Determinants of self-reported periodontal health in South Africa: Results from a national survey

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Determinants of self-reported periodontal health in South Africa: Results from a national survey

by

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Submitted in partial fulfilment of
the requirements for the degree of

Master of Science (Odontology)

in the

School of Dentistry

Faculty of Health Sciences

(Community Dentistry)

University of Pretoria

Pretoria

October 2010

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DECLARATION

I declare that every aspect of this dissertation entitled "Determinants of Self-Reported Periodontal Health in South Africa: Results from a National Survey" was undertaken by me. It has not been submitted for any degree or examination in any university, and all the resource materials used and/or quoted have been duly acknowledged.

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DEDICATION

This dissertation is dedicated

to the cherished memory of my father,

Mr SF Okagbare,

whose educational dream for all his children is being realized,

and

to my dear mother,

Mrs M Edewhosa-Okagbare,

for her unceasing prayers and love.

ACKNOWLEDGEMENTS

First and foremost, all praise and glory and thanks for the completion of this dissertation goes to ALMIGHTY GOD.

I offer my profound thanks to Prof. OA Ayo-Yusuf, for making the dataset for this study available to me, and for his uncompromising stand on scholarship and his insistence on excellence in his supervisory capacity.

Special thanks are owed to Prof. PJ van Wyk, my Head of Department.

I would like to thank Drs Bukola Olutola and Flavia Senkubuge for their valuable support.

The 2003 SADHS survey was funded by the South African National Department of Health and was co-ordinated by the Medical Research Council of South Africa. Data from this study were obtained with permission from the National Department of Health, for which I am grateful.

Finally, my appreciation goes to Enoor, my wife, and my sons – Emueje, Emuobo and Toma – who felt most deeply the impact of my absence from home, and to the rest of my family, who prayed for me and supported me during my studies.

ABSTRACT

Background: Since self-reported periodontal or 'gum' health may be explained by the same factors that are associated with clinical periodontal health status, it has been suggested as a useful measure for service planning and for monitoring periodontal health in developing and resource-limited countries, where logistics and the costs of clinical oral surveys may be major barriers to risk factor surveillance.

Objectives: To determine the systemic health and lifestyle factors associated with self-reported poor periodontal health status in South Africa.

Data source: The second South African Demographic and Health Survey (SADHS) done in 2003.

Methods: This secondary data analysis focused on data on dentate adults aged ≥15 years who participated in the 2003 SADHS (n=6,319). Information obtained included socio-demographic data, health risk behaviours (tobacco and alcohol use) and chronic diseases. Nutrient intake was computed based on food frequency items contained in a Nutrient Index (N-Index) developed for use in South Africa. Taking into account the complex sample design used in the SADHS, data analysis included the use of t-test, Chi-square and multiple logistic regression analysis. The level of significance was set at $p<0.05$.

Results: Of the respondents, 4.6% (95% CI = 3.9 - 5.5) self-reported having had a 'gum problem' or poor periodontal health in the 6 months prior to the survey date. In the general dentate population, those who reported poor periodontal health were older than those who did not report poor periodontal health at a significant level (36.2% vs. 38.8%; p = 0.02); and they were more likely to be problem drinkers (2.53; 95% CI = 1.68 – 3.82), as compared to non-drinkers. Having suffered a stroke (4.13; 95% CI = 1.53 – 11.11) or suffering from arthritis (1.70; 95% CI = 1.00 = 2.90) were significant associated with higher odds of reporting poor periodontal health. Black South Africans have higher odds of reporting poor periodontal health (3.91; 95% CI = 1.38 – 11.05) than white South Africans. On further stratifying the study participants into younger (≤45 years) and older (>45 years) adults, factors associated with poor periodontal health were found to be different. In particular, reporting making yearly preventive dental care visits was significantly associated with reporting poor periodontal health only among younger adults (OR = 0.40; 95%CI = 0.18 – 0.90), while the racial gradient in reporting poor periodontal health remained significant only for older adults.

Conclusion: The study's findings highlight the need to integrate oral health promotion with general health promotion programmes, especially those targeted at chronic disease prevention and rehabilitation.

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CHAPTER 1

INTRODUCTION

1.1 Background

Periodontal disease is characterized by chronic gingival inflammation, which may extend into subjacent periodontal structures with loss of attachment.[1] In dental literature, periodontal diseases are generally classified into two groups: gingivitis, which is the inflammation the gingivae (gum), and periodontitis, which damages the tissues that support the teeth (beneath the gum).

Periodontal diseases are considered some of the most widespread diseases amongst humans. They are caused by the activity of bacteria present in bacterial plaque that accumulates from inadequate oral hygiene practices.

The bacteria that form plaque also release toxins that stimulate the immune system to overproduce powerful infection-fighting factors called cytokines. Ordinarily, cytokines, which are hormone-like proteins, are important for healing. In excess, however, they can cause inflammation and severe tissue damage. Two cytokines that are particularly important in periodontal diseases are known as tumour necrosis factor-alpha (TNF-alpha) and interleukin-1 beta.

In addition, white blood cells produced by the immune response to these bacteria also release a family of enzymes called matrix metalloproteinases (MMPs), which break down connective tissue.

The integrity of the periodontium is thus broken by the activity of bacteria present in dental plaque. On the other hand, periodontal integrity is maintained by the combined effects of host factors, adequate nutrition, adequate oral self-care and the absence of undermining systemic conditions. Risk factors such as smoking, alcohol intake, poor nutrition and immuno-suppression associated with chronic diseases (such as diabetes or HIV) have also been known to pose a risk that periodontal diseases will develop.

In South Africa, the prevalence of periodontal diseases is high. Fewer than 2% of younger adults (35- to 44-year-olds)[2] and fewer than 15% of 15-year-old children[3] in South Africa have healthy gums. Experiencing 'bleeding gums' when brushing the teeth gently and painful gums are the most common symptoms of periodontal disease.[4] Given that such symptoms are likely to make people seek care, it has been suggested that self-reported poor periodontal health status is a better measure of future service demand for periodontal care than a diagnosis determined by a professional.[5]

The perception of need is not easily measured. However, the realization that 'bleeding or painful gums' are abnormal is a prerequisite for seeking treatment or professional help.[6] Therefore, for the purposes of appropriate service planning, including oral health human resource planning and the allocation of resources, it remains important to understand the factors associated with the self-reporting of poor periodontal conditions because they have an impact on the utilization of services.[6]

1.2 Rationale for the study

As part of the 1988/89 South African National Oral Health Survey,[2] periodontal health assessment was carried out using the Community Periodontal Index Treatment Need (CPITN). This survey was limited to dentate individuals in five metropolitan areas whose ages ranged from 12 to 64 years. Two important groups were therefore excluded, namely people in the rural areas and the elderly. The survey also did not sufficiently investigate the determinants of poor periodontal health. Nevertheless, it remains the largest clinical examination of periodontal health status in South Africa to date.

Other prior studies have also either involved a relatively small sample of South Africans and/or have mainly been descriptive, including the more recent reports of self-reported poor periodontal health from the two

South African Demographic and Health surveys,[7-8] which did not deal adequately with the factors independently associated with reporting poor periodontal health in South Africa. Hence, there was a need for large and nationally representative sample studies that provide for an analytical approach, with controls for potential confounding factors, to establish independent factors associated with self-reported periodontal health status in South Africa.

This study is the first in South Africa we are aware of that systematically investigated the determinants of self-reported periodontal status using a large and nationally representative sample, in spite of the significant burden associated with high cost and compromise of the oral health-related quality of life of those suffering from poor periodontal health.

1.3 Potential benefits of the study

The findings of this study may be used by policymakers and stakeholders to make informed decisions in the planning of appropriate and effective intervention programmes and strategies for the prevention and control of periodontal diseases, thus reducing the associated burden, in terms of cost and compromised oral and general health-related quality of life.

CHAPTER 2

LITERATURE REVIEW

2.1 Factors linked to periodontal diseases

The clinical factors associated with periodontal diseases have been well established.[9] However, the emerging public health or integrative approaches to improving oral health now also dictate that we acquire a greater understanding of the social determinants of periodontal diseases in the general population.[10] Furthermore, understanding the social determinants of periodontal diseases would be important in addressing inequities in oral health among South Africans. It is pertinent that addressing health inequities remains a priority on the public health agenda in South Africa,[11] as it is in many other countries.[12]

Recent publications have suggested that poor lifestyle is a possible mediator of social disparities in oral health.[13] Lifestyle – including dietary and smoking habits, alcohol consumption, obesity and some systemic diseases – has been independently associated with periodontal diseases,[14] along with poor oral hygiene. Some severe forms of periodontal diseases have been reported to be on the increase as a result of the increasing prevalence of tobacco use, obesity, diabetes and HIV/AIDS.[15-17]

2.2 Validity and usefulness of self-reported periodontal diseases

Since self-reported periodontal health status may be explained by the same factors that are associated with clinical periodontal health status, it has been suggested that it may be a useful measure for monitoring periodontal health in developing and resource-limited settings, where logistics and the costs associated with a clinical oral survey may make such a survey non-viable.[18-20]

The alternative clinical diagnostic protocol (using probes) is considered 'invasive' and it may result in a high rate of refusal of clinical examination, especially because of the likely difficulty of convincing potential participants that there is adequate infection control, given the low literacy level and high prevalence of HIV infection in South Africa.[16] Moreover, intra- and inter-examiner variations in clinical diagnostic protocol have been suggested to be potential sources of measurement error in themselves.[4]

In recent years, a lot of studies have been conducted to examine the validity or usefulness of self-reported periodontal diseases.[21-23] While the sensitivity and specificity of self-reported items for diagnosis of periodontal disease history were found to be generally low,[22] the general consensus is that their combination with established risk factors or other predictors of periodontal disease increases sensitivity and specificity and that they then become useful and valid tools in epidemiological studies of periodontal health.[23-24,26]

Self-reporting may lead to under-reporting, because some subjects are likely to remember only severe and chronic or very recent gum problems, while others may be unaware of their condition.[27-28] In spite of this disadvantage, self-reported periodontal diseases have been suggested to be a useful measure in the determination of periodontal disease history, especially in large national epidemiological surveys, where the alternative clinical diagnostic protocol (using probes) is not practicable. In particular, it has been suggested that self-reporting provides a simple, valid, time- and cost-efficient alternative to clinical assessment in capturing perceptions of health.[29-30]

In addition to the above literature supporting the usefulness of self-reporting, this study was based on the 2003 SADHS,[8] which was conducted in line with the current WHO STEPwise approach to chronic disease risk factor surveillance.[31] The current WHO initiative, STEPS, recommends measurement protocols at three levels of monitoring, depending on the resources available across developing and more developed countries worldwide. It starts by gathering key information on risk factors by means of a questionnaire (a self-report measure). The next step is simple physical/physiological measurements of health risks such as blood pressure, body mass, and then the final step is moving on to a more complex collection of blood samples for biochemical analysis, including fasting blood sugar and blood lipids tests.[31] The STEPwise approach therefore provides an entry point for low and middle income countries. For example, South Africa is a middle-income country which has limited infrastructure and resources to conduct large scale clinical examinations such as the ones possible in the developed economies of North America and some European countries regularly. Hence, the 2003 SADHS used the self-report measure option as the entry point.

2.3 Association between unhealthy lifestyle and poor periodontal health

2.3.1 Tobacco use

Tobacco use (pipe/cigarette smoking and smokeless tobacco) has been found to be a risk factor for many chronic diseases, such as cancer, periodontal and cardiovascular diseases.[32] Less emphasis has been placed on smokeless tobacco (SLT), probably because some consider SLT (oral snuff and chewing tobacco) to be a safer and less harmful alternative to smoking.[33] However, both forms of tobacco contain the alkaloid nicotine, an important agent in the tobacco-periodontal disease association, amongst others. Nicotine and other tobacco products produce local and systemic effects, making the periodontium more susceptible to infections.[34-36]

Locally, the cytotoxic and vasoactive substances (such as nicotine) from tobacco smoke can inhibit tissue perfusion and cell proliferation and metabolism.[34] The reduced blood flow within the gingiva may lead to reduced gingival bleeding, which tends to mask the actual destructive effects of nicotine within the periodontium that continue insidiously.[34]

Systemically nicotine causes depression of the phagocytic function of polymorphonuclocytes (PMN) and impairment of soft tissue and bone cell function, delaying healing of the periodontium following trauma and bacterial insult.[37]

The three components of cigarette smoke that seem to interfere with the healing of the periodontium are nicotine, carbon monoxide and hydrogen cyanide. Nicotine is absorbed in the lungs, where it enters the blood circulation and is capable of producing specific effects such as the diminished proliferation of erythrocytes, fibroblasts and microphages.[35,37] In addition, nicotine induces platelet aggregation with increased blood viscosity. This phenomenon favours the formation of microclots, leading to capillary embolism and ischemia of the affected tissues. Vasoconstriction, a by-product of nicotine, is due to the release of catecholamines, which also induce the formation of chalones. These interfere with normal wound healing and epithelialization.[34,37]

Carbon monoxide has a greater capability for binding to haemoglobin than oxygen, thus reducing the amount of oxygen binding to haemoglobin and diminishing the distribution of oxygen to tissues, with consequent cellular hypoxia (this causes the over-production of cytokines, particularly the interleukins) and interference with normal healing of the periodontium. Hydrogen cyanide also participates in the alteration of oxygen metabolism and distribution, further delaying wound healing and epithelialization.[37]

Nicotine in tobacco impairs the serum antibody response to some periodontal pathogens. It also alters the polymorphonuclear leukocyte function of chemotaxis and phagocytosis. Furthermore, tobacco products, nicotine and its primary metabolite cotinine inhibit the attachment and growth of human periodontal ligament (PDL) fibroblasts. All these may partly explain the role that tobacco use plays in the initiation and progression of periodontal diseases.[35]

Nicotine also extends a favourable habitat for bacteria such as Porphyromonas gingivalis, Prevotella intermedia, Actinobacillus actinomycetemcomitans to shallow sites (≤5 mm). Molecular by-products of smoking interfere with mechanisms that normally contain the growth of damaging bacteria at the surface of the oral mucosa in gingival crevices. In this way, smoking and smokeless tobacco use can promote the early development of periodontal lesions.[36]

Black South Africans constitute a very large percentage of those who use SLTs.[38] Oral snuff or chewing tobacco use is most commonly associated with traditional rituals,[37] and is used for its perceived medicinal benefits such as a cure for toothache and also for relaxation and pleasure.[38] The nicotine content of smokeless tobacco products has been reported to be much higher than that of cigarettes, and it is the most predominant form of tobacco use among black South African women.[33,39] Smokeless tobacco users in South Africa are mostly heavy users. They use an estimated nicotine yield as high as 400mg per week.[33]

A single dose of nicotine from snuff use is twice that of smoking a cigarette and the typical single dose of nicotine from chewing tobacco is fifteen times that of a cigarette in the United States of America.[40] The nicotine content of South African smokeless tobacco products ranges from low to very high.[33] It is therefore suggested that, while smokers of cigarettes are likely to suffer from, as well as to report, periodontal diseases, smokeless tobacco users are also more likely to suffer from and report periodontal diseases. Many studies have repeatedly demonstrated tobacco to be an independent risk factor for periodontal disease[41-42] and it accounts for about half the cases of periodontal disease in the USA, for example.[42-43]

2.3.2 Alcohol intake

In Denmark,[44] an inverse relationship was found between high total alcohol intake and periodontal disease. In addition, the association between type-specific alcohol and periodontal diseases showed a lower prevalence of periodontal diseases among men who consume more drinks of wine or spirit. For women, no pattern between alcohol consumption and periodontal disease was observed.

The link between alcohol and health is influenced by several factors, such as drinking patterns, the amount and type of alcohol consumed, and age and gender.[44-46] Research has found differences in the effects of binge-like drinking on the periodontium in adolescents, compared with that of adults.[47] Normally, as people age from adolescence to adulthood, they become more sensitive to the effects of alcohol.[47] However, it has been suggested that more research is needed to determine whether severe alcohol-induced tissue damage is strictly a cumulative process that begins in adolescence and culminates in adulthood as a result of long-term chronic heavy drinking, or whether serious alcohol-related health problems can already emerge during the teenage years.[47]

It has been suggested that wine enhances the human immune response by protecting people against infection.[42] Besides this protective influence of certain alcoholic drinks on the host reactions, another protective effect has been attributed to a possible antimicrobial effect, similar to that obtained by using some mouth rinses containing alcohol.[44]

These effects notwithstanding, a number of other studies have reported a positive association between excessive alcohol ingestion and periodontal diseases, because such ingestion promotes the progression of disease after the initiation of inflammatory changes by bacterial plaque.[48-49] Whereas periodontal diseases are initiated by bacterial accumulations, the pathogenesis of tissue breakdown involves the inflammatory host response.[50]

Several biological effects of alcohol consumption on host defence mechanisms, including decreased inflammatory response and altered cytokine production, may explain an association between alcohol and periodontal diseases.[51] Alcohol damages neutrophils, macrophages, and alters the functioning of T cells, increasing the likelihood of infections.[51]

Alcohol is also associated with some blood clotting deficiencies.[48] Prothrombin production, vitamin K activity, and clotting mechanisms may be disrupted and haemorrhage may take place, leading to bleeding gums.

Additionally, excessive alcohol use has been associated with nutritional deficiencies,[49] which may lead to altered periodontal integrity. Hence, excessive alcohol consumption, especially in association with malnutrition and liver diseases (which are immunosuppressive and common in problem drinkers) tend to increase the incidence of periodontal diseases.[49]

2.3.3 Nutrient intake

Compromised host defence responses associated with malnutrition may make the periodontium more susceptible to infectious organisms that are a normal component of the oral flora.[52] The acute phase protein response to tissue injury is impaired to varying degrees in malnourished individuals.[51] During periods of malnutrition, the magnitude of the inflammatory response is limited, resulting in an impaired host response.[52-53] This could result in a greater amount of tissue destruction, leading to a compromised periodontium. Along with dental and/or pharmacological treatment of the underlying local aetiological factors, nutritional management goals focus on provision of adequate calories, protein and micronutrients to promote tissue repair, restoration of the host defence mechanisms, and overall well-being.[53]

However, there is some controversy regarding the precise relationship between nutritional status and periodontal disease.[52-53] It is important to note that although some nutritional deficiencies (notably vitamin C and folate) can alter the disease process, periodontal diseases are not caused by these deficiencies, nor can they be cured by nutrient supplementation alone.[55-56] Historically, vitamin A deficiency[58] was cited as a cause of gingivitis. However, to the best of our knowledge, at the time of this study, there research studies have been published within the last decade showing that a deficiency of this vitamin is the cause of gingivitis.

There is an established relationship between low dietary vitamin C intake and a greater risk of periodontal disease.[59] Vitamin B_{12} and bioactive folate are also involved in a common metabolic pathway supplying essential methyl groups necessary for deoxyribonucleic acid (DNA) and protein synthesis.[60] However, the evidence of the role played by folic acid – a nutrient with implications for multiple health risks – as a risk indicator for periodontal diseases remains inconclusive.[61]

It has been suggested that not all folic acid is transformed into its bioactive form, folate. This situation is particularly likely among problem drinkers.[60] Alcohol interferes with folate metabolism in the liver because it impairs the mitochondrial function and the ultrastructural changes in sites of oxidative enzyme activity. It can inactivate folate in the blood and tissues, profoundly depleting the body stores and also blocks the absorption of folate.

Folate, an essential carrier of 1-carbon moieties such as methyl and formyl groups within human cells, is crucial for the *de novo* synthesis of several important building blocks of human macromolecules, including purines, monophosphate and methione.[63] This potential mechanism of action may explain, in part, the adverse effects on periodontal health of folic acid deficiency and/or the non-availability of folate.

2.3.4 Role of body mass index

It has been reported that the prevalence of periodontal diseases is 76% higher amongst young obese people (with a body mass index over 30 kg/m^2) aged between 18 and 34 years than in normal-weight individuals.[64] Obesity, which is common in Type 2 diabetes, may predispose some individuals to periodontal diseases. Insulin resistance mediates the relationship between obesity and periodontal diseases.[65] People who have a higher body mass index (BMI) tend to produce more pro-inflammatory cytokines, which leads to systemic inflammation and insulin resistance.

2.4 Age, gender and other systemic factors associated with poor periodontal health

Periodontal disease is age-related. Cumulative evidence consistently shows that aging is associated with reduced cell-mediated immune reactivity and therefore plays an important role in the pathogenesis of periodontal disease.[66]

It has been noted that males tend to carry a disproportionate burden of poor periodontal health.[67] Nonetheless, it has been suggested that the modifying role of gender in relation to poor periodontal health status need not necessarily be attributed to gender as such, but may be related to differences in dental health awareness and practices between the sexes.[68]

Patients suffering from periodontal diseases in many cases also suffer from some immuno-suppressive systemic diseases such as diabetes, infective diseases such as HIV[17] and/or malnutrition.[52] An adequate supply of micronutrients, among other things, is necessary to allow the immune system to produce immunoglobulin, and the activating factors for all types of mononuclear and polymorphonuclear macrophages. Infective diseases are associated with a depressed immunity, opening the door to opportunistic infections.

Many of the mechanisms by which diabetes influences the periodontium are similar to the pathophysiology of the classic microvascular and macrovascular diabetic complications of impaired wound healing. There are few differences in the subgingival microbiota between diabetic and non-diabetic patients with periodontal dieases.[69] The latter observation suggests that alterations in the host immune-inflammatory response to potential pathogens may play a predominant role. Diabetes may result in the impairment of neutrophil adherence, chemotaxis, and phagocytosis, which may facilitate the persistence of bacteria in the periodontal pockets, and significantly increase periodontal destruction.[70] While neutrophils are often hypofunctional in diabetes, the patients may possess or develop hyper-responsive monocyte/macrophage phenotype in respect of the plaque antigens, resulting in a significant increase in the production of the pro-inflammatory cytokines and mediators.[71] This hyperinflammatory response results in elevated levels of pro-inflammatory cytokines in the gingival crevice fluid (GCF). High levels of triglycerides (which are common in Type 2 diabetes) also appear to impair periodontal health.[71]

GCF is a serum transudate. Therefore, elevated serum levels of glucose when diabetes is poorly controlled will result in high glucose levels in GCF, supporting bacterial growth and setting the stage for periodontal diseases. Diabetes can also cause blood vessels to thicken and become less elastic, which decreases the flow of oxygen and nutrients to the periodontium and slows the removal of harmful waste.[69]

The findings of a study conducted by Katz *et al.*[72] positively associated periodontal diseases with total cholesterol and LDL-cholesterol. Cholesterol is carried through the bloodstream in packages called lipoproteins. High-density lipoproteins or HDLs are the 'good' types of lipoprotein which carry cholesterol away from body cells and tissues to the liver for excretion from the body. Low-density lipoproteins or LDLs are the 'bad' types of lipoprotein responsible for depositing cholesterol on artery walls.

The amount of cholesterol circulating in the blood is affected by more than the amount of cholesterol consumed. It is also influenced by the amount and kinds of fats consumed. Specifically, diets rich in saturated fats tend to raise the level of blood cholesterol, while monounsaturated fats and polyunsaturated fats help to lower it.[72]

The more cholesterol there is in a person's blood, the greater the likelihood that some will build up or accumulate on the inner linings of artery walls as 'plaques' or 'crud' (cholesterol, fatty deposits, and other substances). These plaques grow in size over time, causing the blood vessel width to become narrower and narrower, until eventually the build-up completely cuts off any blood flow through the artery, gradually leading to arteriosclerosis and ischaemia.

If the blood vessel supplies the periodontium, periodontal diseases develop and progress easily, because of the lack of essential supply of oxygen and the nutrients needed to fight off infections.[72] If the artery leads to the brain, a stroke may result, with the attendant consequence of physical inability of the patient to perform adequate dental plaque control, especially among those with poor functional status, as observed with advanced age, and this phenomenon is greater in women.[73]

In an Australian study of 130 people, half of whom had rheumatoid arthritis, and half of whom did not, the 65 people who had rheumatoid arthritis (a chronic multisystem disease of presumed autoimmune aetiology[74]) were found to be more than twice as likely to have periodontal diseases than the group without arthritis. This study found no difference in plaque deposits and bleeding indices between the group with rheumatoid arthritis and the control group, indicating that the progression of periodontal disease in the arthritis group was due to factors other than a difference in oral hygiene.[74]

At present, researchers do not claim that the relationship between the two diseases is causal. Some think a bacterial infection may trigger the development of periodontal diseases in persons with rheumatoid arthritis.

However, since periodontal disease and rheumatoid arthritis have very similar pathologies, other researchers have argued that this association may be a reflection of a common underlying disturbance in the regulation of the inflammatory response in these individuals.[74] It was found in an experimental animal study that both rheumatoid arthritis and periodontal disease share a hyper-inflammatory genotype and functional interferences in innate and adaptive immune responses. [75]

2.5 Preventive yearly dental visit and bacterial plaque control

Preventive dental care visits provide opportunities for regular scaling and other clinical interventions that remove local causes (such as caries and defective fillings) of periodontal diseases. They also allow patients to be given relevant oral health education in bacterial plaque control through home care. All these factors may play a joint role in differences in periodontal health, because the amount of oral bacteria present has been shown to be greater in people who visited the dentist least, and whose educational levels were low.[76]

Adequate removal of dental plaque through regular tooth brushing is essential to maintain gum health. Dental practitioners generally recommend thorough brushing twice daily with fluoride toothpaste, because such a practice is of more value than cursory daily brushing, but adequate oral hygiene depends more upon the quality of tooth brushing than its frequency.[77]

2.6 Role of socioeconomic status

Education and material wealth are potential socioeconomic risk factors.[78] There are controversies regarding the relationship between socioeconomic status (SES) and periodontal health status. Education and income do not fully explain oral health disparities.[13] Unfortunately, most studies have failed to assess the effects of several possible types of positive and negative psychosocial factors (such as individual-level and area-level psychosocial stressors/resources) which have implications for social gradients in self-rated oral health.[10,13] Out of a group of 47 studies reviewed by Klinge and Norlund,[78] 34 demonstrated a consistent association between socioeconomic factors and periodontal health status, while 13 did not.

It has been proposed that the distinct pattern of health behaviour and attitudes within certain social groups is mainly related to educational level.[79] Life-style factors such as diet, alcohol and tobacco use are also usually influenced in significant ways by a person's socioeconomic status,[42] and hence, they are potential confounders of the association of socioeconomic status and periodontal diseases. Health habits, including oral hygiene habits, are associated with socioeconomic conditions. For example, it has been documented that smokeless tobacco use is more common among older, less educated and socio-economically disadvantaged rural women.[39,80] The less educated also tend to smoke more,[42] consume more alcohol, have lower mean incomes,[42] and consequently may visit the dentist less regularly,[43] all of which might be implicated in the development of periodontal diseases.

2.7 Racial or ethnic differences

Racial or ethnic differences have long been associated with the occurrence of periodontal diseases. There are strong associations between racial/ethnic group and life-style habits which influence periodontal health status. It is possible that the racial differences may be mediated by differences in behavioural risk factors such as tobacco and alcohol use.

For instance, poor periodontal health is reportedly prevalent among South African Asians/Indians, who also are the group which predominantly practises the custom of betel nut chewing (with or without tobacco) and have the highest prevalence of diabetes.[2,7] The relatively high prevalence of periodontal disease in this population group may therefore also be due to the possible effect of betel nut (Areca catechu) in increasing blood sugar levels and the risk of Type 2 diabetes, which in turns increases the risk of poor periodontal health.[81]

This observation notwithstanding, periodontal diseases have generally been found to be most frequent among black South Africans (who smoke the least) as compared to white South Africans.[2,7-8] This observation was consistently demonstrated during the 1988/89 national oral health and 1998 and 2003 SADHSs.[2,7-8]

Genetic factors have been suggested by some researchers[82] as another possible explanation of racial/ethnic differences in periodontal diseases. Differences in genetic makeup have also been suggested to partly explain the variation in individual susceptibility to periodontal diseases.[82] Genetic factors determine the amplitude of a person's immune response and the inflammatory process to bacterial insult, playing an important role in the conversion of gingivitis to periodontal disease. People who are interleukin (IL-1) genotype positive has been reported to be three times more likely to suffer periodontal diseases than people who are IL-1 genotype negative.[83]

In order to understand and address racial disparities in periodontal health better, it has been suggested that efforts should also include examining psychosocial determinants across racial divides which are likely additional contributors to racial differences in periodontal disease prevalence.[13]

In general, it is clear from the literature that only limited information is available on social determinants and systemic health factors associated with periodontal health in South Africa. In particular, despite the fact that the current national oral health promotion framework proposes the integration of oral health with general health promotion programmes,[84] thus far, no national study has systematically investigated the independent role played by potential systemic risk factors in the periodontal health status of South Africans. For example, it may be that race is a confounder for the known socio-economic class influence on poor periodontal health, given the strong association between socioeconomic status and race and an unhealthy lifestyle in South Africa.[85] It therefore remains important to explore the independent association between lifestyle and systemic factors and self-reported periodontal health status among South Africans.

CHAPTER 3

AIM AND OBJECTIVES

3.1 Aim of study

The aim of this study is to identify the determinants of self-reported poor periodontal health status among dentate South Africans aged 15 years and above. This will provide a scientific evidence-base to inform the planning of priority public health programmes for the prevention and control of periodontal diseases and subsequent improvement in the health-related quality of life of South Africans.

3.2 Specific objectives

The specific objectives of this study are the following:

(i) To assess the prevalence of self-reported poor periodontal health status among South Africans; and

(ii) To examine the independent association between systemic health and lifestyle factors (tobacco use, alcohol intake and nutritional status) and self-reported poor periodontal health status among South Africans.

3.3 Research question

The following research question is addressed in this study:

> **What systemic health and lifestyle factors are independently associated with self-reported poor periodontal health status in South Africa?**

3.4 Hypothesis

The null hypothesis in this study is the following:

> There is no association between systemic health and life-style factors and self-reported poor periodontal health status in South Africa.

CHAPTER 4

METHOD AND STUDY DESIGN

4.1 Study design

This is a cross-sectional secondary data analysis.

4.2 Data source

The data used in this study were obtained from a 2003 South African household survey conducted between mid-October 2003 and August 2004. This cross-sectional household survey involved a nationally representative sample of individuals aged 15 years and over who participated in the second South African Demographic and Health Survey (SADHS) 2003. The variables examined in this study formed part of the items in the questionnaire used during this survey (see Appendix D for an excerpt of the relevant questions from the questionnaire).

4.3 Study population and sampling

4.3.1 Study population

The study population was all the dentate respondents who were 15 years or older who participated in the 2003/2004 SADHS.

4.3.2 Sampling method

The sampling method used for the SADHS (2003) has been previously published (SADHS, 2003)[8]. Briefly, a stratified, two-staged probability sample design was employed by the 2003 SADHS, using the 2001 census data as a sample frame. The first stage in each of the nine provinces was to randomly select census enumeration areas as primary sampling units, with a probability of being selected that was proportional to size, based on the number of households in the enumeration areas. The second stage involved a systematic sampling of households from the selected enumeration areas. The data were made up of ten strata, one from each of the nine provinces. An additional stratum was selected in order to cover sample areas with a predominantly Indian/Asian population, because of the small representation of this group (3% of the total South African population). The tenth stratum therefore consisted of all census enumerated areas with a minimum of 80% of the population identified as Indian/Asian.

One thousand households were allocated to each stratum. Adults, both males and females, aged 15 and over in every second household were eligible to participate as respondents in the survey (SADHS 2003). A total of 9,614 adults were eligible, out of which only 8,115 were interviewed. This yielded a response rate of 84.4%. Out of the 8,115 interviewed, for the purposes of this study, the sample size was limited only to the 6,319 dentate adults. This therefore largely allowed the exclusion of reports of 'gum problems' that may not be related to the periodontal tissues (tissues supporting the teeth).

4.4 Measures and definitions

The measurement tool employed in this survey was an interview schedule using the SADHS Adult Health Questionnaire. Interviewers engaged in this exercise were co-trained by personnel from the Medical Research Council, the Human Sciences Research Council (HSRC), the Department of Health (DoH), ORC MACRO International (Maryland, USA) and consultants hired by the Africa Strategic Research Corporation.

All the respondents completed a questionnaire that included the respondent's age, sex, area of residence and race/population group.

4.4.1 Self-rated general health assessment

In order to determine the respondents' general health, the respondents were asked 'Would you say your health is poor, average, good, or very good/excellent?' The responses were then dichotomized as good/excellent (good and very good/excellent) or not good (poor and average).

4.4.2 Systemic disease assessment

To determine whether respondents suffer from a systemic disease, respondents were asked 'Has a doctor or nurse or health worker at a clinic or hospital told you that you have or have had any of the following conditions – "Diabetes or blood sugar"; "Arthritis"; "High blood cholesterol or fats in the blood"; "Stroke"?' The response options were 'Yes' (coded as 1), 'No' (coded as 2), and 'Don't know' (coded as 8). All those who responded 'Yes' for a particular condition were categorized as having the respective chronic condition(s). However, at the level of data analysis, 'Yes' was coded as 1, 'No' and 'Don't know' were coded together as 0.

4.4.3 Self-reported periodontal health assessment

As in the WHO STEPwise questionnaire,[31] the participants were asked 'Have you had pain or problems with your mouth and/or teeth in the last 6 months?' Response options were 'Yes' and 'No'. Participants were also asked to indicate which part of their mouth was affected. Those who answered in the affirmative in respect of their 'gums' were classified as self-reporting poor periodontal or 'gum' health.

4.4.4 Preventive yearly dental visit and regular tooth brushing

The respondents were asked 'What do you usually do to look after your teeth/mouth?' The options were 'Clean/brush/floss?' and 'Visit dentist/dental therapist/oral hygienist/oral therapist at least once a year?' Anyone who indicated visiting a dental practitioner was categorized as making a yearly dental visit. Similarly, anyone who indicated that he or she usually cleans/brushes/flosses was categorized as brushing regularly.

4.4.5 Body mass index measure

The weights and heights of respondents were measured in triplicate to determine the body mass index (BMI), which was calculated as weight in kilograms divided by height in metres squared (kg/m^2). A BMI of <18.5 was classified as thinness or underweight; a BMI of ≥25 to 30 was classified as overweight, while a BMI of >30 was classified as obese.

4.4.6 Tobacco use assessment

The history of each respondent's tobacco use was recorded. The respondents were classified based on their responses to the questions 'Do you currently smoke any tobacco products such as cigarettes, cigars or pipes? Do you currently use any smokeless tobacco such as snuff or chewing tobacco?' The response options were 'Yes' and 'No'. When the response was 'Yes' for either product, a respondent was accordingly categorized as a 'current smoker' and/or a 'current smokeless tobacco user'.

4.4.7 Alcohol intake assessment

Those who responded with 'No' to the question 'Have you ever consumed a drink that contains alcohol such as beer, wine, spirits, or sorghum beer within the past 12 months?' were classified as 'Does not drink alcohol'.

Responses to the CAGE questionnaire[86] were used to determine the intensity of alcohol use, in other words, 'problem drinking'. In this study, the CAGE scale was assessed using the Cronbach alpha coefficient (Cronbach α), a proxy measure of a scale's reliability. Four items from the CAGE scale were used to assess problem drinking. The response options of CAGE scale items were coded as follows: 'Yes' was coded as 1, and 'No' was coded as 0. The CAGE scale item questions asked were the following:

- 'Have you ever felt that you should cut down on your drinking?'
- 'Have people annoyed you by criticizing your drinking?'
- 'Have you ever felt bad or guilty about your drinking?'

- 'Have you ever had a drink first thing in the morning to steady your nerves or get rid of a hang over?'

Anyone who drinks and scored a 2 or higher on the CAGE scale was classified as a problem drinker, otherwise, the respondent was categorized as 'drinking, but not problem drinking'.

4.4.8 Nutrient intake assessment

Nutrient intake was assessed using a previously validated brief 30-item food frequency questionnaire.[87] The food items used in the Nutritional Index measure developed for use in South Africa were included in the adult health questionnaire of the 2003 SADHS; and they were used to compute the respondents' nutrient intake scores. The items were derived from dietary studies of over thirty years to identify the foods commonly eaten by different ethnic groups in South Africa.[87]

For each nutrient, except iron and vitamin A, an intake of less than 33% of the required daily allowance (RDA) provides a score of 3; an intake of 33.3% to 66.6% of the RDA provides a score of 2; an intake of 66.6 to 99.9% of the RDA provides a score of 1; and a value of 100% of the RDA provides a score of 0.[8] Vitamin A and iron provide double the score in each category, because of their status as important nutrients in the South African environment. The maximum micronutrient score obtainable was 45 points – the higher the score, the worse the person's nutritional status.[8] In this study, the study population was categorized into three micronutrient groups derived from ranking the total micronutrient points obtained. A poorer score would be closer to 45: nutrient points between 28 and 45 fell into the 'poor' category; nutrient points between 14 and 27 were classed as 'intermediate'; and nutrient points between 0 and 13 were regarded as 'good'.

4.4.9 Socioeconomic status assessment

Socioeconomic status was assessed by means of the Household Questionnaire, using the material wealth index, as with previous studies in South Africa. This index was assessed by the question 'Does your household have any of the following items in working condition – A radio? A television? A computer? A refrigerator? A landline telephone? A cell phone?' The respondents were also asked if any member of the household had a bicycle, a motorcycle or motor scooter, a car or truck, a donkey or a horse or a sheep/goat or cattle. Using principal components analysis, best fitted items were a car, radio, TV, computer, refrigerator, landline and cell phone. The reliability coefficient for this 7-item scale was high (Cronbach α = 0.78). The index scores derived from the total (derived from the response options 'No', which was coded as 0, or Yes, which was coded as 1) were then ranked to classify the study participants into three categories – thus as belonging to the 'Lowest', 'Middle' and 'Highest' socioeconomic status.

The first question asked to determine the educational levels of the study participants was: 'Have you ever attended school?' Participants that responded in the affirmative also answered the question: 'What is the highest level of school you have completed?' Based on the responses in years, respondents were categorized into three groups, namely 'No school/primary school (0 – 7 years schooling)', 'Some high school (8 – 12 years schooling)' and 'Tertiary (> 12 years schooling)'.

4.5 Data analysis

This secondary data analysis involved an analysis of the data on the dentate adults ≥ 15 years who participated in the 2003 SADHS (n = 6,319). The information obtained included socio-demographic characteristics, data on lifestyle factors related to health risk behaviours (tobacco use, alcohol use and dietary intake) and chronic systemic diseases known to influence periodontal health.[13] Analysis was performed using STATA version 10 software (STATA Corporation, College Station TX), adjusting for the cluster sample design by using the 'svy' command option.

Data analysis included t-test, Chi-square and multiple logistic regression analysis. The level of significance was set at $p<0.05$ (two-tailed). The correlation coefficient between tooth problems and gum problems was determined to be low ($r=0.06$); thus, no co-linearity between these two variables could be demonstrated. They therefore truly represent two separate conditions.

Since age and gender are potential effect modifiers with regard to the potential influence of systemic and lifestyle risk factors on periodontal health,[44-46] all analyses were stratified to compare determinants among younger adults with those among older adults; and also among males compared to females. In the analyses involving age stratification, the age of 45 years was chosen as the reference age between younger adults and older adults in order to accommodate more individuals suffering from rapid progression periodontal diseases (an early-onset periodontitis) who still have some teeth left. This decision was informed by the finding of a study conducted by Loe *et al*. in Sri Lanka, between 1970 and 1985, in which people suffering from rapid progression periodontal diseases were found to have lost all their teeth by the age of 45 years.[81]

For the purposes of the logistic regression, all independent variables that showed significant association with self-reported poor periodontal health status at a 10% level of significance (p=0.10) in the bivariate analysis were entered in a single block. Starting with the full models, variables were then removed if p>0.05 (the backward deletion method). This process was repeated until a final model was derived which included only variables that contributed significantly. This allowed the independent relationship between each of the determinants and the odds of self-reporting poor periodontal health to be established.

Bivariate logistic regression was applied, because the main outcome measure (self-reported poor periodontal health) was dichotomous (that is, coded as 1 or 0). In addition, the model diagnostic measure, namely the relationship between sensitivity (the ability to identify the diseased individuals correctly) and the false-positive fractions for each model, was applied using the receiver operating characteristic (ROC) curve of the test.

4.6 Ethical considerations

Ethical clearance for the original 2003 SADHS was obtained from the ethics committee of the Medical Research Council. Permission for using the data set in the current study was obtained from the Department of Health by the supervisor and written permission to access the dataset was obtained from the supervisor. The current study protocol was further subjected to review and was approved by the School of Dentistry Research Committee of the University of Pretoria.

CHAPTER 5

RESULTS

5.1 Demographic factors (race/ethinicity, rural/urban, gender, age)

The general characteristics of the study population are shown in Figure 1. Of the 6,319 respondents, 4.6% (95% CI = 3.9 - 5.5) reported poor periodontal health.

Black South Africans, as opposed to white South Africans (5.0% vs. 1.6%; p = 0.04), and those that were least educated compared to those with tertiary education (5.7% vs. 2.4%; p = 0.03) were most likely to report periodontal or gum problems (Figure 1). However, there was no significant difference between the rural and urban populations in reporting poor periodontal health (Figure 1).

Similarly, men were not significantly different from women in reporting poor periodontal health in South Africa (Figure 1).

Furthermore in the bivariate analysis, compared to those who did not report poor periodontal health, those who reported poor periodontal health status were older at a significant level (36.2 years vs. 38.8 years; p = 0.02).

5.2 Extrinsic factors

5.2.1 Dental visits

Reporting making yearly preventive dental visits was associated with a lower prevalence of self-reported poor periodontal health.

5.2.2 Tobacco use

There was a significant positive association between self-reported poor periodontal health and current smokeless tobacco use, but there was not a significant positive association with current smoking (Table 1).

5.2.3 Alcohol use

In addition, those who were classified as problem drinkers on the CAGE scale reported a higher prevalence of poor periodontal health, compared to those who do not drink. The reliability of the CAGE scale in the current study population was considered satisfactory, as reflected by the good internal consistency of responses to the four scale items (Cronbach $\alpha = 0.69$).

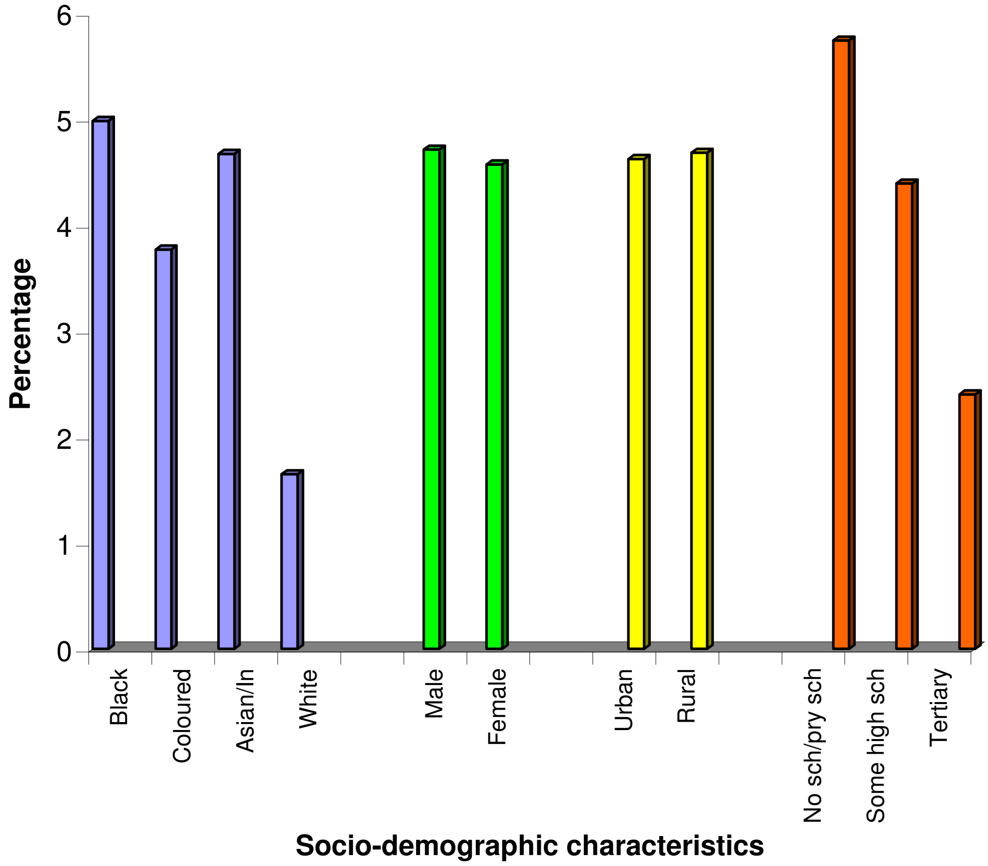

Figure 1: Frequency distribution of self-reported poor periodontal health status by socio-demographic characteristics

Table 1: Bivariate analysis of factors associated with self-reported poor periodontal health status among dentate South Africans

Variables		Poor periodontal health status	
Health behaviour		**%**	**p-value***
Regular tooth brushing	No	4.3 (n=23)	
	Yes	4.7 (n=247)	0.74
Preventive yearly dental visit	No	4.8 (n=262)	
	Yes	2.1 (n=1)	0.03
Smokeless tobacco current	No	4.4 (n=242)	
	Yes	7.7 (n=26)	0.02
Smoke current	No	4.4 (n=209)	
	Yes	5.6 (n=61)	0.27
Problem drinking (CAGE)	Does not drink alcohol	3.6 (n=153)	
	Not problem drinker	5.4 (n=55)	
	Problem drinker	8.6 (n=62)	<0.001
Nutrient intake	Poor	3.9 (n=120)	
	Intermediate	4.7 (n=92)	
	Good	5.5 (n=58)	0.19
Body mass index	Underweight	3.1 (n=25)	
	Normal weight	5.1 (n=119)	
	Overweight	3.8 (n=64)	
	Obese	5.2 (n=52)	0.28
Chronic conditions			
Self-rated general health	Not good	5.0 (n=174)	
	Good /excellent	4.2 (n=93)	0.25
High blood cholesterol	No	4.5 (n=256)	
	Yes	8.8 (n=13)	0.08
Stroke	No	4.5 (n=262)	
	Yes	16.4 (n=8)	0.001
Diabetes	No	4.6 (n=251)	
	Yes	7.0 (n=19)	0.19
Arthritis	No	4.4 (n=238)	
	Yes	7.3 (n=31)	0.05
Material wealth index	Lowest rank	4.3 (n=69)	
	Middle	5.2 (n=113)	
	Highest rank	4.3 (n=85)	0.48

**Chi-square statistics*

5.3 Chronic health conditions

Of the chronic health conditions, reporting suffering from arthritis and reporting having suffered a stroke were significantly associated with reporting poor periodontal health. Those who reported a past diagnosis of high blood cholesterol also tended to be more likely to report poor periodontal health (Table 1).

5.4 Bivariate associations

5.4.1 Age

The potential modifying effect of age with regard to the other covariates was examined in a stratified analysis (Table 2).

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Table 2: Bivariate association between self-reported poor periodontal health status and potential risk factors stratified by age

Variables		≤45 years	p-value	>45 years	p-value
		Age			
Health behaviour					
Regular tooth brushing	No	2.9 (n=10)		6.5 (n=12)	
	Yes	4.2 (n=163)	0.30	5.6 (n=76)	0.66
Preventive yearly dental visit	No	4.3 (n=169)		5.8 (n=84)	
	Yes	1.4 (n=4)	0.03	3.8 (n=4)	0.45
Smokeless tobacco current	No	4.1(n=164)		4.9 (n=69)	
	Yes	4.2 (n=8)	0.93	11.4 (n=18)	0.006
Smoke current	No	4.0 (n=133)		5.4 (n=71)	
	Yes	4.6 (n=40)	0.57	6.7 (n=17)	0.63
Problem drinking (CAGE)	Does not drink alcohol	2.9 (n=93)		5.7 (n=58)	
	Not problem drinker	5.7 (n=38)		4.6 (n=14)	
	Problem drinker	8.3 (n=42)	<0.001	7.3 (n=16)	0.60
Nutrient intake	Poor	3.7 (n=83)		4.5 (n=33)	
	Intermediate	4.2 (n=51)		6.1 (n=38)	
	Good	4.8 (n=39)	0.58	6.7 (n=17)	0.47
Body mass index	Underweight	2.8 (n=22)		1.7 (n=2)	
	Normal weight	4.8 (n=87)		5.7 (n=9)	
	Overweight	3.1 (n=38)		5.2 (n=23)	
	Obese	4.0 (n=21)	0.21	7.0 (n=29)	0.45
Chronic conditions					
Self-rated general health	Not good health	4.2 (n=101)		6.6 (n=67)	
	Good/excellent health	4.1 (n=69)	0.95	3.5 (n=21)	0.06
High blood cholesterol	No	4.0 (n=165)		5.6 (n=82)	
	Yes	10.9(n=7)	0.03	7.7 (n=6)	0.61
Had stroke	No	4.1 (n=171)		5.3 (n=82)	
	Yes	7.2 (n=2)	0.47	20.4 (n=6)	0.004
Diabetes	No	4.2 (n=168)		5.6 (n=77)	
	Yes	4.7 (n=6)	0.81	7.1 (n=11)	0.58
Arthritis	No	4.0 (n=163)		5.4 (n=66)	
	Yes	9.6 (n=10)	0.03	6.8 (n=21)	0.52
Material wealth index	Lowest rank	3.5 (n=43)		6.0 (n=24)	
	Middle	4.5 (n=71)		7.0 (n=38)	
	Highest rank	4.2 (n=56)	0.62	4.6 (n=26)	0.43
Race/ethnicity	White	1.9 (n=3)		1.3 (n=2)	
	Black	4.3 (n=135)		6.5 (n=71)	
	Coloured	4.3 (n=17)		2.0 (n=2)	
	Asian/Indian	3.7 (n=18)	0.41	6.3 (n=13)	0.04
Education	No school/primary school	4.2 (n=37)		6.8 (n=61)	
	Some high school	4.4 (n=124)		4.9 (n=26)	
	Tertiary	2.7 (n=12)	0.43	1.3 (n=1)	0.08
Gender	Male	4.7 (n=82)		4.8 (n=29)	
	Female	3.9 (n=100)	0.38	6.2 (n=59)	0.35

A lack of preventive dental visits, higher alcohol use, high blood cholesterol and arthritis were found to be significantly associated with self-reported poor periodontal health among younger adults aged ≤45 years in a bivariate analysis (Table 2).

On the other hand, currently using smokeless tobacco, reporting having suffered a stroke and being non-white were found to be significantly associated with reporting poor periodontal health among older adults aged >45 years.

Self-rated general health and education tended towards statistical significance among the older adults, as poor periodontal health was higher among those who self-rated their general health as poor and had no schooling or had only completed primary school (Table 2).

5.4.2 Gender

The potential modifying role of gender on the other variables was also examined in a stratified bivariate analysis (Table 3).

Table 3: Bivariate association between self-reported poor periodontal health status and potential risk factors stratified by gender

		Gender			
Variables		**Male**	**p-value**	**Female**	**p-value**
Health behaviour					
Regular tooth brushing	No	4.0 (n=7)		4.4 (n=16)	
	Yes	4.8 (n=104)	0.73	4.6 (n=143)	0.92
Preventive yearly dental visit	No	4.8 (n=108)		4.7 (n=154)	
	Yes	2.2 (n=3)	0.20	2.0 (n=5)	0.09
Smokeless tobacco current	No	4.6 (n=106)		4.2 (n=139)	
	Yes	18.8 (n=5)	0.001	6.6 (n=21)	0.11
Smoke current	No	3.7 (n=63)		4.8 (n=146)	
	Yes	6.5 (n=48)	0.04	3.1 (n=13)	0.27
Problem drinking (CAGE)	Does not drink alcohol	2.8 (n=43)		4.0 (n=110)	
	Not problem drinker	4.7 (n=27)		6.4 (n=28)	
	Problem drinker	9.3 (n=41)	<0.0001	7.1 (n=21)	0.05
Nutrient intake	Poor	3.5 (n=46)		4.2 (n=74)	
	Intermediate	5.2 (n=38)		4.4 (n=54)	
	Good	5.9 (n=27)	0.17	4.6 (n=159)	0.55
Body mass index	Underweight	3.1 (n=13)		3.3 (n=12)	
	Normal weight	6.0 (n=68)		4.1 (n=51)	
	Overweight	3.4 (n=20)		4.0 (n=44)	
	Obese	1.7 (n=6)	0.05	6.0 (n=46)	0.24
Chronic conditions					
Self-rated general health	Not good health	5.6 (n=73)		4.6 (n=101)	
	Good/excellent health	3.9 (n=37)	0.18	4.5 (n=56)	0.87
High blood cholesterol	No	4.6 (n=106)		4.5 (n=150)	
	Yes	10.3 (n=5)	0.19	7.6 (n=8)	0.21
Had stroke	No	4.6 (n=108)		4.4 (n=154)	
	Yes	15.8 (n=2)	0.08	16.9 (n=5)	0.007
Diabetes	No	4.7 (n=102)		4.5 (n=149)	
	Yes	6.0 (n=9)	0.54	7.6 (n=10)	0.22
Arthritis	No	4.7 (n=101)		4.3 (n=137)	
	Yes	6.2 (n=10)	0.56	7.9 (n=21)	0.04
Material wealth index	Lowest rank	4.2 (n=29)		4.4 (n=24)	
	Middle	5.1 (n=46)		5.2 (n=67)	
	Highest rank	4.7 (n=34)	0.78	4.0 (n=51)	0.54
Race/ethnicity	White	0 (n=0)		3.1 (n=5)	
	Black	5.2 (n=92)		4.8 (n=120)	
	Coloured	5.0 (n=8)		3.0 (n=12)	
	Asian/Indian	3.7	0.13	5.4 (n=22)	0.41
Education	No school/primary school	6.6 (n=44)		5.2 (n=60)	
	Some high school	4.2 (n=63)		4.6 (n=89)	
	Tertiary	2.2 (n=4)	0.07	2.6 (n=10)	0.25
Age	≤45 years	4.7 (n=82)		3.9 (n=100)	
	>45 years	4.8 (n=29)	0.93	6.2 (n=59)	0.02

Among men, current tobacco use and alcohol use were significantly associated with the high prevalence of self-reported poor periodontal health, with problem drinkers reporting the highest prevalence.

Higher body mass index was also marginally significantly associated with reporting of poor periodontal health (Table 3); however, interestingly, obese men had a lower prevalence of self-reported poor periodontal health status when compared with men of normal weight.

Among women, suffering from arthritis and having suffered a stroke, as well as alcohol use, were significantly associated with the reporting of poor periodontal health, with problem drinkers also reporting the highest prevalence. Older adult women reported a higher prevalence of poor periodontal health than younger women. A lack of preventive yearly dental visits and current smokeless tobacco use tended towards significance among women, while among men education and reporting having suffered a stroke also tended towards significance with regard to reporting poor periodontal health (Table 3).

5.5 Multi-variable adjusted logistic models

As a follow up to the series of stratified bivariate analyses reported above, two series of multi-variable adjusted logistic models were similarly constructed, in order to control for potential confounders.

Table 4: Results of logistic regression analysis of overall dentate population using self-reported poor periodontal health status as the dependent variable

Independent variables		Odds ratio	(95% Conf. Interval)	p-value
White		1 (referent)		
Black		3.91	1.38 – 11.05	0.01
Coloured		2.58	0.86 – 7.78	0.09
Asian/Indian		3.48	1.18 – 10.27	0.02
Does not drink alcohol		1 (referent)		
Not problem drinker		1.82	1.17 – 2.84	0.01
Problem drinker		2.53	1.68 – 3.82	<0.001
Had stroke	No	1 (referent)		
	Yes	4.13	1.53 – 11.11	0.01
Arthritis	No	1 (referent)		
	Yes	1.70	1.00 – 2.90	0.05

Area under receiver operating characteristic curve (ROC) = 0.61

The results of the logistic regression analysis of the overall dentate population of this study showed that the factors significantly associated with odds of self-reported poor periodontal health status included excessive alcohol consumption, reporting having suffered a stroke, as well as currently suffering from arthritis and being of any other race than white. Being classified a problem-drinker on a CAGE scale and self-identifying as a black South African had the highest odds of reporting poor periodontal health (Table 4).

Table 5: Logistic regression model of self-reported poor periodontal health status among younger adults ≤45 years (n=4,431)

Independent variables		Odds ratio	(95% Conf. Interval)	p-value
Does not drink alcohol		1 (referent)		
Not problem drinker		1.58	1.02 – 2.45	0.04
Problem drinker		2.46	1.63 – 3.71	<0.001
Preventive yearly dental visit	No	1 (referent)		
	Yes	0.40	0.18 – 0.90	0.03
Arthritis	No	1 (referent)		
	Yes	1.72	1.02 – 2.91	0.04

Area under receiver operating characteristic curve (ROC) = 0.58

Table 6: Logistic regression model of self-reported poor periodontal health status among older adults >45 years (n=1,774)

Independent variables		Odds ratio	(95% Conf. Interval)	p-value
White		1 (referent)		
Black		3.21	1.18 – 8.74	0.02
Coloured		2.42	0.81 – 7.20	0.11
Asian/Indian		3.02	1.05 – 8.72	0.04
Had stroke	No	1 (referent)		
	Yes	4.30	1.68 – 10.96	0.002

Area under receiver operating characteristic curve (ROC) = 0.55

The factors associated with reporting poor periodontal health among younger adults were different from those associated with poor periodontal health among older adults. The factors significantly associated with reporting higher odds of poor periodontal health among adults aged ≤45 years included suffering from arthritis (OR = 1.72 95% CI = 1.02 – 2.91) and alcohol use, with problem drinkers having the highest odds of reporting poor periodontal health status (OR = 2.46; 95% CI = 1.63

– 3.71). Furthermore, reporting making a yearly preventive dental visit was found to be significantly associated with lower odds of reporting poor periodontal health (OR = 0.40; 95% CI = 0.18 – 0.90) among younger adults (Table 5).

By contrast, significant racial disparity in reporting poor periodontal health was observed only among older adults aged >45 years, with black South Africans having the highest odds of reporting poor periodontal health (OR = 3.21; 95% CI = 1.18 - 8.74), when compared to white South Africans (Table 6). Also significant among these older adults was reporting having suffered a stroke (OR = 4.30; 95% CI = 1.68 - 10.96).

Table 7: Logistic regression model of self-reported poor periodontal health status among males (n=2,608)

Independent variables		Odds ratio	(95% Conf. Interval)	p-value
Does not drink alcohol		1 (referent)		
Not problem drinker		1.53	0.99 – 2.36	0.06
Problem drinker		2.51	1.68 – 3.76	<0.001
Smokeless tobacco current	No	1 (referent)		
	Yes	1.82	1.09 – 3.01	0.02

Area under receiver operating characteristic curve (ROC) = 0.57

Although this was a limited model, there was still an observable difference in the predictors of poor periodontal health among males as compared to females. Notably, in addition to the positive association of the intensity of alcohol use in both sexes, current use of smokeless tobacco was significantly associated with poor periodontal health only among males (Table 7), while a history of having a stroke was independently associated with poor periodontal health only among females (Table 8).

Table 8: Logistic regression model of self-reported poor periodontal health status among females (n=3,711)

Independent variables		Odds ratio	(95% Conf. Interval)	p-value
Does not drink alcohol		1 (referent)		
Not problem drinker		1.51	0.97 – 2.33	0.07
Problem drinker		2.52	1.67 – 3.78	<0.001
Had stroke	No	1 (referent)		
	Yes	4.16	1.56 – 11.09	0.004

Area under receiver operating characteristic curve (ROC) = 0.57

CHAPTER 6

DISCUSSION

6.1 Introduction

The primary objective of this study was to assess the prevalence of self-reported poor periodontal health status among dentate South Africans aged 15 years and above. In addition, the study sought to specifically examine the association between systemic health and lifestyle factors (tobacco use, alcohol intake and nutritional status) and self-reported poor periodontal health status.

The study results show that the prevalence of self-reported poor periodontal health status in South Africa in 2003 was 4.6%. This figure is close to the generally observed percentage prevalence of moderate to severe periodontal diseases among adults, which has been reported to be between 5.0% and 11.6%.[88] Conceivably, people are more likely to remember the moderate to severe forms of the disease. Nevertheless, the 4.6% prevalence found in this study is likely to be considerably lower than the true estimate, considering the low literacy level and income of most South Africans.[89-90] This view is supported by the previous observations that accurate self-assessment of health is directly contingent on social circumstances (education and income), as well as psychosocial factors[10,13] and that disadvantaged groups tend to report lower levels of poor health than advantaged groups.[91] In spite of this potential reporting bias, studies have also shown that disadvantaged populations are consistently more likely to self-report poor health (in this instance, periodontal health) than advantaged populations are, because of the enormous burden of poor health in disadvantaged populations.[92]

6.2 Age and self-reported poor periodontal health status

Compared to those who did not report poor periodontal health status, those who reported poor periodontal health status in this study were older at a significant level in the bivariate analysis. However, after controlling for the presence of chronic systemic conditions associated with aging, age was no longer significantly associated with reporting poor periodontal health.

Nevertheless, age has often been regarded as an effect modifier with regard to self-reported periodontal health status.[93] The modifying effect of age on self-reported poor periodontal health status with regard to other determinants observed in this study population indicates that the determinants frequently associated with reporting poor periodontal health among younger adults ≤45 years of age may not be the same as those associated with the disease among older adults >45 years of age.

This finding is consistent with dental literature[47,66,93] and may be due to the disparities in the physiological processes of the two groups.[47]

6.3 Gender and self-reported poor periodontal health status

No significant difference was found in this study between males and females in the reporting of poor periodontal health status in the general population. This finding is consistent with the observations reported by a previous study.[94] However, other studies[67,95] found a significant difference between males and females in the reporting of poor periodontal health. Even though there was no significant association between gender and poor periodontal health in this study, gender differences were observed with regard to the effect of some risk factors regarding periodontal health. A plausible explanation for this lack of significant gender association in the general population is therefore possibly related to cancelling-out or levelling-up effects of differences in systemic health and those associated with lifestyle factors. Hence, this study provides further support for the suggestion that gender disparity in periodontal health status may not be attributable to gender *per se*, but may be attributable to the differential contributions of systemic health and lifestyle factors across genders.[95]

For example, in this study, women who reported having suffered from a stroke displayed higher odds of poor periodontal health, while men who reported currently using SLT products had higher odds of poor periodontal health, with both sexes reporting almost the same adjusted odds ratios with regard to alcohol use. Women, as opposed to men, who had had a stroke and demonstrated higher odds of poor periodontal health in this study may not be unrelated to the findings of Van Wijk *et al.*, who suggested that the extent of functional limitation associated with a stroke and, therefore, with difficulty in self-care, is greater in females.[73] Considering that in contrast to women, SLT use as compared to smoking is less prevalent among men in South Africa,[8] the significantly higher odds of poor periodontal health associated with SLT use only among men suggests a possible contribution of additional source of tobacco toxicants other than SLT. The prevalence of dual tobacco use has been found to be higher among male smokeless tobacco users in the United States of America;[96] it may therefore well be that many of these South African male SLT users also smoke. Dual tobacco users have indeed been reported to have higher estimated daily nicotine exposure levels than single product users[97] and it has been suggested that the effect of nicotine on the periodontium is dose-dependent.[98-99]

6.4 Preventive dental visit and regular tooth brushing

Reporting making preventive dental visits was significantly associated with lower odds of reporting poor periodontal health among younger adults aged ≤ 45 years. However, among older adults >45 years, the association of preventive dental visits with self-reported poor periodontal health was not significant. This may be so because it is likely that older adults may generally have all experienced poor periodontal health already, so that visiting the dentist would make less of a difference, as opposed to the younger population.

The finding of this study that daily tooth brushing was not associated with self-reporting poor periodontal health status may be explained by the fact that what was measured was the frequency of daily tooth brushing and not the ability of the individuals to adequately remove bacterial plaque (the quality of brushing has been shown to be more important than the frequency with regard to controlling periodontal disease).[77]

6.5 Alcohol use and self-reported poor periodontal health status

Alcohol use was found to be strongly associated with higher odds of self-reported poor periodontal health and this is consistent with the findings of other studies.[44-48] This is particularly so among younger adults (men and women) ≤45 years of age, with problem drinkers displaying the highest odds of self-reported poor periodontal health status. South Africa is reported to have one of the highest levels of alcohol consumption per drinker in the world and the younger adults aged ≤45 years were more self-indulgent in terms of excessive alcohol intake.[100] In addition to the excessive alcohol intake by younger adults, they also drank mainly sorghum beer[100] and less wine. Wine has been suggested to enhance the immune system.[42] It was therefore, not surprising that this group of younger adults was more likely to suffer from the negative effects of alcohol, as alcohol has been suggested to block the absorption of some micronutrients, such as folic acid, as well as interfere with their metabolism, among other things, thus impairing their bioavailability which is important for the maintenance of periodontal health.[62]

6.6 Nutrient intake and self-reported poor periodontal health status

In contrast to the findings of some previous studies,[52-56] this study did not find a significant association between nutrient intake and poor periodontal health status. It is possible that this may be related to (an) as yet uncontrolled confounding factor(s) or a measurement error.

Alternatively, this finding may be due to the fact that dietary nutrient intake was measured – it has been suggested that not all micronutrients are transformed to their bioactive forms. This situation is particularly likely among problem drinkers, as exemplified by prior findings on folic acid intake.[62]

This study therefore suggests the need for further studies in the future to determine whether this lack of association accurately reflects the South African situation. In particular, there is need to examine the interaction between alcohol use and micronutrient availability in relation to periodontal health in South Africans.

6.7 Tobacco use and self-reporting poor periodontal health status

In this study, current smoking status was not significantly associated with self-reported poor periodontal health status. This may be due to the vasoconstrictive actions of nicotine and other smoke constituents[33] that tend to mask the bleeding tendencies of a diseased periodontium among smokers. Bergstrom *et al.*[98] have reported that the overt and clinical signs of gingival inflammation, such as redness, bleeding and exudation, are less evident in smokers than in non-smokers. This reduced redness, bleeding and exudation may also be attributable to the heavier keratinization of the gingivae (gums) in smokers.[98]

Unlike current smoking status, current smokeless tobacco use status was significantly associated with self-reported poor periodontal health. This was, however, found only among the older population, among whom the use of smokeless tobacco has been found to be more prevalent.[39,80] Furthermore, it is conceivable that older adults would also have used smokeless tobacco for longer periods, and are thus more vulnerable to its adverse effects. The significant association of smokeless tobacco to periodontal disease may be due to the nicotine content of smokeless tobacco, which is reportedly higher than that of cigarettes.[33] In South

Africa, the estimated free base nicotine equivalent of 1g of the most popular SLT brands may be up to that of 10 cigarettes of any brand.[33] Moreover, smokeless tobacco users in South Africa are mostly heavy users.[33] The difference in finding between the effects of smokeless tobacco and smoking highlights the additional impact of smoke constituents on periodontal disease presentation.

6.8 Chronic systemic conditions and self-reported poor periodontal health status

Diabetes was not found to be significantly associated with poor periodontal health in this study. This observation may be partly attributable to possible misclassification bias. Some of the participants in this study may in fact be unaware that they are diabetic, even though they reported poor periodontal health which may be associated with the diabetes. This is why caution should be exercised in generalizing from these findings.

Another plausible explanation for the lack of association between diabetes and periodontal health conditions reported by the participants is the possibility that most of diabetics in this study may already have too few teeth left, having lost their teeth to severe periodontal diseases; hence, they had little periodontium to complain of. This view is supported by the fact that Khader *et al*. previously demonstrated in a meta-analysis that diabetics experience a significantly higher severity of periodontal disease than non-diabetics, even though they have the same extent of periodontal disease.[101] However, the possible differences in the remaining number of teeth could not be controlled for in this study, because the information gathered from the dentate participants in this survey did not include details on the number of missing teeth. The reasons for this lack of association may therefore require further elucidation in future studies.

Having had a stroke was strongly associated with higher odds of self-reported poor periodontal health in this study, especially among adults aged >45 years and women. Since self-reporting of general health status in the general population was not significantly associated with reporting poor periodontal health status, the positive association of having had a stroke with poor periodontal health status, particularly among older adults and women, may be more likely to be due to low dexterity caused by the physical or functional limitations that commonly result from a stroke[73,102] rather than a common causal pathobiological pathway between strokes and poor periodontal status. Furthermore, consistent with the current study findings, the extent of functional limitation associated with a stroke and thus difficulty in self-care has been reported to increase with advanced aged and is greater in females.[73] However, the fact that having had a stroke was not significantly associated with self-reported poor periodontal health among adults ≤45 years after controlling for potential confounders may be due to the lower prevalence of strokes among younger adults, since the risk of having a stroke has been observed to increase with age.[103]

Consistent with the literature, the results of this study provide further evidence of a significant association between rheumatoid arthritis and higher odds of reporting poor periodontal health.[74] Although this association may possibly also be related to a functional limitation of the hand used in brushing, it may also partly be a reflection of a common underlying regulatory disturbance of the inflammatory response between arthritis and poor periodontal health in these individuals.[74] In support of a common underlying inflammatory response as opposed to function limitation is the fact that this association was found only among younger adults whom are less likely to have developed severe functional limitations associated with arthritis that could affect adequate plaque control. This view of a common underlying inflammatory disturbance is further supported by the fact that aggressive periodontal disease, which is strongly associated with arthritis, is one of the early-onset forms of periodontitis found only in younger adults. Indeed, both periodontal disease and arthritis have been reported to share a common hyper-inflammatory genotype and functional interferences in innate and adaptive immune responses.[75]

This study findings is therefore, consistent with the findings of the Australian study referred to earlier on, in the literature review.[74] The Australian study did not find differences in the plaque deposits and bleeding indices between a group with rheumatoid arthritis and the group without the condition. The authors then suggested that the progression of periodontal disease in the group suffering from arthritis is likely to be due to factors other than a difference in oral hygiene.[74]

The lack of a significant association of arthritis with poor periodontal health among older adults may be also be due to the same reason for the lack of significant association between a lack of preventive yearly dental visits and reporting poor periodontal health in older adults. Periodontal diseases are chronic conditions. Older people may already have developed poor periodontal health status to such an extent that suffering from arthritis would not make much of a difference.

High blood cholesterol tended to be significantly associated with poor periodontal health in the bivariate analysis, but this association was lost after controlling for potential confounders in a multivariate analysis. This lack of significance is possibly related to low statistical power to detect the difference (Type II error). It is therefore difficult to conclude whether high blood cholesterol contributed to poor periodontal health or not. Therefore, there is a need for controlled follow-up studies. Nevertheless, it is pertinent to note that high blood cholesterol is a risk factor for heart diseases and the development of subsequent complications such as a stroke. It is therefore not surprising that after controlling for stroke, high blood cholesterol lost significance.

6.9 Socioeconomic factors

Material wealth and level of education were used as measures of participants' socioeconomic status in this study. Material wealth was not significantly associated with reporting poor periodontal health status in this study. This is in contrast with the findings of other studies[104-105] which have demonstrated that lower wealth status was significantly associated with poor periodontal health. The difference in observation may be related to differences in measures of poverty status in this study as compared to the measures used in the studies reviewed.

In contrast to material wealth, in the bivariate analysis, education was negatively associated with the reporting of poor periodontal health, especially among males and older adults, although it was only marginally significant. The least educated were most likely to report poor periodontal health – this finding is consistent with those from numerous other studies,[39,76-77] which provide consistent evidence that a person's level of education greatly influences his or her oral health behaviour and attitudes and subsequently results in poorer periodontal health. However, education as a factor lost significance after controlling for lifestyle and systemic health factors, thus confirming previous observations that the effect of education is mediated through differences in health risk behaviours and health status across the education gradient.[79]

Individuals' education level has indeed been suggested as not fully explaining the effect of socioeconomic status on periodontal health status.[13] It has been suggested that the role of socioeconomic factors in disparities in periodontal health is mediated through psychosocial stressors[10] and the mastery of individuals over their relative economic and social positioning.[106] However, these concepts were not examined in this study. Therefore, more studies focusing on the protective roles of psychosocial factors, such as high self-esteem and religiosity, are recommended in order to better understand the interplay of race, income and education in explaining the role of socioeconomic status in social disparities in periodontal health.

6.10 Race/ Ethnicity and self-reported periodontal diseases

In this study, race was strongly associated with self-reported poor periodontal health status. Consistent with some previous findings,[2,7] in the SADHS 2003, black South Africans reported the highest rates of poor periodontal health. This racial disparity was particularly prominent among older adults >45 years of age. This observation is likely to be a result of the generally low level of education among older black South African adults,[89] as a lower level of education has strongly been associated with more health-damaging behaviour and attitudes.[79] Genetic factors may also partly explain racial and ethnic differences in the prevalence of poor periodontal health, but the overall influence of socioeconomic risk factors or social behaviour[10,13] should not be ignored. Most white South Africans continue to occupy the highest income bracket;[90] and black South Africans are the least educated – for reasons partly related to the legacy of apartheid rule in South Africa.[87] Good nutrition, adequate oral self-care and making regular preventive dental visits are all associated with higher income and education of the individual or a group of people. Conversely, poverty and a low level of education may lead to poor nutrition, poor oral self-care and an inability to access oral health care facilities. Therefore, the observation of racial disparities in self-reported periodontal health only in older adults may suggest improvements in the level of education and thus improved oral self-care and access to oral health services among the younger adult cohorts.

Another factor that may be responsible for black South Africans' reporting the highest odds of poor periodontal health may partly be the previously reported higher levels of alcohol consumption (particularly the non-wine alcoholic drinks) among black South Africans as compared to other racial groups.[107] Excessive alcohol intake is indeed likely to aggravate the adverse effect of plaque created by poor oral care, as problem drinkers have also been reported to be less likely to seek dental care.[43]

In addition, the popular use of smokeless tobacco by black South Africans may also be a major factor contributing to the observed higher odds of self-reported poor periodontal health found among these older adults.[33,39]

The Asian/Indian South African population, like the black South African group, also reported a relatively high incidence of poor periodontal health and this concurs with the findings of previous studies.[2,7] The high odds of self-reported poor periodontal status found among the Asian/Indian South Africans may be due the high prevalence of betel nut chewing in this group.[108]

6.11 Limitations and strengths of the study

This study's findings should be interpreted in the context of the limitations imposed by the methodology. There is potential underreporting, as participants could possibly try to provide interviewers with socially desirable responses. Recall bias is also possible, particularly in respect of a history of past experience of periodontal problems. The current study also did not exhaust all possible determinants of periodontal diseases, as the factors explored were limited by variables that could be derived from the questionnaire used in the survey from which the data used in this study were taken.

Due consideration should also be given to the limitations of the present study in interpreting the findings, because the information gathered from participants in the SADHS did not include data on the number of teeth people missed. Participants with fewer teeth have less periodontium to complain of and the possible differences were not controlled for, as no data was available on the number of teeth remaining per person among the dentate population studied.

Furthermore, an obvious problem with cross-sectional studies is that exposure and outcomes are measured simultaneously, thus the temporal order of events is unknown. This limits any speculation on causality.

There is a possibility of misclassification bias in responses related to arthritis, because the questionnaire did not specify the type of arthritis. However, because most of the respondents who reported arthritis were younger adults, it is reasonable to assume they were suffering from rheumatoid arthritis, as opposed to osteoarthritis, which is found more in older adults.[109]

Also, most of the models are limited with regard to predictive variables and model fit, so there is a need for further comprehensive investigations that include more predictors in order to obtain better-fitting models.

These limitations notwithstanding, this study, to our knowledge, is the first in South Africa that provides information on the factors associated with the self-reporting of poor periodontal health using a large nationally representative sample in a developing country. This can form the basis of further investigations for the purposes of policy making. Another strength of the current study is its ethnic/racial diversity and the systematic approach that was employed.

CHAPTER 7

CONCLUSION AND RECOMMENDATIONS

7.1 Conclusion

The findings of this study indicate that the prevalence of self-reported poor periodontal health among dentate South Africans aged 15 years and above is 4.6%.

- Those who reported poor periodontal health tend to be older at a significant level, particularly so among females.
- Black South Africans were the most likely to report poor periodontal health, when compared with white South Africans, particularly so among older adults.
- Alcohol use was associated with significantly higher odds of reporting poor periodontal health, with those classified as problem drinkers on the CAGE scale displaying the highest odds of reporting poor periodontal health, especially among younger adults.
- People who suffer from arthritis or who have suffered from a stroke were the most likely to self-report poor periodontal health.
- Reporting making a yearly preventive dental visit was significantly associated with lower odds of reporting poor periodontal health status, particularly among young adults aged ≤45 years.
- In the general population, this study failed to demonstrate a significant association between tobacco use and higher odds of self-

reporting poor periodontal health, but among older adult males, current smokeless tobacco use status was significantly associated with higher odds of self-reported poor periodontal health status.

7.2 Recommendations

The following recommendations are made on the basis of the findings:

- The effect of systemic health and lifestyle factors on self-reported poor periodontal health status in this study varied with the age and gender of the individuals. Consequently, a targeted approach in disease control and prevention is indicated. For instance, prioritizing the targeting of young adults aged ≤45 years with problem drinking may be an important public health intervention to promote periodontal health in South Africa.
- In line with a common-risk factor approach, public oral health interventions should also address all health risk factors common to strokes and poor periodontal health, including preventing excessive alcohol use, preventing the onset of tobacco use, and promoting cessation among those who have started using tobacco in order to avoid an adverse periodontal health impact at an older age.
- Although age and race are unmodifiable risk factors, there is a need for further study of the mechanisms or factors associated with continued ethnic disparities in poor periodontal health status in South Africa.

- In line with a recently published national oral health promotion framework, oral health care needs to be integrated with chronic care, particularly with regard to rehabilitation services for those who may have suffered a stroke.
- Furthermore, making preventive yearly dental visits remains a major challenge for most South Africans. All the key players in the delivery of oral health care should encourage efforts to make it an attractive or easy choice/option; as such visits protect people against poor periodontal health. Such intervention would need to address financial and geographic barriers to accessing preventive oral health care. These interventions may include support for universal insurance coverage and the availability of oral health services in all primary health care facilities across the country.

Immense public health benefits can be derived from implementing the above recommendations, especially if they are incorporated or included in efforts by clinicians and policy makers to develop appropriate and effective community-based and population-based intervention programmes and strategies for the prevention and control of periodontal diseases.

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Appendix A

UNIVERSITEIT VAN PRETORIA
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Faculty of Health Sciences
School of Dentistry

2010/06/07

Dr TE Okagbare

AMENDED TITLE OF PROTOCOL: DENT 02/09

We would like to inform you that the amended title of your protocol has been approved by RESCOM.

New Title: **"DETERMINANTS OF SELF-REPORTED PERIODONTAL HEALTH IN SOUTH AFRICA: RESULTS FROM A NATIONAL SURVEY"**

Yours sincerely

PROF PJ VAN WYK
CHAIRMAN: RESEARCH COMMITTEE

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Appendix B

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1908 - 2008

UNIVERSITEIT VAN PRETORIA
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Dept. Community Dentistry
School of Dentistry
Faculty of Health Sciences

01/02/2009

The Head
Department of Community Dentistry
School of Dentistry
University of Pretoria

Attention: Professor PJ van Wyk

ACCESS TO THE SADHS 2003 DATASET OBTAINED WITH PERMISSION FROM THE NATIONAL DEPARTMENT OF HEALTH

I hereby grant permission to Dr TE Okagbare, student number: 28563604, to use the dataset obtained from our ongoing project on Smokeless tobacco use and Health Consequences, for use in the study titled: 'DETERMINANTS OF SELF-REPORTED PERIODONTAL HEALTH IN SOUTH AFRICA: RESULT FROM A NATIONAL SURVEY'.

Approval for the use of the dataset has been granted by the Directorate for Health Information, Evaluation and Research of the National Department of Health (attached).

I further confirm that the use of the data will be restricted for hIS research report and no one else outside of the research team will be given access to the dataset without my approval.

Please do not hesitate to contact me, should you require further information.

Yours Sincerely,

Prof OA Ayo Yusuf, BDS, MSc, DHSM, MPH, PhD
Department of Community Dentistry
School of Dentistry
University of Pretoria
Tel: 012 319 2514
Fax: 012 323 7616

Appendix C

The User agrees that his/her signature indicates his/her agreement to comply with the above-stated requirements (Points 1-9)

Please complete this form

Data Set for which Agreement is signed	Demographic Health Survey, [illegible]
Name (Print or Type)	Olalekan Ayo-Yusuf
Organisation	University of Pretoria
Department	Community Dentistry/Public health
Status	Senior Lecturer/Senior Stomatologist
Title	Dr
Address	Dental Hospital, P O Box 1266, Pretoria [illegible]
City	Pretoria
Province	Gauteng
Country	South Africa
Telephone	012 3192514
Fax	012 3237616
E-mail	[illegible]
Signature	[signature]
Witness' Name	
Witness' Contact No	
DOH Representative*	[signature]
Date	[illegible]

*The Data User's Agreement must be signed by the Chief Director for Health Information, Evaluation and Research

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Appendix D

SOUTH AFRICA DEMOGRAPHIC AND HEALTH SURVEY 2003 QUESTIONNAIRE

HOUSEHOLD QUESTIONNAIRE

IDENTIFICATION

EA TYPE (URBAN FORMAL=1; URBAN INFORMAL=2; RURAL FORMAL=3; TRIBAL AREA=4)?

HOUSEHOLD SCHEDULE

(4) SEX
Is (NAME) male (1) or female (2)?

(7) AGE
How old is (NAME)? IN YEARS

(12) How would (NAME) describe himself/herself in terms of population group?

1=BLACK AFRICAN
2=COLOURED
3=INDIAN OR ASIAN
4=WHITE
5=OTHER

NO	QUESTIONS AND FILTERS	CODING CATEGORIES
18	EDUCATION Has (NAME) ever attended school?	YES………………………..……….1 NO………………………..……….2
	IF ATTENDED SCHOOL	
19	What is the highest level of school (NAME) has completed? ***CODES FOR Q.19 EDUCATION LEVEL:	

	00 = LESS THAN ONE YEAR 01 = SUB A/GRADE 1 02 = SUB B/GRADE 2 03 = STANDARD I/GRADE 3 04 = STANDARD 2/GRADE 4 05 = STANDARD 3/GRADE 5 06 = STANDARD 4/GRADE 6 07 = STANDARD 5/GRADE 7 08 = STANDARD 6/GRADE 8 09 = STANDARD 7/GRADE 9 10 = STANDARD 8/GRADE 10 11 = STANDARD 9/GRADE 11 12 = STANDARD 10/GRADE 12 13 = FURTHER STUDIES INCOMPLETE 14 = DIPLOMA/OTHER POST-SCHOOL COMPLETE 15 = FURTHER DEGREE COMPLETED 18 = DON'T KNOW	
	IF AGE LESS THAN 25 YEARS	
20	Is (NAME) currently attending school?	YES……………………………1 NO……………………………2 DON'T KNOW………………8
32	Does your household have any of the following items in working condition? Radio? Television? Computer? Refrigerator? Landline telephone? Cell phone?	YES NO RADIO……………………1 2 TELEVISION………………1 2 COMPUT……………………1 2 REFFIGERATOR……………1 2 LANDLINE TELEPHONE………………1 2 CELL PHONE………………1 2
41	Does any member of your household own: A bicycle? A motorcycle or motor scooter? A car or truck? A donkey or a horse? Sheep/goat or cattle?	YES NO BICYCLE……………………1 2 MOTORCYCLE/SCOOTER…..1 2 CAR/TRUCK………………1 2 DONKEY/HORSE…………1 2 SHEEP/CATTLE/GOATS…1 2

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ADULT HEALTH QUESTIONNAIRE

SECTION 3: QUALITY OF LIFE AND CLINICAL CONDITIONS

NO	QUESTIONS AND FILTERS	CODING CATEGORIES
10B	Would you say your health is poor, average, good, or very good/excellent?	POOR……………………………….....1 AVERAGE…………………………....2 GOOD……………………………....3 VERYGOOD/EXCELLENT…………4
11	Has a doctor or nurse or health worker at a clinic or hospital told you that you have or have had any of the following conditions:	
11C	Stroke?	YES……………..…………………....1 NO…………………………………..2 DON'T KNOW……………………..8
11D	High blood cholesterol or fats in the blood?	YES……………..…………………....1 NO…………………………………..2 DON'T KNOW……………………..8
11E	Diabetes or Blood Sugar?	YES……………..…………………....1 NO…………………………………..2 DON'T KNOW……………………..8
11H	Sore joints, e.g. Arthritis, Gout?	YES……………..…………………....1 NO…………………………………..2 DON'T KNOW……………………..8

SECTION 4: DENTAL HEALTH

NO	QUESTIONS AND FILTERS	CODING CATEGORIES
13B	Have you had pain or problems with your mouth or/and teeth in the last 6 months?	YES……….……………………………1 NO…………………………………….2
13C	Please indicate which part of your mouth is affected:	TEETH……………………………….A GUMS……………………………….B ULCERS/SORES IN THE MOUTH….C DENTURES………………………….D OTHER (SPECIFY)………………....X
13E	What do you usually do to look after your mouth/teeth?	RINSE MOUTH……………………….A CLEAN/BRUSH/FLOSS………………B

		EAT LESS SWEET FOOD/DRINK LESS SWEET DRINKS..........................C VISIT DENTIST/DENTAL THERAPIST/ORAL HYGIENIST/ORAL THERAPIST AT LEAST ONCE A YEAR.......................................D OTHER (SPECIFY)........................X

SECTION 8: HABITS AND LIFESTYLE

8C: TOBACCO USE

NO	QUESTIONS AND FILTERS	CODING CATEGORIES
33 A	Do you currently smoke any tobacco products, such as cigarettes, cigars and pipe?	YES..1 NO...2
38 A	Do you currently use any smokeless tobacco such as snuff or chewing tobacco?	YES..1 NO...2

8D: ALCOHOL USE

NO	QUESTIONS AND FILTERS	CODING CATEGORIES
42 A	Have you ever consumed a drink that contains alcohol such as beer, wine, spirits or sorghum beer?	YES..1 NO...2
42B	Was this within the past 12 months?	YES..1 NO...2
45 A	Have you ever felt you should cut down on your drinking?	YES..1 NO...2
45B	Have people annoyed you by criticizing your drinking?	YES..1 NO...2
45 C	Have you ever felt bad or guilty about your drinking?	YES..1 NO...2
45 D	Have you ever had a drink first thing in the morning to steady your nerves or get rid of a hangover?	YES..1 NO...2

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ANTHROPOMETRIC DATA SHEET

50	WEIGHT (KG)				

51	HEIGHT (CM)				

54	SYSTOLIC BLOOD PRESSURE 1			
55	DIASTOLIC BLOOD PRESSURE 1			
56	PULSE 1			