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Global Oral Health Inequalities: Task Group—Periodontal Disease

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ABSTRACT

Periodontal diseases constitute one of the major global oral health burdens, and periodontitis remains a major cause of tooth loss in adults worldwide. The World Health Organization recently reported that severe periodontitis exists in 5-20% of adult populations, and most children and adolescents exhibit signs of gingivitis. Likely reasons to account for these prevalent diseases include genetic, epigenetic, and environmental risk factors, as well as individual and socio-economic determinants. Currently, there are fundamental gaps in knowledge of such fundamental issues as the mechanisms of initiation and progression of periodontal diseases, which are undefined; inability to identify high-risk forms of gingivitis that progress to periodontitis; lack of evidence on how to prevent the diseases effectively; inability to detect disease activity and predict treatment efficacy; and limited information on the effects of integration of periodontal health as a part of the health care program designed to promote general health and prevent chronic diseases. In the present report, 12 basic, translational, and applied research areas have been proposed to address the issue of global periodontal health inequality. We believe that the oral health burden caused by periodontal diseases could be relieved significantly in the near future through an effective global collaboration.

INTRODUCTION

Periodontal diseases including gingivitis and periodontitis are the most commonly occurring yet unusual infections in humans, due to the anatomically unique periodontal structure and the nature of the pathogenic plaque biofilm infection (Socransky and Haffajee, 1997; Armitage, 2002; Jin, 2011). Periodontitis

is characterized by bacteria-induced inflammatory destruction of tooth-supporting tissues and alveolar bone, and it remains a major cause of tooth loss in adults in both developed and developing countries (Pihlström *et al.*, 2005). Disease severity is dependent upon a dynamic equilibrium of bacteria-host interactions which are significantly influenced by various genetic, epigenetic, and environmental factors in a susceptible host (Page *et al.*, 1997; Jin, 2008; Kornman, 2008). A great range of risk factors has been studied, including individual determinants, social and behavioral factors, systemic factors, genetic factors, tooth factors, and microbial risk factors (Page *et al.*, 1997; Nunn, 2003; Heitz-Mayfield and Lang, 2010; Shum *et al.*, 2010).

The impact of periodontal diseases on an affected individual is increasingly apparent and becomes more significant with progression of the diseases, beginning with gingival recession and associated dentin hypersensitivity at an early stage. The disease then progresses toward tooth mobility, pathological migration, and, eventually, tooth loss, thereby affecting chewing and speech functions, aesthetics, psychological aspects, and quality of life, as well as increasing financial burden (Jin, 2009) (Fig. 1). It should be emphasized that periodontal diseases not only significantly affect oral health, but are also associated with systemic disorders such as cardiovascular diseases, diabetes, pre-term birth, and aspiration pneumonia (Jin *et al.*, 2003; Pihlström *et al.*, 2005; Williams *et al.*, 2008; Armitage and Robertson, 2009; Tonetti, 2009; Lu and Jin, 2010; Li *et al.*, 2011).

GLOBAL INEQUALITY IN PERIODONTAL HEALTH AND DISEASE

Oral health is generally recognized as an important and integral part of general well-being. Ninety percent of the global population has experienced oral or dental problems in their lifetime (Beaglehole *et al.*, 2009), but oral health remains a neglected area of global health in both national and international politics (Beaglehole *et al.*, 2009; Editorial, 2009). Common oral diseases such as caries and periodontal diseases remain global problems and are recognized as constituting the most important oral health burdens. This is particularly the case in underprivileged sub-populations in both developing and developed countries (Corbet *et al.*, 2002; Petersen and Ogawa, 2005; Hugoson and Norderyd, 2008; Hugoson *et al.*, 2008). It is worthy of note that even in high-income countries with advanced public oral

Key Words

gingivitis, periodontitis, tooth loss, risk factors, oral health, systemic disorders.

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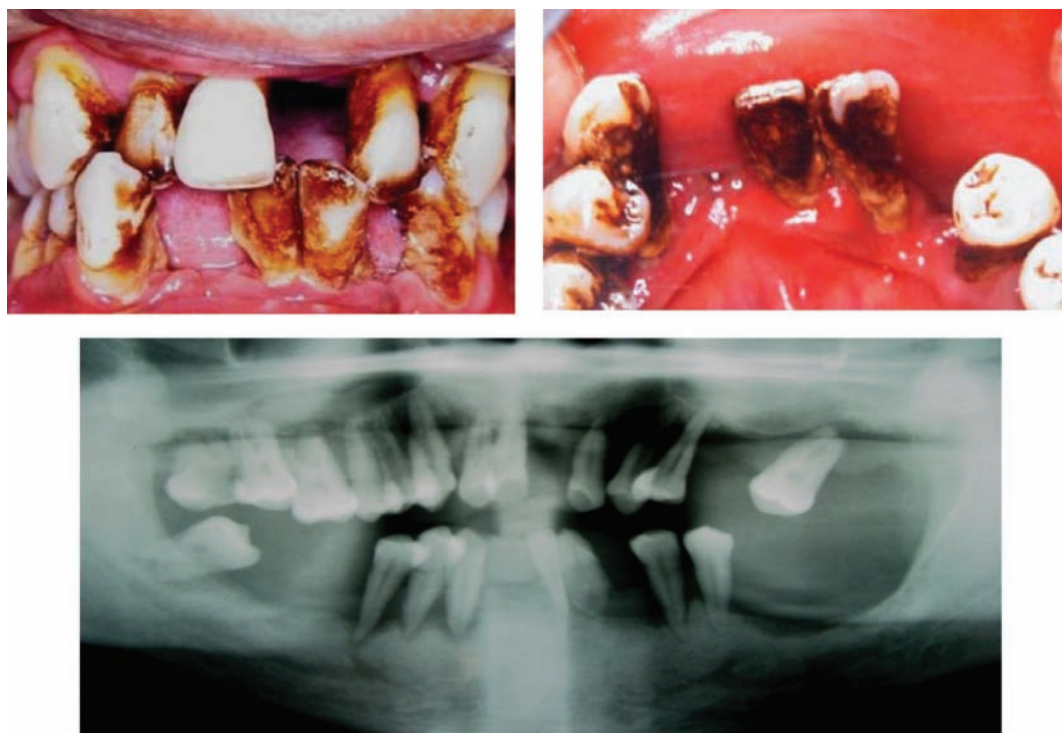


Fig. 1. A 31-year-old male patient presents with untreated advanced periodontitis with substantial destruction of periodontal tissues and alveolar bone as well as multiple missing teeth.

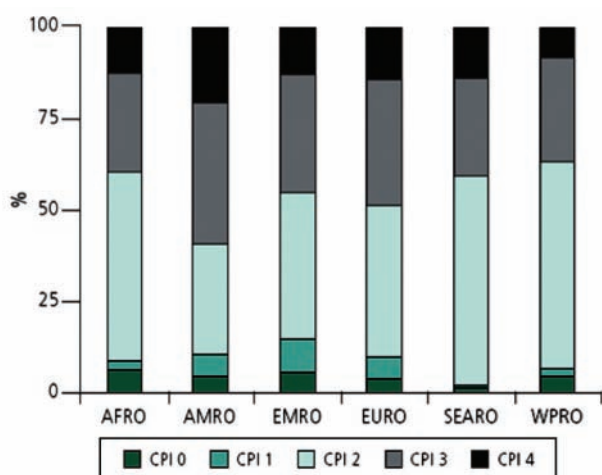


Fig. 2. Mean percentage of maximum Community Periodontal Index (CPI) scores among 35- to 44-year-olds, by WHO region. Reprinted from Petersen *et al.* (2005) with permission from the WHO.

health care, inequalities in periodontal health remain a major public health issue (Watt and Sheiham, 1999).

A recent report from the World Health Organization (WHO) shows that severe periodontitis exists in 5-20% of most adult populations worldwide (Fig. 2; Petersen *et al.*, 2005). Analysis of the data from the WHO Global Oral Health Data Bank shows that periodontal diseases are highly prevalent among 35- to 44-year-old adults in all the regions, and most children and adolescents exhibit signs of gingivitis (Global Oral Health Data

Bank, 2004; Petersen *et al.*, 2005). The WHO Global Oral Health Program has worked tirelessly since 2003 to increase the general awareness of oral health worldwide and to point out the importance of oral health as an essential component of general health and quality of life (Petersen, 2009). In the Seventh Global Conference on Health Promotion organized by the WHO in 2009, oral health promotion was selected for the first time as a sub-plenary theme for formal discussion and global implementation (Petersen and Kwan, 2010). Inequalities in periodontal health between and within countries may often reflect the inequities in general health in both magnitude and extent (Petersen, 2007). Socio-economic inequalities in health status and outcomes have been studied and reported extensively from all parts of the world, and these inequities significantly affect health status and health outcomes globally, including oral health (Hobdell *et al.*, 2002).

LIKELY REASONS TO ACCOUNT FOR PERIODONTAL HEALTH INEQUALITIES

Risk Factors

Although periodontal diseases are highly prevalent in all populations that have been presented in 'The Oral Health Atlas' recently published by the FDI World Dental Federation (Beaglehole *et al.*, 2009), severe periodontitis affects about 5-20% of individuals in both developed and developing countries (Løe *et al.*, 1986; Holmgren *et al.*, 1994; Söder *et al.*, 1994; Baelum *et al.*, 1996; Papapanou, 1996; Petersen *et al.*, 2005; Beaglehole *et al.*, 2009). Periodontal destruction is caused by

Table 1. General and Local Established or Potential Risk Factors of Periodontal Diseases

General/Systemic Factors
Subject determinants
Patient compliance and access to regular dental care
Socio-economic status
Tobacco smoking
Uncontrolled diabetes mellitus
History of periodontitis
Neutrophil dysfunction and other acquired immunologic dysfunctions
Genetic traits
Human immunodeficiency virus (HIV) infection
Medications (e.g., phenytoin, nifedipine, and cyclosporin)
Stress
Nutritional deficiency
Hormones
Obesity
Osteoporosis
Excessive alcohol consumption
Local Factors
Poor oral hygiene
Microbial factors
Anatomic plaque-retentive factors
Furcation involvements
Enamel pearls and cervical enamel projections
Root abnormalities (e.g., root grooves)
Root proximity and open contacts
Impacted third molars
Overhanging restorations
Pulpal involvement and root fracture
External root resorption
Trauma from occlusion
Parafunctional habits
Tooth mobility

uncontrolled host responses to pathogenic plaque biofilms. Some factors that may modify the balance of normal oral microbiota and host interactions may increase the likelihood of the individual's developing periodontal diseases. Some of these risk factors in the causative chain for periodontal diseases include poor oral hygiene, tobacco smoking, socio-economic status, malnutrition, psychological conditions, drug use, and local conditions, such as poor dental restorations and anatomical defects that make it difficult for individuals to perform oral hygiene. In addition, uncontrolled diabetes mellitus, obesity, untreated HIV infection, and genetic variables linked to hyper-inflammatory polymorphisms are risk factors (Kornman and Löe, 1993; Page *et al.*, 1997; Saito *et al.*, 2001; Nunn, 2003; Kinane *et al.*, 2005; Klinge and Norlund, 2005; Heitz-Mayfield and Lang, 2010) (Table 1). Tobacco smoking is among the most important modifiable environmental risk factors for periodontitis (Kinane and Chestnutt, 2000). In this regard, periodontal diseases are complex multi-factorial conditions. Risk assessment and control are therefore fundamentally important in clinical practice (Editorial, 2008; Matuliene *et al.*, 2010).

Social Determinants

It has been suggested that the social determinants of health (*i.e.*, educational background, economic status, living conditions,

lifestyles, and working environment) are largely responsible for oral and periodontal health inequalities worldwide (Petersen *et al.*, 2005; Petersen and Kwan, 2010). Among the three common oral diseases (dental caries, periodontal disease, and oral cancer), periodontal disease exhibits the strongest association with social, economic, and behavioral risk variables (Hobdell *et al.*, 2003). These determinants may affect a range of oral health outcomes, increase exposure to risk factors, and hinder access to and utilization of oral health services. Therefore, interventions that modify the socio-economic environment and enhance control of risk factors are important strategies for promotion of oral health in the community. In addition, these interventions need to be integrated with overall efforts at chronic disease prevention and general health promotion (Petersen and Kwan, 2010; Marmot and Bell, 2011).

Access to Oral Health Services and Patient Compliance

Professional oral care is a key component for prevention, treatment, and maintenance of periodontal health. Therefore, effective instruction in daily oral hygiene practices and patient compliance with regular supportive periodontal care are crucial for long-term maintenance of periodontal health and prevention of disease recurrence (Matuliene *et al.*, 2010).

Awareness of and Attitude toward Oral and Periodontal Health

Individuals are frequently unaware that they have periodontal disease, since most forms of gingivitis and periodontitis are painless. Occasional gingival bleeding is often the only symptom noticed by patients until the late stages of the disease, when mobile teeth and painful periodontal abscesses frequently occur. In many cultures and societies, only emergency dental care is sought, when periodontitis has destroyed most of the supporting bone and tissues around the teeth. This poor periodontal health awareness significantly influences daily oral hygiene practices and routine periodontal care provided by dentists, periodontists, and dental hygienists. Similarly, in many cultures, tooth loss is considered an inevitable outcome of the normal aging process. Such attitudes and cultural beliefs can be detrimental to oral and periodontal health. Although it is evident that periodontal diseases are interrelated with diabetes mellitus, many patients are unaware of this link and the associated clinical implications (Allen *et al.*, 2008; Al-Khabbaz *et al.*, 2011).

Dental Insurance Schemes

In developed countries, oral health service systems are based upon demand for care provided by private dental practitioners to patients, with or without third-party payment schemes, or by public health sectors in Scandinavian countries and the United Kingdom (Petersen *et al.*, 2005). Comparable oral health service systems are simply not available in most developing countries, and limited resources are primarily allocated to emergency oral care and pain relief (Petersen *et al.*, 2005).

Income Inequality

Previous studies have shown that periodontal diseases are associated with individuals' income and socio-economic position (Sheiham and Nicolau, 2005; Sabbah *et al.*, 2007). A very recent ecological study showed that higher levels of income inequality (*i.e.*, relative income rather than absolute income) in affluent, developed countries, measured by the Gini coefficient and 20:20 ratio, were significantly associated with periodontal disease severity in adults, even after adjustment for measures of absolute national income (Sabbah *et al.*, 2010). Psychosocial background, stress, and behavioral factors may partly account for the aforementioned relationships (Sheiham and Nicolau, 2005; Sabbah *et al.*, 2009).

FUNDAMENTAL GAPS IN KNOWLEDGE AND UNDERSTANDING

Recent research into the etiopathogenesis of periodontal diseases indicates that various genetic, epigenetic, and environmental factors may significantly modify the dynamic equilibrium of bacteria-host interactions in a susceptible host (Page *et al.*, 1997; Jin, 2008; Kornman, 2008). How these factors affect the initiation and progression of periodontal disease and how they interact with other risk factors to affect the phenotypic profiles remain unclear. Personalized periodontal care by incorporation of individual risk profile may be promising in future clinical practice.

Gingivitis is the precursor to periodontitis, and a recent longitudinal study has shown that persistent gingivitis represents a pre-condition and potential risk factor for periodontal attachment loss and tooth loss (Lang *et al.*, 2009). However, it is clear that only some cases of gingivitis progress to periodontitis. Unfortunately, it is currently not possible to identify the type of gingivitis that will lead to destruction of tooth-supporting periodontal tissues and alveolar bone. Identification of high-risk forms of gingivitis (*i.e.*, those that progress to periodontitis) is a high research priority, since this could lead to the implementation of interventions that prevent the progression of gingivitis to destructive periodontitis.

Efficient techniques for the early detection of periodontal disease and the evaluation of disease activity, as well as treatment efficacy, remain to be established. Diagnostic and prognostic tests based on assaying components of saliva and gingival crevicular fluid are in the early stages of discovery and hold great promise for future application in identifying individuals who are at risk of developing periodontitis and to predict periodontal therapy outcomes (Giannobile *et al.*, 2009; Zhang *et al.*, 2009).

Promotion of oral and periodontal health is crucial for addressing periodontal health inequalities worldwide. Limited information is available on the effects of integration of oral and periodontal health as a part of the programs designed to promote general health and prevent chronic diseases.

Prevention is the key to periodontal health. This can be achieved through effective daily personal plaque control at home and the regular seeking of professional supportive care. Although professional dental care is of great importance for achieving the preventive and therapeutic goals, poor daily plaque control and patient compliance are the major obstacles to be overcome. In recent years, various psychological models of behavior change have been increasingly incorporated into

clinical dental practice (Renz and Newton, 2009). Limited information is available on critical assessment of the appropriateness and effectiveness of these models in the management of periodontal patients. Moreover, longitudinal studies on how to enhance personal oral hygiene practice and how to prevent periodontal disease effectively are still lacking.

REASONS FOR FAILURE TO IMPLEMENT AT SCALE MEASURES THAT HAVE BEEN SHOWN TO BE EFFECTIVE IN CLINICAL OR LABORATORY STUDIES

Periodontal diseases can be controlled, and periodontal health is capable of being maintained. Poor awareness of the importance of periodontal health and the consequences of the disease among the public and even among some general dental practitioners is one of the most common reasons for failure to control and treat periodontal diseases effectively on a population basis. Lack of awareness often leads to delayed treatment.

Lack of appropriate oral healthcare systems and qualified oral health care professionals, including dental hygienists, exists in resource-poor developing countries.

There is a lack of nationwide, evidence-based, effective oral health promotion strategies and policies, as well as the capacity in healthcare systems to promote oral and periodontal health, especially in developing countries. More effective oral health education systems should be developed and undertaken at the community level.

Most current dental education curricula are still based upon the traditional 'restorative model', while 'symptom-driven' dental visit patterns remain the prevalent route for access to primary dental and periodontal care. We recommend that the prevention-driven 'well-being model' should be implemented in dental education and continuing professional development schemes as well as in public education about oral health.

Periodontal screening and care are not adequately incorporated into the management of patients by general dental practitioners. Dentists often prefer to treat rather than prevent oral diseases and maintain periodontal health, especially in developing countries. In many societies, dentists are not compensated for preventive services. Systems need to be instituted that compensate dentists for all services provided, including examination, preventive and restorative treatment, and health maintenance.

There is a lack of effective teamwork with medical professionals in identifying and controlling the risk factors that are shared by, or common to, both oral and systemic diseases. Dentists and physicians are therefore strongly encouraged to work together for optimal control of the common risk factors that affect oral and general health.

There is a lack of long-term, regular supportive periodontal care, including maintenance care for patients with dental implants.

PRIORITIES FOR BASIC, TRANSLATIONAL, AND APPLIED RESEARCH

This Task Group proposes 12 important research areas to address the global periodontal health inequalities through international

Table 2. The Basic, Translational, and Applied Research Agenda Items Proposed by the Periodontal Disease Task Group for the IADR's Global Oral Health Inequalities: The Research Agenda

- Cross-cultural studies to identify socio-economic factors that hinder the development and implementation of intervention strategies to prevent periodontal diseases.
- Development and validation of cost-effective preventive and supportive care schemes suitable for application in underserved populations.
- Multicenter, longitudinal studies on establishing effective oral health care programs for prevention of periodontal diseases.
- Development of a holistic preventive approach for prevention and control of major chronic diseases (including gingivitis and periodontitis) in humans through improving socio-economic situations and promotion of healthy life style (e.g., control of obesity, smoking cessation, healthy diet, and regular physical exercise, etc.).
- Further study on the link of periodontal diseases and systemic disorders as well as the effects of periodontal diseases and care on quality of life.
- Economic impacts of periodontal disease and periodontal care as well as the related health disparities study.
- Comparative effectiveness research in daily periodontal care (e.g., basic periodontal treatment).
- Clinical study on incorporation of patient or subjective-based outcome measures.
- Identification of genetic variations that underline complex disease traits in vulnerable populations, and determination of how those genetic variations interact with environmental factors to affect the initiation and progression of periodontal diseases.
- Mucosal vaccination research for prevention and control of periodontal diseases.
- Sensitive salivary biomarkers for identification of high-risk individuals, which will facilitate periodontal screening, early diagnosis, and in-time treatment.
- Prospective study on the effectiveness of host modulatory therapy in moderately to highly susceptible patients.

collaborations (Table 2). We believe that the periodontal disease burden could be relieved significantly in the near future through effective global teamwork.

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