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Contents **Page**

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Message from Editor In Chief

Greetings !

The 9th International Conference of Asian Academy of Preventive Dentistry (ICAAPD) held in Kuala Lumpur, Malaysia in 2010 successfully brought forth the importance of sharing knowledge and experiences as well as identification of problems and needs of diverse Asian nations.

While problems identified maybe similar, what intrigues oral health prevention and dental public health proponents are the uniqueness in how nations managed their problems under different cultural landscapes. The ideas themselves are the Art of Survival! The 7th Volume of IJOH hence, takes pride in sharing some of the above information as penned down by our colleagues from several nations on their work, thoughts or research findings. We know there are many more potential good work that can be published.

IJOH, a peer reviewed official journal of the Academy and published annually since seven years ago, aims to move on and improve in the near future and be listed amongst the best. We are optimistic that we can reach that height one day in the near future. But we are realistic enough to note that we can only reach there if more of our professionals send in articles to be published in the future editions of IJOH. So, please do not hesitate just to do that!

Until we meet again at the 10th ICAAPD meeting in Ulanbaatar, Mongolia on 14-16 September 2012, best wishes for a Prosperous and Productive 2012 and sincere thanks to all colleagues, manuscript contributors, editors and reviewers as well as the moral and professional support of Members, Board of Executive of Asian Academy of Preventive Dentistry.

Sincerely

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Original Article

A discussion of factors influencing the oral health of Australian Aboriginal and Torres Strait Islander population

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Abstract

Aboriginal and Torres Strait Islander people encompass the Indigenous population of Australia. There is evidence to support glaring disparities in health outcomes ranging from life expectancy to oral health among Aboriginal and Torres Strait Islanders, compared to the rest of Australians. Narrowing down such inequalities has become one of the overarching goals of policymakers. Indigenous people carry a significant burden of oral diseases such as dental caries, tooth loss and periodontal disease, compounded by an unsatisfactory level of utilisation of dental care services. However, little is discussed about the distinct influence of social determinants on those issues. Against this backdrop, this discussion reviews the potential influence of social determinants on poor oral health outcomes for the Australian Aboriginal and Torres Strait Islander population. It is clearly acknowledged that factors including race relations, housing and social history are important global influences (upstream) on health capacity. More specifically, geography, employment and education are well known factors with direct (downstream) influence on peoples oral (and general health). Consideration of these influential factors provides the rationale for narrowing down the oral health inequality gap among Aboriginal and Torres Strait Islanders and rest of Australians.

Keywords: Aboriginal and Torres Strait Islander people, social determinants, oral disease burden.

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Introduction

Aboriginal and Torres Strait Islander people are the Indigenous population of Australia, representing 2.5% of the total Australian population[1]. There are stark disparities in the health and well-being of Aboriginal and Torres Strait Islander people compared to non-Indigenous Australians. Aboriginal and Torres Strait Islander people have a life expectancy 15-20 years shorter, over 40% of Indigenous children have been in detention centres, there are lower levels of employment and education and much higher levels of homelessness and chronic disease[2,3,4,5,6,7,8,9]. In Australia health care has improved significantly over the past century and the general population is significantly healthier as a result. Nevertheless, there has been sluggishness in translating these advances to ameliorate glaringly worse health outcomes for Aboriginal and Torres Strait Islander people[10].

Indigenous people suffer very significant oral health issues.[11] this lead to poor quality of life and significant suffering. It is estimated that the rates of dental caries for Aboriginal children is twice the comparable non-indigenous children.[12] This burden of disease has for a very long while being under-estimated in the data presented as many Aboriginal people have suffered significant disengagement from mainstream health systems and therefore have suffered at a population level from under-reported disease burden in the mainstream reporting systems.

This discussion reviews the factors influencing the substantial burden of oral disease and oral health inequalities among Aboriginal and Torres Strait Islander people.

Method

This discussion is not a systematic review. Research focused on Aboriginal oral health is limited and spread over a significant time-span. There are very few publications focused on this area, and all but a tiny minority would be deemed to have significant flaws based on the principles of systematic review. From this base the authors decided to extract from PubMed all publications associated with key words that include Indigenous Australians in preparing the discussion paper. It was clearly evident that taking a full systematic approach on such a small and diverse array of published work would result in a very limited outcome.

Oral disease burden

Aboriginal[a] Australians experience higher rates of oral disease and visit the dentist less frequently than their non-Indigenous counterparts[13,14,15,16]. They also suffer

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[a] For simplicity the rest of the text of this review will use the term Aboriginal but should be read as inclusive of Torres Strait Islander people.

levels of untreated caries more than twice that found in the non-Indigenous population[17]. In older generations, Aboriginal Australians are 5 times more likely to be edentulous, have higher reported levels of periodontal disease, are more likely to report fair/poor oral health and to experience toothache and food avoidance[18,19,20]. Moreover, they experience higher levels of attrition and tooth wear, are more likely to report a need for a filling or extraction and are more likely to have a tooth loss due to pathology or trauma[18,19,20]. In addition, Aboriginal Australians are more likely to suffer from oral cancer and other sinister pathologies[8]. Aboriginal children experience higher levels of oral disease than non-Indigenous children[21,22,23,24,25]. Hospitalisation for oral disease is more common among Indigenous Australian children[20] whilst visits to the school dental service and private dental care are less common[13,21].

Philosophical perspectives on health

The philosophical beliefs for life of Aboriginal people is different from Europeans and embedded in a strong commitment towards a more holistic, extended identity which is intrinsically interlinked to nature, society, knowledge, values and spirituality[26]. Moreover, the philosophical perspective of these people has been identified as an important influential factor on their health outcomes[27]. Health itself is a multidimensional construct with physical, psychological, emotional and spiritual dimensions and oral health is an integral component of overall health and well-being of an individual. Against this backdrop there is a need for culturally appropriate, oral health care by embodying a *holistic approach* aimed at reducing inequalities in oral health and access to dental care among Aboriginal people. Nevertheless, there is a lack of coherent articulation and capturing of the values of *"the Aboriginal concept of holism*" in existing explicit health policies[28].

History/Colonialisation

The colonisation of Australia has not been recognised as a contributory factor to the health and well-being of Aboriginal Australians[29,30]. Durkheim (1933), investigated the effects that industrialisation had on health, and found that the declining health of the nation could be attributed in part to the alienating effect of industrialisation. He claimed that modern society relinquished traditional beliefs without finding satisfying substitutes that are required for the needed social solidarity, social control, psychological support and systems of meaning[31]. Applying a similar argument to the Australian context it can be said that European colonisers took traditional philosophical perspectives to life, culture and religion which were not replaced with satisfactory substitutes, leading to a decline in the social fabric of the people and ultimately a decline in health.

Racism

There is a past history of violence towards the Aboriginal Australians in the 19th century as well as the racist policies during the 20th century[32, 33,34, 35,36,37,38]. This has resulted in a deep sense of insecurity and mistrust within the Aboriginal communities towards the mainstream institutions of non-Indigenous society, including the health system[32,34,35]. Racism affects not only the fabric of a society but also has significant detrimental effects on the population as individuals[34,39,40]. Racism has been shown to lead to depression and stress[34,39].

Employment and Welfare

Employment impacts positively on people's health, including oral health, by increasing their sense of self worth and self esteem[41,40,42]. Currently in Australia, Aboriginal people report significantly higher rates of unemployment[4,6,7]. In 2004, 52 percent of all Indigenous people relied on welfare as the main source of income[7], the reliance on such a system and the consequent lack of 'usefulness' felt by the many Aboriginal people can be harmful to their general, mental and oral health. It is known that a decrease in mental health is associated with an increase in health risk behaviours and preventable diseases such as dental caries[43,44,45,46]. Moreover, the perceived 'welfare nation' creates additional health problems for the Aboriginal people, with welfare often used as a means to discriminate against them[47,48]. Welfare recipient often rely heavily on the under-staffed and arguably under-funded public dental care system. There is evidence to support the theory that the Australians on welfare are less likely to access dental care for regular maintenance[10] rather attending at times where an actual problem exists[13]. Statistics show only one in five health care card holders receives dental care from a public dental clinic per year[49] and have on average 3.5 less teeth than non-card holders[49]. Those 'eligible for public dental care' were more likely to have untreated dental decay, periodontal disease, have irregular dental attendance and be six time more likely to have complete tooth loss than higher income people[50,51]. Due to the number of people trying to access public dental services and the scarcity of dentists willing to work in the public sector[15,52,53], waiting periods for public dental care are lengthy in many parts of Australia[19,52,53].

Housing

Overcrowding is a common occurrence in Aboriginal communities especially in rural, remote and town areas[4,7,35,54]. The links between preventable infectious diseases and overcrowding are well recognised with many reports of increased levels of scabies, inner ear infections and dental caries in overcrowded situations[7,29,32,54,55]. In one remote Western Australian community, where over-crowding is common many patients comment that they have toothbrushes, but they do not last long as someone else quickly takes them[56]. As well as the quantity of housing, the quality is also a concern for Aboriginal people. A survey conducted in 2001 by Bailie and Runcie[54] revealed that only 54 percent of all households had the ability to wash people (that is hot/cold running water with a drain) and one could extrapolate from this that the same percentage would have the ability to brush their teeth. Only 38 percent had the facilities to prepare food (taps, stoves, bench etc).

In terms of home ownership, most recent statistics indicate that less than 30 percent of Aboriginal people own their own homes compared to 70 percent of non-Indigenous Australians[7]. Whilst not directly impacting on health it does complicate the equation for Aboriginal

people reducing their ability to be 'master of their own destiny' with resultant flow-on effects to health[35].

Education

Aboriginal people currently have poorer educational outcomes than their non-Indigenous counterparts[2,3,4,7,35,57]. Moreover, year 12 retention rate for Aboriginal children is 36 percent compared to 73 percent for the total Australian population[48]. It has been hypothesised that lower educational attainment levels are related to inferior oral health outcomes and lower dental attendance among population groups[17,58].

General Health

Aboriginal people experience health problems which have oral consequences at levels higher than non-Indigenous Australians. Diabetes, renal disease, rheumatic fever and psychological illness are such examples and have been shown to influence the incidence, treatment and the progression of dental disease[2,5,6,7,59,60,61,62]. The incidence of diabetes among Aboriginal people is disproportionately high (29.6 percent with 3.4 percent of non-Indigenous people)[63] and is a considerable health problem. The relationship between diabetes and periodontal disease is well established[59,60]. One study found that persons with non-insulin dependant diabetes mellitus are up to 3.4 times more likely to have periodontal disease than people without diabetes[60,61]. It is also important to note that uncontrolled diabetes is also closely associated with many other oral conditions such as xerostomia and fungal infections. Aboriginal children have the highest rate of rheumatic fever in the world[62] and precautions are necessary to prevent bacterial endocarditis when considering dental treatment.

About half of all Aboriginal people are smokers which is double the population average for Australia[13]. The links between smoking and oral pathology, particularly periodontitis and oral neoplasms[61,63] are now well established. In the case of psychological illness, Aboriginal people are more likely to suffer from depression and overwhelming feelings of hopelessness than the non-Indigenous population[45,61]. This again may have a negative effect on oral health, as regular tooth brushing and oral hygiene maintenance are neglected when a difficult period of life is encountered and anxiety and stress may lead to improper nutritional intake (carious foods) and xerostomia[43,64,65].

Geography

Over a quarter of Aboriginal people live in rural and remote areas and research indicates higher levels of oral disease among rural and remote dwellers compared to their urban counterparts[49,64]. The reasons for this are probably related to the aforementioned problems of the public dental health service in Australia and the lack of access to dental professionals for both treatment and preventive education in the remote and rural areas. The Australian dental services are poorly distributed geographically with no dentists available in some rural and remote areas[66].

Fluoride

The efficacy of fluoride in the prevention and control of dental caries is well-established[67]. Fluoridated water has long been proven as an effective measure in protecting against dental caries[67,68,69]. Exposure to fluoride has been recognized as an influential factor for oral health disparities[70]. There is a marked variation in water fluoride levels among rural and remote Aboriginal communities[71] compounded by the difficulties encountered in fluoridating their water supplies thus making it unavailable as a preventive measure. Furthermore, rural and remote Aboriginal communities are further disadvantaged by the unavailability of fluoride toothpastes and if available, the three times higher costs compared to cities[71]. These factors interfere with maximizing the benefits of tooth brushing with fluoride toothpaste as a routine behaviour conducive to oral health.

Diet

Prior to colonisation Aboriginal people had a healthy traditional diet of a variety of bush foods. Studies have shown that during this time, dental caries was exceedingly rare among Aboriginal people[72,73]. However, as at present traditional ways of obtaining and cooking food have been all but lost, and replaced with food which is highly processed and low in nutrition. The Western Australian Child Health Survey reported that the diet of only one in five Aboriginal children met all four of its indicators of dietary quality[74]. Studies also have shown consumption of sugar, white flour and sweetened carbonated beverages at much higher levels than in the non-Indigenous population in remote communities[2,3,4,61,74,65,75].

The high costs of fresh produce in remote regions (with food reportedly up to 150 -180 percent more expensive than that in major centres) has contributed to the increased demand for cheaper, cariogenic foods with lower nutritional value[18,61]. The effect of diet on oral health is not exclusively confined to dental caries. Studies report that malnutrition, particularly in children, is a modifying factor for periodontal disease. Studies across Australia have shown that nutritional deficiencies amongst Aboriginal people are disproportionately higher than non-Indigenous people[67-69]. Malnutrition has also been associated with enamel hypoplasia which increases the susceptibility of a tooth to dental caries[61].

Summary

The conclusion that is drawn from this discussion is that there is a very complex set of variables leading to poor health outcomes (and in particular oral health outcomes) for Aboriginal people. The interplay of upstream and downstream variables varies from community to community and the strength of each variable differs dramatically. The key outcome of this discussion is the requirement of policy makers to accept that a more suitable and holistic approach to oral health care is needed. Imperative to this is the requirement to take a community by community approach to looking at each variable - and its weighted influence in individual communities. At the core of these influences is the overarching effect of colonialisation and disempowerment. These pervasive factors have been

found world over to have very significant negative effects on general health and wellbeing, and, as has been offered here, with deleterious follow-on effects to oral health.

Conclusion

Oral diseases are largely preventable, and when they do occur, interventions are available to limit their progression, alleviate symptoms and restore function to near normal. Improved oral health for all Australians should be a significant public health goal and equitable dental care delivery should be a significant health service goal. The current oral health crisis faced by Aboriginal and Torres Strait Islander people results from the same set of factors that have led to poor general health and is aggravated by the current dental systems 'neglect' for the poor and socially disenfranchised.

Strategies to reduce the burden of oral disease and narrowing inequalities in oral health among Aboriginal and Torres Strait Islander people need to originate from policymakers in robust collaboration with local communities, almost at the level of each unique community. The development of practical strategies to address oral health have seen some innovative models that have had sustainable success particularly in remote areas of Australia based on addressing in a local way the issues outlined in this discussion[76].

It is also important to ensure cultural security in provision of oral health care to indigenous communities. Social and economic inequalities magnify oral health inequalities among Aboriginal Australians compared to the general Australian population. An insight and understanding into social determinants as upstream (eg. historic, political, social and economic contexts), intermediate (eg. community infrastructure, resources, systems and capacities) and downstream (eg. health behaviours, physical and social environments) effect on the oral health of Aboriginal and Torres Strait Islander people, as reviewed here, provide the basis for lasting health improvements by cooperative action.

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Original Article

A Modified Aesthetic Component of IOTN among Malaysian Population

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Abstract

Introduction: Index of Orthodontic Treatment Need (IOTN) consists of two components, Dental Health Component (DHC) and Aesthetic Component (AC) are widely used to prioritize orthodontic treatment need. However, the AC can be subjective in evaluating treatment need and exclude some of malocclusion such as reverse overjet and openbite. The objective of this study is to develop a modified AC (mAC) of IOTN which represent all types of malocclusion and is also closely related to the DHC. **Methods:** A total of 100 anterior views photographs taken from Orthodontic Clinic. The photographs were classified into 3 main groups according to treatment need i.e. no/slight treatment need group, moderate need group and need treatment group. Nine orthodontists rated the photos from grade 1- 10 using conventional AC. Photographs which represent each type of malocclusion with the highest agreement were selected into the new mAC. DHC criteria was used as a guide during all selection procedures. **Results:** From 100 photos, 24% photos fall into no treatment group, 41% photos fall into moderate need group and 35% photos in need treatment group. 16 photos were further selected to form the new mAC and the percentage of agreement range from 44.4 to 100%. **Conclusions:** A new modified Aesthetic Component of IOTN has been developed which comprises of 16 photographs with various types of malocclusion incorporated. However, it will be further tested before being adopted in local setting.

Keywords: *aesthetic, treatment need, orthodontic, IOTN*

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Introduction

Demand for orthodontic treatment has continually risen, as reflected by increasing number of patients on waiting lists for orthodontic treatment. In view of the fact that resources are insufficient to meet the demand for orthodontic care, there is a need to prioritize orthodontic treatment in order to reduce the long waiting time. A good method of measuring malocclusion is important for assessing level of treatment need. Determination of orthodontic treatment need should not be supported from professional view point only, but it should also be assessed by patient.

Assessment of aesthetic was initially done using the Standardized Continuum of Aesthetic Need (SCAN) by Evans and Shaw (1987). This index was then incorporated into the IOTN as a component of measuring aesthetic[1]. IOTN as a whole consists of two separate components, the Dental Health Component (DHC) and Aesthetic Component (AC). The AC of IOTN consists of a ten-point scale illustrated by a series of photographs showing different levels of dental attractiveness, grade 1 representing the most attractive and grade 10 the least attractive dentitions.

The AC of IOTN was found to be useful tools in assessing patient's self-perception of their dental aesthetic and can be use as an instrument in patients counseling. However, there are few disadvantages of this conventional AC. The two components of IOTN often are not intercorrelated to each other where dissimilarity of treatment need was made[2]. Furthermore, AC of IOTN was developed based on Caucasian population and did not cover all types of malocclusion such as Class III malocclusion, anterior open bite and reverse overjet as these malocclusions are presented more in Malaysian population as noted by Woon et al.[3].

The selection of AC grade can be promptly attained if the patient's particular occlusal traits were represented in the photographs. This observation was reflected in the results from previous studies which indicated that there are high tendency of patients to match their occlusal morphology to the photographs presented in the AC[4-6]. Therefore, the aim of this study was to develop a modified Aesthetic Component (mAC) of IOTN which counteract the disadvantages of the conventional AC of IOTN.

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Materials and Methods

Stratification of photographs

100 frontal views of intraoral photographs were selected based on inclusion and exclusion criteria listed in Table 1. All photographs were taken from Orthodontic Screening Clinic and Out Patient Clinic, Universiti Kebangsaan Malaysia. Ethical approval and patients' consent were obtained prior to the start of this study. The photographs were classified into 3 groups based on treatment need graded i.e. no/ slight need treatment group, moderate need treatment group and need treatment group. In order to make the classification procedure more objective, all photographs were classified based on criteria presented in the DHC of IOTN. This stratification procedure was done by 3 orthodontists in order to facilitate the validation process. Calibration for assessment of treatment need among member of project was done.

Rating of photographs by Orthodontists

The 100 photographs which have been classified into three groups based on treatment need were then rated by 9 orthodontists from Universiti Kebangsaan Malaysia and Ministry of Health. The photographs were viewed in the form of soft copy (Powerpoint presentation). After viewing each photograph, the orthodontists rated the photographs from score of 1 to 10 based on their justification of dental attractiveness in a scoring sheet provided. During validation, DHC of IOTN was also provided as a guide in order to make the judgment more objective.

Data were analyzed using SPSS software version 19.0. Each photographs' grades were analyzed descriptively. The photographs with the highest frequency of agreement in one allocated grade were pooled together. In a case of a similar highest frequency for 2 grade of one photograph, the photograph was placed in both grades as selected by the participants.

The pooled photographs in the individual grade were then ranked in a descending order based on the frequency of agreement. The selection of photograph to be incorporated into the newly modified AC was done by project team. The DHC criteria were used as a guide in the placement of selected photographs into the allocated grades of 1 to 10.

Photographs with high ranking and presence of various types of malocclusion e.g. reverse overjet, openbite and crossbite were incorporated in the new mAC. These photographs were selected to represent each grade of IOTN from 1-10. Short initials were used together with the main AC grade to represent additional occlusal traits that were incorporated in the new mAC as shown in Table 1.

Results

Stratification of photographs

From the 100 photographs, 25 photographs were classified in the no/slight need treatment group, 37 photographs in moderate need treatment group and 38 photographs in the need treatment group. Calibration between team members were made with the kappa value of 0.92.

Rating of photographs by Orthodontists

Total number of photographs being selected into the AC grades from 1 to 10 is shown in Figure 1. In the no/slight treatment group (Grade 1-4), most photographs were pooled in grade 3 (8%), followed by in grade 2 (7%). 5% photographs were placed in grade 1 and 4 % photographs in grade 4.

Table 1 : Percentage of agreement among Orthodontists

Photograph	Number of Orthodontists	Percentage of agreement (%)
1	8	88.9
2	9	100
3	7	77.8
4	5	55.0
5SP	5	55.6
6CR	7	77.8
6XB	5	55.6
7OP	6	66.7
7OB	6	66.7
7OJ	4	44.4
8OJ	6	66.7
9OB	5	55.6
9XB	6	66.7
10OP	9	100
10CR	9	100
10RV	8	88.9

SP- spacing, CR- crowding, XB- crossbite, OP-openbite, OB-overbite, OJ-overjet, RV-reverse overjet

In the moderate treatment group (grade 5-7), 20% of the photographs were pooled in the middle grade i.e. grade 6, 15% photographs in grade 7 and 6% of the photographs in grade 5. In the need treatment group (grade 8-10), similar pattern of selection were seen. Most photographs were pooled in the middle grade of 9 (18%). This was followed by the end grade of 10 (10%). Only 7% of the photographs were selected into the grade 8.

The modified AC of IOTN

A total of 16 photographs from 100 photographs were selected to represent each grade and types of malocclusion (Figure 2). Table 1 showed percentage of agreement among orthodontists for the selected photographs.

For the no/slight treatment need group, the highest ranking photographs in each allocated grade were selected to represent each grade. The agreement was between 55-100% as shown in Table 1.

Starting from grade 5 onwards, short initial has been introduced in the mAC grade to incorporate various malocclusions. Spacing was represented by the photograph 5SP with agreement of 55.6 %. Crowding were represent in mAC by grade 6CR and 10CR with 77.8% and 100% agreement respectively. Anterior crossbite was shown in mAC grade of 6XB with agreement of 55.6% while posterior crossbite was represented by the mAC grade of 9XB (66.7%). Grade mAC of 7OP and 10OP represent openbite with agreement of 66.7% and 100% respectively. Deep overbite are shown in mAC grade 7OB with agreement of 66.7% and mAC grade 9OB with agreement of 55.6%. Meanwhile, overjet are represented in 7OJ and 8OJ with agreement of 44.4% and 66.7% respectively. Malocclusion with reverse overjet was also incorporated in this new mAC of grade 10RV with agreement of 89% achieved.

Discussion

The Modified Aesthetic Component of IOTN which had been developed consists of 16 intra-oral anterior view photographs as shown in Figure 2. The treatment need category grading from the conventional AC whereby grade 1 to 4 represent no need treatment category, grade 5,6 and 7 represent moderate need group and 8,9,10 represent need treatment group 7 were maintained in the new modified AC.

Modified Aesthetic Component consists of 6 additional photographs that were added to include more types of malocclusion that have not been covered in the conventional Aesthetic Component. Among the 6 additional photographs, 1 additional photograph was placed in the grade 6 and 9 and another 2 photographs were added in grades 7 and 10. The types of malocclusion added in this new mAC were reverse overjet, crossbite, anterior open bite and spacing.

Those malocclusions were included to represent some of malocclusion as presented in a study done in Malaysia by Woon et al.[3]. Reverse overjet were found in 4.7% of Chinese population, 2% in Malay and 2.4% in Indians. This study also showed 6% of Chinese, 1.3 % of Malay presented with openbite. Posterior crossbite were found in 6.5% of Chinese, 5.7 % in Malay and 4.8% in Indians.

Dissatisfaction with dental appearance is widely related to the severity of occlusal irregularities[8] but there were differences in the recognition and evaluation of dental features[9]. Therefore, by incorporating more types of malocclusion, the decision in choosing the grade for Aesthetic Component would be more quickly and easily as stated by Grzywacz [4]. The absence of similarity of dental photographs made assessment of Aesthetic Component difficult for the patients [4] as patients tend to match up their own malocclusion to the photograph provided in Aesthetic Component [4-6].

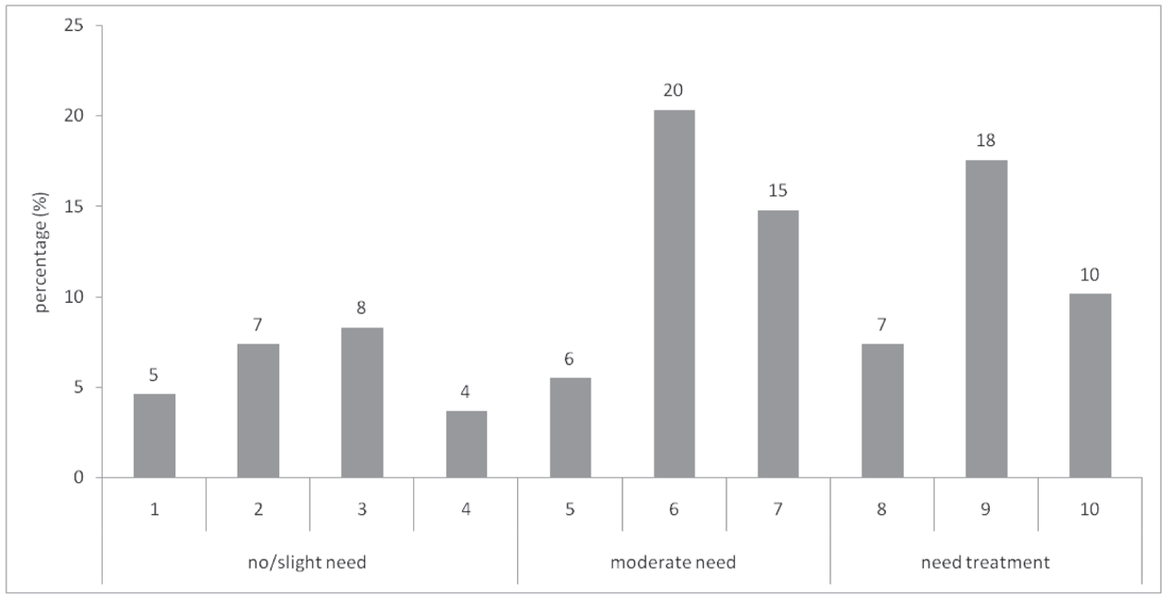

Figure 1 : Percentage of photographs being selected into the AC grades according to treatment need category of no/slight need, moderate need and need of treatment.

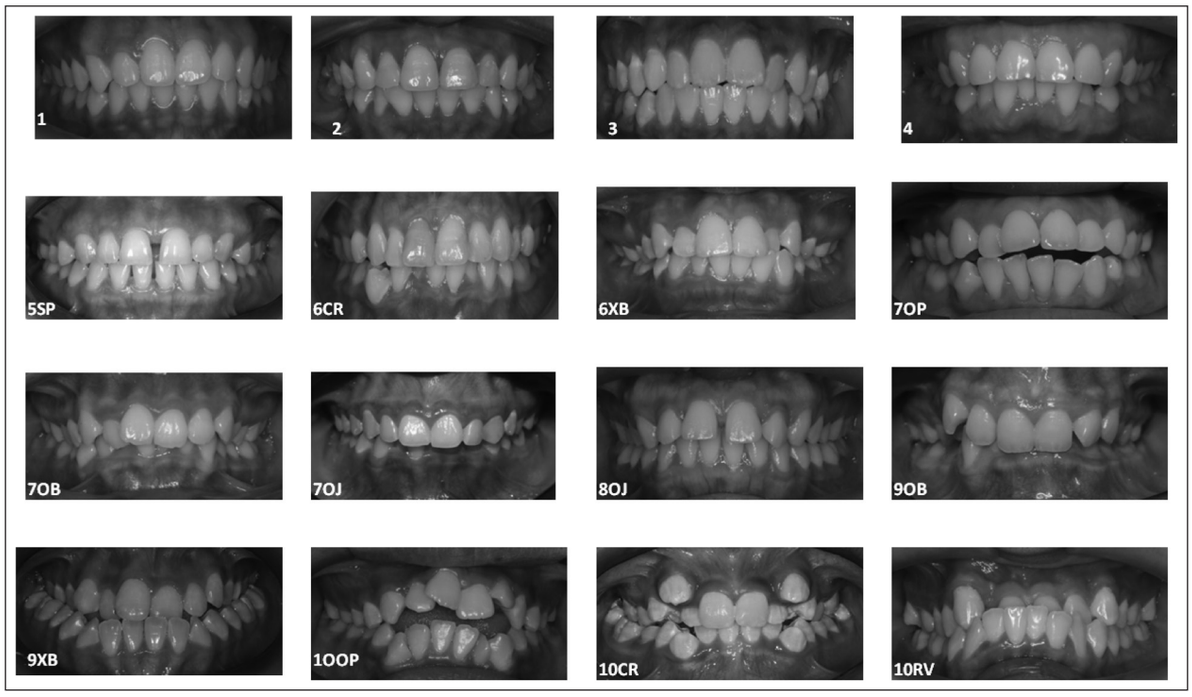

Figure 2: Modified Aesthetic Component of IOTN

The treatment needs assessed using DHC and AC can be contradictory where one component suggested for treatment and not for the other component. This was found in study by Abdullah and Rock[2] where orthodontist scored 47.9% of the student in need treatment group according to DHC whilst only 22.8% in AC. Therefore in order to produce a new modified AC that correlate closely with DHC, the orthodontists were requested to use Dental Heath Component grading as a guide to produce a scale that almost correlate with AC grade.

This procedure might lessen the subjectivity of the AC of IOTN and the discrepancies between the grade scored in DHC and AC would be minimized. A study by Mugonzibwa et al. has proven that by incorporating more types of malocclusion in the AC, the discrepancy between DHC and AC can be reduced. They incorporated additional 8 photographs in the Aesthetic Component and better agreement of 22% in DHC and 11% in AC were found[10].

With the modification of Aesthetic Component, it may offer a better reflection of lay person's evaluation of their own dental attractiveness and serve as a basis for discussions between orthodontists, parents and children[6]. It can also serve better function in assessing level of attractiveness. A field testing of this newly modified AC of IOTN will be conducted to test its effectiveness in assessing level of treatment need in schoolchildren.

Conclusion

Modified Aesthetic Component of IOTN has been developed which comprises of 16 photographs with various types of malocclusion incorporated.

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Original Article

Effect of socioeconomic status on gingival health following periodontal therapy

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Abstract

Objective: To evaluate the effect of socioeconomic status (SES) on oral hygiene maintenance in patients with moderate to severe gingival inflammation following periodontal therapy. **Materials and methods:** Eighty subjects with moderate to severe gingival inflammation were selected in an age group of 30-60 years. Gingival inflammation was assessed based on the modified sulcus bleeding index (mBSI) and oral hygiene was assessed using Patient hygiene performance index (PHP). Both the values were recorded at baseline and 3 weeks after periodontal therapy. The socio-economic status was recorded based on the education, occupation and family income per month (in Indian rupees `) using KuppuSwamy's socioeconomic status scale (2007). **Results:** Moderate to severe gingival inflammation and fair to poor scores of patient hygiene performance were obtained before treatment. However, these scores were seen to improve after periodontal therapy irrespective of the socio economic strata. The results were found to be statistically significant within the groups ($P < 0.001$). **Conclusion:** SES has a significant effect on the oral hygiene maintenance and the presence of gingival inflammation. Oral assessment after periodontal therapy revealed that people from lower and disadvantaged groups were as equally inclined to practice oral health care as those from more affluent groups.

Keywords: *socio economic status, gingivitis, periodontal therapy, maintenance*

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Effect of socioeconomic status on gingival health following periodontal therapy

Gingivitis and periodontitis are two major forms of inflammatory diseases affecting the periodontium. The primary etiologic factor being bacterial plaque, which initiates destruction of gingival tissues and periodontal attachment apparatus.[1,2] While gingivitis reflects the reversible inflammatory changes in the gingiva, periodontitis is characterized by loss of connective tissue attachment and alveolar bone respectively.

The mainstay of periodontal therapy to date involves the reduction of the bacterial plaque, thereby reducing or eliminating inflammation and allowing the gingival tissues to heal.[3] To prevent further progression of the disease process as well as to prevent re-initiation of inflammation, an appropriate supportive periodontal maintenance program is needed to be followed. This supportive program includes effective personal as well as professional care and also periodic monitoring of the gingival health of the individuals.

The field of social determinants of health is thought to be the most complex and challenging of all. It is concerned with the key aspects of living and working circumstances of individuals, thus reflecting their lifestyle.[4] Inequalities in socioeconomic status underlie many health disparities in the world, including oral health. It has been documented that people at a socioeconomic disadvantage suffer a heavier burden of oral health problems than their better-off counterparts.Population groups with highest poverty rates and low education level are often found to suffer the worst oral health status. At the same time, a high level of education increases the opportunity to engage in oral health-promoting behaviors.

The present study has been conducted to evaluate the effect of socioeconomic status on the oral hygiene maintenance after periodontal therapy.

Materials and Methods

80 subjects who reported to the department of Periodontology, Manipal College of Dental Sciences Mangalore, with moderate to severe gingival inflammation [based on the modified sulcus bleeding index (mSBI) index (Mombelli,1987)][5] were included in the study. The age ranged from 30 to 60 years, and those included were systemically healthy. Patients who were diabetic, hypertensive, on immunosuppressant's, smokers, pan chewers, subjects who were on antibiotic therapy for 3 months before the study and those who underwent professional oral prophylaxis 6 months prior to the start of the study were excluded.

The bleeding index involved examining all the teeth using a periodontal probe. The scoring criterion was as follows.

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Grade 0 – no bleeding on probing
Grade 1 – pinpoint bleeding
Grade 2 – a confluent line of bleeding is seen
Grade 3 – spontaneous bleeding is seen

An informed consent was then obtained from the included subjects and their socio economic status was recorded using the kuppuswamy's index (2007).[6]

The oral hygiene status was recorded using the Patient hygiene performance index (PHP) given by Podshadley A.G & Haley J.V 1968.[7]

This index involves the use of a mouth mirror to examine the indexed teeth; maxillary right first molar,maxillary right central incisor, maxillary left first molar, mandibular left first molar, mandibular left central incisor and mandibular right first molar.

The tooth surfaces which are assessed are the buccal of the maxillary molars, the lingual of the mandibular molars, and the labial of the maxillary and mandibular incisors.

To assess the debris on each surface, the examiner must mentally divide the tooth into five sections. The clinical crown is subdivided longitudinally into mesial, middle, and distal thirds.The mesial and distal thirds make up the first two subdivisions; each area extends to the middle third of its adjacent proximal surface. The remaining middle third is then subdivided horizontally into the gingival, middle, and occlusal thirds.Each of the subdivisions is examined for the presence of the pink-stained oral debris. If no debris is present, 0 is assigned to that section; if debris is present, 1 is assigned. The value of 1 is assigned only to those areas on which debris is definitely present. The lesser score of 0 is assigned to all questionable areas.

The baseline values of the Patient hygiene performance index (PHP1) and the modified sulcus bleeding index (mSBI1) were recorded. Periodontal therapy comprising of supragingival scaling was then carried out for the included subjects. They were given instructions on home care and each of the subjects was provided with a standard soft tooth brush. They were recalled after 1 week for subgingival scaling. At the end of 3 weeks, the PHP and mSBI were again recorded as PHP2 and mSBI2 and were then compared with the baseline values.

Statistical analysis was carried out using the statistical package SPSS 11.5. Kendalls tau – b test was used to compare mSBI and PHP before and after treatment. Chi square test (x2) was used to determine the associations and for comparison between the groups. A value of $p < 0.05$ was considered statistically significant.

Results

Out of the 80 subjects who participated in the study, 55 % (44) were males and 45% (36) females, with a mean age of 38.41 years (SD = 7.34). The demographic characteristics of the subjects have been given in table 1.

A statistically significant difference was seen in both the mSBI and PHP scores when compared before and after treatment. (Table 2 and Table 3).

A p value of< 0.001 was noted and found to be statistically significant when the mSBI values (mSBI1 and mSBI2) were recorded before and after treatment. After receiving non- surgical treatment, the scores of 28 subjects (93.3 %) changed from poor to fair; 23 subjects (56.1%) from fair to good and of 2 subjects (22.2%) from good to excellent. (Table 2)

Similar improvement and change in values was noted with regards to PHP values before and after treatment. The scores of 30 subjects (90.9%) changed from poor to fair; 23 subjects (62.2%) from fair to good and of 4 subjects (40.0%) from good to excellent which was found to be statistically significant. ($p< 0.001$) (Table 3)

In the present study it was noted that as the socioeconomic status increased, there was a reduction in both the mSBI and PHP values of both the groups (before and after treatment). (Table 4 and Table 5).

When the individual variables of the socioeconomic status viz. education level, occupation and family income were observed and compared with the mSBI and PHP values a similar trend of subjects with severe gingival inflammation and poorer oral hygiene was seen among those who had an income of rupees 979, who were unemployed and illiterates. These scores were however seen to improve after receiving nonsurgical treatment. (Graph 1,2,3)

Discussion

In the present study, female subjects had a better patient performance hygiene score compared to male subjects. This is similar to the studies conducted by various authors wherein, the periodontal condition of females was found to be better than that of the males.[8,9,10, 11, 12, 13]

Consciousness of appearance, including oral hygiene being more on part of females could be a possible explanation for consistency in the findings.

A magnitude of disease conditions is associated with SES and the cause or effect of it on the disease is plausible. Generally, those who are better educated, wealthier, and live in more desirable circumstances enjoy better health status than the less educated and poorer segments of society, and gingival and periodontal diseases are no exception.[14, 15] The prevalence of gingival diseases and its severity varies in varied social conditions. It is seen that people from a higher social class, those with a higher level of education, those living in urban areas have less severe form of gingival inflammation when compared to those who are socially backward.It is likely that the widely observed relation between SES levels and gingival health is a function of better oral hygiene among the better educated, more positive attitudes toward oral hygiene, and a greater frequency of dental visits among the more dentally aware.[16, 17]

This study demonstrated a relation between the gingival status and the educational level, occupation and the income of the subjects. With decrease in the overall level of education, reduced monthly income and among those who were unemployed, moderate to severe gingival inflammation was seen. Similarly, the patient hygiene performance score was poor among the subjects belonging to the lower socioeconomic class. This observation is in

Table 1. Description of participant characteristics

Variable	N (percentage)
Age (mean ± SD)	40.20 ± 6.21
Gender	
• Female	44 (55 %)
• Male	36 (45 %)
SES	
• Upper	7 (8.8%)
• Upper middle	3 (3.8%)
• Middle	38 (47.5%)
• Upper lower	28 (35.0%)
• Lower	4 (5.0%)
Occupation	
• Professional	4 (5%)
• Semi professional	7 (8.8%)
• Clerical, shop owner	10 (12.5%)
• Skilled	14 (17.5%)
• Semi-skilled	8 (10%)
• Unskilled	16 (20.0%)
• Unemployed	21 (26.3%)
Family income (in rupees)	
• > 2000	5 (6.3%)
• 1000 – 1999	17 (21.3%)
• 750 – 999	16 (20.0%)
• 500 – 749	18 (22.5%)
• 300 – 499	12 (15.0%)
• 101- 299	10 (12.5%)
• < 100	2 (2.5%)
Education	
• Professional/ honors	_ (0.0%)
• Graduate	14 (17.5%)
• Intermediate/ post high school	13 (16.3 %)
• High school	23 (28.8%)
• Middle school	13 (16.3%)
• Primary school	11 (13.8%)
• Illiterate	5 (6.3%)

Table 2. mSBI values before and after non- surgical treatment

		mSBI 1			
mSBI2		Good	Fair	Poor	Total
	Excellent	2 (22.2%)	0 (.0%)	0 (.0%)	2 (2.5 %)
	Good	7 (77.8%)	23 (56.1%)	2 (6.7%)	32 (40.0 %)
	Fair	0 (.0%)	18 (43.9%)	28 (93.3%)	46 (57.5 %)
	Total	9 (100 %)	41 (100%)	30 (100 %)	80 (100%)

Table 3. PHP values before and after non- surgical treatment

		PHP1			
PHP2		Good	Fair	Poor	Total
	Excellent	4 (40.0%	1 (2.7%)	0 (.0%)	5 (6.3 %)
	Good	6 (60.0%)	23 (62.2%)	3 (9.1%)	32 (40.0 %)
	Fair	0 (.0%)	13 (35.1%)	30 (90.9%)	43 (53.8 %)
	Total	10 (100 %)	41 (100%)	30 (100 %)	80 (100%)

Table 4. Socioeconomic status and mSBI scores

	SBI 1			SBI 2		
	Good	**Fair**	**Poor**	**Excellent**	**Good**	**Fair**
	N (%)	**N (%)**	**N (%)**	**N (%)**	**N (%)**	**N (%)**
Upper	5 (71.4%)	2 (28.6 %)	0 (0 %)	0 (0 %)	7 (100 %)	0 (0 %)
Upper middle	2 (66.7 %%)	1 (33.3 %)	0 (0 %)	1 (33.3 %)	2 (66.7 %)	0 (0 %)
Lower middle	2 (5.3%)	30 (78.9%)	6 (15.8 %)	1 (2.6%)	17 (44.7 %)	20 (52.6%)
Upper lower	0 (0%)	8 (28.6 %)	20 (71.4 %)	0 (0 %)	6 (21.4 %)	22 (78.6 %)
Lower	0 (0 %)	0 (0 %)	4 (100 %)	0 (0 %)	0 (0 %)	4 (100%)
Total	9 (11.3 %)	41 (51.3 %)	33 (37.5 %)	2 (2.5 %)	32 (40 %)	46 (57.5 %)

x2 = 68.26 p < 0.001
Very highly significant

x2 = 32.77 p < 0.001
Very highly significant

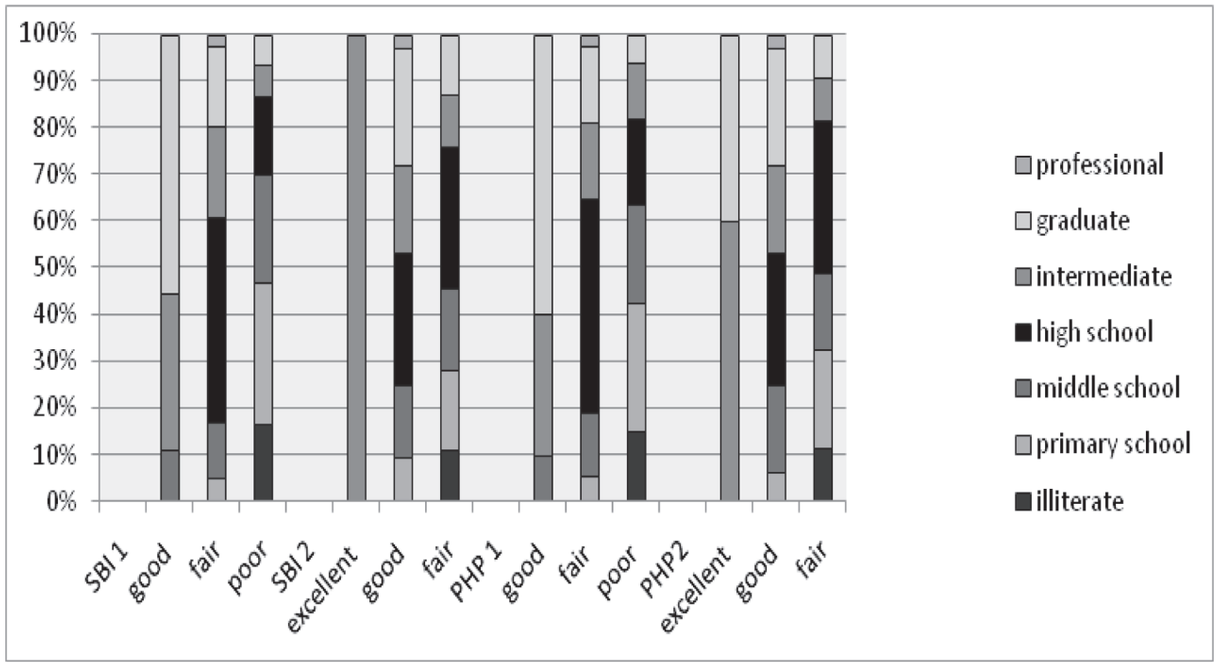
Table5. Socioeconomic status and PHP scores

SES	PHP1			PHP2		
	Good	**Fair**	**Poor**	**Excellent**	**Good**	**Fair**
	N (%)	**N (%)**	**N (%)**	**N (%)**	**N (%)**	**N (%)**
Upper	5 (71.4%)	2 (28.6 %)	0 (0 %)	1 (14.3 %)	6 (85.7 %)	0 (0 %)
Upper middle	3 (100%)	0 (0. %)	0 (0 %)	2 (66.7 %)	1 (33.3 %)	0 (0 %)
Lower middle	2 (5.3%)	27 (71.1%)	9 (23.7 %)	2 (5.3 %)	18 (47.4 %)	18 (47.4 %)
Upper lower	0 (0%)	8 (28.6 %)	20 (71.4 %)	0 (0 %)	7 (25.0 5)	21 (75.0 %)
Lower	0 (0 %)	0 (0 %)	4 (100 %)	0 (0 %)	0 (0 %)	4 (100.0 %)
Total	10 (12.5 %)	37 (46.3 %)	33 (41.3 %)	5 (6.3 %)	32 (40.0 %)	43 (53.8 %)

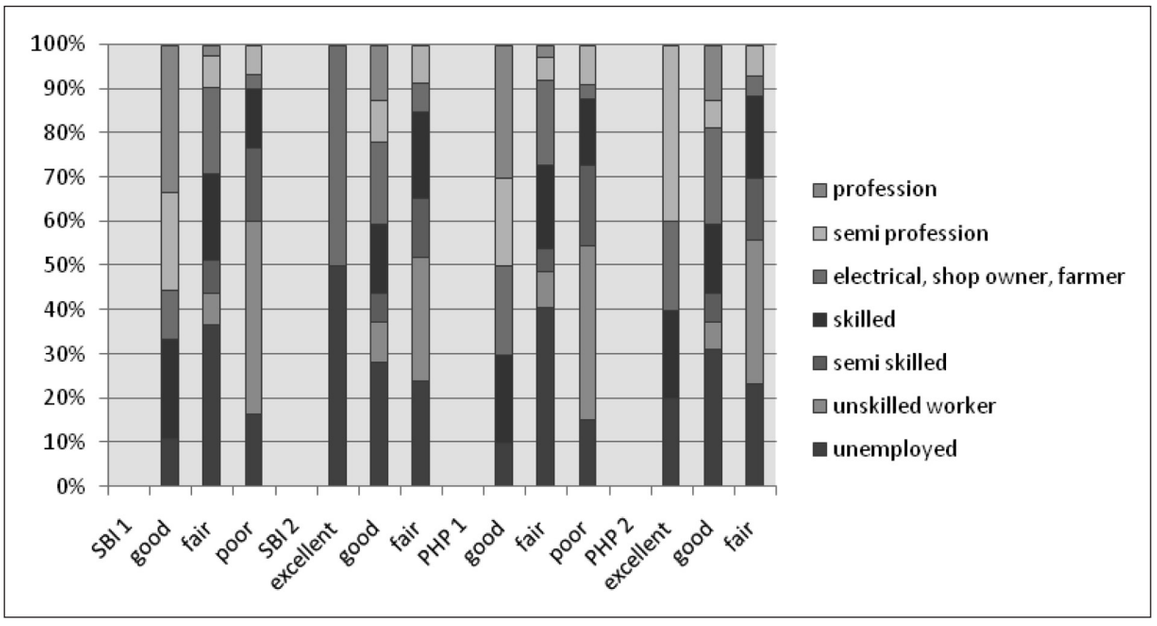
x2 = 70.65 p < 0.001
very highly significant

x2 = 37.29 p < 0.001
very highly significant

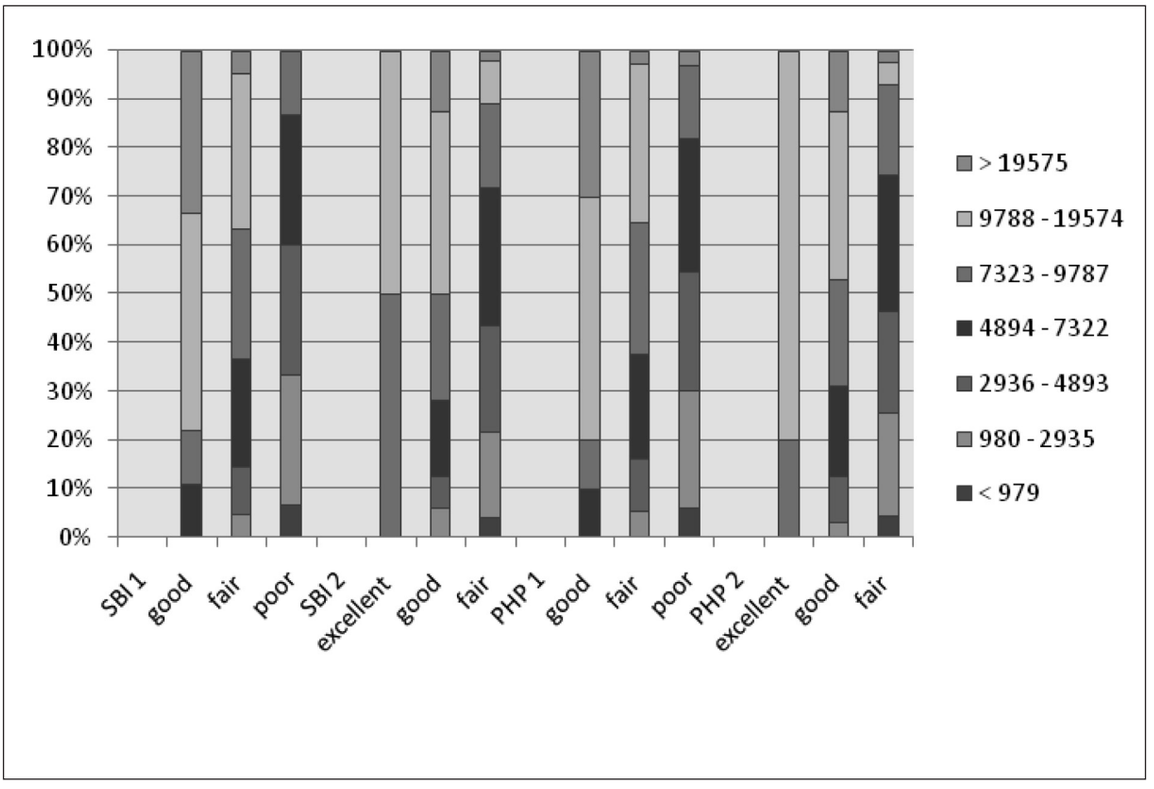
Graph 1: Education level and the sulcus bleeding index and patient hygiene performance index scores



Graph 2: Occupation and the sulcus bleeding index and patient hygiene performance index scores



Graph 3: Family income and the sulcus bleeding index and patient hygiene performance index scores



agreement with the observations of other authors.[18, 19]

It was also noted in the present study that the levels of PHP and the scores of mSBI improved after non- surgical therapy irrespective of the socio economic status of the subject, and were statistically significant.

A significant misconception held by many is that poor oral health behavior is the reason why people on low incomes experience poor oral health. Contemporary research challenges this notion by showing that people from disadvantaged groups are as equally inclined to practice oral health self-care as those from more affluent groups.[20]

Conclusion

Although oral health has dramatically improved overall in the last 20 years, oral health inequalities have widened. The present study reemphasizes the significant effect of SES on the oral hygiene maintenance and the presence of gingival inflammation. Oral assessment after non-surgical therapy also revealed that people from disadvantaged groups were as equally inclined to practice oral health self-care as those from more affluent groups.

A reduction in oral health inequalities will only be achieved through the implementation of effective and appropriate health promotion policies which focus action on the underlying social, economic and environmental causes of dental disease.It is necessaryto implement strategies that would help to diminish the disparities observed across diverse socioeconomic groups.

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Original Article

Calibration Trial involving Cambodian Dentists based on the WHO Oral Health Survey Basic Method

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Abstract

This trial aimed to standardize the practices of local dentists in Cambodia by teaching them the WHO Oral Health Survey Basic Method and measuring whether sufficient inter-examiner agreement could be reached to meet the WHO global standard. Four dentists from the Health Science University in Cambodia were enrolled as examiners to be calibrated. The calibration procedure consisted of both theoretical and practical activities based on the WHO Oral Health Surveys Basic Methods (4th edition). Crown and root examinations for were performed to assess dentition status, and the Community Periodontal Index (CPI) was utilized to evaluate periodontal status. The percentage agreement between each pair of examiners ranged from 82-92% for crown status, 61-80% for root status, and 40-67% for CPI. The kappa statistics for crown status and root status ranged from 0.70 to 0.85 (mean κ =0.80) and from 0.42 to 0.69 (mean κ =0.53), respectively, while those for CPI ranged from 0.09 to 0.53 (mean κ =0.32). Our results indicate that that inter-examiner agreement for crown status was sufficient; however, those for root status and CPI were inadequate.

Keywords: *calibration, crown status, root status, CPI, Cambodia*

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Introduction

The importance of oral health to general health has been recognized by the Cambodian Ministry of Health, which is currently recovering from decades of conflict. The first ever national oral health survey of Cambodia was carried out in 1990[1]. Following the survey, a national oral health plan outlining goals for the year 2000 was agreed in 1992[2]. This plan described the steps that should be taken to improve oral health status in Cambodia. In addition, the amount of qualified dental manpower has gradually been increased although the ratio of dentists to the general population remains low and does not currently meet the dental demands of Cambodians. According to the WHO World Health statistics published in 2009, there were 209 dental personnel in Cambodia, which equated to less than one dentist per 10,000 people[3].

Against this background, epidemiological surveys of oral health in Cambodia are still in their early stages; i.e., few studies have investigated dentition[4,5] or periodontal status[6,7]. Moreover, no oral health surveys using internationally recognized criteria have been undertaken in Cambodia for a long time because of a shortage of dental care experts and[4] the limited resources available for dental health[2]. In addition information about the population's current oral health status is unlikely to be comparable with global trends. Therefore, it is necessary to educate and train oral health personnel using a standard global method to allow them to collect adequate data in future oral health surveys in Cambodia. Accordingly, this trial aimed to standardize the practices of local dentists in Cambodia by teaching them the WHO Oral Health Survey Basic Method and measure whether sufficient inter-examiner agreement could be reached to meet the WHO global standards[8].

Methods

In 2010, a calibration training session was conducted at the Health Science University in Cambodia. Four local dentists, one from each specialized dentistry department; i.e., periodontics, prosthodontics, endodontics, and preventive dentistry, were enrolled as dental examiners to be calibrated. Prior to and during the study, dental students of the university also joined the course as recorders. Trained and experienced oral epidemiologists from the WHO Collaborating Center for the Translation of Oral Health Science, Niigata University, calibrated the dental examiners and recorders using both theoretical and practical activities based on the WHO Oral Health Surveys Basic Methods (4th edition)[8].

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Training sessions, including the field exercises, were conducted for 4 days. On day 1, an academic lecture was provided, which covered following topics: 1) the necessity of performing oral health surveys using international criteria, 2) the procedure for oral health surveys, and 3) the criteria for assessing dentition status and periodontal tissue status outlined by the WHO global standards. A clinical demonstration was also provided to enable dentition and periodontal status to be recorded. On days 2 and 3, training practice using volunteer subjects was performed at the Health Science University as well as in the local community. All assessments were checked by trained and experienced oral epidemiologists.

According to the WHO Oral Health Survey Basic Method (4th edition)[8] the crown and root were assessed as a measure of dentition status, and the Community Periodontal Index (CPI) was used to evaluate periodontal status (Table 1).

The crown and root statuses of all present teeth including the third molar teeth were examined. To measure CPI, ten index teeth (17, 16, 11, 26, 27, 37, 36, 31, 46, and 47) in six sextants were probed using the WHO CPI probe with a 0.5 mm ball tip. If no index teeth were present, all remaining teeth in the sextant were examined. The highest score was recorded as the score for the sextant.

On the last day, a calibration test was carried out. The volunteers were composed of 48 local residents. Informed consent was obtained from all volunteers prior to them being examined. Inter-examiner agreement was assessed using the kappa value (κ) through duplicate examinations of the 48 volunteers.

Results

Tables 2 to 4 show the reliability of each examiner with regard to the CPI (Table 2), crown status (Table 3), and root status (Table 4). The percentage agreement between each pair of examiners ranged from 82-92% for crown status, 61-80% for root status, and 40-67% for CPI. The kappa statistics for crown status and root status ranged from 0.70 to 0.85 (mean κ =0.80) and from 0.42 to 0.69 (mean κ =0.53); respectively, while those for CPI ranged from 0.09 to 0.53 (mean κ =0.32).

Discussion

To allow oral health surveys to be performed, calibrations have to be carried out to standardize the clinical judgments of the participating healthcare staff[9,10]. The process of examiner calibration is important for planning and conducting oral health surveys. The use of kappa statistics has been recommended for calculating inter-examiner agreement since they are a measurement of adjusted agreement that takes into consideration the likelihood of chance agreement[11]. According to the WHO, agreement should range from 85-95% for most assessments.

Our results indicated that the inter-examiner agreement for crown status had reached a sufficient level; however those for root status and CPI were inadequate. This finding is in accordance with a previous study by Chu et al[5], who reported that the inter-examiner agreement for CPI was lower than that for dentition status (0.93 for dentition status vs. 0.74 for CPI). As the measurement of CPI depends on tactile sensation with a CPI probe, rather than visual sensation as is the case for crown status, it is difficult to measure CPI accurately. As calculus deposits were diagnosed very frequently among the volunteers, we also observed large discrepancies between CPI codes 0 and 2 as well as codes 1 and 2.

With regard to root status, the diagnosis of codes 0 and 8 was less consistent among the examiners. Unclear cement enamel junctions might have been the major reason for the poor oral health conditions of the volunteer subjects, who displayed dental problems such as calculus deposits and inappropriate restorations.

According to the WHO Oral Health Survey Basic Method (4th Edition), training in the criteria usually requires 2-3 days with a further 2-3 days for calibration, although extra time might be needed depending on how many examiners are being trained and the number of indices included in the survey. It is also recommended that an interval of at least a few days should be present between the training and calibration to allow the examiners time to assimilate their new knowledge and practice the procedures. The length of our calibration training generally agreed with the WHO recommendation; however, it was necessary

Table 1. The criteria and codes described by the WHO Oral Health Survey Basic Method (4th edition)

CPI	CROWN	ROOT
0 Healthy	0 Sound	0 Sound
1 Bleeding	1 Decayed	1 Decayed
2 Calculus deposits	2 Filled, with decay	2 Filled, with decay
3 Pocket depth of 4-5 mm	3 Filled, no decay	3 Filled, no decay
4 Pocket depth of 6+mm	4 Missing, as a result of caries	7 Bridge abutment, special crown, veneer, implant
X Excluded	5 Missing, any other reason	8 Unerupted tooth
9 Not recorded	6 Fissure sealant	9 Not recorded
	7 Bridge abutment, special crown, veneer, implant	
	8 Unerupted tooth	
	T Trauma	
	9 Not record	

Table 2. Agreement and kappa values for CPI between all pairs of examiners

		EX-1						
		0	**1**	**2**	**3**	**4**	**X**	**Total**
EX-2	**0**	7	1	4	0	0	0	12
	1	0	5	9	0	0	2	16
	2	0	0	17	0	0	0	17
	3	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0
	X	0	0	0	0	0	3	3
	Total	7	6	30	0	0	5	48

Agreement: 67%, Kappa: 0.52

		EX-1						
		0	**1**	**2**	**3**	**4**	**X**	**Total**
EX-3	**0**	0	1	19	0	0	0	20
	1	0	2	9	0	0	0	11
	2	0	0	12	0	0	0	12
	3	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0
	X	0	0	0	0	0	5	5
	Total	0	3	40	0	0	5	48

Agreement: 40%, Kappa: 0.21

		EX-1						
		0	**1**	**2**	**3**	**4**	**X**	**Total**
EX-4	**0**	5	2	5	0	0	0	12
	1	0	1	1	0	0	1	3
	2	1	1	22	0	0	0	24
	3	0	1	4	0	0	0	5
	4	0	0	0	0	0	0	0
	X	0	0	0	0	0	4	4
	Total	6	5	32	0	0	5	48

Agreement: 67%, Kappa: 0.46

		EX-2						
		0	**1**	**2**	**3**	**4**	**X**	**Total**
EX-3	**0**	3	4	11	0	0	0	18
	1	0	6	4	0	0	2	12
	2	0	1	12	0	0	0	13
	3	0	0	1	0	0	0	1
	4	0	0	0	0	0	0	0
	X	0	2	0	0	0	2	4
	Total	3	13	28	0	0	4	48

Agreement: 48%, Kappa: 0.30

		EX-2						
		0	**1**	**2**	**3**	**4**	**X**	**Total**
	0	1	3	5	0	0	0	9
	1	0	0	1	0	0	0	1
	2	0	11	24	0	0	0	35
EX-4	**3**	0	0	2	0	0	0	2
	4	0	0	0	0	0	0	0
	X	0	0	0	0	0	1	1
	Total	1	14	32	0	0	1	48

Agreement: 54%, Kappa: 0.09

		EX-3						
		0	**1**	**2**	**3**	**4**	**X**	**Total**
	0	13	1	1	0	0	0	15
	1	4	4	1	0	0	0	9
	2	11	4	6	0	0	0	21
EX-4	**3**	0	0	0	0	0	0	0
	4	0	0	0	0	0	0	0
	X	0	0	0	0	0	3	3
	Total	28	9	8	0	0	3	48

Agreement: 54%, Kappa: 0.35

Table 3. Agreement and kappa values for crown status between all pairs of examiners

		EX-1										
		0	**1**	**2**	**3**	**4,5**	**6**	**7**	**8**	**9**	**T**	**Total**
	0	140	4	0	3	1	0	0	0	0	0	148
	1	1	13	0	0	2	0	0	0	0	0	16
	2	0	0	0	0	0	0	0	0	0	0	0
	3	3	0	1	7	0	0	0	0	0	0	11
	4,5	1	2	0	0	35	0	3	2	0	0	43
EX-2	**6**	0	0	0	0	0	0	0	0	0	0	0
	7	0	1	0	0	1	0	22	0	0	0	24
	8	1	0	0	0	0	0	0	13	0	0	14
	9	0	0	0	0	0	0	0	0	0	0	0
	T	0	0	0	0	0	0	0	0	0	0	0
	Total	146	20	1	10	39	0	25	15	0	0	256

Agreement: 90%, Kappa: 0.84

		EX-1										
		0	**1**	**2**	**3**	**4,5**	**6**	**7**	**8**	**9**	**T**	**Total**
EX-3	**0**	160	2	0	4	0	0	0	0	0	0	166
	1	4	10	0	0	0	0	0	0	0	0	14
	2	0	0	0	0	0	0	0	0	0	0	0
	3	4	0	0	6	0	0	0	0	0	0	10
	4,5	0	2	0	0	36	0	0	2	0	0	40
	6	0	0	0	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	18	0	0	0	18
	8	0	0	0	0	1	0	0	5	0	0	6
	9	0	0	0	0	0	0	0	0	0	0	0
	T	2	0	0	0	0	0	0	0	0	0	2
	Total	170	14	0	10	37	0	18	7	0	0	256

Agreement: 92%, Kappa: 0.85

		EX-1										
		0	**1**	**2**	**3**	**4,5**	**6**	**7**	**8**	**9**	**T**	**Total**
EX-4	**0**	145	5	0	0	2	0	0	0	0	0	152
	1	1	11	0	0	2	0	0	0	0	0	14
	2	1	0	0	0	0	0	0	0	0	0	1
	3	6	1	1	12	0	0	0	0	0	0	20
	4,5	1	3	0	0	37	0	4	5	0	0	50
	6	0	0	0	0	0	0	0	0	0	0	0
	7	0	0	0	1	1	0	16	0	0	0	18
	8	0	0	0	0	0	0	0	0	0	0	0
	9	0	0	0	0	0	0	0	1	0	0	1
	T	0	0	0	0	0	0	0	0	0	0	0
	Total	154	20	1	13	42	0	20	6	0	0	256

Agreement: 86%, Kappa: 0.77

		EX-2										
		0	**1**	**2**	**3**	**4,5**	**6**	**7**	**8**	**9**	**T**	**Total**
EX-3	**0**	134	1	2	1	1	0	0	0	0	0	139
	1	3	9	2	0	1	0	0	1	0	0	16
	2	0	2	0	1	0	0	0	0	0	0	3
	3	1	0	1	8	0	0	0	0	0	0	10
	4,5	2	0	0	0	47	0	6	0	0	0	55
	6	0	0	0	0	0	0	0	0	0	0	0
	7	0	0	0	0	2	0	17	0	0	0	19
	8	1	0	0	0	1	0	0	12	0	0	14
	9	0	0	0	0	0	0	0	0	0	0	0
	T	0	0	0	0	0	0	0	0	0	0	0
	Total	141	12	5	10	52	0	23	13	0	0	256

Agreement: 89%, Kappa: 0.82

		EX-2										
		0	**1**	**2**	**3**	**4,5**	**6**	**7**	**8**	**9**	**T**	**Total**
	0	189	2	0	1	1	0	1	0	0	0	194
	1	1	5	0	0	0	0	0	0	0	0	6
	2	0	0	0	0	0	0	0	0	0	0	0
	3	1	1	2	5	2	0	0	0	0	0	11
	4,5	0	0	1	2	22	0	0	3	0	0	28
EX-4	**6**	0	0	0	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	17	0	0	0	17
	8	0	0	0	0	0	0	0	0	0	0	0
	9	0	0	0	0	0	0	0	0	0	0	0
	T	0	0	0	0	0	0	0	0	0	0	0
	Total	191	8	3	8	25	0	18	3	0	0	256

Agreement: 93%, Kappa: 0.83

		EX-3										
		0	**1**	**2**	**3**	**4,5**	**6**	**7**	**8**	**9**	**T**	**Total**
	0	144	6	0	1	1	0	0	1	0	0	153
	1	3	7	1	3	0	0	0	1	0	0	15
	2	0	0	0	0	0	0	0	0	0	0	0
	3	0	1	3	6	0	0	0	0	0	0	10
	4,5	1	0	0	0	29	0	2	15	0	0	47
EX-4	**6**	0	0	0	0	0	0	0	0	0	0	0
	7	0	1	0	0	4	0	23	1	0	0	29
	8	1	0	0	0	0	0	0	0	0	0	1
	9	1	0	0	0	0	0	0	0	0	0	1
	T	0	0	0	0	0	0	0	0	0	0	0
	Total	150	15	4	10	34	0	25	18	0	0	256

Agreement: 82%, Kappa: 0.70

Table 4. Agreement and kappa values for root status between all pairs of examiners

		EX-1							
		0	**1**	**2**	**3**	**7**	**8**	**9**	**Total**
	0	31	0	0	0	0	3	1	35
	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
EX-2	**3**	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0	0
	8	52	1	0	0	0	98	5	156
	9	5	0	0	0	0	2	58	65
	Total	88	1	0	0	0	103	64	256

Agreement: 73%, Kappa: 0.58

		EX-1							
		0	**1**	**2**	**3**	**7**	**8**	**9**	**Total**
EX-3	**0**	58	0	0	0	0	6	0	35
	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0	0
	8	66	0	0	0	0	75	2	156
	9	0	0	0	0	0	1	82	65
	Total	124	0	0	0	0	82	64	256

Agreement: 71%, Kappa: 0.56

		EX-1							
		0	**1**	**2**	**3**	**7**	**8**	**9**	**Total**
EX-4	**0**	20	0	0	0	0	3	2	25
	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0	0
	8	81	0	0	0	0	84	2	167
	9	9	0	0	0	0	3	52	64
	Total	110	0	0	0	0	90	56	256

Agreement: 61%, Kappa: 0.42

		EX-2							
		0	**1**	**2**	**3**	**7**	**8**	**9**	**Total**
EX-3	**0**	42	1	0	0	0	17	0	60
	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0	0
	8	20	0	0	0	0	98	3	121
	9	0	0	0	0	0	10	65	75
	Total	62	1	0	0	0	125	68	256

Agreement: 80%, Kappa: 0.69

		EX-2							
		0	**1**	**2**	**3**	**7**	**8**	**9**	**Total**
EX-4	**0**	7	0	0	0	0	6	0	13
	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0	0
	8	44	0	0	0	0	163	3	210
	9	0	0	0	0	0	5	28	33
	Total	51	0	0	0	0	174	31	256

Agreement: 77%, Kappa: 0.46

		EX-3							
		0	**1**	**2**	**3**	**7**	**8**	**9**	**Total**
EX-4	**0**	11	0	0	0	0	2	1	14
	1	0	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	7	0	0	0	0	0	0	0	0
	8	42	1	0	0	0	134	8	185
	9	0	0	0	0	0	14	43	57
	Total	53	1	0	0	0	150	52	256

Agreement: 73%, Kappa: 0.49

to allow appropriate intervals for the local examiners to assimilate their new knowledge and practice the skills they were taught. In fact, communication difficulties including language problems were often experienced in the seminar.

There is very little information about oral health status examinations by local dentists in Cambodia. The Cambodian dentists that participated in this trial had never been calibrated to the WHO global standards for oral health surveys. With regard to the education and training of Cambodian dentists, this trial has some merits in that it increased the participants' knowledge about the value of being calibrated to a standard global method although the outcomes were not satisfactory. Chher T et al.[12] stated that training programs and supervisory procedures should be encouraged to improve the current situation in Cambodia, and further training sessions will be needed to cultivate a better understanding of global standards.

In conclusion, this trial succeeded at standardizing the methods that Cambodian dentists use to measure crown status according to the WHO global standard.

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Original Article

Salivary Function Tests: Possible Risk Indicators of Dental Caries in Children with Cleft Lip and Palate

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Abstract

This comparative cross sectional study was conducted with an aim to evaluate the salivary function tests and biochemical salivary parameters in children with cleft lip and palate and compare them with age matched non-cleft high caries risk and non-cleft caries free children. A total of 73 children in the age range of 4-9 years, 23 of whom were children with cleft lip and palate (CLP), 25 non-cleft high caries risk and 25 non-cleft caries free children were included. Various salivary parameters viz. buffering capacity, pH (Saliva Check buffer kits, GC Cooperation, USA) and viscosity of saliva (Ostwald's viscosimeter) were analyzed. The biochemical parameters studied were calcium, phosphorous and alkaline phosphatase, analyzed using automated analyzer (Modular P800, Roche, Japan). The mean deft+DMFT figures for high caries risk children was 12.73±3.42, and for cleft lip and palate group was 10.14±6.09, with no significant difference between the two. Among the salivary function tests, buffering capacity was lower in both the high caries risk and cleft lip and palate group compared to caries free children. There was no significant difference in salivary pH and viscosity of saliva between the three study groups. Among the biochemical parameters, levels of phosphorous were significantly higher in caries free group compared to children in cleft lip and palate group and high caries risk group and levels of alkaline phosphatase were higher in high caries risk group and cleft lip and palate group and lower in caries free group. The results have revealed that combination of salivary parameters should be evaluated to identify individuals at high risk for dental caries including those with cleft lip and palate.

Keywords *Cleft lip and palate, dental caries, buffering capacity, salivary biochemical parameters*

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Introduction

Saliva has an important role to play in maintaining the oral health of an individual due to its composition and physical & chemical properties. The alteration of the routine salivary parameters viz. buffering capacity, pH, viscosity, salivary flow rate and biochemical parameters like levels of calcium, phosphorous and alkaline phosphatase affect the dental caries status of the individuals[5,6]. The assessment of these parameters can thus aid in identifying individuals at high caries risk, which can thus aid in planning primary preventive oral health education programs for them. Studies have revealed that caries free children (DMFT=0) have high (>6.0) to intermediate (4.5-5.5) salivary buffering capacity, and high caries risk children have very low to low buffering capacity of saliva (<4.0)[7,8]. The relation between biochemical parameters viz.calcium and phosphate levels in saliva and dental caries has remained inconclusive in the literature[1-4,7,9-12] as dental caries is a multifactorial disease with phases of de and re-mineralization in a dynamic environment.

Children with cleft lip and palate have been considered as a high caries risk group as studies[13-16] have reported high prevalence and severity of dental caries among these children because of abnormally placed teeth, anatomy of cleft area, tight repaired lip, nasal discharge through cleft, hypoplastic defects, night time feeding habit and sugary food consumption etc[13,17-22], all of which can have an influence on the salivary parameters. No data on biochemical salivary indicators and salivary function tests, however exists in these children inspite of them being high risk candidates for dental caries, the prevalence varying between 1.9 to 13.5 among different communities around the world[17,23].

This calls for an imperative need to investigate in detail the salivary risk indicators of dental caries in children with cleft lip and palate, in order to plan and implement an effective preventive regimen for these patients, based upon their specific needs, at an early age, for prevention of dental caries. The present study was thus conducted with an aim to evaluate the salivary function tests and biochemical parameters of saliva in children with cleft lip and palate

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and compare these with age matched non-cleft high caries risk and non-cleft caries free children.

Material and Methods

The sample comprised of a total of 73 children in the age range of 4-9 years, distributed in three groups. Group I included 23 children with cleft lip and palate stratified on the basis of cleft type i.e Group 3 (Balkrishnan classification[24]) which includes children with combined cleft lip and palate, age range 4-9 years and those with no history of any previous dental visits. These children were available from the unit of Pediatric Dentistry and Department of Plastic Surgery of the institute which get patients from the entire Northern region of India. Group II and Group III comprised of healthy high caries risk (n=25) and healthy caries free (n=25), age matched children without cleft lip and palate respectively. For selection of children in Group II and III, children in the age range of 4-9 years were examined in three schools of Chandigarh for dental caries status. The criterion for Group II were children with deft+ DMFT of ≥5, as per Modified Koch's criteria[25] and for Group III, Caries free children using the same index. During the initial screening in schools, children fulfilling the criteria were selected and reexamined in the unit of Pediatric Dentistry for inclusion in Groups II and III respectively.

Exclusion criteria included children with any diagnosed systemic and metabolic problems like rickets, hyperparathyroidism, osteomalacia, osteitis deformans, those with any known syndrome, mentally retarded or those undergoing orthodontic treatment and ones with history of antibiotic intake during the last one month.

The study was approved by the Institutional Review Board (IRB) and a written informed consent was obtained from parents of all the selected children included in the study. The parents of every child were interviewed using a structured questionnaire as regards the demographic data, 24 hour dietary recall, frequency of tooth brushing per day, type of tooth paste used and its frequency and other factors which could have had a bearing on dental caries.

Samples of stimulated whole saliva were collected from the subjects using paraffin wax (1gram). The test samples were collected in mid morning at least 1hour after eating, tooth brushing or use of any mouthwash. The first minute collected saliva was either expectorated or swallowed, following which 5 mL stimulated saliva was collected in chilled plastic containers (20 mL). The pH and buffering capacity of stimulated saliva was evaluated using commercially available buffer kits *(Saliva Check buffer kits, GC Cooperation, USA)*. The pH was noted after ten seconds of dipping the pH strip in saliva and color change was compared with the chart provided in the kit by the manufacturer. Buffering capacity of saliva was calculated based on the color change of the three test pads, as per scores given on the chart provided in the kit. Viscosity of saliva was assessed using Ostwald's Viscosimeter[26].

After collection of saliva samples, 1 mL of stimulated saliva from chilled plastic containers was transferred to Eppendorf tubes. These tubes were coded and transported to the Department of Biochemistry of the institute, within 1 hour of collection. Stimulated saliva was centrifuged at 10,000g at 4°C for 20 minutes. The supernatant was then separated and transferred to vials which were then analyzed for the levels of calcium, phosphorous and alkaline phosphatase in a Random Access Autoanalyzer (*Modular P800, Roche, Japan)*. The level of calcium in saliva was analyzed as per the method of Connerty and Bridges[26], which is based on the formation of calcium cresolphthalein complex on interaction of calcium with o-cresolphthalein complexone. The levels of inorganic phosphorous in saliva were estimated by the method of Henry *et al.*[28].The preferred method for the determination of inorganic phosphorous was based on the formation of ammonium phosphomolybdate with subsequent reduction to molybdenum blue. Alkaline phosphatase in saliva was measured by the method of Tietz *et al.*[29], which is a recommended and standardized method for the determination of alkaline phosphatase activity using an optimized substrate concentration and 2- amino-2-methyl-1-propanol as buffers along with the cations magnesium and zinc.

Results

The mean age of children in cleft lip and palate group (Group I), high caries risk group (Group II) and caries free group (Group III) was 6.55±1.8, 6.09±1.3 and 7.01±1.2 years respectively. The dental caries status of children in both the cleft lip and palate group (Group I) and non cleft high caries risk group (Group II) was very high, the mean dmft+DMFT being 10.14±6.09 in Group I and 12.73±3.42 in Group II. The corresponding dmft figures were 8.65±5.80 and 12.64±3.43 respectively. Frequency of sugar consumption was significantly lower in Caries free group compared to Groups I and II. The oral hygiene practices i.e the frequency of tooth brushing and use of fluoridated toothpaste did not show any statistically significant differences among the three groups. Thus these factors did not contribute to the high caries in Groups I and II.

The salivary tests for **buffering capacity** revealed that 48% of children in Group I and 40% in Group II had very low buffering capacity compared to only 12% (n=3) children with very low buffering capacity in caries free group (Group III). Normal buffering capacity was seen in only one child (4%) in Group I and none in Group II compared to 40% children in Caries free group (Group III), with significant differences between Group I and III *($p<0.003$)* and Group II and III *($p<0.001$)* (Figure 1).

The **pH** of stimulated saliva, using pH strip, was 7.14±0.51, 7.24±0.38 and 7.30±0.35 in children with cleft lip and palate, non cleft high caries risk group and caries free group respectively, with no significant difference between the groups (Table 1).

The **viscosity** of saliva showed a trend of an inverse relation with caries status as highest figures were seen in non-cleft high caries risk group, being 1.5±0.22, followed by children in cleft lip and palate group (1.4±0.34) and least in caries free group (1.3±0.22), no significant difference was however seen between the groups.

Among the biochemical parameters, the **phosphorous** concentration in saliva was found to be highest in non-

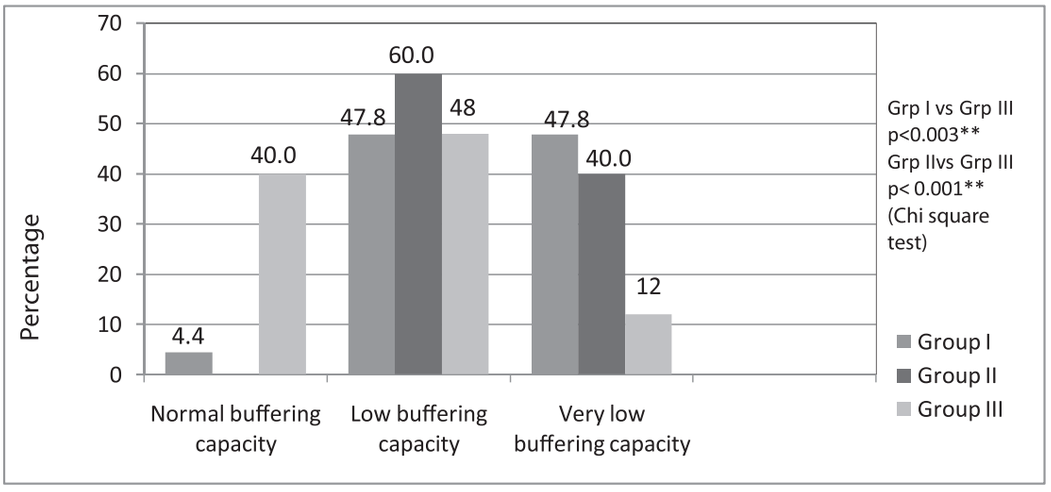


Fig 1 Distribution of subjects according to the buffering capacity of saliva

cleft caries free children i.e. 18.50±7.50 mg/dL and low in children with caries i.e non-cleft high caries risk group (14.10±5.62 mg/dL) and children with cleft lip and palate (13.60±4.50 mg/dL) with significant difference between caries free and high caries risk children *(p<0.008**)* and caries free and children with cleft lip and palate *(p<0.01*)*. Phosphorous levels in saliva showed a significant inverse correlation with overall caries status (r- 0.38, p<0.003). The salivary **calcium** concentration was not found to differ among the three groups, being 2.87±1.10 mg/dL for non-cleft caries free children, 2.76±1.13 mg/dL for children with cleft lip and palate and 2.72±1.47 mg/dL for non-cleft high caries risk children. **Alkaline phosphatase** levels in saliva were the highest in children with cleft lip and palate i.e. 8.30±8.21 IU/L, followed by high caries group i.e. 5.88±4.07 IU/L and low in caries free group i.e. 4.92±4.23 IU/L, with no significant difference among the groups (Figure 2), showing a trend of direct relation with dental caries.

Non parametric test (Chi square test) was used for categorical data (buffering capacity) while Annova was applied for non-categorical data (calcium level) and Mann Whitney test was applied for skewed data (pH, phosphorous and alkaline phosphatase levels)for comparison.

Discussion

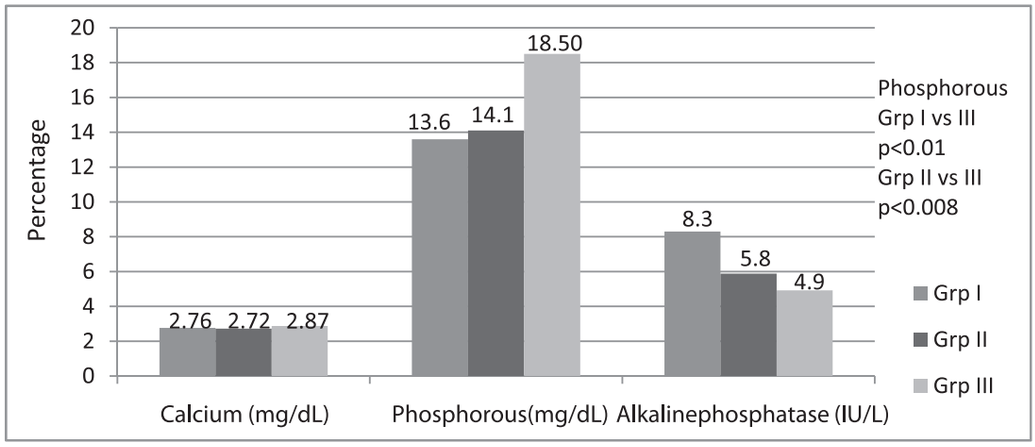
Children with cleft lip and palate were found to be at high caries risk similar to non-cleft high caries risk children. Though they were not screened for dental caries at the time of inclusion compared to High caries risk group, where children with ≥5 deft+ DMFT were selected according to Koch's criteria[25]. Earlier studies have also shown a high prevalence of dental caries in these children [13,15,16].

On comparing the **buffering capacity** of saliva in the three groups, 96% of children with cleft lip and palate (Group I), had either low or very low buffering capacity and only 4.4% had normal buffering capacity. Similarly, 100% of non-cleft high caries risk children showed very low (40%) and low (60%) buffering capacity, with no child having normal buffering capacity. Thus a low buffering capacity of saliva in these two groups possibly caused high caries, as saliva buffers viz bicarbonates and phosphates which have the potential to neutralize the acidity of saliva decrease with decreasing buffering capacity. In caries free group, 40% children had normal buffering capacity of saliva, again showing an inverse association between buffering capacity of saliva and dental caries. Fosdick *et al*[30] supported this association by reporting that the buffering capacity of saliva of an average caries immune patient

Table 1. Stimulated salivary pH in 4-9 year children using pH strip method

Groups	**N**	**Salivary pH**		***p* value**
		Mean±S.D.	**Range**	
Cleft lip and palate (Grp I)	23	7.14±0.51	6.6-7.8	0.28 (NS)
High caries risk (Grp II)	25	7.24±0.38	6.8-7.8	
Caries free (Grp III)	25	7.30±0.35	6.6-7.8	
Total	73	7.25±0.42	6.6-7.8	

Fig 2 Comparison of calcium, phosphorous and alkaline phosphatase levels in saliva of the three study groups



is about 40% higher than that of the caries susceptible individual. Infant *et al*[31] also found a similar association as they found a significantly high buffering capacity of saliva of 10-11 year old caries free children (6.0-6.5) compared to caries active group. Dahllof *et al.*[14], however did not find any significant difference in buffering capacity of 5-6 year old children with cleft lip &/ or palate and the control group without cleft.

Salivary pH did not show any significant difference between the three study groups. There are very few studies on salivary pH showing a significant correlation with dental caries in high caries risk children[28,32-34] and probably no data in children with cleft lip and palate. Literature review on salivary pH and dental caries is inconclusive. Johansson *et al.*[31] reported a negative correlation between stimulated salivary pH and caries prevalence in Indian children with malnutrition. However Prabhakar *et al.*[32], found no significant difference in the mean pH of unstimulated saliva in caries free (7.15±0.15) and caries active children (7.07±0.43). In contrast, Toledo *et al.*[24], in a study on 60, 4-6 year children found that there was highly significant difference in pH of unstimulated saliva between children with cavitated lesions (pH- 6.42±0.42) and those without cavities (pH- 6.72±0.37) ($p<0.008$).

Salivary viscosity in the present study showed an inverse correlation with dental caries. Limited data exists on the relationship between the **viscosity** of saliva and dental caries in high caries risk children and no studies have been carried out in children with cleft lip and palate. A direct relationship between salivary viscosity and caries has been reported by Ericsson *et al.*[35]. However, Toledo *et al.*[27], in a study on 4-6 year old children, found no significant difference in viscosity of saliva between children with cavitated (2.07±0.69) and non cavitated lesions (1.87±0.60). In contrast, Rashkova *et al.*[34] found a significant difference in salivary viscosity of children with high and low DMFT, the saliva was fluid in children with DMFT of 4.25 and bubbly and viscous in those with DMFT of 10.27, corroborating the findings of the present study.

Amongst the salivary biochemical indicators, levels of **phosphorous** in saliva of children with cleft lip and palate and that of high caries risk children were low in comparison to high levels in caries free children, thus showing an inverse correlation with dental caries. Thus low salivary phosphorous levels can be an important indicator for high caries risk even in children with cleft lip and palate. The equilibrium between demineralization and remineralization depends on the salivary calcium and phosphate concentration as well as the level of the salivary alkaline phosphatase. The levels of calcium and phosphate are such that the saliva is supersaturated with respect to hydroxyapatite at normal intraoral pH.

The levels of **calcium** in saliva did not show any significant difference among the three groups and cannot thus be taken as a reliable indicator for diagnosing the risk for dental caries. On correlating calcium and phosphorous levels with dental caries, only phosphorous levels in saliva showed a significant inverse correlation with overall caries status (r- 0.38, $p<0.003$). The results depict that individuals with high concentration of calcium in saliva, may not necessarily have high concentration of phosphorous or vice versa. Similar findings have been shown by Gron *et al.* (1973)[1] who did not show any correlation between the concentrations of the two ions in saliva. It is basically not the high calcium or phosphorous levels in saliva that repress enamel dissolution, rather it is the dynamic function of all the ions that form the hydroxyapatite crystal. The correlation between calcium and phosphate levels in saliva and dental caries has remained inconclusive in the literature as dental caries is a multifactorial disease with phases of de and remineralization in a dynamic environment. A clear association between the two ions i.e. calcium and phosphate in such an environment may not thus be possible. The review of studies on this aspect point to a similar unclear association, Shaw & Murray[10] reported that mean calcium and phosphorous concentration in saliva in their study was higher for the caries free group (calcium-27.3±22.3 µg/mL & phosphorous- 117.7±53.1 µg/dL) and low for high caries group (calcium-22.1±14.2 µg/mL & phosphorous-90.4±44.7µg/dL), but statistically significant difference between caries free and high caries group was found for only the salivary phosphorous levels ($p<0.05$). In contrast, Maijer and Classen[11] and Turtola[12]

observed a direct relation of calcium and phosphorous concentration with caries activity. These contradictory results might be due to differences in methodology of different studies reported in literature. Dental caries is a complex disease and the benefits of saliva get masked by factors like life style, diet, cariogenic microflora etc. *The levels of calcium in saliva may not thus be a reliable indicator and possibly have diminished role in the caries risk assessment.*

The levels of **alkaline phosphatase** are high in children with high caries risk and cleft lip and palate possibly due to the high caries causing an altered response of the body by secreting alkaline phosphatase. Other possible sources of alkaline phosphatase, besides the secretion by parotid gland, could be oral bacteria, minor salivary glands and food accounting for its increased concentration[2]. The results of the present study are in agreement with study of Vijayprasad *et al.*[4], who have revealed direct and highly significant positive correlation between alkaline phosphatase and dental caries. The enzyme activity in their study was higher for the rampant caries group (18.66 KA) and low for caries free group (4.68 KA), the difference being statistically significant ($p<0.001$). A similar direct correlation as seen in the present study has been reported by Ghandhy *et al.*[9] on 30, 4-6 year old children, where alkaline phosphatase and phosphorous concentration were significantly higher in children with rampant caries compared to caries free group. *Thus alkaline phosphatase appears to be another good indicator of high caries activity.*

The evaluation of various salivary parameters in Group I and II has shown that inspite of differences in dental caries status (deft+DMFT) between children with cleft lip and palate (0-20) and high caries risk children (8-20), the biochemical salivary parameters (alkaline phosphatase and phosphorous) and buffering capacity among children of the two groups was similar. Thus children with cleft lip and palate are at high risk for dental caries equivalent to high caries risk children. The results of the present study have revealed that buffering capacity of saliva, salivary phosphorous levels and salivary alkaline phosphatase levels (Biochemical salivary parameters) are good indicators of caries risk assessment in children with cleft lip and palate. These parameters showed a change in saliva of these children regardless of dental caries status (0-20) compared to Group II (8-20) where these parameters were studied in known high caries risk children. Routine salivary parameters like pH and viscosity of stimulated saliva may not be very reliable for predicting the caries activity. It can thus be concluded that individual salivary parameters cannot determine the true caries risk of an individual, a combination of salivary function tests, biochemical indicators and microbiological tests is important for diagnosing the risk status. Longitudinal studies are required to evaluate the changes in the salivary parameters with age and after institution of oral health primary preventive measures in children

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Original Article

Self-reported systemic disorders and its correlation with periodontal disease: A retrospective study

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Abstract
The purposes of this retrospective study were to investigate the occurence of self-reported systemic disorders in patients referred to the Periodontal Department, Universiti Kebangsaan Malaysia and to explore possible relationship between general health and severity of periodontal disease in this population. Data were collected from dental records of 663 subjects. Out of 663 subjects, 609 periodontal patients met all the criteria. These records were examined to determine patients' self reported systemic conditions and smoking history. In addition, the number of remaining teeth and the number of periodontal diseased sites with a probing depth of 5mm or more were recorded. Fifty two per cent of the subjects were found to have systemic disease reported in the medical history. Hypertension and diabetes mellitus were among the most frequent medical conditions encountered in this study which were 22.5% and 15.9% respectively. The mean age of the patients was 48 years old. There was significant difference in the remaining teeth in patients with diabetes mellitus, cardiovascular disease and hypertension. However, no significant associations between periodontal pockets ≥5mm and systemic disorders were found. In conclusion, findings showed no significant association between investigated systemic disoders and periodontal disease. However diabetes mellitus, cardiovascular disease and hypertension were closely associated with remaining teeth in periodontal patients.,

Keywords: *periodontal disease, self-reporting, systemic disease.*

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Introduction

Systemic disorder as it relates to periodontal disease has long been a subject of interest to periodontists. Many of these systemic disorders have been implicated as having some influence on the periodontal tissues. Several studies have been published pointing towards an association between periodontal disease and some systemic disorders or diseases such as cardiovascular disease[1], type 2 diabetes mellitus[2], pre-term low birth weight[3], osteoporosis[4] and rheumatoid arthritis.[5] In most instances, systemic disorders are known to be a contributing factor rather than a primary etiologic factor in periodontal disease[6].

Brasher and Rees found 40% of 644 self-reported periodontal patients had systemic conditions and 61% of their patient population were 19 to 39 years of age[7]. Furthermore, another study by Suomi et al. showed 56% of 529 adult patients had a positive history of one or more self-reported systemic conditions[8].

In conjunction with that, assessing the medical history of patients before treatment is one of the most crucial part of the dentist's responsibility. A higher percentage of the population is achieving longevity today and many of them are presenting to dental clinics with complex health problems that warrant our attention before initiating a treatment plan. This is especially true for the periodontist, because periodontal patients are frequently older than patients are more likely to have medical problems than the patients of many other dentists[9]. Most studies identifying medical conditions in dental patients have advocated using a written questionnaire followed by a verbal review[7,10,11]. Although the information obtained in a "patient-provided" history is not completely valid for every specific condition, it has been shown to give high accuracy for broad systemic disease categories[12]. In United States, the Behavioural Risk Factor Surveillance System (BFRSS), a self- reported survey system has been widely accepted as efficient means of assessing disease such as heart disease, cancer, stroke and diabetes, and has been used in recent years to monitor trends in dental visits, dental scaling and tooth loss[13].

Tooth loss has been used as one of the indicators for periodontal disease progression and current periodontal status respectively. In the Asian population, a study showed that there was an increasing trend for tooth loss due to periodontal disease rather than caries[14]. This alarming issue of periodontal disease and remaining teeth has been widely discussed as most people today want to keep their teeth for a lifetime in order to achieve better quality of life.

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Therefore, this study investigated the frequency of medical conditions found in self-reported periodontal patients and explored the possible relationship between general health and severity of periodontal disease.

Materials and methods.

The study was reviewed and approved by the Ethical Committee of Faculty of Dentistry, Universiti Kebangsaan Malaysia (DD/038/20). This was a retrospective study based on consecutive selection of patients at the Department of Periodontology, Universiti Kebangsaan Malaysia. Patients referred during the time period from 2000 to 2008 were included in the study if they fulfilled the following inclusion criterias:

- completed examination and diagnosis forms and periodontal charting forms;
- periodontal diseased sites with a probing depth of 5mm or more.

  The data was collected from the dental records of 663 subjects. Six hundred and nine patients met all the criteria whereas 54 patients had incomplete data. Of 609, 324 (53%) were males and 285 (47%) were females. Pertaining to the dental records, the following variables were recorded:
- social demographic data - age, sex;
- smoking history;
- number of remaining teeth;
- number of periodontal diseased sites with a probing depth of 5mm or more; and
- self-reported presence of bone/joint disorders, cardiovascular disease, diabetes mellitus, other endocrine diseases, drug allergy, gastrointestinal disease, hypertension, hematologic disease, kidney dysfunction, liver disease, neoplasm, neurologic, psychogenic, respiratory diseases and other diseases.

Descriptive statistics and statistical analyses were performed with a computerised statistical package, software Statistical Package for Service Solution (SPSS) version[16].

Results

Table 1 demonstrates the demographic data showing age, gender and smoking status of all periodontal patients. The mean age of the patients was 48 (±11-23) years old. In our sample population, the highest age distribution percentage (44%) was the oldest group (more than 50 years old). Gender distribution was comparable and there were 25% smokers in our study.

Figure 1 shows the occurrence of self-reported systemic disorders where more than half of the patients reported to have systemic disorders. The condition with the highest prevelence was hypertension, 137 patients (22.5%) and the least frequent was kidney dysfunction with 0.2%. The second most frequently reported condition was diabetes mellitus at 15.9 %. The next noted category was drug allergy, 6.6% (Table 2).

The mean remaining teeth for this study was 20. Patients who reported the presence of psychogenic disorders, hematologic, bone/joint disease and cardiovascular problems had fewer remaining teeth as compared to those not reporting these diseases (Table 3).

Student t-test revealed patients with diabetes mellitus, cardiovascular disease and hypertension were found to be significantly associated with the number of remaining teeth ($p<0.05$) (Table 3). There was no significant association between remaining teeth and patients with drug allergy, respiratory, bone/joint, gastrointestinal, neurologic disorders and other endocrine diseases, hematologic, psychogenic and liver diseases, kidney dysfunction or neoplasm. Patients with periodontal pockets ≥ 5mm also showed no association with systemic disorders (Table 4).

Table 1: Demographic data of periodontal patients

Age	**Frequency**	**%**
20 - 29	46	7.6
30 - 39	88	14.4
40 - 49	207	34
> 50	268	44
Gender	**Frequency**	**%**
Male	324	53
Female	285	47
Smoking status	**Frequency**	**%**
Smoking	155	25
Non-smoking	454	75
Totals	**609**	**100**

Figure 1: Occurance of patient reported with systemic disorders

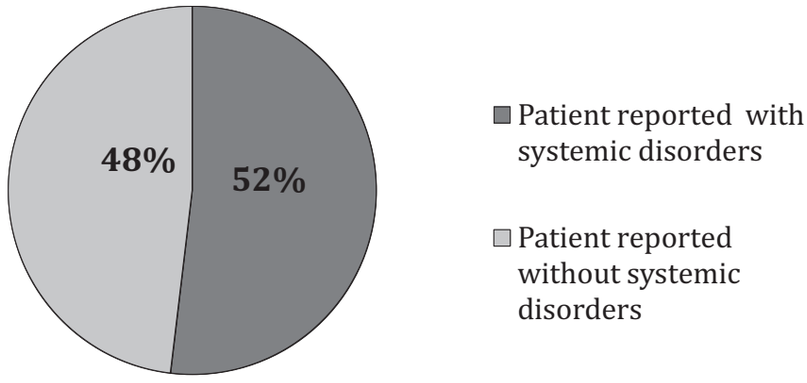

Table 2: Occurrence of systemic disorders in patients with periodontitis

Systemic disorders	Male	Female	Total ¶	%
Hypertension	73	64	137	22.5
Diabetes Mellitus	57	40	97	15.9
Drug allergy	17	23	40	6.6
Respiratory	16	17	33	5.4
Cardiovascular dis	23	5	28	4.6
Bone/joint disease	14	13	27	4.4
Gastrointestinal	10	10	20	3.3
Neurologic	5	7	12	2
Other endocrine dis	1	8	9	1.5
Hematologic	1	6	7	1.1
Neoplasm	2	4	6	1
Psychogenic	0	2	2	0.3
Liver disease	0	2	2	0.3
Kidney dysfunction	1	0	1	0.2
Others	19	21	40	6.6

¶ Total of patients did not add up to 100% because one patient may have history of one or more medical conditions

Discussion

In this study, the relationship between systemic disorders and periodontal conditions in terms of number of remaining teeth and periodontal pocket depths were investigated using the retrospective data of 609 patients referred to Periodontology Department. Of the 609 patients, 316 periodontal patients (52%) reported having systemic disease (Figure 1). Similar prevalence was also shown in a study of 590 periodontal patients by Peacock & Carson (52.5%)[15]. Therefore, the results of this study support the findings of previous investigations that showed a high percentage of periodontal patients with systemic disorders. Systemic conditions are considered to be potential complicating factors in periodontal management as they will require adjustments in the treatment approaches, drugs or medications used, or in the length of appointments. Thus, identification of all past and present medical conditions in periodontal patients is essential for their total well-being, as well as their oral health care.

The mean age of periodontal patients in this study was 48 (±11-23) years, which is comparable to the study conducted by Lagervall et al, 53.1 years[16]. Epidemiological studies have shown that degree, prevalence and severity of periodontal breakdown increase with age[17].

The most common condition encountered in our patients in this study was hypertension (22.5%). This reported result was higher compared to studies by Lagervall et al[16] and Brady & Martinoff[18] where 14.7% and 14.4% of their studied population had hypertension. Therefore, we have to be aware that 4 out of 10 patients who sit on a dental chair in our clinic may have hypertension. This finding was comparable to the general Malaysian

Table 3: Associations between remaining teeth in patients with and without systemic disorders.

	Systemic disease		Remaining teeth		t-test	P value	95% CI
Systemic disorders	**Yes N**	**No N**	**Yes Mean(SD)**	**No Mean(SD)**			
Hypertension	137	472	19.26(6.61)	20.84(6.33)	2.554	0.011*	0.366, 2.805
Diabetes	97	512	19.01(6.59)	20.76(6.36)	2.474	0.014*	0.361, 3.145
Drug allergy	40	569	20.40(5.63)	20.49(6.48)	0.086	0.932	-1.976, 2.157
Respiratory	33	576	19.03(6.49)	20.57(6.41)	1.337	0.182	-0.720, 3.795
Cardiovascular	28	581	17.64(7.06)	20.62(6.37)	2.405	0.016*	0.546, 5.411
Bone/joint dis	27	582	18.44(8.03)	20.58(6.33)	1.69	0.092	-0.346, 4.616
Gastrointestinal	20	589	20.80(5.97)	20.47(6.44)	-0.223	0.824	-3.199, 2.546
Neurologic	12	597	19.50(7.52)	20.50(6.40)	0.536	0.592	-2.678, 4.687
Other endocrine	9	600	19.78(7.12)	20.50(6.42)	0.332	0.74	-3.525, 4.959
Hematologic	7	602	16.86(7.94)	20.53(6.40)	1.503	0.133	-1.124, 8.463
Neoplasm	6	603	21.67(8.11)	20.47(6.41)	-0.453	0.651	-6.376, 3.988
Psychogenic	2	607	12.00(1.41)	20.51(6.41)	1.874	0.061	-0.409, 17.434
Liver disease	2	607	20.00(9.89)	20.49(6.42)	0.107	0.915	-8.461, 9.433
Kidney dysfunction	1	608	28.00 (-)	20.47(6.42)	-1.171	0.242	-20.157, 5.101
Others	40	569	11.75(11.5)	18.09(18.3)	2.16	0.031	0.575, 12.101

SD, standard deviation
*p-value <0.05 represents a significant difference

Table 4: Associations between periodontal pockets ≥ 5mm with and without systemic disorders.

	Systemic disorders		Periodontal pocket ≥ 5mm		t-test	P value	95% CI
Systemic disorders	**Yes N**	**No N**	**Yes Mean(SD)**	**No Mean(SD)**			
Hypertension	137	472	19.23(19.37)	17.22(17.56)	-1.154	0.249	-5.444, 1.413
Diabetes	97	512	15.15(13.88)	18.15(18.64)	1.504	0.133	-0.915, 6.903
Drug allergy	40	569	17.72(14.72)	17.67(18.21)	-0.019	0.985	-5.842, 5.728
Respiratory	33	576	16.82(14.55)	17.72(18.18)	0.28	0.78	-5.428, 7.232
Cardiovascular	28	581	13.07(10.31	17.89(18.21)	1.386	0.166	-2.010, 11.654
Bone/joint dis	27	582	11.52(13.44)	17.92(18.13)	1.821	0.069	-0.505, 13.382
Gastrointestinal	20	589	12.80(13.72)	17.84(18.10)	1.232	0.219	-2.994,13.068
Neurologic	12	597	25.42(26.64)	17.52(17.77)	-1.508	0.132	-18.193, 2.391
Other endocrine	9	600	15.89(16.22)	17.70(18.03)	0.299	0.765	-10.067, 13.685
Hematologic	7	602	6.14(11.43)	17.81(18.01)	1.708	0.088	-1.750, 25.075
Neoplasm	6	603	13.50(13.20)	17.71(18.03)	0.57	0.569	-10.293, 18.719
Psychogenic	2	607	20.50(17.67)	17.66(18.00)	-0.222	0.824	-27.886, 22.210
Liver disease	2	607	29.50(7.77)	17.63(18.00)	-0.931	0.352	-36.898, 13.164
Kidney dysfunction	1	608	11.00(-)	17.68(18.00)	0.371	0.711	-28.70, 42.07
Others	40	569	19.55(7.39)	20.55(6.35)	0.951	0.342	-1.065, 3.065

SD, standard deviation
*p-value <0.05 represents a significant difference

population where the current prevalence of hypertension was reported to be 30%[19]. In our study, 27 patients took calcium channel blocker as their anti-hypertensive drug. The most common side effect of the drug is gingival hyperplasia and a recent study found in patients using calcium channel blockers greater periodontal attachment loss/bone loss was detected[20]. Apart from that, severe periodontal disease was associated with 25% to 90% increase in risk for cardiovascular disease[1].

Ninety-seven or 15.9% of our patients were diabetic. This was an alarming finding compared to studies by Lagervall et al reporting only 4.9%[16] and Peacock and Carson about 4% of the diabetic patients presented with periodontal disease[15]. According to Dr. Hilary King of the World Health Organisation (WHO), epidemiologists predict that the population of diabetic individuals will increase up to 300 million by the year 2025 and almost half of that will be in the Asia Oceania region21. In addition to that, there will be a 3-fold rise of diabetes in Asia and much of these will be seen in China, India and other rapidly developing Asian nations like Singapore, Malaysia and Thailand[22]. At the same time the prevalence and incidence of diabetes complications will also increase. Periodontitis has been described as the sixth complication of diabetes mellitus[23]. The relationship between periodontitis prevalence and severity and the level of metabolic control of diabetes has not been clearly elucidated, however there were numerous clinical evidence showing that poor glycemic control increases the risk in diabetic patients to have severe attachment loss, deeper periodontal probing depth, bone loss and gingival inflammation[24].

Drug allergies were reported by 6.6% of the patients in this study. The prevalence reported was lower than other studies[15,16]. Therefore, obtaining a precise history of all drugs taken by patients is thus crucial, especially in the older patient who may be taking a combination of many different medications. Dentists should be alert to potential adverse drug interactions since this group of patients may have decreased metabolism and clearance of drugs.

The mean number of remaining teeth for the whole sample in this study was 20 which was lower than that reported by Lagervall et al. i.e. 25.3[16]. In this study, the number of remaining teeth was found to be significantly correlated with diabetes mellitus, cardiovascular disease and hypertension. These findings are also supported by many other studies which reported an association between tooth loss and cardiovascular disease[25,26,27].

Based on the present study's findings, it is very important to create greater awareness of oral health on systemic health to the public. In a study by Habashneh et al, 62% of the diabetic patients did not receive advice from a physician to check on their dental condition[28]. This is an area where education can be valuable in changing perceptions regarding the harmful effects of periodontal disease on the systemic disorders, for example, the importance of dental care for diabetic patients. Patients should know that dentists should be included in their health care professional team. The dentists can play their roles in treating periodontal patients with systemic diseases by assessing, advising and closely monitoring these patients. Apart from that, comprehensive programmmes can be planned and there should be concerted efforts all round including smart partnerships between the relevant government agencies, non-government organisations and research institutions in order to make it successful.

This study is not without any limitations. Firstly, the present results were based on self-reported data of systemic disorders. The respondents might have under-reported, over-reported or chose not to respond hence might affect validity when interpreting the results in this retrospective study. However, some previous studies have explored the validity of simple self reported medical questionnaires in dentistry[10,12,29]. The validity seems to vary within a rather wide range (66-95%) for different disorders and studies. This method has been shown to be reliable and cost effective[10,11,30]. A recent study by Ho et al. showed that there was high agreement (κ=0.79-0.90) between self-reported health conditions and the actual presence of the systemic conditions[31]. However, in future research, self-administered questionnaire completed by patients should always be checked by the attending dentist in order to obtain valid health history[11]. Self-reported systemic disorders can be validated by performing clinical examination and investigation in order to confirm the disease.

Secondly, the number of tooth loss cannot be distinguished in our records whether it was due to caries, periodontal disease, congenitally missing, missing due to trauma, orthodontic treatment or any other causes. Also, patients with no access to oral health care and poor oral health beliefs can act as cofounders which will also increase the likelihood of the patients to have systemic disorders as they adopt poor health promoting activities[27]. In order to overcome the problem, detailed reasons of tooth loss must be recorded clearly and only patients who meet the criteria can be included in the study. Thirdly, recording periodontal pocket depths can be inaccurate in determining disease severity, therefore measurement of attachment loss can be suggested in future research. Finally, this retrospective data was based on many examiners. In future prospective study it can be suggested to limit the number of examiners in order to reduce inter examiner variability.

Conclusion

In summary, the present findings suggested there was a relationship between periodontal disease and diabetes mellitus, cardiovascular disease and hypertension. These patients were also found to have the least number of remaining teeth. However, further studies are needed to explain the true causal relationship between periodontal disease and various systemic medical conditions.

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