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Chapter 1

General introduction

Introduction

Periodontitis is a disease that affects the supporting tissues of the teeth and is characterized by deepening of periodontal pockets, connective tissue attachment loss and alveolar bone loss. Microorganisms are undoubtedly the principal cause of the disease and bacteria like *Aggregatibacter actinomycetemcomitans*, *Porphyromonas gingivalis*, *Prevotella intermedia*, *Tannerella forsythensis*, *Fusobacterium nucleatum*, and *Parvimonas micra* are strong markers of periodontitis in adults (Van Winkelhoff et al. 2002). However, the bacterial elicited host response dictates the disease progression (Bartold & Van Dyke 2013). The host immune response results in production of inflammatory mediators and matrix metalloproteinase leading to connective tissue destruction and bone loss (Darveau et al. 1997, Graves 2008, Kornman et al. 1997). Herpesviruses, besides periodontopathogenic microbiota, may have a role in etiopathogenesis of periodontitis. *Human Cytomegalovirus* (HCMV), *Epstein-Barr virus* (EBV) and *Herpes Simplex virus* (HSV) have been reported to be related to periodontitis (Contreras & Slots 1996, Contreras & Slots 1998, Parra & Slots 1996, Saygun et al. 2002), particularly in actively progressing periodontal lesions (Ting et al. 2000, Yapar et al. 2003, Kubar et al. 2004). It is suggested that periodontal pockets serve as a reservoir of salivary HCMV and EBV (Saygun et al. 2005). The presence of these viruses decreases the resistance of periodontal tissue, thereby permitting subgingival overgrowth of periopathogens (Slots & Contreras 2000).

As mentioned above, the host response is of decisive importance for the disease and is influenced by genetic predisposition, systemic and environmental conditions as well as life style factors. The effect of smoking in the development of periodontitis is well documented and there is strong evidence demonstrating that tobacco smoking habit is a very important risk factor contributing to a higher prevalence and severity of periodontitis in adults (Albandar 2002, Albandar et al. 2000, Tonetti 1998). There is also evidence that subjects with poorly controlled type 2 diabetes mellitus (DM) have poorer periodontal health than subjects with better controlled DM or without DM (Taylor et al. 1998). Poor glycemic control as a result of prolonged elevated blood glucose in diabetes, has been related to periodontitis progression. In a study of distinct, homogenous population in Gullah African Americans, people suffering from type 2 DM with poor glycemic control had more severe CAL and PPD (Bandyopadhyay et al. 2010), while a number of putative factors, including specific gene polymorphism, have been identified in association studies (Borrell & Papapanou 2005, Genco 2005). However, other possible modifiable systemic factors such as balanced nutrition

or supplementation of nutrients have not been thoroughly evaluated in periodontal research, although reports of the possible effects of nutrient deficiency and supplementation have appeared early in the periodontal literature (Glickman 1948a, b, Leggot et al. 1991).

Indonesia is a developing country in which the prevalence of periodontal disease approximates 96.58% of the population (Situmorang 2005). In relation to oral health, malnutrition, specifically insufficient vitamin supply, has been shown to induce oral disease which is particularly evident among lower social class communities and in developing countries (Deen et al. 1999, Dummet 1983, Enwonwu 1985, Enwonwu & Salako 2012). Research in Africa, India and South America indicate that contrary to observations in industrialized countries, ANUG in developing world affects primarily impoverished young population residing in unsanitary surroundings, and generally immunocompromised by malnutrition and various infections (Enwonwu et al. 2004, Jimenez & Baer 1975, Pindborg et al. 1966). Nevertheless, a subset of population in developed countries may have also a deficiency in vitamin C, for instance, in elderly community (Amarasena et al. 2005). The level of vitamin C in plasma is affected not only by dietary intake, but also by stability of vitamin C in plasma. The plasma protein haptoglobin has been associated to prevent vitamin C oxidation, and this protein has three major phenotypes (Hp 1-1, Hp 1-2 and Hp 2-2), which the latter has been shown to have the lowest prevention of vitamin C from oxidation (Langlois et al. 1997).

Related to nutrition, obesity often experienced by people with overconsumption of carbohydrates and fats and may lead to periodontal disease (Suvan et al. 2011). The systemic effects of this poor diet include the upregulated CRP and HbA1c levels which can also lead to increased risk of periodontal disease (Paraskevas et al. 2008, Morita et al. 2012). Another micronutrient that has been frequently related to periodontal health is vitamin D. Several studies showed a linear association between plasma vitamin D and the percentage of bleeding pockets as well as its effect on gingivitis (Dietrich et al. 2005, Hiremath et al. 2013). However, the relationship between vitamin D and periodontal breakdown is still controversial (Alshoubi et al. 2013, Miley et al. 2009, Millen et al. 2013, Liu et al. 2009).

Progressive periodontitis may eventually lead to tooth loss, which often reduces the quality of life, chewing problems and decreased masticatory function, especially if many teeth are involved. Caries and periodontal disease are regarded as the main reasons for tooth loss although the relative contribution of these two diseases varies between studies (Akhter et al. 2008, Montandon et al. 2012, Shigli et al. 2009, Susin et al. 2006).

In 2002 the third examination was carried out of a 15-year longitudinal study on the initiation and progression of periodontal disease in an Indonesian rural population deprived from regular dental care (Van der Velden et al. 2006). The results showed that 20% of the population developed severe periodontitis. Unfortunately a number of the above described variables were not included in this study. Therefore, in 2005 and 2011 two additional studies were initiated.

Outline of this thesis

The overall aim of the PhD research described in this thesis was to investigate in this Indonesian population, associations between the periodontal condition assessed by alveolar and periapical bone loss with the plasma levels of vitamin C, vitamin D, HbA1c and CRP, the Hp phenotype, the presence of putative periodontopathic bacteria and viruses, dietary habits and anthropometrics; and the effect of vitamin C supplementation on the levels of plasma vitamin C, HbA1c, CRP and on putative periodontopathic bacteria and viruses. The outline of this thesis is as follows :

1. To investigate the relationship between plasma vitamin C levels and the severity of periodontitis (chapter 2).
2. To investigate the relationship between the amount of alveolar and periapical bone loss and the plasma levels of vitamin C, vitamin D, HbA1c and CRP, the Hp phenotype, the presence of putative periodontopathic bacteria and viruses, dietary habits and anthropometrics (chapter 3).
3. To assess the effect of vitamin C supplementation on the plasma levels of vitamin C, HbA1c and CRP as well as on putative periodontopathic bacteria and viruses (chapter 4).
4. To investigate on the basis of radiographic information and previous examination forms the relative contribution of caries and periodontal disease to tooth loss and to analyze the prevalence of caries and its sequelae (chapter 5).

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Chapter 1

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