diagnosis in this study. In addition, it would be difficult to design a psychosocial intervention specifically to treat depression and loneliness in the setting of a dental hospital, given i) that patients are primarily motivated to receive dental treatment, and ii) that brief and focused treatments for depression, generally cognitive/behaviourally oriented, would need at least 15 sessions to be effective. Therefore, a psychosocial intervention not specifically treating depression and loneliness but containing components such as those above suggested would be more practical for use with periodontal patients. The sort of intervention proposed might of course prevent or reduce significantly RPP patients' loneliness and depression if these psychosocial conditions are a consequence of the rapidly progressive form of the disease, and it would be important to monitor loneliness and depression on an ongoing basis. Those patients with serious psychological disorders disrupting their life, who seem on the present evidence to be rare in the setting of a dental hospital, could be referred to
receive psychological and/or psychiatric treatment, and would not take part in studies involving this type of psychosocial intervention.

In the first study, the finding that RCAP patients did not show significantly more psychosocial maladjustment than controls cannot definitely exclude the possibility that psychosocial factors could be of aetiological importance to RCAP. For instance, although RCAP and control patients in the first study did not differ significantly on number of life events, total perceived stress and average perceived stress, these stress variables could yet be of relevance to the progression of RCAP. It is known that the effects of stress vary among different subjects. While some individuals are resistant to stress, other may develop a range of symptoms or illness, for instance, hypertension, headache, ulcers, cardiovascular disorders, and infections (including perhaps different forms of CP). It is also possible that other stress variables not included in the first study (e.g., daily hassles) may be relevant to RCAP progression. Future prospective and long-term studies as suggested above are needed to further clarify the role of psychosocial factors in RCAP and other currently recognized forms of CP.

The results of the second study reported in this thesis (psychosocial factors and dental plaque levels in chronic periodontitis patients) showed that depression, state anxiety, trait anxiety, total perceived stress, average perceived stress and loneliness did not predict significantly dental plaque accumulation. These findings are inconsistent with those obtained in a previous study by Kurer et al. (1995) who reported a low but significant correlation between depression and dental plaque levels. As discussed previously in chapter 5, the difference in findings in the two studies cannot be attributed to differing operational definitions of depression (measured by the same scale in both studies) or to a smaller number of subjects in the present study (there were more subjects in the study reported in this thesis). The inconsistent findings of the two studies might however be a consequence
of different methods used to score dental plaque. Future research is indicated to clarify the contradictory findings.

Although a significant association between depression and dental plaque accumulation was not found in the study presented in this thesis, it is plausible that patients who, unlike the subjects reported here, are severely depressed may show significantly increased levels of dental plaque. Preston (1941) observed that depressed patients accumulated calculus more quickly than other classes of patients and offered two hypotheses to explain this phenomenon: i) depression can reduce patients' motivation to perform physical activities, leading them to take less care of their mouths; ii) depression may induce a chemical change in saliva, which in turn would increase calculus.

It is currently well established that a loss of interest or pleasure in almost all daily activities (work, recreation, personal hygiene) is one of the symptoms of a clinical depressive syndrome. Although it appears that no systematic study has investigated the association between clinical depression and dental plaque levels, clinical observation indicates that major depression is often associated with a disinterest in performing oral hygiene techniques (Friedlander & West 1991). Concerning changes in saliva, a diminution in whole-mouth resting salivary flow (Palmai & Blackwell 1965, Noble & Lader 1971, Amin et al. 1980) and a decrement in parotid salivary output (Gottlieb & Paulson 1961, Bolwig & Rafaelsen 1972) have been noted in untreated depressed patients. The magnitude of the decrease in salivary flow, both whole-mouth and parotid, seems to be directly associated with severity of depression (Peck 1959, Davies & Palmer 1964). In addition, the tricyclic and heterocyclic antidepressant medications (unlike the monoamine oxidase inhibitors) intensify the problem of decrease in salivary flow by blocking parasympathetic stimulation of the salivary glands (Handelman et al. 1986, Clemmesen 1988, Friedlander & West 1991). As suggested by Gupta (1966) and Friedlander & West (1991),
hyposalivation probably results in an intensification of chronic inflammatory periodontal disease because a diminution in the mechanical cleansing actions of saliva allows for increased bacterial adhesion to teeth and accumulation of dental plaque at the gingival margin. Therefore, it appears that a decreased interest in performing oral hygiene behaviour and hyposalivation, related to clinical depressive conditions or/and antidepressive medication, may result in higher dental plaque accumulation and calculus formation, which, in turn, could adversely affect the periodontium. Again, future studies are indicated to clarify the answers to these questions.

Although the results of the second study reported in this thesis indicated that total perceived stress and average perceived stress did not significantly predict dental plaque accumulation, Croucher et al. (1995) found that subjects who reported higher numbers of negative life events had significantly higher levels of dental plaque. The discrepancy between the two studies concerning a significant association between a stress variable and levels of dental plaque may be explained by the diverse nature of the stress variables in the two studies. Future studies are needed to further investigate the association between different aspects of the stress experience (i.e., different stress variables such as number of major life events, perceived stress of major life events, number of negative life events and daily hassles) and dental plaque accumulation.

A pilot psychosocial intervention involving the components suggested above is currently being undertaken by the author at the Eastman Dental Hospital. As it is a more prolonged study and still ongoing it was not possible to include it in this thesis. It may be of interest in this context, however, to report a single case from it suggesting an association between the stresses of daily living, daily hassles, and dental plaque accumulation. A male RPP patient randomly assigned to the experimental group, who receive a psychosocial intervention in addition to standard periodontal therapy, was responding well to the
procedure to achieve and maintain a high level of oral hygiene. Starting in the first session of treatment with 98% of dental plaque, he showed progressive reduction of plaque in the second and third sessions to 53% and 24%, respectively. However, in the fourth session the percentage of plaque increased to 43%. The patient appeared at this session to be more tired than usual, and for the first time at hospital presented with cold sores. It transpired that he was under increased pressure at work, as happened from time to time when the company had a large number of contracts to be fulfilled quickly. The patient reported that he was sleeping approximately five/six hours per day and was feeling without energy to perform routine activities such as helping his wife with housework and caring for their children.

It may be noted that in the above reported case no major life event, such as death of a loved one, loss of a job or family relocation, happened with the patient. The stress he was experiencing appeared to be associated with the nature of his work, and part of the relatively minor, but more frequently experienced, stressors, termed hassles. Therefore, as suggested above, future research could examine the putative association of various aspects of the stress experience (including daily hassles) and dental plaque accumulation. In addition, long-term studies, involving multiple measurements of stress variables and dental plaque, might be more sensitive in this respect. For instance, Schou & Wight (1994), in a study designed to evaluate a dental health campaign, found that although mean plaque scores of non-deprived and deprived children did not differ significantly before the campaign, the non-deprived children showed a significant decrease in plaque one and four months after the campaign.

The gender difference reported in the second study of this thesis, where women were found to have significantly less plaque than men, might be of clinical significance. This finding is consistent with previous reports of greater periodontal disease severity in men
compared to women (Miller et al. 1987, Grossi et al. 1995), and appears to support the view that differences in sex-role norms lead females to value health more than males, and so to engage in more health-protective behaviours. Therefore, future studies aiming to evaluate psychosocial interventions or periodontal therapies intending to inhibit periodontal destruction need to control for the possible confounding effect of sex differences.

Although educational background did not significantly predict dental plaque accumulation in the second study, dental plaque accumulation tended to decrease as level of education increased, which is consistent with previous findings (Belting & Gupta 1961, Grossi 1995).

The fact that smoking was found to be non-significant as a predictor of dental plaque in the second study of this thesis is in accord with recent findings indicating that smokers and non-smokers do not differ on dental plaque accumulation. Curiously, however, the association between smoking and dental plaque in the second study was if anything in a negative direction: as smoking increased dental plaque tended to decrease. This negative trend, if it were to be confirmed, might be a consequence of more awareness concerning the adverse effects of smoking on general and oral health, and increased social pressure to quit smoking in recent years. Smokers might be trying to compensate for their harmful habit by increasing their oral hygiene.

RCAP and the severity of RCAP have been directly related to accumulations of plaque, while the extent and severity of periodontal destruction in RPP are usually considered to be greater than would be expected on the basis of the observed plaque levels. Taking a psychosocial perspective, however, it might have been anticipated that RPP patients would present higher levels of dental plaque accumulation given that they report higher level of distress (more depression and loneliness in the first study), which could lead them to neglect oral hygiene. In fact, the results of the second study showed that RPP and
RCAP patients did not differ significantly on mean levels of dental plaque, before they started periodontal treatment. However, because RCAP and RPP patients are secondary referrals from general dental practitioners, it is not possible to know whether they originally differed on dental plaque accumulation. Both RCAP and RPP patients could have received oral hygiene instruction from their general dental practitioner.

An interesting finding of the second study concerns the difference with regard to quantities smoked between groups, with the RPP patients smoking significantly more than RCAP patients. Similarly, in the first study the RPP patients tended to smoke more than RCAP and control patients, but the difference between the three groups was not significant. These two sets of findings may be related to the stage of periodontal treatment which patients were at in the two studies. In the first study RPP and RCAP patients were certainly aware of the risk factors and nature of their condition as they had been under periodontal treatment for at least six months. On the other hand, in the second study RPP and RCAP patients were attending the Periodontal Diagnostic Clinic, possibly did not have previous significant information about their disease, and had not started to receive periodontal treatment. As RPP is of earlier onset and a more severe condition than RCAP it is possible that the RPP patients under treatment in study 1 received stronger advice from the periodontal staff to quit or reduce smoking than RCAP patients. If this is the case the RPP patients in study 1 would be expected to have decreased their smoking proportionately more than the RCAP, and so have reduced the difference in quantities smoked between the two groups seen before treatment in study 2. In addition, RPP patients under treatment are likely to have been made more aware of the nature and risk factors of their condition and for this reason also may feel more encouraged than RCAP patients to reduce or quit smoking. Consistent with this hypothesis is evidence that pressure from health professionals is particularly effective in influencing smoking behaviour. When smokers are
asked what would be the strongest motivating influence on them to quit, advice from a
doctor is given far more force than regulations, increased tobacco taxes, family pressure,
or public campaigns (Solberg et al. 1990).

As reviewed earlier, recent findings have suggested that smoking is a major risk
factor in the development and progression of CP. The data indicate a direct effect of
smoking on the periodontal tissues. After adjusting for plaque levels between smokers and
non-smokers, it has been demonstrated that smokers, compared to non-smokers, have
greater probing depths, clinical attachment loss, and bone loss. Putative mechanisms by
which smoking may have a deleterious effect in periodontitis include immunosuppression,
impaired soft-tissue-cell function, and impaired bone-cell function. Smoking has been
shown to be associated with high periodontitis susceptibility, more severe disease, onset of
disease in young adults, disease progression, and treatment failure. The findings of the
second study are consistent with the reported associations of smoking with more severe
disease and onset of disease in young adults. RPP is a more severe condition than RCAP,
and RPP patients who are younger adults smoked significantly more than RCAP, before
they started to receive periodontal treatment. The reason of this observed difference in
smoking between RPP and RCAP patients is not known. However, it could be that younger
people smoke more than older people irrespective of chronic inflammatory periodontal
disease.

Another finding that emerged from the second study was a marginally significant
correlation between smoking and depression. This is consistent with previous findings
indicating a significant and constant association between increased depression and increase
in smoking. Depression whether defined as a trait, symptom, or as a diagnosable disorder,
has been shown to be overrepresented among smokers.

These two findings of the second study (RPP patients smoked significantly more
than RCAP, and a marginally significant association between depression and smoking) are compatible with the hypothesis that emotional disturbances can induce smoking, thus indirectly affecting the periodontal tissues. As RPP patients were found to be more depressed than RCAP and control patients in study 1, it may be that depression may affect RPP progression via increase in smoking, among other possible mechanisms.

Taking into consideration that the available evidence recommends that smoking status be considered in the clinical management of CP, and that smoking cessation appears to be essential for the successful treatment of periodontitis, smokers with CP, principally RPP patients, may receive significant benefits from psychosocial interventions designed to help them achieve and maintain smoking cessation. A dental hospital setting may be considered appropriate to conduct such interventions. Dentists and doctors have the lowest rate of tobacco use of any adult group in society (Wyshak et al. 1980). In addition, advice from doctor's and dentist's appears to be a strong motivating influence on smokers to quit (Solberg et al. 1990). Because smoking behaviour is complex, involving an interaction between psychological with pharmacological and social factors, and many smoking cessation interventions have yielded impressive but temporary effects, it is important that smoking cessation interventions involve a variety of components and techniques, focusing on obtaining as well as maintaining abstinence (Bernstein 1969, Hunt & Matarazzo 1970, Blaney 1985). Some multicomponent interventions may be adapted for use in a dental hospital setting, given that they have been shown to be effective in helping individuals to obtain and maintain abstinence (Delahunt & Curran 1976, Lando 1977, Solberg et al. 1990, Stevens et al. 1993).

The results of the third study of this thesis (psychosocial factors and tooth wear with a significant component of attrition) indicated that there was no significant relationship between the combined psychosocial factors (total perceived stress, average perceived stress,
state anxiety, trait anxiety) and the diagnosis of tooth wear with a significant component of attrition (attrition group) or nonsignificant tooth wear (controls). However, univariate analysis of variance showed that one of the psychosocial factors, trait anxiety, differed significantly between the two groups. The attrition group presented significantly more trait anxiety than controls.

In the process of interpreting these results it is important to keep in mind a number of considerations. Firstly, although it appears that no previous study has examined possible associations between psychosocial factors and tooth wear with a significant component of attrition, attrition has been consistently linked to bruxism (Eccles 1982, Attanasio 1991, Pingitore et al. 1991, Leung & Robson 1991, Bishop et al. 1994, Lee & Eakle 1995) and there is evidence of significant associations between stress variables and bruxism (Rugh & Solberg 1976, Rao & Glaros 1979, Funch & Gale 1980, Pingitore et al. 1991, Hicks & Conti 1991). Secondly, in the third study it was not possible to determine whether a tooth-wear patient was currently suffering from tooth wear due to attrition, or whether this disorder had been active in the past but was currently stable. Therefore, it is possible that a significant proportion of patients in the experimental group were not currently experiencing tooth wear as they were not going through a specially stressful or anxious period in their lives. Thirdly, the association between stress and bruxism appears to be complex. For instance, Pingitore et al. (1991) found that stress was significant only in conjunction with a stress mediator, type A behaviour. Also Hicks & Conti (1991) observed that a fair number of bruxers reported either only one or no stress-related symptoms, suggesting that stress-related variables should be viewed as a factor in the aetiology of bruxism in some individuals but not the cause of this parafunctional behaviour.

With the above considerations in mind, a tentative interpretation of the results of the third study was made. That is, although the attrition patients were not going through a
particularly stressful or anxious period in their lives, their higher trait anxiety would predispose them to react with more anxiety and stress in more demanding situations, increasing their bruxist behaviour and tooth wear. Further long-term studies involving multiple assessment of psychosocial factors and tooth wear are necessary to test this hypothesis.

Taking into account the probable multifactorial aetiology of attrition and bruxism, future research needs to involve a multivariate approach incorporating measures of psychosocial factors such as stress variables, stress mediators such as trait anxiety and type A behaviour, and occlusal factors. Because the host resistance of tooth structure appears to be of importance in determining the various consequences of bruxism including the degree of attrition, a measure of tooth tissue resistance could also be included in future studies. Unfortunately, however, there appears to be no current measure of tooth tissue resistance which could be used in such clinical studies. Future research will also require construction of accurate study casts (for reliable measurement of tooth wear) and will need to involve multiple measurements of tooth wear, and of the psychosocial and occlusal factors. In addition, when possible, sleep-related bruxing, which is presumably more important than day-time bruxing in terms of attrition, could be assessed electromyographically.

Although the third study examined putative associations between a number of psychosocial factors and tooth wear with a significant component of attrition, it is presumable that psychosocial factors may be involved in the progression of tooth wear in other groups of patients such as those with gastric ulcers, anorexia nervosa, bulimia nervosa, and alcoholics.

The studies reported in this thesis have shown that:

i) RPP, RCAP and control patients differed significantly in the combined psychosocial
factors, and RPP patients presented significantly more depression and loneliness than RCAP and control patients (which is an original contribution to this area of scientific knowledge); ii) depression, state anxiety, trait anxiety, total perceived stress, average perceived stress, and loneliness did not predict significantly dental plaque accumulation in CP patients with RPP and RCAP (although it would be a completely new finding when the study was being planned, currently it adds an original contribution only in relation to trait anxiety, total and average perceived stress and loneliness); iii) also, education, form of CP and smoking were not significant predictors of dental plaque (this accords with previous findings in terms of education and smoking, however it appears to be new evidence concerning the relationship between form of CP and plaque); iv) only gender contributed significantly to prediction of dental plaque: females had lower dental plaque levels than males (this confirms previous findings); v) RPP patients smoked significantly more than RCAP patients, before starting periodontal treatment (this appears not to have been investigated before); vi) there was a marginally significant correlation between depression and smoking in CP patients with RPP and RCAP (this confirms previous reported associations between depression and smoking, although it seems that this is the first time that the association between depression and smoking has been examined in patients with two forms of CP); vii) the attrition and control groups did not differ significantly on the combined psychosocial factors, but attrition patients presented significantly more trait anxiety than controls (this seems to be an innovative finding).

Overall it can be concluded: i) that the investigated psychosocial factors are not equally associated with different forms of CP, particularly depression and loneliness may be of relevance to RPP progression; ii) that the psychosocial factors may be of importance to periodontal destruction via a mechanism other than neglect of oral hygiene; iii) that trait
anxiety might contribute to progression of tooth wear associated with attrition.

Finally, a number of suggestions were made in terms of further research. In order to clarify whether psychosocial factors are of importance to progression of different forms of CP, principally RPP, prospective studies were recommended. Such studies could investigate all three links "X-Y-Z" simultaneously, involving multiple measurements of i) psychosocial factors as potential activators, ii) physiological responses such as immune variables, iii) periodontal tissue variables. The evaluation of efficacy of psychosocial intervention in the treatment of patients with RPP and other forms of periodontitis could also provide evidence for or against the existence of causal relationships between psychosocial factors and disease progression. Future research was also suggested to examine the relationship between depression and dental plaque levels, particularly in patients with a clinical depressive syndrome. Long-term studies were recommended to investigate the association between different stress variables (especially daily hassles and number of negative life events) and dental plaque accumulation. Studies to further clarify the importance of trait anxiety and other relevant psychosocial factors to the progression of tooth wear associated with attrition basically need: i) to include not only psychosocial variables, but also other factors presumed to be of aetiological importance to attrition and bruxism, such as occlusal variables; ii) to assess tooth wear accurately; and iii) to involve multiple measurements of tooth wear and its putative aetiological factors.
REFERENCES


Antoni, M. H., Brickman, S. L., Klimas, N., Imia-Fins, A., Ironson, G., Quillian, R.,
correlates of illness burden in chronic fatigue syndrome. *Clinical Infectious Diseases*
18(suppl 1), S73-S78.

among mature men and women. *Journal of Aging and Health* 2, 3-14.


VIII: Probing attachment changes related to clinical characteristics. *Journal of Clinical
Periodontology* 14, 425-432.

Stress, coping, family conflict, and adolescent alcohol use. *Journal of Behavioral Medicine*
10, 449-466.

Baker, E. G., Crook, G. H. & Schwacher, E. D. (1961) Personality correlates of

and Psychosomatics* 38, 173-177.


Periodontology* 18, 427-430.


Carranza, F. A. (1990b) The periodontal pocket. In Glickman's Clinical Periodontology,


Periodontology 54, 402-407.


533-534.


Grossi, S. G., Genco, R. J., Machtel, E. E., Ho, A. W., Koch, G., Dunford, R., Zambon,


Scandinavica 46, 255-265.


relaxation training and hypnotherapy modify the immune response to stress, and is hypnotizability relevant? *Contemporary Hypnosis* 13, 100-108.


Lando, H. A. (1977) Successful treatment of smokers with a broad-spectrum behavioral


Lynch, J. J. (1977)*The broken heart: The medical consequences of loneliness in America.*


Spielberger, C. D., Barker, L., Russell, S., Silva De Crane, R., Westberry, L., Knight, J. &


## Appendix 1: Questionnaires* Used Throughout the Research Work

i) **UCL/EASTMAN QUESTIONNAIRE 1**

   *Section 1. Demographic information.*  
   *Section 2. Smoking, drinking & drug use.*  
   *Section 3. Dental care.*

ii) **UCL/EASTMAN QUESTIONNAIRE 2**

   *The somatization symptom dimension of the Hopkins Symptom Checklist.*

iii) **UCL/EASTMAN QUESTIONNAIRE 3**

   *The Modifiers and Perceived Stress Scale.*

iv) **UCL/EASTMAN QUESTIONNAIRE 4**

   *State anxiety scale of the State/Trait Anxiety Inventory.*

v) **UCL/EASTMAN QUESTIONNAIRE 5**

   *Trait anxiety scale of the State/Trait Anxiety Inventory.*

vi) **UCL/EASTMAN QUESTIONNAIRE 6**

   *The depression subscale of the Hospital Anxiety and Depression Scale.*

vii) **UCL/EASTMAN QUESTIONNAIRE 7**

   *The revised UCLA Loneliness Scale.*

*These questionnaires are reproduced in the form in which they were presented to the subjects, but have been reduced (70%) to fit the page layout regulations of the thesis.*
This first questionnaire is designed to collect information about things which might affect the health of your gums.

All the information in this questionnaire and the ones which follow will be treated as confidential. No one will have access to this information except the researchers. The code number at the top of this page is for administrative purposes and cannot be used to identify you by name.

Please read each question and write in the answer or circle the number that fits your answer best. Don't spend too much time answering the questions.

If you have any problems please ask. THANK YOU FOR YOUR HELP

SECTION 1 First of all we would like to know a little about you.

1 What is your age?
2 What is your present (or most recent) occupation?
3 Are you male or female?
4 How would you describe your ethnic background?
   1 African           2 Afro-Caribbean
   3 Asian            4 South-East Asian
   5 White European   6 White non-European
   7 Other (Please give details) ..........................................

4 Are living with a regular partner?
   Yes 1 No 2
   (If 'no', please ignore questionnaire number 6).

5 Which of the following best describes your educational background?
   1 Left school at 16
   2 Left school at 18
   3 After 18 years of age went on to College, Polytechnic or University.
   4 Other. (Please give details) .............................................
SECTION 2  Smoking, Drinking, Medicines & Drug Use.

Many things affect the health of people's gums. We would like to ask you some questions about things which might affect your gums.

7  Do you smoke tobacco now?  
   1  Yes  2  No

If you have answered No to this question please go to question 14

8  How many manufactured cigarettes do you smoke per day  ............... 

and/or

9  About how many ounces of tobacco do you use each week for hand-rolled cigarettes?  ...............  

10 Do you smoke cigars?  
   1  Yes  2  No

11 If yes, how many cigars per week?  ...............  

12 Do you smoke a pipe?  
   1  Yes  2  No

13 About how many ounces of tobacco do you smoke each week?  ...............  

14 If you are not a smoker at present did you smoke in the past?  
   1  Yes  2  No

15 In the past 12 months have you taken an alcoholic drink on average:

   1  Twice a day or more  
   2  Almost daily  
   3  Once or twice a week  
   4  Once or twice a month  
   5  Special occasions only  
   6  Never

16 Think back five years, how often did you take an alcoholic drink then?

   1  A lot more than now  
   2  A bit more than now  
   3  About the same as now  
   4  A bit less than now  
   5  A lot less than now
17 Please write below the names of any prescribed medicines you are taking now.

18 Are you using any drugs, such as those listed below, now?
   Cannabis (Marijuana, Dope, Grass), Amyl Nitrate (Poppers),
   Amphetamines (Speed), Cocaine (Coke), Heroin/Opium (Smack)
   1 Yes  2 No

   If 'Yes' please say which.............................................................

   If 'No' Have you used any of the above drugs in the past?
   1 Yes  2 No

   If 'Yes' to this question please say which....................................

   How long ago did you stop using the drug(s)? ............................

SECTION 3 Dental Care.

In each of the following sections please circle the number next to the statement which most closely corresponds to what you actually did over the past year.

19 Over the past 12 months I have brushed my teeth and gums -

   1. Never
   2. Less than once per week
   3. At least once per week.
   4 At least once per day
   5. At least twice per day
   6. More often than twice per day.
20 Over the past 12 months I have used dental floss -

1. Never
2. Less than once per week
3. At least once per week.
4. At least once per day
5. At least twice per day
6. More often than twice per day.

21 Over the past 12 months I have used an antiseptic*/fluoride*/antiplaque* mouthwash -

* please delete as appropriate

1. Never
2. Less than once per week
3. At least once per week.
4. At least once per day
5. At least twice per day
6. More often than twice per day.

Please write in here any other tooth or gum care activity you have engaged in over the past year and say how often:-
How have you felt DURING the PAST SEVEN DAYS including today? For EACH symptom please circle the number which best describes how much it has bothered you during the past seven days.

<table>
<thead>
<tr>
<th></th>
<th>Not at all</th>
<th>A little</th>
<th>Moderately</th>
<th>Quite a bit</th>
<th>Extremely</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Headaches</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. Faintness or dizziness</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. Pains in the heart or chest</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. Feeling low in energy or slowed down</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. Pains in the lower part of your back</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>6. Soreness of your muscles</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>7. Trouble getting your breath</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>8. Hot or cold spells</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>9. Numbness or tingling in parts of your body</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>10. A lump in your throat</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>11. Weakness in parts of your body</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>12. Heavy feelings in your arms or legs</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
Please tick any of the following events which happened to you in the past year and, for the ticked event(s) only, indicate on the first scale how long ago and on the other two scales circle a number to show the amount of life stress caused and the degree of social support you received.

<table>
<thead>
<tr>
<th>Events</th>
<th>When this event happened</th>
<th>Amount of life stress caused to me by the event</th>
<th>Degree of support I received from family and friends</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase in expenses</td>
<td>This month: 1 2 3 4 5 6 7-12</td>
<td>Number of months ago: 0 1 2 3 4 5 6 7-12</td>
<td>None 1 2 3 4 5 6 7 8 9</td>
</tr>
<tr>
<td>Own illness/injury/surgery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Been admitted to hospital</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sexual difficulties</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illness/injury/surgery of someone in the family</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visitors at home</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arguments with spouse/partner</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lost job/Started new job/New responsibility</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase in workload/hours</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Death of close family member</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure caused by a need to achieve something</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children in trouble</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A catastrophe such as a fire, robbery, traffic accident</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Death of close friend</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gained new family member</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Had legal problems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trouble with boss/co-workers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illness/injury/surgery/surgery of a friend</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family member moving out</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unfavourable change in weight/appearance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lost money (loan, gambling)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moved</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family member in hospital</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Argument with relatives</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lost something important</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Went into debt (large loan)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spouse started/stopped work</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married/moved in with someone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other (please specify)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Use the scales to indicate the time since the event occurred (left column), the amount of life stress caused (middle column), and the degree of social support received (right column).
DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you feel right now, that is, at this moment. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Not at all</th>
<th>Somewhat</th>
<th>Moderately so</th>
<th>Very much so</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I feel calm</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. I feel secure</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. I am tense</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. I am regretful</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. I feel at ease</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>6. I feel upset</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>7. I am presently worrying over possible misfortunes</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>8. I feel rested</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>9. I feel anxious</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>10. I feel comfortable</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>11. I feel self-confident</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>12. I feel nervous</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>13. I feel jittery</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>14. I feel 'highly strung'</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>15. I am relaxed</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>16. I am content</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>17. I am worried</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>18. I feel over-excited and 'rattled'</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>19. I feel joyful</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>20. I feel pleasant</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
DIRECTIONS: A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to the right of the statement to indicate how you generally feel. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Almost never</th>
<th>Sometimes</th>
<th>Often</th>
<th>Almost always</th>
</tr>
</thead>
<tbody>
<tr>
<td>21. I feel pleasant</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>22. I tire quickly</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>23. I feel like crying</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>24. I wish I could be as happy as others seem to be</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>25. I am losing out on things because I can't make up my mind soon enough</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>26. I feel rested</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>27. I am &quot;calm, cool, and collected&quot;</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>28. I feel that difficulties are piling up so that I cannot overcome them</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>29. I worry too much over something that really doesn't matter</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>30. I am happy</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>31. I am inclined to take things hard</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>32. I lack self-confidence</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>33. I feel secure</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>34. I try to avoid facing a crisis or difficulty</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>35. I feel blue</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>36. I am content</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>37. Some unimportant thought runs through my mind and bothers me</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>38. I take disappointments so keenly that I can't put them out of my mind</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>39. I am a steady person</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>40. I get in a state of tension or turmoil as I think over my recent concerns and interests</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
Please read each item and circle the number on the scale (0-3) which comes closest to how you have been feeling over the past week. Do not take too long over your replies, your immediate reaction to each item will probably be more accurate than a long thought-out response.

1. I still enjoy the things I used to enjoy:
   - 0 Definitely as much
   - 1 Not quite so much
   - 2 Only a little
   - 3 Hardly at all

2. I can laugh and see the funny side of things:
   - 0 As much as I always could
   - 1 Not quite so much now
   - 2 Definitely not so much now
   - 3 Not at all

3. I feel cheerful:
   - 0 Not at all
   - 1 Not often
   - 2 Sometimes
   - 3 Most of the time

4. I feel as if I am slowed down:
   - 0 Nearly all the time
   - 1 Very often
   - 2 Sometimes
   - 3 Not at all

5. I have lost interest in my appearance:
   - 0 Definitely
   - 1 I don't take so much care as I should
   - 2 I may not take quite as much care
   - 3 I take just as much care as ever

6. I look forward with enjoyment to things:
   - 0 As much as I ever did
   - 1 Rather less than I used to do
   - 2 Definitely less than I used to do
   - 3 Hardly at all

7. I can enjoy a good book or radio or TV programme:
   - 0 Often
   - 1 Sometimes
   - 2 Not often
   - 3 Very seldom
## UCL/EASTMAN QUESTIONNAIRE 7

Indicate how often you feel the way described in each of the following statements by circling the appropriate number on the scale 1 - 4 for each.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Never</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Often</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I feel in tune with the people around me</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. I lack companionship</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. There is no one I can turn to</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. I do not feel alone</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. I feel part of a group of friends</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>6. I have a lot in common with the people around me</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>7. I am no longer close to anyone</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>8. My interests and ideas are not shared by those around me</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>9. I am an outgoing person</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>10. There are people I feel close to</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>11. I feel left out</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>12. My social relationships are superficial</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>13. No one really knows me well</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>14. I feel isolated from others</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>15. I can find companionship when I want it</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>16. There are people who really understand me</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>17. I am unhappy being so withdrawn</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>18. People are around me but not with me</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>19. There are people I can talk to</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>20. There are people I can turn to</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
Appendix 2: A Summary of Previous Studies Concerning the Reliability and Validity of the Psychosocial Measures

The Somatization Symptom Dimension of the Hopkins Symptom Checklist (HSCL)

Reliability essentially concerns the accuracy with which measurement is accomplished. Derogatis et al. (1974) reported that the internal consistency reliability of the Somatization Symptom Dimension of the Hopkins Symptom Checklist was high: The coefficient alpha (based on N = 1435) was equal to 0.87. They also found test-retest coefficient of 0.82, based on a sample of 425 anxious neurotic outpatients with the two evaluations performed one week apart.

In general, validity of a scale refers to the question whether it is in fact measuring the construct of interest. At the operational level, validation generally consists of a set of correlational procedures in which the scale under validation is correlated with more-or-less accepted measures of the construct of interest. Concerning the validational research for the somatization dimension, Derogatis et al. (1974) reviewed a broad range of studies supporting the criterion-related validity of this subscale. This form of validity is oriented toward the applied rather than the theoretical aspects of validation, and is important in establishing the value of the measurement scale for practical clinical decisions. In particular, an important series of studies reviewed by Derogatis et al. (1974) indicated the somatization subscale sensitivity to the effects of psychotropic drugs.

Construct validity is a form of validity which focuses on the theoretical constructs underlying the measurement scales that serve as operational definitions at the level of criterion-related validity. Derogatis et al. (1974) also reviewed studies which indicated validity for the symptoms constructs of the HSCL, including somatization.

The Modifiers and Perceived Stress Scale

Linn (1986) reported that two-week test-retest reliabilities for number of stressful
life events, total perceived stress and total social support were $r(43) = 0.88$, $p < 0.001$; $r(43) = 0.79$, $p < 0.001$; and $r(43) = 0.69$, $p < 0.001$, respectively. In the process of assessing the validity of the instrument, independent assessments of stress by social workers correlated significantly with the total perceived stress score and with average perceived stress score (Linn 1986). In addition, average perceived stress scores correlated higher and more often with psychological and physical indicators of stress in 200 men than did total perceived stress scores (Linn 1986).

*The State Trait Anxiety Inventory (STAI)*

Spielberger et al. (1970) investigated the test-retest reliability of the STAI. The subjects retested after one hour were exposed during the test-retest interval to the following conditions: a brief period of relaxation training; a difficult IQ test; and a film that depicted accidents resulting in serious injury or death. As anticipated, the test-retest correlations for the A-Trait scale were reasonably high, ranging from 0.73 to 0.86 while those for the A-State were relatively low, ranging from 0.16 to 0.54. The low $r$'s for the A-State reflect the influence of unique situational factors existing at the time of testing, given that A-State, differently from A-trait, has a transitory nature and may vary in intensity and fluctuate over time. Spielberger et al. (1970) also found that the internal consistency of both STAI scales was reasonably good. The reliability coefficients ranged from 0.83 to 0.92 and 0.86 to 0.92 for A-State and A-Trait, respectively. In addition, Spielberger et al. (1970) provided evidence of: i) the content validity of the A-State and A-Trait Scales, ii) the concurrent validity of the A-Trait scale, and iii) the construct validity of the A-state scale. Their findings suggested that females are more emotionally labile than males and/or that they are more willing to report their feelings.

*The Depression Subscale of the Hospital Anxiety and Depression Scale (HADS)*

Zigmond & Snaith (1983) examined the internal consistency of the depression
subscale of the HADS by calculating correlations between each item and the total score of the remaining items. They reported that the present items in the depression subscale had correlations ranging from 0.30 to 0.60, all significant beyond \( p < 0.02 \). Higher scores reflect more severe states of depression, as correlation of the subscale scores and the psychiatric ratings was \( r = 0.70, p < 0.001 \) (Zigmond & Snaith 1983). For the depression subscale Zigmond & Snaith (1983) found that a score of 7 or less indicated non-cases of clinical depression, scores of 8-10 indicated doubtful cases and scores of 11 or more indicated definite cases of clinical depression. These score ranges produced the best results with 1% false positives and 1% false negatives.

*The Revised UCLA Loneliness Scale*

The revised UCLA Loneliness scale has high internal consistency, with a coefficient alpha of 0.94 (Russell et al. 1980). Concurrent validity for the measure was indicated by demonstrating that lonely people report experiencing emotions theoretically linked to loneliness and do not report experiencing emotions unrelated to loneliness. In addition, lonely individuals reported more limited social activities and relationships (Russell et al. 1980). In the discriminant validational research for the scale, multiple regression analysis revealed that the loneliness index explained significant amounts of variance beyond the amount accounted for by distress and personality measures. Furthermore, after controlling for the effects of mood and personality variables, loneliness scores were significantly related to relevant interpersonal contact indices (Russell 1982).
Psychosocial factors in inflammatory periodontal diseases

A review


Abstract. Reviewing the literature concerning the possible rôle of psychosocial factors in the aetiology of inflammatory periodontal diseases, it may be concluded that there is evidence which strongly suggests that emotional stress is one of the predisposing factors to ANUG. On the other hand, it is not clear that the scientific evidence is sufficient to substantiate the hypothesis that psychosocial factors are aetiological importance in periodontitis. The proposed mechanisms which may mediate the putative relationship between psychosocial conditions and inflammatory periodontal diseases remain to be tested. However, psychoneuroimmunologic studies make lowered host resistance especially interesting as a possible mechanism. Although available studies do not definitively support causal relationships, they suggest that psychosocial factors may be involved in the aetiology of inflammatory periodontal diseases, which, in turn, would relate to clinical management of these conditions.

The aetiology of inflammatory periodontal diseases is complex. There are many processes at work, and, probably, no single one of these is the causative factor in all cases (Moulton et al. 1952, Gupta 1966, Meyer 1989). The aetiological significance of biological and behavioural risk factors, including systemic conditions, smoking, oral cleanliness, and age, has been demonstrated. However, a significant proportion of the variation in disease severity cannot be explained taking only these factors into consideration (Marcenes & Sheiham 1992). The remaining variance, at least in part, may be explained by important psychosocial factors. Seymour (1991) presents a model of chronic inflammatory periodontal diseases in which genetic factors divide the population into susceptible and non-susceptible individuals. In general, the periodontal tissues of susceptible individuals are in balance with their oral flora, and any lesion of the periodontium is present in its stable form. Progressive disease results when this balance is disrupted, and this may involve a depression of immune responsiveness as a result of factors such as physical and mental stress (Ballieux 1991). According to Krasner (1978) patients can have missing and unreplaceable teeth and yet not show marked periodontal destruction. However, if those patients’ resistance is lowered by their inability to cope with stressful life events, then overt inflammatory periodontal disease may be manifested.

Several workers in the field have pointed out a possible association between psychosocial factors and inflammatory periodontal diseases on the basis of their clinical observations (De Marco 1976, Lowental 1981, Davies et al. 1985).

In addition to clinical observations, periodontologists have conducted studies which have yielded positive correlative findings between psychosocial factors and inflammatory periodontal diseases. Most of these have used clinical populations. In an early study Moulton et al. (1952) reported that severe cases of ANUG were preceded by acute anxiety arising from a conflict about dependency and/or sexual needs. In addition, severe chronic periodontitis cases presented: (i) a background of longstanding less acute conflict, mainly related to dependency needs; and (ii) significant marital conflict and psychosomatic symptoms. By assessment of psychiatric patients and normal subjects, Baker et al. (1961) found signifi-
cant correlations between periodontal status and such factors as age, broken home, marital adjustment, and toothbrushing frequency, calculus, bruxism, and clenching were held constant. Furthermore, in the experimental group the severity of inflammatory periodontal disease increased significantly as the degree of anxiety increased. The authors suggested that the periodontal changes in the psychiatric patients were mediated through one or more processes related to anxiety, and under the control of the autonomous nervous system.

Davis & Jenkins (1962), without employing controls, investigated possible associations between what they called "psychological measures of stress" and periodontal disease, again in psychiatric patients. They found that anxiety was significantly correlated with periodontal index. The authors speculated that anxiety alters concentrations of adrenal corticoids and other hormones. Thus level of inflammatory periodontal disease is presumably related to levels of circulating corticosteroids.

Vogel et al. (1977) evaluated possible relationships between neuroticism/introversion and inflammatory periodontal disease/plaque scores in fifty subjects registering for treatment at a dental school clinic. Significant correlations were found between introversion and plaque, and between introversion and inflammatory periodontal disease as measured both clinically and radiographically. There was also a significant correlation between neuroticism and radiographic measures of inflammatory periodontal disease.

Ludenia & Donhan (1983) using the multidimensional health locus of control scale (MHLC) (Wallston & Wallston 1978) examined the relationship between health locus of control and the following variables: age, depression, trait anger, trait anxiety, and dental ratings of oral hygiene and inflammatory periodontal disease. Locus of control has been defined as the degree to which individuals perceive events in their lives as being a consequence of their own actions, and thereby controllable (internal control or internality), or as being the result of forces beyond their control, and therefore due to chance, fate, or powerful others (external control or externality) (LeBlanc 1976). Trait anger and trait anxiety were measured by trait subscales of the state-trait personality inventory (Spielberger et al. 1979). Psychological trait variables refer to an inherited or acquired characteristic which is relatively consistent, persistent and stable (Wolman 1989). On the other hand, state variables are conceptualized as transitory states or conditions which may vary in intensity and fluctuate over time. To measure depression Ludenia and Donhan used the Beck depression inventory (Beck 1967). They found that trait anxiety, depression and trait anger were correlated negatively and significantly to health internality. Trait anxiety was related positively and significantly to both health externality and powerful others externality (this dimension of the MHLC reflects an individual's belief that powerful others are in control, e.g., health care professionals).

Contrary to the authors' prediction, however, status of oral hygiene and degree of inflammatory periodontal disease were not correlated to either health internality or health externality.

Although there are earlier studies which focused on the relationship between stressful life situations and ANUG scores, the first study systematically to relate self-reported measures of life events stress and periodontal disease generally (gingivitis and periodontitis) in humans appears to have been reported by Green et al. (1986). Gingival and periodontal pathology, stressful life events and somatic symptomatology were investigated in 50 male veterans. Somatic symptomatology reflects distress arising from perceptions of bodily dysfunction, e.g., headaches, faintness and pains in the heart or chest. A significant association was evident between life events stress and periodontal status. Moreover, for individuals who scored high on somatic symptomatology, a particularly conspicuous relation between life stress and periodontal disease was found. Similarly, Marcenes et al. (1993) investigated possible associations between eight specific negative life events and self-reported oral symptoms, namely, toothache or trouble with the gums. After the authors adjusted for the other variables studied, marital or family problems remained significantly associated with self-reported acute and chronic oral symptoms.

Marcenes & Sheiham (1992) undertook a correlational study to establish whether oral health status is associated with work stress. A clinical examination recorded the number of decayed, missing and filled tooth surfaces, periodontal pockets and the presence of gingival bleeding on probing. Questionnaires were used to measure psychosocial factors (work demand, work variety, work control, and marital quality) and the following behavioural risk data: frequency of dental attendance, toothbrushing frequency, sugar consumption and type of toothpaste. Both of these sets of variables were considered, along with age and socio-economic status, in the statistical analysis. A significant association was found between poor periodontal status and high work mental demand and low marital quality. In addition, the relationship between work mental demand and periodontal status was independent of risk-related behaviours. Mechanisms suggested to explain how psychosocial factors may affect periodontal tissues included alterations in saliva flow and immune system suppression.

Psychosocial factors and ANUG

Possibly because of its very nature (acute painful onset, short-lived infection, ease of diagnosis, and multiple predisposing factors), ANUG is the most studied periodontal disorder in relation to psychosocial predisposing factors. By examining 9577 men in the Danish defence forces, Findborg (1952) concluded that after some months of service, there was a considerable increase in the number of ANUG cases. Similarly, Grupe & Wilder (1956) reported that ANUG was present in 2.2% of a newly inducted army personnel population. This, plus the coincidence of ANUG with nail biting suggested a psychosomatic aetiological factor. Giddon et al. (1965) in an epidemiological study of a university population, reported that the monthly prevalence of ANUG appeared to have some relation to situational factors such as academic examinations or vacation periods. Reviewing the literature, Goldhaber & Giddon (1964) concluded that the most conspicuous ANUG predisposing factors in susceptible individuals were smoking, gingivitis, or local trauma, in
Evidence for a relationship between emotional conditions and ANUG also comes from studies in which individuals were assessed over time while exposed to stressful situations. Formicola et al. (1970) investigated personality traits of student naval aviators, who were undergoing preflight training. Comparing students with ANUG with a healthy control group they found a significant positive correlation between dominance and ANUG, and a significant negative correlation between depression and ANUG. The investigators suggested that suppression of dominance during military training could create emotional disturbance and a subsequent increase in ANUG incidence for a dominant type of individual. Another military personnel study (Shields 1977) found that ANUG patients reported more stress, felt more debilitated (suffered more colds, sore throats, etc.), and were heavier smokers compared to controls.

Shannon et al. (1969) investigated the possibility of a relationship between stress, as measured by urine steroid excretion rate, and ANUG in 474 males being screened for military duty. Subjects were divided into 6 groups: slight gingivitis, moderate gingivitis, severe gingivitis, periodontitis, ANUG, and normal. Although the excretion rate of 17-hydroxy-corticosterone (17-OHCS) was considerably higher for the ANUG group, no statistically significant differences were found, possibly due to the large variance in the 17-OHCS measurements and the small size of the ANUG group. To cope with the problem of wide normal variation in 17-OHCS, Maupin & Bell (1975) designed a study using each patient as an experimental subject during the course of ANUG and as his own control after the resolution of the disease. All eleven subjects presented with significantly higher 17-OHCS levels during the course of ANUG than after its resolution. Furthermore, 9 subjects, when questioned, could identify stressful situations or personal problems that they felt were of special concern. However, it is not clear from the paper whether these events preceded or occurred during the ANUG episode.

Cohen-Cole et al. (1983) and Cogen et al. (1983) investigated the role of psychosocial factors and immune suppression in ANUG. Initially, 35 patients showing ANUG and 35 controls, matched for age, sex, and dental hygiene, completed rating questionnaires, gave blood for tests of immune and endocrine function, and collected overnight and spot urines. The rating questionnaires and urine collections were repeated two weeks later, after resolution of ANUG, when the Minnesota multiphasic personality inventory (MMPI) (Dahlstrom & Welsh 1960) was administered. Compared to controls the ANUG patients presented the following significant differences: (i) more state anxiety before disease resolution, while trait anxiety was higher both during ANUG and after its resolution; (ii) higher scores on the depression and psychopathic deviation scales of the MMPI; (iii) a greater magnitude of recent stressful events; (iv) more life events during the previous year, more overall distress and readjustment related to these events, and also more negative life events; (v) higher scores in the emotionally disordered range on the general health questionnaire (Goldberg 1978) and in the depressed range on the Center for Epidemiological Studies depression screening test (Comstock & Helsing 1976), before and after disease resolution; (vi) elevated serum cortisol levels before ANUG resolution, and elevated overnight urine-free cortisol before and after disease resolution; (vii) depressed lymphocyte proliferation after mitogen stimulation; (viii) depressed PMN leukotaxis and phagocytosis. These findings provide preliminary support for the hypothesis that stress is a predisposing factor for ANUG, and that endocrine and immune changes may mediate the relationship between psychosocial factors and ANUG.

Laboratory Animal Studies

There are a few laboratory animal studies that might suggest a causal relationship between stress and inflammatory periodontal disease. Making use of a variety of stressors, most of these experiments were based on Selye's concept of the general adaptation syndrome (Selye 1946, 1948, 1975).

Ratcliff (1956), for instance, stressed rats by adhesive tape immobilization and withholding food for 68 h. The histologic observations revealed the following pathologic alterations in the periodontium of the experimental animals compared to controls: (i) a marked sloughing of the keratinized layers of the free gingival epithelium, (ii) a definite split in the gingival crevicular epithelium, (iii) degeneration of the connective tissue of the periodontal ligament and (iv) reductions in the numbers of osteoblasts and cementoblasts. However, these changes could have been the result of food deprivation rather than emotional stress.

Fedi (1958) produced stress in Syrian hamsters with cold, water bath and violent physical exercise, and 10% formalin injections, each for a 2-week period. The experimental animals, compared to controls, presented a stress reaction which included irregular arrangements of periodontal ligament principal fibres, osteoblasts and new bone formation.

Stress induction employing an intermittent ringing of bells and exposure to bright lights in rats and hamsters was carried out during a twelve-week investigation by Gupta et al. (1960). Compared to controls they found moderate statistically significant differences in number and extent of calcified tissue lesions in the experimental hamsters but not in the rats. The most pronounced changes were in the alveolar bone, with endosteal osteoporosis in the interradicular septi and osteoclastic activity at the alveolar crest.

Studying the effect of repeated pregnancies and subcutaneous injections of ACTH upon rat periodontium, Karr & Ingle (1964) found significantly greater inflammatory response of the papillae of the experimental subjects compared with the same area of the controls. Furthermore, the epithelial attachment of the experimental animals was significantly more apical. However, pregnancy has many specific body effects and these results may not be exclusively attributable to stress.

Shklar & Glickman (1953) observed no gross or microscopic alterations in the periodontal tissues of rats stressed with injections of 4% formaldehyde in the groin (4 injections within 48 h). The same authors (Shklar & Glickman 1959) conducted a second experiment, again in rats but using exposure to cold as the stressor, in which the duration of stress was extended to 2 weeks, 1 month, and 4 months. After 2 weeks of exposure to cold, alveolar osteoporosis and some periodontal ligament changes (reduction in fibroblasts and a granular appearance of the collagen bundles) were seen. However, after 4 months of exposure, the periodontium was essenti-
ally normal, suggesting that adaptation had occurred.

Studying gingival injury healing processes in rats under stress due to injections of 0.5 ml turpentine into the hind leg, Stahl (1961) found that the injured-stressed animals showed delayed organization of the connective tissue in wound areas, and a striking reduction in osseous regeneration of the alveolar ridge compared to the wounds of non-stressed rats.

Cohen et al. (1969) subjected 150 mice to 3 different stressors from one to 4-week intervals. Mice receiving daily injections of cortisone demonstrated apical proliferation of epithelial attachment, periodontal pocket formation, calculus deposition, inflammation and alveolar bone loss. Mice subjected to cold stress presented minor changes characterized by decreased osteoblastic activity. No changes were found in mice receiving 0.05 mg of adrenaline daily.

Possible Mechanisms of Action of Psychosocial Factors on Periodontal Tissues


Such mechanisms include neglect of oral hygiene, changes in diet, increase in smoking and other pathogenic oral behaviours, bruxism, alterations in gingival circulation, changes in saliva, endocrine imbalances, and lowered host resistance. By examining these mechanisms it is evident that some may involve psychologically-related changes in behaviour which enhance vulnerability to periodontal breakdown. For instance, intensity of oral health behaviour, such as tooth brushing and other home dental care, may decrease during periods of distress, while rates of oral pathogenic behaviour such as bruxism, smoking, other drug use or adverse dietary practices can increase (McGlynn et al. 1990). On the other hand, there are mechanisms involving physiologic pathways through which psychosocial factors may influence periodontal tissues: alterations in saliva, changes in gingival circulation, endocrine imbalances and lowered host resistance. The most commonly proposed mechanisms underlying a link between psychosocial factors and inflammatory periodontal diseases can be summarised as follows.

Neglect of oral hygiene

It has been reported that psychological disturbances can lead patients to neglect oral hygiene and that the resultant accumulation of plaque is detrimental to the periodontal tissues (Miller & Firestone 1947, Moulton et al. 1952, Gupta 1966, Ringdor & Cheraskin 1969, Meyer 1989). Belting & Gupta (1961), comparing psychiatric patients with controls found that the severity of inflammatory periodontal disease increased significantly in both groups as the level of calculus increased. They also found more moderate and heavy calculus in the psychiatric group than in the control group.

Changes in dietary intake

Emotional conditions are thought to modify dietary intake, thus indirectly affecting periodontal status (Miller & Firestone 1947, Moulton et al. 1952, Zaidens 1954, Gupta 1966, Ringdor & Cheraskin 1969, Meyer 1989). This can involve, for instance, the consumption of excessive quantities of refined carbohydrates and softer diets, requiring less vigorous mastication and therefore predisposing to plaque accumulation at the approximal risk site (Newman 1974).

Smoking and other harmful oral habits

Among the many harmful oral habits which are believed to be induced by emotional disturbances, smoking is possibly the most important in relation to worsened periodontal conditions (Rivera-Hidalgo 1986, Haber 1994). Furthermore, the following effects of circulating nicotine have been mentioned: (i) vasoconstriction, produced by the release of adrenaline and noradrenaline, which is supposed (Manhold et al. 1971) to result in a lack of nutrients for the periodontal tissues; (ii) suppression of in vitro secondary antibody responses (Roszman & Rogers 1973); and (iii) inhibition of oral neutrophil function (Kenney et al. 1977).

Bruxism

Bruxism, which is thought to be induced by stress (Kristal 1978, McGlynn et al. 1990), has been considered of aetiological importance in chronic inflammatory periodontal disease (Goldberg 1973, Meyer 1989). However, it is difficult to find scientific evidence to substantiate this claim, which seems to be basically supported only by clinical observations.

Gingival circulation

Manhold et al. (1971) tested the hypothesis that in long or continued emotions a constant constriction of the blood vessels would produce a lack of oxygen and nutrient materials for the periodontal tissues. They found a lower ability of the tissues of rats under stress to utilize oxygen. However, according to Rugi et al. (1984), this proposed mechanism remains obscure because Manhold and colleagues did not perform a detailed metabolic analysis. Furthermore, smoking and stress have been implicated in reducing gingival blood flow which, in turn, could increase the possibility of necrosis of tissues, with subsequent reduced resistance to plaque (Clarke et al. 1981).

Alteration in saliva flow and components

It is assumed that both increase and decrease in salivary flow, induced by emotional disturbance, may affect the periodontium adversely (Gupta 1966). Moreover, emotional distress may also produce changes in saliva pH and chemical composition (Ringdor & Cheraskin 1969, Fournier & Mascr 1988). There is no clear evidence that these emotional-induced changes in saliva relate to worsened periodontal conditions.

Endocrine changes

It has long been known that stress can affect the endocrine system (Selye 1973). Although interactions between stress-endocrine-periodontal changes are not yet well understood, some hypotheses have been proposed. Davis & Jenkins (1962) suspected that periodontal status is related to alterations in the concentration of adrenal corticoids and other hormones involved in the general adaptation syndrome, as reported by Selye (1946). Moulton et al.
These studies have produced data to support the premise that excessive stress associated with life-change events and psychological responses to them can alter host defences and increase vulnerability to certain illnesses, especially those intimately associated with immunologic mechanisms, such as infection, autoimmune disease and malignancy. A useful review of PNI studies and theory in relation to cancer has recently been presented by Andersen et al. (1994).

The PNI literature is summarized below in terms of 4 categories: (i) stressful life events, (ii) dysphoric responses (feelings of anxiety, restlessness, dissatisfaction, or depression), (iii) vulnerability and (iv) PNI intervention studies. While the first three categories involve explanatory frameworks in which life events are presumed to have immune suppressive effects (Kaplan 1991), the last one includes studies which have used a number of different strategies intended to modulate immune function. It is worth mentioning here that there are mutual influences among these categories and their effects on the immune system, and some studies have made use of more than one of them.

Stressful life events
Numerous PNI research reports implicitly or explicitly account for immunosuppression in terms of acute or chronic stressful life experiences.

Those studies involving acute or temporally discrete stressful circumstances in turn have employed either general or specific life events measures. Acute stress studies using general measures are considered first. Kiecolt-Glaser et al. (1984a) found among medical students that those with high scores for stressful life events had lower levels of natural killer (NK) cell activity than low scorers. Similarly, Kemeny et al. (1989), in a study of patients with recurrent genital herpes simplex virus, reported that subjects with high levels of stressful experience presented a lower proportion of both helper/inducer and suppressor/cytotoxic cells. This study also suggested that current distress over situations that had occurred in the past 6 months, as well as worry about events that might occur in the subsequent 6-month period, may be associated with immunosuppression. In a prospective study, Cohen et al. (1991) investigated the relationship between stress and vulnerability to colds by inoculating subjects with one of 5 diverse viruses or a placebo. It was found that rates of both respiratory infection and clinical colds increased proportionally with increases in stress.

Studies involving more specific measures of acute stressful events include observation of the influence of experiences such as examinations, bereavement and separation/divorce. Kiecolt-Glaser et al. (1984a) found a significant decrease in NK activity and a significant increase in plasma IgA in medical students at the beginning of their final examinations, compared to baseline measures. Kiecolt-Glaser & Glaser (1992) reported further evidence that academic examinations can produce significant changes suggestive of immunosuppression: decline in NK cell activity; a dramatic decrease in gamma interferon production; consistently large increases in antibody titres to latent herpes viruses, specifically Epstein Barr Virus (EBV) and Herpes Simplex Type 1 (HSV-1); decrease of T-cell killing of EBV-infected target cells; a poorer proliferative response to mitogens; and a lower percentage of peripheral blood T-lymphocytes expressing the interleukin 2 (IL-2) receptor.

Kiecolt-Glaser et al. (1987) have also investigated the psychologic and immunologic concomitants of marital quality and marital disruption in women. Women who had separated from their husbands within the previous year had poorer immune function than socio-demographically matched married women, with significantly lower %s of NK and helper cells, and significantly higher antibody titres to EBV. In addition, poorer marital quality in the married cohort was a significant predictor of depression and poorer response in 3 functional immunologic assays: blastogenesis with 2 different mitogens, and antibody titres to EBV.

In addition to studies involving acute stressors, some researchers have investigated immune system responses to more chronic stressors. Arnett et al. (1987), for instance, focused prospectively on immunologic effects of long-term unemployment. The results indicated that unemployment of more than 9 months duration is accompanied by a significant decrease in lymphocyte reactivity to phytohaemagglutinin (PHA) and purified protein derivative of tuberculosis (PPD).

Kiecolt-Glaser et al. (1991) investigated changes in depression, immunity
and health in caregivers who had already been caring for spouses for an average of five years compared with sociodemographically matched controls. Over a 13-month period, the caregivers showed down-regulation on three measures of cellular immunity relative to controls: decrease in lymphocyte proliferation with two mitogens, and increased antibody titres to EBV. The caregivers also presented a much greater incidence of depressive disorders, and significantly more days of infectious illness, primarily upper respiratory tract infections.

Dorian et al. (1985) studied chronic work stress in nineteen accountants and twelve controls at four points encompassing the tax season. The accountants experienced higher levels of anxiety, depression, somatic symptoms, obsessive compulsiveness and interpersonal sensitivity throughout the year with a peak in such symptoms during the April tax deadline period. In addition, the accountants identified more life events as having major psychological impact and responded to these events with emotion-focused coping styles of avoidance and denial. They also felt less able to predict, control and cope with environmental demands, and documented fewer supportive relationships than controls. The accountant group, also displayed an increase in immunologic defence at the time of peak stress, followed by suppression during the post-stress period. The following immunologic parameters showed this pattern. (i) interleukin generation; (ii) interleukin responsiveness; (iii) NK cell activity; (iv) lymphocyte reactivity to PHA.

Ongoing stressful circumstances may be reflected also in poor marital quality, which among married men has been significantly associated with greater depression, distress, loneliness, higher antibody titres to EBV, and lower helper/suppressor ratios (Kiecolt-Glaser et al. 1988).

**Dysphoric responses**

Many studies have reported that dysphoria (a generalized feeling of anxiety, dissatisfaction, restlessness or depression) is associated with down-regulation of immune function. Dysphoric responses have been measured in terms of depressive affect (a feeling of depression attached to ideas or idea-complexes), reports of unhappiness, anxiety, hostility, loneliness and clinical depression (Kaplan 1991). However, it should be noted that such or similar measures may also be used to indicate vulnerability to stressors.

Linn et al. (1984) reported that bereaved subjects with high scores on depression showed a reduced proliferative response to PHA. Similarly, severity of depressive symptoms in women was associated with a decline in NK cell activity, a reduction in suppressor/cytotoxic cells, and an increase in the ratio of helper to suppressor/cytotoxic cells (Irwin et al. 1987). In patients with recurrent genital herpes simplex virus those presenting with high levels of anxiety, depressive mood or hostility had a lower proportion of suppressor/cytotoxic cells (Kemeny et al. 1989). Fredrikson et al. (1993) found that among women, undergoing chemotherapy for breast cancer, those characterized by high compared to low trait anxiety showed compromised immune function. The total number of monocytes as well as NK activity was lower in the more anxious group. Loneliness has been associated with decreased NK cell activity among medical students (Kiecolt-Glaser et al. 1984a), and with reduced proliferative response to PHA and decline in NK cell activity among psychiatric inpatients (Kiecolt-Glaser et al. 1984b).

Associations also have been found between clinical depression and immunosuppression. For instance, Schleifer et al. (1984) found that hospitalized depressed patients showed a poorer proliferative response to three mitogens, compared with matched controls. In addition, the absolute numbers of T and B cells were lower in the depressed group.

**Vulnerability**

Many reports of psychosocial correlates of immune function may be interpreted in terms of concepts similar to vulnerability, defined as "the inability to forestall, or to assuage the distress accompanying adverse life circumstances" (Kaplan 1991). Vulnerability may be understood as the absence of personal dispositions and social resources that are presumed to prevent the occurrence, or to reduce the intensity, of dysphoria associated with stressors. Although in some studies the psychosocial measures were intended to reflect vulnerability, they can also be interpreted as indicating other factors such as dysphoria.

Canter et al. (1972) found an association between psychological vulnerability (defined by scores on hypochondriasis, morale-loss and ego-strength scales) and hypersensitive reactions to immunization procedures. In a laboratory study, Sieber et al. (1992) assessed changes in NK cell activity and proportions of circulating T and NK lymphocyte subsets in adult males, immediately after exposure to controllable or uncontrollable stress (noise), as well as 24 and 72 h later. Subjects who perceived that they had control over the noise as well as no-noise controls showed no reduction in NK activity. By contrast, subjects who perceived that they had no control over the stressor, which reflects vulnerability, showed lower NK activity immediately after the conclusion of the first 20-min stress session, and this reduction persisted 72 h later. More numerous, however, are studies in which the psychosocial variables may be inferred rather than having been presented as indices of vulnerability. For instance, Liedeman & Prilipko (1978) reported that the peripheral blood of schizophrenics was characterized by the presence of lymphocytes which did not respond to T mitogens. This finding is consistent with the belief that psychological disorders are interpretable as expressing an inability to deal with stressful life circumstances as a result of an inadequate repertoire of coping, adaptive, and defence mechanisms. Reviewing the findings on immunologic accompaniments of mental illness, Solomon (1981) has reported the following: abnormalities in levels of immunoglobulins; abnormal heterophile antibodies; the presence of autoantibodies to a variety of self-components, including the presence of antibrain antibodies; deficiency immune responsivity; and morphologic and functional abnormalities of immune cells.

The literature is also consistent with the position that the absence of social support renders the person vulnerable to stressors and, in turn, to immunosuppression. In a study of patients at an early stage of breast cancer, social support was positively related to NK cell activity (Levy et al. 1985). On the contrary, the lack of social support is thought to be associated with decrements in immune function. Variables such as loneliness and disruption of...
conditioning has not been studied extensively in humans. Recently, Bovbjerg (e.g., Ader et al. 1991). However, immunity through classical conditioning also seems to be associated with depressive evidence of the modulation of both consistent with improved immune function or superficial resistance, social contact, or no intervention. PNI intervention studies have employed a number of strategies, such as relaxation, hypnosis, physical exercise, classical conditioning, self-disclosure, and cognitive-behavioural therapies. Relaxation and hypnosis have been the most used interventions. Walker et al. (1993) provide a useful review of the literature on the modulation of immune responsiveness to stress by hypnosis and relaxation. In some studies investigating immediate and delayed hypersensitivity reactions, subjects are injected with the same antigen in both arms (e.g., purified tuberculin protein derivative), and under hypnosis it is suggested that while one arm will show characteristic changes (e.g., erythema, wheal, burning and itching), the other will not. In most studies differences in responsiveness between the two arms have been reported (Black 1963a, 1963b, Black & Friedman 1965, Zachariae & Bjerring 1990). However, it is not clear whether the observed changes express modulation of immune function or superficial changes in the skin. Relaxation techniques also seem to be associated with higher levels of immunocompetence. Kiecolt-Glaser et al. (1983) assigned geriatric residents to 1 of 3 conditions: relaxation, social contact, or no intervention. The relaxation group, compared to the others, showed a significant enhancement in NK cell activity and decreases in HSV antibody titres, both consistent with improved immune function.

Animal studies have provided impressive evidence of the modulation of immunity through classical conditioning (e.g., Adel et al. 1991). However, conditioning has not been studied extensively in humans. Recently, Bovbjerg et al. (1990) reported that women undergoing cyclic chemotherapy for ovarian cancer developed anticipatory immune suppression. This finding is consistent with the hypothesis that patients receiving chemotherapy can develop conditioned immune suppression, nausea and vomiting after repeated pairings of hospital stimuli with the immunosuppressive and emetic effects of chemotherapy. LaPerriere et al. (1990) assigned 50 HIV-seropositive and HIV-seronegative healthy men to 1 of 2 groups: aerobic training or no intervention. Subjects were assessed after the five-week training period, 72 h before notification of serostatus, and a week after notification. Seropositive no-intervention subjects showed increases in anxiety and depression, and also a decline in NK cell numbers after notification. Seropositive exercisers presented no psychosocial or immunologic alteration. In contrast, an intensive stress-reduction intervention (involving relaxation, stress management skills and health behaviours) did not produce immunologic positive alterations among HIV-seropositive men when compared with their controls (Coates et al. 1989).

Pennebaker et al. (1988) studied the relationship between self-disclosure and immune functioning. Students were assigned to one of two groups. While half wrote about traumatic or troubling experiences (self-disclosure condition) for 20 min on 4 consecutive days, the others wrote about trivial events and experiences (control condition). Experimental subjects showed a higher mitogen response after the intervention, compared with controls. Finally, it is clear that there are more studies concerning the effects of stressors on the immune system than there are about the consequences of PNI interventions. It would be particularly interesting to know more about the duration and relevance of any immunologic alterations observed after PNI interventions.

Methodological issues of PNI studies

Examining the findings of the previously described PNI studies it may be observed that stress and other psychosocial factors can induce changes in immune function, which frequently have been assumed to reflect immunosuppression which, in turn, is presumed to increase proneness to illness. However, it is still difficult to specify the conditions under which stress downregulates immune function and thereby increases susceptibility to illness. It is known that some people whose lives appear to be ordered and happy do become ill, and, by contrast, others pass through periods of life stress without suffering disease. What is known is that stress sometimes plays a rôlle in the onset and progression of certain disorders (Dohrenwend & Dohrenwend 1984). Sieber et al. (1992) pointed out three parameters of stress-induced immunosuppression that need clarification: (i) timing and duration of effects, (ii) the rôlle of subjects’ controllability over the stressors, and (iii) the impact that personal dispositions may have on the stress-immunosuppression relationship. Further, it may be questioned whether stress-induced changes in some aspects of the immune response can be taken as indicators of overall immune system functioning, creating an increased vulnerability of the individual to microorganisms (Ballieux 1991). It is essential to conduct further prospective studies to know whether stress-induced changes in immune function are implicated in diverse illnesses, including inflammatory periodontal diseases. Moreover, due to the nature of the immune system, it is important that such prospective studies include: (i) a control group; (ii) assessment/control of health behaviours such as sleep, smoking, physical activity, and alcohol; (iii) simultaneous collection of blood samples from the different subject groups; (iv) multiple immunological assays as well as health/illness measures.

Conclusions

Analyzing human studies concerning psychosocial factors and inflammatory periodontal diseases, it may be concluded that there is evidence which strongly suggests that emotional stress is one of the predisposing factors to ANUG (Mouton et al. 1952, Shannon et al. 1969, Maupin & Bell 1975, Formicola et al. 1970, Shields 1977, Cohen-Cole et al. 1983, Cogen et al. 1983).

On the other hand, taking into account the fact that studies concerning the relationship between psychosocial factors and periodontitis have yielded only correlative findings and furthermore have for the most part used a periodontal index which included both gingivitis and periodontitis features (Belt-
Changes in the periodontium caused by emotional stress are still under debate. Some studies have indicated that emotional stress significantly affects the periodontium (Shklar & Gupta 1961, Davis & Jenkins 1962, Vogel et al. 1977, Green et al. 1986, Marçenes & Sheiham 1992), while others have not found any significant effect of emotional stress on the periodontium (Gupta et al. 1960; Ratcliff 1956, Karren & Ingle 1953). Routine examination of periodontitis and food deprivation, making it difficult to establish the impact of stressors with significance specific effects such as pregnancy and food deprivation, making the interpretation of results as an effect of emotional stress doubtable. Other studies did not find any significant effects in the periodontium of a short period of stress (Shklar & Glickman 1953) or only effects for one of two animal species studied (Gupta et al. 1960; Cogen et al. 1983). The changes in the periodontium caused by some stressors may be either not significant or transitory. Consequently, new experimental studies controlling period of stress, type of stressor, and different animal species and strains, are necessary to elucidate the effects of stress on animal periodontal tissues. Moreover, it is not possible to separate the effects of physical from emotional stress in these animal studies.

The mechanisms which may mediate possible relationships between psychosocial conditions and inflammatory periodontal diseases remain a fertile area for research. There appears to be no study which has shown that stress has induced changes in behaviour which, in turn, have worsened periodontal conditions. In relation to the physiologic pathways through which psychosocial factors could influence periodontal breakdown, the following proposed mechanisms remain to be tested by future research: alterations in salivary flow and composition, changes in gingival circulation, endocrine alterations, and lowered host defence. Among them, the last is particularly interesting given that PNI studies have been presenting evidence that psychosocial factors can produce immunosuppression, which is presumed to increase vulnerability to a range of diseases. Although Cogen et al. (1983) have found significant associations between psychosocial factors, endocrine alterations, immune suppression and ANUG, there appears not to be any research which has systematically investigated whether stress-induced immune suppression can play a significant role in the onset and progression of periodontitis.

The available scientific evidence thus does not definitively support a causal relationship between psychosocial factors and inflammatory periodontal diseases. The studies reviewed above nevertheless do indicate the possible operation of psychosocial factors in the aetiology of inflammatory periodontal diseases, though at the moment the more suggestive evidence relates to ANUG. Consequently, it is important that the practitioner is aware of these factors, and takes them into consideration. The clinical management of inflammatory periodontal diseases might benefit from an exploration of these relationships, principally when disease severity cannot be explained by the established aetiological factors, when there is no response to periodontal treatment, or when there is a sudden, marked and inexplicable increase in the rate of periodontal destruction. On the basis of clinical evidence that psychosocial factors may be affecting periodontal conditions adversely, the patient might be informed of this possibility and, if appropriate, referred for psychological support.

Zusammenfassung

Psychosoziale Faktoren bei entzündlichen Parodontalkrankheiten: Eine Übersicht


Résumé

Facteurs psycho-sociaux dans les maladies parodontales inflammatoires: une revue

Examinant la littérature en ce qui concerne le rôle possible des facteurs psycho-sociaux dans l'étiologie des maladies parodontales inflammatoires, il y aurait une preuve suggerant que le stress émotionnel est un des facteurs prédisposant à la gingivite aigüe nécrotique. D'autre part, il n'est pas clair que la preuve scientifique soit suffisante pour soutenir l'hypothèse selon laquelle les facteurs psycho-sociaux ont une importance étiologique dans la parodontite. Les mécanismes proposés pouvant être les médiateurs entre les conditions psycho-sociales et les maladies parodontales inflammatoires doivent encore être testés. Cependant les études psychoneuro-immunologiques proposent l'abaissement de la résistance de l'hôte en tant que mécanisme possible. Bien qu'aucune étude ne parvienne à prouver de manière définitive
References


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Psychosocial factors and adult onset rapidly progressive periodontitis


Abstract. On the basis of clinical observations, some periodontologists have suggested an association between psychosocial factors such as depression, stress and anxiety, and adult onset rapidly progressive periodontitis (RPP). This study investigated more formally possible associations between a number of relevant psychosocial factors and RPP. The significance of the psychosocial variables was assessed by comparing 3 groups: 50 patients with RPP, 50 patients with routine chronic adult periodontitis (RCAP), and 50 patients without significant periodontal destruction (controls). It was anticipated that the RPP group would show higher levels of psychosocial maladjustment than the RCAP and control groups. A between-subjects multivariate analysis of covariance indicated that the combined psychosocial variables were significantly related to the periodontal diagnosis. 2 psychosocial factors, depression and loneliness, were significant in distinguishing between groups. The RPP group presented significantly increased depression and loneliness compared to the RCAP and control groups. Future research is indicated to further clarify the significance of these psychosocial differences in relation to the onset and progression of RPP.

Periodontologists have demonstrated the aetiological significance in chronic periodontitis (CP) of biological and behavioural risk factors, including a range of systemic conditions, smoking, oral cleanliness, and age. However, a significant proportion of the variation in disease severity cannot be explained taking only these factors into consideration (Marcenes & Sheiham 1992). The remaining variance, at least in part, may be explained by important psychosocial factors.

Most studies in humans have found significant associations between psychosocial factors and chronic inflammatory periodontal disease (Moulton et al. 1952, Baker et al. 1961, Belting & Gupta 1961, Davis & Jenkins 1962, Vogel et al. 1977, Green et al. 1986, Marcenes and Sheiham 1992). These studies have yielded correlative findings, and have for the most part used a periodontal index which included both chronic gingivitis and CP features. Although a preliminary prospective study, with a sample of 18 subjects (Freedman & Goss 1993) has indicated that an increase in pocket depth was significantly predicted by psychological factors such as occupational stress and type-A personality, the evidence at present does not definitively support a causal relationship between psychosocial factors and CP (Monteiro da Silva et al. 1995). In addition, CP can differ with respect to bacterial aetiology, host response and rate of progression, and psychosocial factors may not be equally associated with the different forms of CP (McGlynn et al. 1990, Monteiro da Silva et al. 1995).

Adult onset rapidly progressive periodontitis (RPP) is more frequently suggested to be associated with psychosocial factors than other current forms of CP. For instance, establishing RPP as a distinct clinical entity, Page et al. (1983) reported that the active phase of the disease was often associated with depression. Davies et al. (1985) noted that, for some RPP patients, the disease appeared to be associated with stress and/or depression. Newman (1993) suggested the possible importance of stress in relation to the time of onset and rate of progression of idiopathic RPP. The present study therefore investigated possible associations between a number of relevant psychosocial variables (number of life events during the previous year, total perceived stress, average perceived stress, total social support, average social support, depression, loneliness, state anxiety, trait anxiety and somatization) and RPP.

In the present study, the significance of the psychosocial variables was assessed by comparing three groups: (i)
Once patients were confirmed as meeting the above mentioned pre-arranged criteria, they were invited to take part in the study. After voluntary written informed consent to participate in the study had been obtained, subjects completed the measures.

**Psychosocial measures**

A modified version of the modifiers and perceived stress scale (Linn 1986) was used to measure number of stressful life events during the previous year, total and average perceived stress in relation to these events, as well as total and average social support received from family and friends to cope with the stressful events. The number of stressful events and the total perceived stress score provide a measure of objective and subjective stress within the person’s environment over a given time. The total social support reflects a subject’s perceived amount of support received to cope with the events that happened in the previous year. On the other hand, the average score is presumed to reflect a person’s usual way of perceiving stress or the tendency to obtain social support (Linn 1986). The instrument contained 28 life events applicable to adults. In addition, subjects were also asked to report any other event(s) not included in the list that had happened in the previous year. For each identified event, the number of months since occurrence was recorded. Subjects also estimated on a 10-point scale (0 = none, 9 = extreme or very much) the degree to which the event was perceived as stressful and the amount of support received from family and friends in coping with the event.

The UCLA loneliness scale (Russell et al. 1980) was included to provide a brief subjective measure of the adequacy of interpersonal contacts. In the validational research for the UCLA scale, multiple regression analysis revealed that the loneliness index explained significant amounts of variance beyond the amount accounted for by distress and personality measures. In addition, after statistically controlling for the effects of mood and personality variables, loneliness scores were significantly related to relevant interpersonal contact indices (Russell 1982). The UCLA scale contains 20 items, 10 positively and 10 negatively worded, followed by a 4-point (1–4) scale. The total score, which may vary from 20 to 80, is the sum of all 20 items.

**Material and Methods**

This study protocol was reviewed and approved by the Joint Research and Ethics Committee of the Eastman Dental Hospital and Institute.

**Subjects**

Subjects were patients from the Eastman Dental Hospital and Institute: 50 with RPP, 50 with RCAP and 50 controls. Subjects with RPP and RCAP had been under treatment in the Periodontology Department for at least 6 months. The controls were patients attending for other conditions in the Conservative Dentistry Department. Patients were excluded if they presented systemic conditions such as diabetes mellitus, HIV infections, neutropenias, Papillon-LeFevre syndrome, and cardiovascular disease, which have shown a significant association with CP. Patients using anticonvulsive, immunosuppressive, and calcium-channel block medications were also excluded because of their relationship with gingival inflammation. In addition, patients with evidence of previous juvenile periodontitis were excluded. The 3 groups were matched exactly for sex (66% were females and 34% males), and as closely as possible for ethnicity (overall 88% were White Europeans, 8% Asians and 4% Africans). Because age is an important criterion in distinguishing RPP from RCAP patients, the three groups could not be matched for age. The means and standard deviations of age for RPP RCAP and control groups were 37.8 (±5.24), 45.2 (±6.36), and 38.8 (±8.83), respectively.

**Procedure**

The following criteria were used to identify and select the RPP patients: diagnosis of chronic periodontitis before 35 years, gross inflammation and pus, advanced bone loss affecting most teeth, multiple vertical osseous defects. The inclusion criteria for RCAP patients were: diagnosis of chronic periodontitis over 35 years of age, even or horizontal bone loss, no gross inflammation or pus. Controls with no significant periodontal destruction were selected by the use of these criteria: no radiographic evidence of bone loss, pocket depths no greater than 4 mm. Therefore, patients with chronic gingivitis were included in this group.
Depression was quantified with the depression subscale of the hospital anxiety and depression scale (HADS) which has been found to be a reliable instrument for detecting states of depression in the setting of a hospital outpatient clinic (Zigmond & Snaith 1983). The subscale consists of 7 items followed by 4-point scales. In the present study the 4-point scales varied from 1 to 4. The total score was obtained by adding all items, and it varied from a minimum of 7 to a maximum of 28. On the basis of previous findings of Zigmond & Snaith (1983), patients with a score of 18 or more would have a high probability of suffering from depressive disorder. While state variables are conceptualized as transitory states or conditions which may vary in intensity and fluctuate over time, trait variables refer to an inherited or acquired characteristic which is relatively consistent, persistent and stable (Wolman 1989). Trait and state anxiety were measured using the Spielberger et al. (1970) state-trait anxiety inventory (STAI), which is one of the most widely used instruments to measure both aspects of anxiety. Subjects respond to each STAI item by rating themselves on a 4-point (1-4) scale. The range of possible total scores varies from a minimum of 20 to a maximum of 80 on both trait and state anxiety subscales.

Somatization was assessed with the somatization symptom dimension of the Hopkins symptom checklist (Derogatis et al. 1974). The 12 items comprising the somatization dimension reflect distress arising from perceptions of bodily dysfunctions. Complaints focused on cardiovascular, gastrointestinal, respiratory, and other systems with marked autonomic mediation are included. Headaches, pain and discomfort localized in the gross musculature and other somatic equivalents of anxiety are also represented. Each item is followed by a 5-point scale (O=not at all, 4=extremely). The total score, obtained by adding all items, potentially varies from O to 48.

Control measures
Potential confounds such as age, smoking status, drinking habits, oral hygiene and educational background, which are known to correlate with periodontitis, were also assessed by questionnaire. Subjects who were smokers answered questions about the number of cigarettes smoked per day, and/or the number of 3 sizes (small, medium and large) of cigars smoked per week, and/or ounces of tobacco used each week for hand-rolled cigarettes or in smoking a pipe. Subjects answered a 6-point scale to assess frequency of intake of alcoholic drinks, ranging from 2 per day or more to never in the past 12 months. Patients completed a questionnaire concerning oral hygiene habits during the previous year including such features as, toothbrushing frequency, frequency of dental floss use, and frequency of use of mouthwash. Relevant demographic data, for instance, sex, and ethnic background were also recorded.

Results
By the use of a commercial statistical program (SPSS-MANOVA), a between-subjects multivariate analysis of covariance was performed on the psychosocial variables (number of life events during the previous year, total perceived stress, average perceived stress, total social support, average social support, depression, loneliness, state anxiety, trait anxiety and somatization) using periodontal diagnosis (RPP, RCAP and no significant periodontal destruction) as the between groups factor. Adjustments were made for the following covariates: smoking status, drinking habits, oral hygiene, educational background and age.

In the process of checking the assumption of multivariate normality, some psychosocial variables which were not normally distributed were effectively normalised by the use of the square root transformation. After transformation, assumptions of normality, homogeneity of variance-covariance matrices, linearity, and multicollinearity were satisfied.

After a distribution is normalized by transformation, the mean is equal to the median. The transformation affects the mean but not the median because the median depends only on rank order of cases. Consequently, conclusions about means of transformed distributions apply to medians of untransformed distributions (Tabachnick & Fidell 1989). Table 1 shows the medians and the values for the 5th and 95th percentiles for the psychosocial variables for RPP, RCAP and control groups.

Covariates were judged to be adequately reliable for covariance analysis as the slopes of the regression lines for the 3 groups were not significantly different for each psychosocial variable regressed on each covariate. With the use of Wilks' criterion, one of the most commonly used criteria for evaluating multivariate differences (Olsen 1974), the combined psychosocial variables were shown to be significantly related to the combined covariates, approximate \( F(50, 609) = 1.43, p = 0.032 \).

Again with the use of Wilks' criterion, it was shown that the combined psychosocial variables were significantly related to the periodontal diagnosis of RPP, RCAP and no significant peri-

<table>
<thead>
<tr>
<th>Psychosocial factors</th>
<th>RPP central 90% median, range (lower/upper)</th>
<th>RCAP central 90% median, range (lower/upper)</th>
<th>Control central 90% median, range (lower/upper)</th>
</tr>
</thead>
<tbody>
<tr>
<td>number of life events</td>
<td>4.00 (1.00, 9.90)</td>
<td>4.00 (1.00, 10.45)</td>
<td>4.00 (1.00, 10.45)</td>
</tr>
<tr>
<td>total perceived stress</td>
<td>20.00 (3.10, 56.60)</td>
<td>18.50 (3.00, 60.35)</td>
<td>17.50 (1.00, 73.45)</td>
</tr>
<tr>
<td>average perceived stress</td>
<td>5.00 (1.40, 9.00)</td>
<td>4.73 (1.28, 8.59)</td>
<td>4.94 (1.00, 7.70)</td>
</tr>
<tr>
<td>total social support</td>
<td>22.50 (1.65, 65.00)</td>
<td>26.50 (3.00, 68.25)</td>
<td>21.00 (2.55, 45.70)</td>
</tr>
<tr>
<td>average social support</td>
<td>5.66 (0.36, 9.00)</td>
<td>6.42 (1.18, 9.00)</td>
<td>5.77 (1.06, 9.00)</td>
</tr>
<tr>
<td>depression</td>
<td>11.00 (7.55, 15.00)</td>
<td>9.00 (7.55, 14.00)</td>
<td>9.00 (7.00, 14.00)</td>
</tr>
<tr>
<td>loneliness</td>
<td>38.50 (24.55, 56.45)</td>
<td>31.50 (21.00, 49.80)</td>
<td>32.00 (20.00, 52.45)</td>
</tr>
<tr>
<td>state anxiety</td>
<td>38.50 (23.55, 55.35)</td>
<td>35.50 (22.00, 49.80)</td>
<td>34.50 (22.65, 52.80)</td>
</tr>
<tr>
<td>trait anxiety</td>
<td>40.00 (26.55, 58.90)</td>
<td>36.00 (25.55, 55.25)</td>
<td>37.00 (22.00, 55.70)</td>
</tr>
<tr>
<td>somatization</td>
<td>3.00 (0.00, 15.45)</td>
<td>3.00 (0.00, 12.00)</td>
<td>3.00 (0.00, 13.00)</td>
</tr>
</tbody>
</table>
odontal destruction, approximate $F(20, 266)=2.22, p=0.002$. Univariate analysis of covariance showed that the three periodontal-diagnosis groups differed significantly on depression and loneliness, $F(2,142)=5.54, p=0.005$ and $F(2,142)=7.52, p=0.001$ respectively. No other differences between the three groups were statistically significant at the 5% level.

In summary, there is a significant association between the 3 periodontal diagnoses of RPP, RCAP, and no significant periodontal destruction and the combined psychosocial variables, after adjusting for the covariates. In addition, 2 psychosocial variables, depression and loneliness, are important in distinguishing between groups. Therefore, comparisons on every pair of groups on depression and loneliness were performed between RPP, RCAP and control groups by the use of simple contrasts in the SPSS MANOVA command. The RPP group presented significantly increased depression when compared to the RCAP and control groups, $t(148)=2.30, p=0.003$ and $t(148)=2.47, p=0.002$, respectively. In addition, the RPP group reported significantly more loneliness than the RCAP and control groups, $t(148)=3.35, p=0.001$ and $t(148)=3.06, p=0.003$, respectively. No other comparison on depression and loneliness was statistically significant at the 5% level.

**Discussion**

The psychosocial variables used in this study were selected on the basis of: (i) the clinical observations linking psychosocial factors to RPP (Page et al. 1983, Davies et al. 1985, Newman 1993); and (ii) the findings of previous correlational studies which investigated their association with chronic inflammatory periodontal disease. Moulton et al. (1952) reported that patients with severe CP presented with many psychosomatic symptoms involving the head, neck, and gastric areas. Baker et al. (1961) found significant correlations between periodontal status and such factors as hysteria scores and somatization (defined in their study as the tendency to develop psychogenic physical complaints or psychosomatic disorders). Belting & Gupta (1961) reported that psychiatric patients presented significantly higher periodontal scores than controls when brushing frequency, calculus and bruxism were held constant. Furthermore, in the psychiatric group the severity of disease increased significantly as the degree of anxiety increased. Davis & Jenkins (1962) found that anxiety was significantly correlated with periodontal index, again in psychiatric patients.

Green et al. (1986) reported a significant association between life events stress and periodontal status. Moreover, for individuals who scored high on somatization, a particularly conspicuous relation between life stress and periodontal disease was found. Marecen es and Sheiham (1992) showed that one work characteristic related to stress, which they referred to as “work mental demand”, was significantly associated with poor periodontal status.

These clinical observations and correlational studies indicated the selection of the following psychosocial variables in the present study: number of life events during the previous year, total perceived stress of life events, average perceived stress of life events, depression, state anxiety, trait anxiety, and somatization. However, 3 other psychosocial variables, total and average social support available to cope with life events, and loneliness, which appear not to have been previously implicated directly with CP in the literature, were also included. These variables were included because there is solid evidence linking interpersonal relationships and health (House et al. 1988). The data suggest that social relationships do not have a mere correlational relationship to health, but have a causal impact: prospective studies that have controlled for baseline health status have reliably shown greater mortality among individuals with fewer relationships (House et al. 1988). Furthermore, several reviews (Pilisuk 1981, Cohen & Sime 1985, Cohen & Wills 1983) confirm that social support has 2 types of effects on health outcomes: indirect/buffering and direct/main. The “buffering model” postulates that support protects individuals from potentially harmful effects of stressors and enhances their coping abilities (Dohrenwend and Dohrenwend 1984, Gatchel et al. 1989). The “main effect model” proposes that social support directly improves well-being by fulfilling basic social needs and social integration. In addition, psychoneuroimmunomologic (PNI) studies have shown an association between loneliness and poorer immune function which, in turn, is assumed to increase vulnerability to illnesses (Kiecolt-Glaser et al. 1984a, b, Glaser et al. 1985, Kiecolt-Glaser & Glaser 1991).

The results of this study show that, even controlling for the covariates, the three periodontal diagnoses of RPP, RCAP, and no significant periodontal destruction differed significantly on the combined psychosocial factors. The RPP patients presented significantly increased depression and loneliness, when compared to RCAP and control patients. These findings suggest that different forms of CP are not equally associated with psychosocial factors (McGlynn et al. 1990, Monteiro da Silva et al. 1995) and support clinical observations linking RPP to psychosocial factors (Page et al. 1983, Davies et al. 1985, Newman 1993).

It is interesting to note that Page et al. (1983) also reported an association between depression and RPP, and speculate about the processes involved in depression associated with infections. Reviewing the literature concerning depression and the immune system, Stein et al. (1991) identified 3 possible processes involved in depression, occurring in the context of HIV-1 infection. According to them, depression may result from: (i) a psychological response to knowledge of the diagnosis, prognosis, and difficulties of dealing with evolving symptoms and debilitations; (ii) a direct neurotropic effect of the virus; and/or (iii) an indirect central nervous system effect secondary to viral activation of the immune system.

Similarly, the psychosocial differences between RPP, RCAP, and control patients reported here may or may not be a psychological response to the diagnosis and prognosis of the rapidly progressive form of the disease. They may or may not have existed before the rapidly progressive form of CP appeared. RPP, being of earlier onset and a more destructive form of periodontitis than RCAP, might itself have produced these psychosocial differences. On the other hand, previous psychosocial characteristics, such as those reported here, might render some individuals more susceptible to RPP. Moreover, neither of these alternatives excludes the possibility that these psychosocial differences might be of importance to the progression of RPP. Even the possibility that these psychosocial differences resulted from a direct or indirect effect of microorganisms on the CNS cannot be definitely ex-
cluded. RPP has been sometimes associated with general malaise, weight loss, depression, and loss of appetite which have been suggested to reflect the existence of a fulminant gingival infection (Page & Schroeder 1982, Page et al. 1983).

The results reported here are consistent with the hypothesis that psychosocial factors are of importance to the onset and progression of RPP (Davies et al. 1983). However, a study of the present design does not permit strong conclusions to be drawn concerning causal relationships, and cannot provide direct evidence that psychosocial factors are of significant influence in establishing RPP. While the putative effects of psychosocial factors on process of periodontal destruction would be more evident in RPP than RCAP patients, considerably more time than the previous year (the most prolonged retrospective time covered by the psychosocial measures employed in the present study) would be necessary for the RPP patients to show evident clinical signs. In summary, although the findings reported here do not prove, they are compatible with a putative causal relationship between psychosocial factors and the onset and progression of RPP.

Among the proposed mechanisms which could mediate possible relationships between psychosocial factors and inflammatory periodontal disease, immunological pathways are of special interest. Recently PNI studies have been presenting evidence to support the premise that psychosocial factors can alter host defences and increase vulnerability to a range of illnesses, especially those intimately associated with immunological mechanisms, such as infection, autoimmune disease and malignancy (Dorian & Garfinkel 1987, Kaplan 1991, Kiecolt-Glaser and Glaser 1991). In fact, immunoregulatory control, either at a systemic or local level, is probably an important factor in the control of CP, and may explain, at least in part, individual variation among patients concerning periodontal destruction, as well as cyclical or other periodontal breakdown (SeYmour et al. 1986). It is possible, therefore, that psychosocial factors are of importance in the onset and progression of RPP via depression of immune function (Balleix 1991, Monteiro da Silva et al. 1995). It remains for further studies to clarify the interactions between psychosocial factors and RPP. Based on an "X-Y-Z" model (Elliot & Eis dorfer 1982) such prospective studies could include multiple measurements of: (i) psychosocial factors as potential activators, (ii) physiological responses such as immunological parameters; (iii) periodontal tissue variables, such as loss of attachment and probing pocket depth.

While there is a current lack of data linking psychosocial factors and different forms of CP in terms of correlational and cause-effect relationships, there is also a problem in relation to all current attempts to link various factors with time of onset and rate of progression of CP. The so-called prognostic indicators are invariably based solely on previous disease experience. Despite this problem, a number of periodontitis therapies intending to inhibit or regenerate lost tissues have been tested. Therefore, in the case of psychosocial factors, one possible approach would be to evaluate the efficacy of psychosocial intervention in the treatment of patients with RPP and other forms of periodontitis.

Acknowledgements
We are especially grateful to CAPES, a Brazilian agency funding the research activities of A. M. Monteiro da Silva, and to Dr. Aviva Petrie for advice and assistance concerning statistical analysis.

Zusammenfassung
Psychosoziale Faktoren und rasch fortschreitende Parodontis


Résumé
Facteurs psycho-sociaux et parodontite à progression rapide débutant à l'âge adulte

Se basant sur des observations cliniques, quelques parodontologues ont émis l'idée qu'il existe une association entre des facteurs psycho-sociaux, tels que la dépression, le stress et l'anxiété, et la parodontite à progression rapide débutant à l'âge adulte (RPP). Le présent travail est une étude plus formelle des associations possibles entre plusieurs facteurs psycho-sociaux particuliers et la RPP. La valeur significative des variables psycho-sociales a été évaluée en comparant 3 groupes: 50 patients avec RPP, 50 patients avec une parodontite chronique ordinaire de l'adulte (RCAP) et 50 patients sans destruction parodontale importante (contrôle=témoins). On escomptait dans le groupe RPP des niveaux d'adaptation psycho-sociale plus élevés que dans le groupe RCAP et dans le groupe témoin. Une analyse multivariate de covarience entre sujets indiquait que les variables psycho-sociales présentaient ensemble une liaison significative avec le diagnostic parodontal. Deux facteurs psycho-sociaux, la dépression et la sensation d'isolement, avaient une importance significative pour la distinction entre les groupes. Dans le groupe RPP, la dépression et la sensation d'isolement étaient augmentées par rapport au groupe RCAP et au groupe témoin. Des recherches sont requises dans l'avenir pour élucider ultérieurement la signification de ces différences psycho-sociales par rapport au début de la RPP et à sa progression.

References


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