Periodontal health in South Pacific Populations: A review

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Abstract: Periodontal (or gum) disease is historically endemic in all indigenous communities in the South Pacific Region. While the disease becomes evident in mature adults the pathology becomes overt by adolescence or earlier. The initial gum inflammation progresses increasingly with age and may lead to pathological destruction of the tooth supporting tissues, tooth loosening and potential tooth loss. For most adults the disease presents as an adult-onset generalized chronic marginal-gingivitis-periodontitis-calcific complex. Microbiological components of dental plaque on tooth surfaces and dental calculus initiate the pathology. While the general clinical features are similar between adults and between communities, epidemiological studies have identified variations in disease progression. Also severity of the disease may be influenced by systemic health factors such as diabetes, known to be common in the Region. A common outcome, loss of teeth, usually becomes evident from the fourth decade onwards. Once established the plaque-gingivitis-calcific-periodontitis complex becomes increasingly difficult to reverse. Early adoption and maintenance of routine oral care actions through family, social, community and educational actions will improve long-term oral health, tooth loss, potentially adverse systemic health and in general better lifestyles. (PHD, 2003; 10 (1), Pages 68-75)

Introduction

This review is based on in excess of 40 reports relevant to periodontal (gum) health in the South Pacific published over the past 50 years for reasons ranging from epidemiology, dental services needs, to periodontal preventive programmes. The available cumulative database provides a perspective on distribution, prevalence and severity of this widespread, debilitating, chronic oral disease in indigenous Pacific populations.

Historically the Pacific island peoples were noted for the splendid appearance and condition of their ‘even rows of immaculate white teeth retained into old age.’ Since those early observations the oral health conditions of island populations have been the subject of many studies. The spread of western trade, diet and culture; increased ease of travel, communications and migration over the past two centuries have considerably modified the way of life in the Region. The prevalence of several systemic diseases such as, diabetes, coronary heart disease, hypertension and obesity have also increased significantly over that time. Dental caries (tooth decay) in particular also increased rapidly as a response to changed diets. Similar negative effects on health associated with lifestyle changes are well documented for Pacific Island migrants to New Zealand.

Despite the association between changed lifestyle (notably diet) and increased levels of tooth decay, there is little or no evidence of a similar link or association between changed lifestyle and levels and severity of gum disease. Development of dental services in the Pacific (as in most countries) has been and remains predominantly a response to treatment needs for, and prevention of, tooth decay. Conversely, gum disease has been and remains a largely unrecognized and ignored endemic disease despite its longer historical presence in the Region than dental caries. Yet its prevention through self-care is simple, low cost and requires but 60 seconds a day!

Figure 2. A typical case of established generalized chronic marginal adult onset periodontitis in a 45 yr-old. Note: dental plaque with staining, inflamed, puffy gums, sub gingival calculus (arrow) and some areas of gum recession. Shallow pocketing was associated with some teeth.

Gum disease is a generic term, which encompasses a range of acute, chronic, and neoplastic pathological conditions of the investing (gingival) and supporting (periodontal) tissues of teeth. However, worldwide the vast majority of gum disease falls within the classification of ‘adult onset chronic marginal periodontitis inflammation.’ The ideal or healthy periodontal state (Figure 1) is commonly ‘short lived’. The initial inflammatory process, gingivitis, affects the investing soft tissues around the teeth; it is the pre-cursor of a deeper progressive inflammation, which adversely affects the tooth’s investing and supporting tissues (Figure 2). Pathological involvement and destruction of the supporting fibres and bone is defined as periodontitis and frequently progresses to cause loosening and loss of teeth (Figures 3 & 4). Gingivitis alone is a reversible condition whereas periodontitis (because of associated bone pathology) is
essentially irreversible. Dental plaque— the primary initiating cause of the gum disease is an apparent normal microbial complex on tooth surfaces; nevertheless it induces and sustains an inflammatory response of the gum tissues. The disease complex appears to be a result of a non-specific response to the numerous plaque bacteria (more than 400 species) although only a small number of specific microorganisms appear to have significant pathogenic potential. Prevention and control of the disease requires moderate to good oral hygiene— achieved either by natural or artificial removal of the plaque deposits.

Figure 3. An advanced case of generalized (all teeth), marginal chronic periodontitis in a 45-50 yr-old. Note: generalized heavy dental plaque, with inflamed, puffy gums and distinct gum recession—exposing sub-gingival calculus (arrow). Teeth either have shallow or deep periodontal pockets. Upper and lower front teeth distinctly mobile due to loss of supporting alveolar bone.

Figure 4. 54 yr-old adult with terminal advanced periodontitis. Note: the usual heavy plaque deposits present on all teeth were physically removed to demonstrate features. Gum tissue is heavily inflamed and considerably receded to exposed large areas of root surface and previous sub-gingival calculus. Numerous teeth have been extracted due to excessive mobility/pain. Remaining upper and lower front teeth excessively mobile. All remaining teeth were scored for deep periodontal pockets

Calculus (or tartar) is calcified dental plaque, which occurs in mature plaque. It adheres firmly to the tooth surfaces and is differentiated into supra- and sub-gingival forms. While the mechanism of formation of the supra form appears to be a physico-chemical phenomenon associated with saliva, the sub-gingival forms in a different environment (periodontal pocket) which is dominated by an inflammatory exudate and plaque microorganisms, not saliva. Because of its porous nature calculus is heavily impregnated with microbial products, which contribute to the inflammatory condition. Unless removed it is a permanent reservoir of bacteria and their metabolites. Self-removal of calculus is not feasible and a time-consuming procedure for dental services— even assuming the need is perceived.

It has been long recognized that variation exists in disease susceptibility and progression commonly obscured by the averaging of grouped data. Not surprisingly this essentially vascular disease is affected by systemic conditions such as, immuno-deficiencies, cardio-vascular conditions and diabetes. Even more alarming are recent suggestions that periodontal diseases may have significance beyond their oral locality. They have been linked to deleterious effects on cardiovascular diseases, respiratory diseases, and adverse pregnancy outcomes as a consequence of systemic distribution of microorganism of dental plaque origin. The objective of this review is to provide evidence on the endemic prevalence of this disease complex and the magnitude of related oral health needs if pain, suffering, tooth loss and impaired lifestyles are to be lessened.

Classifications and databases

Despite many proposals on classification criteria of periodontal or gum diseases over the past 50 years no one classification of severity has found universal favor in epidemiology, health services or clinical research. Nevertheless, epidemiological and public health data usually includes disease severity categories interpretable in terms of early, moderate or advanced disease. In some surveys it is recorded as moderate or severe depending on pocketing depth; the presence of calculus is often not identified— and sub-gingival calculus rarely. In recent years the single most frequently used index in the Pacific Region has been the WHO recommended Community Periodontal Index of Community Needs (CPITN) procedure. In this review the data presented, irrespective of method of recording gum conditions used in individual studies, has been evaluated within a broad perspective defined by the presence or absence of gingivitis, periodontitis and the associated phenomena of dental plaque and calculus. It is unlikely that variations in clinical assessment of gum conditions significantly alter the distribution pattern reported. Most assessing procedures are based on recording of conditions of a just a few ‘index’ teeth (not all thirty-two teeth).

Epidemiological data assembled in the Pacific Region over the past three decades identifies endemic generalized chronic marginal gingivitis-periodontitis-calculus complex as the typical profile of gum health. Reasonably standardized epidemiological databases from communities such as Fiji, Tonga, Samoa and Niue, provide valuable profiles on the disease complex, its prevalence and progress with age. While this review data is limited to published reports, unpublished reports on other communities are accessible on the WHO CPITN database (www.whocollab.od.mah.se)).

Summaries of country profiles

Australia: One report on a small group of indigenous peoples identified only mild gingivitis and calculus in their subjects. Another reported severe gum disease and
The presence of calculus in adults over age 35 years with an average of six mobile teeth per adult - indicative of advanced disease. Endemic gingivitis was observed in children, and was considered, a predictor of inevitable severe gum disease in adulthood. An 'improved' living condition under western-style administration was given as the reason for the deteriorating oral health of Aborigines.

**Cook Islands:** Oral health of a Pukapuka Island community was recorded as part of a general health survey. The oral health report observed that of 497 children and adults 45% (225) had gum disease. Of the 225 with gum disease - 76% were rated as having mild-severe gingivitis and 24% with severe periodontitis. Supra and subgingival calculus was common and correlated with gum disease severity. While the disease was not very prevalent in 14 yr-olds and younger, 92% of those over 40 years were affected. The author concluded that the public health of Susceptible, with the disease commencing in early life and progressed resolutely with age. Although systemic health and nutritional factors in the community were assessed no correlations were found, with the exception of possible deficiencies of vitamins A and C, linked to their gum conditions. Another study of islanders on Mangania, Rarotonga and Pukapuka found that of 320 young subjects aged between 10-20 years, 27% had obvious gum problems; 13% of cases were associated with calculus deposits.

**Fiji:** A WHO report, in 1969, included 5479 subjects aged between 3-54 years and concluded that gum disease was of severe only. About 60% of the samples were apparently free of periodontitis and only 5% had deep (>6mm) pockets (Figure 5). The author observed that the population generally adhered to their traditional diet - unspoiled by 'civilized' foods of the modern world. Yet in 1986 an epidemiological survey noted that gum disease affected 60% of the 15-57 yr-olds with at least moderate severe disease and 14% of 30+ yr-olds had advanced disease. The high prevalence of missing teeth appeared to be the result of gum disease rather than caries.

On the other hand, a 1992 report of a national survey on periodontal health of 4326 children and adults assessed revealed that the severity of gum disease was at a level considered to be a major public health problem (Figure 6). About 30% of adults by 55 years showed signs of moderate disease although advanced disease was relatively uncommon. Even young subjects showed evidence of disease. About 57% of 13-14 yr-olds had signs of gingivitis, with calculus deposits evident in 39%. With age the percentage of persons with healthy tissues decreased from 28% for adolescents to just 4% by the fifth decade. Periodontal pockets increased from 1% for young people to 20% for older subjects. Calculus was observed in 58% of young people and 74% of older people. Tooth loss increased rapidly with age from almost 7 teeth per middle-aged person to over 16 teeth in older people. However, the authors could not differentiate between tooth loss resulting from tooth decay and gum disease. Tooth loss was presumed to be a consequence of gum disease.

A third national survey, 1998, evaluated oral health, of 2000 children and adults (35-44 yr-olds). It was concluded that gum disease was very prevalent. For the 35-44 yr-olds, 33% showed evidence of periodontal pocketing, and 52% had gingivitis.

**French Polynesia:** A study of children's oral health found that 9% of 10-14 yr-olds showed evidence of gum pocketing, which increased to 20% for 15-19 yr-olds. This was significantly higher than that found for Chinese and European residents. However the high caries prevalence was of much greater concern than gum disease.

**Nauru:** Gum disease was recognized as a major problem in Nauruans as early as 1959. Most young adult Nauruans showed signs of disease - although the severity varied considerably. Apparently removal of calculus at intervals reduced the prevalence significant. It is noteworthy that the Nauruan population has one of the highest reported prevalence of adult onset diabetes, more than 40% of the adult community, in the Pacific.

**New Zealand:** An early report on gum conditions of the indigenous population reported poor gum health with severe gum disease evident in children and adults in a rural Maori community. The findings approximated to conditions described in surveys in South East Asian populations. Later national surveys also identified Maori and Pacific island communities with poorer gum health than Caucasians. A further study reported that generalized chronic marginal gum disease was evident in 42% of subjects by age 45 years. The authors considered that disease control for most subjects would require major scaling of calculus by early adulthood.

**Niue:** A public health survey of dental health services, 1968, included profiling of dental conditions. The date for periodontal conditions provided a valuable profile which may be typical for the Pacific. It was observed that a generalized marginal chronic inflammatory disease affected most adults - commencing in teenage years and progressed to severe disease by middle age. For example, 18% of people are affected by 30 years of age, 51% by age 50 years and almost all individuals by 60 years (Figure 7). The frequency of calculus correlated with the change in the prevalence of periodontitis.
Papua New Guinea: Studies as far back as 1955 identified a particularly early deterioration in gum health even compared with other Region communities. The presence of severe periodontitis, gingivitis, associated gum abscesses, calculus and heavy plaque by 30 years was 'characteristic' of the indigenous communities. Betel and tobacco chewing was a contributing factor to the onset of severe disease.

Tokelau Islands: An early 1963 comprehensive study of the Tokelau population provided an excellent cross sectional epidemiological description of a population profile. It revealed that early adulthood was a critical time for gum health because of established poor oral hygiene and deposition of calculus (Figure 8). Chronic gingivitis affected 20% of younger people (<15 years) with 10% showing periodontitis. The prevalence of disease escalated rapidly with age with over 90% of adults over 55 years showing a gingivitis/periodontitis/calculus complex. Oral hygiene worsened appreciably with age. A significant correlation between the high prevalence of gum disease and missing teeth was evident particularly as the level of tooth decay was low. A strong correlation also existed between sub-gingival calculus, advanced periodontitis and missing teeth. A 1989 study of 554 adults revealed that 75% of the adults experienced severe gum disease.

Western Samoa: Poor standards of oral hygiene, a low caries prevalence, widespread intense gingivitis and destructive periodontitis were detailed in 1974 based on oral observations of 1680 people, aged 5 years and older. Gum disease is considered the major cause of tooth loss in W.Samoans.

Tonga and W. Samoa: In 1981 W. Samoan and Tongan villagers, 15-59 yr-olds were assessed in detail, clinically and radiographically, for periodontal health. Villages and villagers were randomly selected based on official population data. This detailed study recorded a high level of sub gingival calculus, gingivitis, progressive apical movement of the gingival attachment and bone loss, characterized both populations. Surprisingly, and without obvious explanation, the prevalence of missing teeth, age for age, was significantly lower in W.Samoan than in Tongan communities - despite the similar (low) tooth decay levels, ethnicity, culture, climate and diet. Tooth loss appeared best explained by the endemic gum disease rather than the relatively uncommon tooth decay. The level of high tooth loss in Tongans - despite low prevalence of tooth decay and relatively low severe gum disease reported in three studies remains unexplained.
Periodontal disease and root caries

Decay of exposed root surfaces is a consequence of gum recession associated with disease. After examination of skulls of Hawaiian Polynesians living in pre-European times it was concluded that tooth decay of root surfaces was common even in ancient peoples with 48% of 26-40 yr-olds and 68% of 40+ yr-olds with evidence of root decay. Surprisingly the author made no reference to alveolar bone resorption as indicative of gum disease being an etiological factor.

Missing teeth

A number of reports on oral conditions refer to significant tooth loss from middle age onwards. Reports on Tokelau, Tonga, Fiji and Cook Is. oral conditions provide a particularly reliable database on tooth loss because reasons and need for extractions were recorded for decay and gum disease. Clearly the availability or otherwise of dental care services influences the prevalence of missing teeth and a few reports included data on the need and reasons for tooth extraction. Information on the magnitude of total tooth loss (edentulism) is also available. Three dedicated projects on the reasons for tooth loss were completed in Tonga Tuvalu and W. Samoa. The reasons for each tooth extracted were documented over a period of several weeks. Decay was most commonly the reason for extractions in younger, and gum disease in older subjects. Root decay was a significant cause of extractions in older adults.

The consequences of tooth decay or gum disease or both (decay of root surfaces) can explain most missing teeth. In examining the data it is clear that missing teeth become a significant factor after age 35 years in four of the nine data sets with 5 teeth (15%) on average missing per subject. Tooth loss in Mangaia, Tokelau, Kiribati and W. Samoa are of a lower order than Fiji an Rarotonga - both
moderate decay prone populations. On the other hand the sharp increase in the prevalence of missing teeth after 45 years in low decay prone populations such as Tonga and Tokelau can be allocated to gum disease. Although not well reported for the Region the prevalence of decay initiated as a cause of gum disease induced recession may explain much of tooth removal in older adults.

While some studies present data differentiating between the reasons for missing teeth, i.e. decay or gum conditions, in moderate to high decay populations this becomes increasingly difficult with age. In general missing teeth before 44 years of age are usually associated with decay, in later age the contributions from decay and gum problems are unclear.

In Tokelau (1963) a surprisingly high need for tooth extraction was reported despite low caries prevalence. Most adults (73-100%) required at least one extraction for tooth decay and more than 16% of adults over 35 years also required multiple more tooth extractions because of gum disease. Data from Tonga showed that almost 20% of adults were edentulous by 55 years and 70% by 64 years; an additional 20% of subjects over 50 years, were recommended for total extraction of their remaining teeth. In Fiji it is estimated that more than 71% of adults, 55+ years, required dentures because of the high level of missing teeth.

Preventive programmes

There is no therapeutic 'magic bullet' that will deal with established endemic gum disease as described for Pacific island populations. All evidence points to a need to reduce the accumulation of microbial plaque on tooth and calculus surfaces as the key factor for successful prevention. Primary prevention, targeted to a few minutes of daily self care is the only practical and feasible approach to overcoming the problem. The magnitude of treatment needs for established disease 'adult onset chronic marginal periodontitis' is beyond health care resources in the Region. While adoption of regular oral cleansing appears a simple solution to problem, the socio-economic barriers impede its general adoption.

Nevertheless several investigators and others, clearly understood that improved oral hygiene (low plaque levels) is essential if destructive gum disease is to be controlled. Camrss, in particular, was ahead of the times in his appreciation of appropriate community dental services required to cope with the magnitude of prevention needs in developing countries. It is unfortunate that his 'vision' and early pilot studies passed unnoticed. The problem has been lack of acceptance and implementation of the essential community preventive programmes that would ensure adoption of oral cleansing as well as general cleanliness in childhood and adolescence. A WHO supported 3-year field trial in Tonga provided a practical test of the outcomes of introducing a 'community preventive programme'. The data showed the expectations of community dental health education, adoption of daily brushing at ages 15 to 40 years, with or without calculus removal. As expected, in all villages the success levels were better the younger the subjects, the less progressed the disease and when mouths were made calculus free. Success was dependent on a community supported, supervised and monitored health education programme.

In the period 1970-85, regional dental personnel benefited from South Pacific Commission (SPC) and World Health organization funded educational activities. This included formal and informal collaborations, and monitoring of oral health initiatives. The outcomes were successful in terms of a more informed dental provider workforce familiar with epidemiological surveys and implementation of various preventive programmes.

Recommendations of chief dental officers' meetings (1978, 1982, 1990) and various training courses over the past 25 years have emphasized the scientific basis; epidemiology of prevention to initiate improved gum health in the Region.

Discussion

The information presented in this review includes data collected using different procedures, field conditions and criteria, by examiners of varying experience. The assessing criteria included subjective overall visual clinical examination; examination limited to index teeth only bases; and assessment with or without use of probing for gum recession and pocket depth. Supra and sub gingival calculus, and missing teeth were not always recorded. While some surveys are based on small samples and minimal criteria others are quite robust in epidemiological terms - cross- sectional with respect to sample size, age, and gender. One of the most detailed studies included data for all teeth assessed, by physical probing for attachment loss (pocket depth and recession) by all tooth surfaces, assessment for gingival inflammation, presence of supra and sub gingival calculus, and missing teeth. This study substantiated the general conclusions of other studies - that progressive, chronic generalized marginal periodontitis and associated calculus is endemic in all adult communities surveyed. It is unlikely that our understanding of the disease distribution and severity will be much advanced by further simple epidemiological studies.

Past and most probably present lifestyles in rural, low socio-economic populations appear incompatible with the maintenance of healthy gum conditions in children and adults. A high proportion of Pacific island communities lead subsistence lifestyles, based on fishing and basic agriculture. The question of dealing with the gum problem poses difficulties. In fact in 1985 it was noted that, from a multi-country survey of Asian populations, that periodontal disease was a 'debilitating dental problem which affects millions'. The author proposed short-term trained aides for removal of calculus, plaque and extraction of teeth affected by terminal gum disease. Camrss was emphatic that control of disease required the input of limited trained dental care providers working with the community care providers to implement appropriate community programmes. Cutress et al demonstrated the potential benefits of introduced brushing in village communities across the age 15-40 years.
Studies of trends in the Pacific islands since the 1950's have identified a wide range of health changes in island communities. These appear mostly linked to dietary changes, and lifestyle changes associated with urbanization. A review of health trends in Pacific Island peoples settled in New Zealand noted an increased prevalence of dental caries, hypertension, coronary heart disease, gout, diabetes and cancer in most island communities but no mention of gum disease. While the slowly progressing and painless nature of the disease commonly excludes its recognition as a health problem, its impact on general health may be significant. Increased diabetes, caries are two other conditions which increase the problems of gum disease of this endemic chronic inflammatory disease of adults. This review concludes that gum disease is endemic throughout the region. While the severity of the disease in adults varies between communities - endemic chronic gum disease is common to most adults throughout life. The only known resolution is the maintenance of dental plaque deposits to a level, which does not induce gingival inflammation.

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