

# Impact of the global burden of periodontal diseases on health, nutrition and wellbeing of mankind: A call for global action

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## Abstract

**Background:** The global burden of periodontal diseases remains high. Population growth trends, changes in risk factors and improved tooth retention will increase the socio-economic burden of periodontitis that is responsible for 3.5 million years lived with disability, 54 billion USD/year in lost productivity and a major portion of the 442 billion USD/year cost for oral diseases.

**Methods:** In the context of the Milan World Exhibition 2015 “Feeding the Planet, Energy for Life,” a green paper was developed and offered for global consultation by the European Federation of Periodontology. The final draft was endorsed by professional organizations around the world and is presented to stakeholders as a call for global action.

**Results:** Specific actions for the public, policymakers, educators and professional organizations have been identified in the areas of prevention, detection and care. These actions align public interest and knowledge, need for self-care, professional intervention and policies to the best scientific evidence to proactively promote periodontal health and effectively manage the global burden of periodontal diseases, in accordance with WHO/UN priorities and strategies for tackling common non-communicable diseases via the Common Risk Factor Approach.

**Conclusions:** A strong and coherent body of evidence allows identification of actionable preventive, diagnostic and therapeutic strategies to effectively promote periodontal health and general wellbeing, and better manage the socio-economic consequences. Action requires consideration of the specific national scenarios.

## KEYWORDS

diagnosis, periodontal diseases, periodontitis, prevention, public health policy, risk factors, treatment

A draft of this paper has been circulated as a green paper for stakeholder consultation by the European Federation of Periodontology. It has been endorsed by the European Federation of Periodontology, the Asian Pacific Society of Periodontology, the Ibero-Panamerican Society of Periodontics and the International Academy of Periodontology as well as the following national learned societies of Periodontology: Argentinian Society of Periodontology, Australian & New Zealand Academy of Periodontists, Australian Society of Periodontology, Austrian Society of Periodontology, Azerbaijan Society of Periodontology, Belgian Society of Periodontology, Brazilian Society of Periodontology, British Society of Periodontology, Chilean Periodontology Society, Chinese Society of Periodontology, Croatian Society of Periodontology, Danish Society of Periodontology, Dutch Society of Periodontology, Finnish Society of Periodontology, French Society of Periodontology and Implantology, German Society of Periodontology, Hellenic Society of Periodontology, Hong Kong Society of Periodontology and Implant Dentistry, Hungarian Society of Periodontology, Indian Society of Periodontology, Indonesian Society of Periodontology, Irish Society of Periodontology, Israeli Society of Periodontology & Osseointegration, Italian Society of Periodontology and Implant Dentistry, Japanese Academy of Clinical Periodontology, Japanese Society of Periodontology, Korean Academy of Periodontology, Lithuanian Association of Periodontology, Malaysian Society of Periodontology, Moroccan Society of Periodontology, Nepalese Society of Periodontology and Oral Implantology, Norwegian Society of Periodontology, Philippine Society of Periodontology, Polish Society of Periodontology, Portuguese Periodontology and Implants Society, Romanian Society of Periodontology, Russian Association of Periodontists, Serbian Society of Periodontology, Society of Periodontology (Singapore), Slovenian Society of Periodontology, Spanish Society of Periodontology, Swiss Society of Periodontology, Swedish Society of Periodontology, Taiwan Academy of Periodontology, Turkish Society of Periodontology, Ukrainian Society of Periodontists. This paper is supported by The American Academy of Periodontology.

## 1 | INTRODUCTION

Periodontal diseases, comprising gingivitis and periodontitis, are probably the most common disease of mankind (Guinness World Records 2001). The recent Global Burden of Disease Study (GBD, 1990–2010) indicates that: (i) severe periodontitis is the 6th most prevalent disease worldwide, with an overall prevalence of 11.2% and around 743 million people affected, and (ii) the global burden of periodontal disease increased by 57.3% from 1990 to 2010 (Jin et al., 2016; Kassebaum et al., 2014a; Marcenes et al., 2013; Murray et al., 2012). As periodontitis is the major cause of tooth loss in adult population worldwide, these individuals are at risk of multiple tooth loss, edentulism and masticatory dysfunction, thereby affecting their nutrition, quality of life and self-esteem as well as imposing huge socio-economic impacts and healthcare costs (Chapple, 2014; Chapple et al., 2015; Petersen & Ogawa, 2012; Pihlstrom, Michalowicz, & Johnson, 2005). Periodontal diseases are responsible for 3.5 million years lived with disability (GBD 2015 Disease and Injury Incidence and Prevalence Collaborators, 2016). The global cost of lost productivity from severe periodontitis alone has been estimated to be 54 billion USD/year, while the total economic impact of periodontal diseases accounts for a major component of the 442 billion USD, direct and indirect cost of oral diseases incurred in 2010 (Listl, Galloway, Mossey, & Marcenes, 2015). The overall prevalence of periodontitis increases with age, and the incidence rises steeply in adults aged 30–40 years. Such burden of periodontitis will continue to increase with the growing ageing population also due to increased tooth retention globally (Jepsen et al., 2017; Kassebaum et al., 2014b; Tonetti et al., 2017). Periodontitis disproportionately affects the vulnerable segments of the population and is a source of social inequality (Jepsen et al., 2017; Jin et al., 2011).

Periodontitis is a chronic non-communicable disease (NCD) that shares social determinants and risk factors with the major NCDs that cause around two-thirds of deaths such as heart disease, diabetes, cancer and chronic respiratory disease (Ezzati & Riboli, 2012; FDI 2013a,b; Jin, 2013; Sheiham & Watt, 2000; United Nations 2011). Tobacco smoking, obesity and poor nutrition (both in terms of caloric intake and quality of the nutritional components) and physical inactivity have all been associated with an increased risk of periodontitis (Chapple et al., 2017). Trends in risk factors are likely to impact the burden of periodontitis, and the rise of smoking in developing countries combined with the obesity/diabetes epidemic will further drive incident periodontitis. Besides the shared risk factors with major NCDs, accumulation of dental biofilms consequent to inadequate self-performed oral hygiene procedures, such as tooth brushing and use of inter-dental cleaning aids, accounts for the initiation and progression of periodontal disease in the population. These biofilms, if not well controlled, interact with the unique susceptibility profile of each individual and may become dysbiotic, thereby initiating and sustaining the disease process which is characterized by the inflammatory destruction of the tooth-supporting apparatus and alveolar bone (Darveau, 2010; Hajishengallis et al., 2011; Kornman, 2008; Sanz et al., 2017). The key presentations of periodontitis in the early stages are gingival bleeding, recession of the gingival margin and halitosis. Measurable

### Clinical Relevance

*Scientific rationale for the study:* The global burden of periodontal diseases remains high and trends in risk factors, improved tooth retention and aging population are likely to bear further increases. Associated morbidity, costs and socio-economic impact will continue to rise.

*Principal findings:* This paper identifies actionable opportunities for prevention, early detection and treatment of periodontal diseases. These have been the subjects of consultation among learned societies in Periodontology worldwide.

*Practical implications:* We propose specific actions to align public interest and knowledge, need for self-care, professional intervention and policies to the best scientific evidence to proactively promote periodontal health and effectively manage the global burden of periodontal diseases. These actions are in accordance with WHO/UN priorities and strategies for tackling common non-communicable diseases (NCDs) via the Common Risk Factor Approach.

changes in oral health-related quality of life are present (Buset et al., 2016; Shanbhag, Dahiya, & Croucher, 2012).

Once a considerable amount of the periodontal attachment has been destroyed by periodontitis both in terms of number of affected teeth and severity, the disease is complicated by an array of signs and symptoms that further impact on the quality of life of the affected individuals. These include tooth migration and drifting, tooth hypermobility, tooth loss and ultimately increasing levels of masticatory dysfunction. Masticatory dysfunction, as the terminal stage of periodontitis, compromises nutrition and general health. However, the early stages of periodontal disease are often symptomless, and a significant number of affected patients do not seek professional care. The relatively “silent” nature of the early stages of the disease, combined with low awareness of periodontal health, leads to many patients seeking “symptom-driven” care for advanced disease through periodontal therapy when available and affordable (Jin, 2015).

Considerable evidence also points to the fact that the effects of periodontitis go beyond the oral cavity and that the body is affected by the haematogenous dissemination of both bacteria and bacterial products originating in the oral biofilms and inflammatory mediators originating in the inflamed periodontium. Through these mechanisms, periodontitis interacts with various systemic diseases, notably diabetes, atherosclerosis, rheumatoid arthritis and pulmonary infections. Loss of masticatory function consequent to periodontal attachment loss and tooth loss due to severe periodontitis impacts on nutrition, as subjects with masticatory dysfunction change their dietary habits usually incorporating more starch and fats and less fresh fruit and vegetables in their diet. The systemic inflammatory burden and poor nutrition consequent to severe periodontitis may contribute to the pathogenesis of chronic NCDs (Tonetti & Kornman, 2013).

Periodontitis can be prevented, easily diagnosed and successfully treated and controlled following appropriate professional care and long-term secondary prevention. Currently, various cultural and socio-economic barriers to professional care prevent the public from applying correct preventive approaches, receiving early diagnosis and seeking treatment, resulting in limited progress in improving periodontal health (Jin et al., 2011). This call for global action aims to draw the attention of oral healthcare professionals, medical practitioners, educators, health officials, payers and the public to opportunities to improve periodontal health and general health. In this document, it is recognized that different countries are at different levels with respect to periodontal health literacy, care and policy. However, even in the most advanced countries, considerable segments of the population continue to present high burdens of disease and have difficulty in accessing health information and professional services.

## 2 | OPPORTUNITY 1—PREVENTION

Prevention is the key for oral health (Editorial, *Lancet* 2009). Periodontitis is preventable through effective management of gingivitis and promotion of healthy lifestyles at both population and individual levels (Chapple et al., 2015; Jepsen et al., 2017). This can be accomplished through: (i) professional instruction of self-performed effective oral hygiene such as tooth brushing and inter-dental cleaning, and (ii) an integrated and population-based approach in health education based on the Common Risk Factor Approach in the context of the recent UN's resolution for establishment of the 2030 sustainable development goals (GBD 2015 SDG Collaborators, 2016; United Nations, 2015). A critical element is that prevention should be tailored to individual needs through diagnosis and risk profiling. Meanwhile, it is emphasized that each individual should play a proactive role in awareness of oral health, self-care measures, health promotion and disease prevention for optimal oral and general health in the course of life.

Conclusions of the recent European Workshop on Periodontology in primary and secondary prevention of periodontal and peri-implant diseases have helped to identify potential large-scale preventive programmes and highlighted specific actions that may reduce the worldwide prevalence of periodontal diseases (Tonetti, Chapple, Jepsen, & Sanz, 2015). These are the key recommendations.

1. Gingival bleeding is an early sign of periodontal disease and a leading risk marker for existing periodontal inflammation that accounts for the onset and progression of periodontitis. Public health campaigns tailored for different susceptible groups (e.g. adolescents, pregnant women and diabetics), professional information and labelling of oral health care products should highlight the importance of gingival bleeding and encourage professional care whenever it is present and persists.
2. Subject motivation, self-care approaches and detailed instruction on the use of mechanical plaque control aids, such as tooth

brushing and inter-dental cleaning, are key in management of gingivitis and prevention of periodontitis.

3. Control of systemic risk factors such as smoking (in the context of the WHO common risk factor approach) is an important component of prevention at both the individual and population levels.
4. An appropriate periodontal diagnosis including an assessment of patient-level factors (e.g. risk factors and life attitudes) should determine the most appropriate professional preventive care and the need for treatment.
5. There is an urgent need for universal implementation of periodontal screening by the oral health care team.
6. Professional mechanical plaque removal is important, but cannot serve as the sole element of professional preventive care. Oral/periodontal health education starting from pre-school period and proactive behaviour change are fundamental to sustained improvements in periodontal health status.
7. Professional preventive care alone is inappropriate in subjects with a clinical diagnosis of periodontitis, as they require effective treatment for their periodontal condition first.
8. The public should be aware that, when gingival bleeding is present, self-medication with chemical plaque control agents may mask more serious underlying periodontal disease and individuals should seek timely professional advice before using anti-gingivitis agents.
9. Long-term success of periodontal therapy requires active participation in a secondary prevention programme specifically designed to meet the needs of these individuals at higher risk of disease recurrence.
10. For optimal long-term tooth retention and oral function, patients participating in secondary prevention programmes require completion of an active phase of periodontal therapy that achieves individually set treatment goals. Secondary prevention is preferably undertaken according to patients' risk profiles with the appropriate frequency of maintenance and patient compliance.

More information is available in the consensus statements of the four workshop working groups (Chapple et al., 2015; Jepsen et al., 2015; Sanz et al., 2015; Tonetti, et al., 2015).

As common oral diseases like periodontitis share risk factors with other NCDs such as heart disease and diabetes, the Common Risk Factor Approach, strongly advocated by the WHO for improving human health, should incorporate self-performed oral hygiene as one of the positive lifestyles. Preventive programmes for NCDs should thus take into account the specific needs to effectively support oral health as one of the fundamental components of general health (United Nations 2011) and include them in large-scale population efforts whenever feasible. Notably, FDI's new definition of oral health recognizes its multidimensional nature and attributes (i.e. disease status, physiological function and psychosocial function), and promotes incorporation of oral health into the mainstream of health and healthcare for effective advocacy of optimal oral and general health (Glick et al., 2016; Lee, Watt, Williams, & Giannobile, 2017).

### 3 | OPPORTUNITY 2—DIAGNOSIS

Periodontitis is easily diagnosed via a full-mouth comprehensive periodontal evaluation. Periodontal probing should be a key component of regular dental visit. Professional periodontal screening approaches that are both sensitive and inexpensive were introduced in several countries more than a quarter of a century ago. Their routine adoption by all oral healthcare professionals has been an elusive objective, and the burden of undiagnosed disease remains high worldwide. Furthermore, diagnosis is frequently delayed until symptoms of advanced periodontal breakdown emerge. Missed or delayed diagnosis often results in very significant increases in both the burden and cost of disease management, and it indeed represents the leading cause of professional litigation in many industrialized countries (Zinman, 2001). Professional organizations around the world recognize the value of a three-step approach to periodontal diagnosis:

1. Patient self-detection of symptoms and signs of periodontal disease to promote awareness and seek professional examination.
2. Professional periodontal screening to segment the population into periodontal health, gingivitis (planning preventive care for these conditions) and periodontitis.
3. Comprehensive periodontal examination and diagnosis to plan appropriate treatment of periodontitis.

Early diagnosis followed by appropriate treatment and secondary prevention has the potential to improve quality of life, preserve teeth and masticatory function, and reduce the lifelong social and financial burden associated with caring for periodontitis.

Periodontal diagnosis should include an assessment of risk factors for periodontitis. As various systemic conditions (e.g. diabetes) interact with periodontitis or its treatment, their screening is part of a standard periodontal examination. Since the adult population in advanced countries is more likely to see an oral healthcare professional than a medical practitioner, screening for and monitoring of conditions such as diabetes, hypertension and obesity in the dental setting may greatly contribute to detection of undiagnosed medical conditions (Genco et al., 2014; Lalla, Kunzel, Burkett, Cheng, & Lamster, 2011). This reshaped and expanded role of oral healthcare professionals would improve patients' oral and general health, while enhancing their roles in the health workforce team (Glick et al., 2012).

It may be useful to stage the extent and severity of periodontitis and the presence of masticatory dysfunction in a given subject, as treatment needs are likely to be different.

*Stage 1: Mild to Moderate Periodontitis* refers to a condition characterized by gingival inflammation and a degree of destruction of the periodontal attachment compatible with oral function.

*Stage 2: Severe Periodontitis* refers to a condition characterized by gingival inflammation, advanced destruction of the periodontal

attachment and presence of vertical bone defects and/or furcation involvement. Oral function may still be preserved but the risk of disease progression leading to tooth loss is high.

*Stage 3: Severe Periodontitis complicated by Masticatory Dysfunction* refers to a condition characterized by gingival inflammation, advanced destruction of the periodontal attachment, presence of vertical bone defects and/or furcation involvement, as well as loss of masticatory function consequent to tooth hypermobility and/or tooth loss.

### 4 | OPPORTUNITY 3—TREATMENT

Periodontal treatment aims to control gingivitis and periodontitis, avoid disease progression leading to tooth loss, retain a functional dentition for a lifetime, preserve self-esteem and improve quality of life.

Overwhelming evidence indicates that periodontitis can be treated and effectively managed in the majority of subjects. Long-term studies report that, after periodontal therapy, rate of tooth loss averaging 0.1 tooth/patient/year is observed in subjects participating in professional secondary prevention programmes in specialist practice (Trombelli, Franceschetti, & Farina, 2015). This rate is generally compatible with the preservation of the dentition for a lifetime in the majority of subjects. A systematic review reporting tooth survival up to 22 years after periodontal therapy in specialist practice indicates that tooth loss due to periodontal reasons ranges from 1.5% to 9.8%, while 36 to 89% of treated subjects do not experience further tooth loss (Chambrone, Chambrone, Lima, & Chambrone, 2010). Higher rates of tooth loss were observed among older individuals and smokers.

Delivery of appropriate periodontal care to the individual patient requires a full diagnostic and prognostic assessment of the case and access to effective treatments to control inflammation and avoid tooth loss. Periodontal treatment requires delivery by a highly skilled, and sometime highly specialized oral health care professional. Access to such professionals remains a challenge in many health systems.

Scientific evidence indicates that periodontal treatment consisting of a series of sequential phases of care is effective and that the effectiveness is also related to the skill level and experience of the oral health care professional. These phases are:

*Phase 1.* Control of risk factors (e.g. smoking cessation and diabetes control) and promotion of healthy lifestyles including adequate self-performed oral hygiene combined with control of periodontal inflammation via professional biofilm removal in the supra- and subgingival environments. This is required for all subjects with a diagnosis of periodontitis. Its effectiveness for the individual patient needs to be assessed and can manage to achieve appropriate levels of plaque control, gingival inflammation and residual periodontal pockets. It may be the only phase of treatment necessary for Stage 1 periodontitis.

*Phase 2.* Subjects who respond well to the first phase of treatment but present with persistent periodontal pockets may benefit

from surgical correction of the anatomical lesions caused by the disease process in order to regain periodontal health, enable adequate self-performed oral hygiene and minimize the risk of recurrence. It is frequently needed for the management of Stage 2 or 3 periodontitis.

*Phase 3.* Once periodontal health has been achieved, rehabilitation of the masticatory function and/or aesthetics may be indicated in the more advanced cases that have experienced tooth loss, masticatory dysfunction, tooth migration or compromise of aesthetics. It is frequently needed for the management of Stage 3 periodontitis.

*Phase 4.* Participation in a professional secondary preventive care programme tailored for the periodontitis patient who is at higher risk of recurrence. These patients require more stringent monitoring and a higher level of care. This is necessary for long-term preservation of the dentition after completion of active periodontal therapy (Phases 1–3) of all periodontitis patients.

A classical study with 30-year follow-up indicates that optimal results are obtained with specialist care followed by participation in secondary prevention programmes in specialist clinics. Failure to deliver structured secondary prevention care in a specialist clinic leads to higher rates of recurrence of periodontitis and tooth loss (Axelsson & Lindhe, 1981; Axelsson, Nyström, & Lindhe, 2004).

Periodontal care is being provided in a variety of health systems around the world and, given the global burden of disease, it requires the active engagement of a highly trained and motivated oral health professional team. As the complexity of treatment increases with disease progression (Stages 1–3 periodontitis), it is important to plan appropriate primary and secondary care in national health systems. Appropriate assessment and enhancement could therefore be performed in every country for optimizing the national oral healthcare strategies and services.

In countries with structured dental services, effective primary care is provided in general dental offices through a dentist-led teamwork with dental hygienists and assistants with clearly defined areas of responsibility. While secondary care is delivered in more specialized centres, usually under the guidance of a specialist. In some countries, tertiary care facilities at academic centres may provide support for the management of unusual and challenging forms of disease.

The remit of primary care facilities comprises periodontal health information, health promotion, instruction in self-performed oral hygiene and preventive care for the general population, diagnosis and monitoring to ensure early detection of periodontitis, effective management of mild and moderate forms of disease (Stage 1 periodontitis), early recognition of subjects responding poorly or incompletely to standard treatment in the primary care setting and consideration of referral to a secondary care facility. Access to specialist care is best performed by referral from a primary care facility but patient self-referral is a possibility. The remit of specialized centres includes the management of more advanced (Stages 2 or 3 periodontitis) or non-responding forms of periodontitis as well as periodontitis in patients with complex medical co-morbidities. In many countries periodontitis

management in secondary care facilities is provided under the guidance of a periodontist or periodontologist—a trained specialist.

At these centres patients are given comprehensive advice on the full spectrum of treatment options available for the management of their periodontitis, and they should be able to receive the most appropriate form of treatment including control of advanced periodontitis (Stage 2 periodontitis), access flap surgery, osseous resective or regenerative periodontal surgery to manage deep residual pockets, management of ridge deformities consequent to tooth loss, rehabilitation of masticatory dysfunction with dental implants (Stage 3 periodontitis), management of aesthetic concerns with periodontal plastic surgery and, most importantly, the necessary specialized secondary preventive care tailored for high-risk individuals.

Technological advances over the last decades have considerably improved the applicability and predictability of these procedures, and advanced periodontal therapy is based on the largest body of scientific evidence in dentistry, that is, the references of European Federation of Periodontology (EFP) and American Academy of Periodontology (AAP) workshops. Since the science supporting periodontal treatment is strong, specific actions should address at the national level the following priorities to improve access to the available care:

1. Enhance public awareness of the early signs of periodontitis and the need for professional diagnosis to differentiate gingivitis and periodontitis.
2. Improve access to care informing patients that periodontitis can be effectively managed and that management is more cost-effective in the early stages of disease.
3. Enhance public and professional awareness of the standard of care for periodontitis in its different stages of severity.
4. Improve access to evidence-based treatment by addressing the misunderstanding that periodontitis can be effectively managed by self-care or self-medication with dentifrices, mouthrinses, herbal or homeopathic remedies, or by professional tooth cleaning alone.
5. Enhance public and professional awareness of the effect of treatment of periodontitis on improvement of oral health-related quality of life.
6. Enhance public and professional awareness of the possibility of individualized case prognosis based on the specific patient profile and stage of disease.
7. Enhance public and professional awareness of the consequences of incomplete and/or ineffective periodontal treatment, that is, higher risk of periodontitis progression and tooth loss due to incomplete and/or ineffective Phase 1 periodontal treatment as evidenced by persistence of periodontal inflammation with bleeding on probing and residual deep periodontal pockets.
8. Enhance public and professional awareness of the inadequacy of limiting treatment of periodontitis to the delivery of preventive professional care alone.
9. Enhance public and professional awareness of the role of dental implants as a part of the rehabilitation of masticatory dysfunction consequent to Stage 3 periodontitis, but not as a method for the treatment of periodontitis.



10. Enhance public and professional awareness of the need to complete treatment of periodontitis before proceeding with replacement of missing teeth with tooth- or implant-supported restorations.
11. Enhance public and professional awareness of the advances that periodontal treatment has made in the last decades and that consequently periodontal prognosis has changed greatly, and that teeth with advanced disease may be saved, for example, through the application of regenerative periodontal therapy.
12. Enhance public and professional awareness of the interdependence of periodontal health and general health, and the need for specific actions to address common risk factors (e.g. smoking, malnutrition, sedentary lifestyles and overweight/obesity) for both periodontitis and other chronic diseases.
13. Enhance public and professional awareness of the large oral care savings consequent to the delivery of appropriate periodontal care.
14. Enhance public and professional awareness of the potential savings for medical care associated with the delivery of appropriate periodontal care in specific groups like diabetics.

Clarifications of the above priorities, along with the availability of the necessary resources, may improve access to care and contribute to the management of the current burden of disease.

## 5 | CONCLUSIONS

Periodontology is supported by a strong and coherent body of scientific evidence; that allows identification of appropriate preventive, diagnostic and therapeutic strategies to effectively reduce the enormous global burden of disease represented by periodontitis, promote periodontal health, enhance general wellbeing and better manage socio-economic consequences. This call for global action has summarized reasonable strategies and undertakings whose implementation requires consideration of the specific national scenarios in terms of resources and health system model.

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## CONFLICT OF INTEREST

Authors report no conflict of interest.

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