

ORAL HEALTH IN AGEING SOCIETIES

Integration of oral health and general health



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Report of a meeting convened at the WHO Centre for
Health Development in Kobe, Japan, 1–3 June 2005



**World Health
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The texts by named authors in this publication are based on their presentations at the meeting on Oral Health in Ageing Societies: Integration of Oral Health and General Health, held from 1 to 3 June 2005, in Kobe, Japan. The named authors alone are responsible for the views expressed in this publication and they do not necessarily represent the decisions, policy or views of the World Health Organization.

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EXECUTIVE SUMMARY

Global population ageing is expected to continue in the 21st century, and maintaining maximum individual and population health throughout the lifespan is thus a significant challenge. Oral health is an essential element of general health and quality of life through an individual's life-course - yet one that is often neglected in integrated approaches for the promotion of general health.

Effective information-sharing between oral health professionals and other health care disciplines is critical for efficient health care and public health. The Ageing and Health Programme (AHP) of the WHO Centre for Health Development, Kobe, Japan, in collaboration with the Oral Health Programme (ORH) at WHO Headquarters, is focusing its research on oral health in ageing societies. Working with ORH and other relevant international bodies, AHP organized a meeting to raise awareness of oral health as an essential factor in general health and to bridge the gap between oral health and other important research and policy areas for individual health and community health.

The objectives of the meeting were to discuss preliminary outcomes of the global state-of-the-science research on the relationship between oral health and general health from a population ageing perspective; to identify appropriate comprehensive and integrated approaches and practices through health policy for better health care based on a multidisciplinary point of view; to assess the feasibility of integrated oral health strategies for development of best practice models through evidence of current practices; to discuss proper oral health policy formulation and common risk factor approaches in oral health promotion and disease prevention in ageing societies with a view to continuous development of a global database; and to promote and re-emphasize the importance of oral health as a component of overall health.

The meeting was held in the WHO Centre for Health Development from 1 to 3 June 2005. Thirty invited participants from twelve WHO Member States, in addition to representatives from the WHO Secretariat, shared information through presentations and intensive discussion during the meeting. **Dr Kreisel**, Director of the Kobe Centre, welcomed all participants in his opening remarks and briefly introduced the Centre's activities with a special focus on oral health in ageing societies. **Dr Petersen** outlined the objectives of the meeting and presented WHO global strategies and approaches for improving the oral health of older people. Following the introductory presentation on global ageing and the core exposé of the relationship between oral health and general health status in ageing societies, 17 presentations covered a variety of multidisciplinary approaches. Discussions followed each session, and overall issues and recommendations were debated on the last day.

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Research on oral health–general health relationships has grown considerably over the past decade. The following conclusions and recommendations emerged from the presentations and discussions and from the background documents:

- The available scientific evidence is particularly strong for a direct relationship between diabetes and periodontal disease and also suggestive of a relation between periodontal disease and diabetes control.
- The evidence of a direct relationship between periodontal disease and cardiovascular diseases and between periodontal disease and respiratory diseases is less convincing. Evidence is limited by the lack of consistency and by the fact that most studies have used a cross-sectional rather than a longitudinal design or have inadequate control for confounding factors. Appropriate analysis with adequate adjustment for age, tobacco use, and other factors suggests that observed associations between periodontitis and cardiovascular disease could be coincidental rather than causal.
- The impact of xerostomia - dry mouth - on health of the oral cavity has significant biological plausibility. One problem lies in distinguishing the effects of medications on dry mouth from those of the underlying health condition. There is sound evidence that dry mouth negatively affects oral function and quality of life.
- Biological and behavioural factors are implicated in the complex two-way relationships between inadequate nutrition and weight loss on the one hand and poor oral health status on the other. Diet and nutrition in old age are affected by changes in the immune system, by tooth loss and the status of the oral cavity, and by environmental factors. The evidence is strong that medications can provoke malabsorption of vitamins and minerals essential for health.
- Psychosocial factors and common risk factors may be involved in the association between poor mental health and visual impairment and poor oral health.
- Men and women may need to be examined separately since biophysiological change and experience may be sex-specific.

Meeting participants considered several recommendations for action towards improved oral health and general health in relation to:

- policy development for oral health and general health;
- health systems capacity-building;
- oral health care delivery;
- research for oral health, general health, and quality of life.

The meeting emphasized the importance of strengthening advocacy for action, legislation, goal-setting, and planning of programmes for better oral and general health in old age.

The participants expressed concern about the limited primary health facilities and access to oral health services in most developing countries. They recommended strongly that oral health systems in all countries be effectively oriented towards disease prevention and health promotion and that systems better match the needs of older people, including the functionally independent, the frail and the functionally dependent. They also emphasized the need for training of health professionals for better service and care, based on multidisciplinary and holistic approaches, and pointed out the instrumental role of caregivers globally in promoting the health of older people.

On the basis of their experience, meeting participants indicated that strengthening of good-quality research into oral health–general health relationships is needed. Translation of knowledge into clinical and public health practice is particularly important as poor and disadvantaged population groups worldwide have yet to benefit fully from advances in health sciences – a statement that is particularly true of the oral health of older people in most countries.

1. BACKGROUND

Demographic transition has been observed worldwide, with a strong trend toward global population ageing. According to the United Nations Population Division, average global life expectancy at birth for both sexes is expected to increase by approximately 5 years to almost 70 within the next 25 years (UNPD, 2003). The global population is expected to grow from the current 6 billion-plus to 8 billion by 2025. Of those 8 billion people, the proportion living in developing and least developed countries is expected to reach 69.2% and 14.4% respectively; that is, an estimated 83.6% of the world's population will be living in developing countries (UNPD, 2003).

The burden of diseases and the risk profiles prevailing among populations are also changing dramatically. Like developed countries, many developing countries are experiencing epidemiological transition, characterized by a shift from infectious to noncommunicable chronic diseases (WHO, 2002a, 2005a). Although malnutrition and infectious diseases such as malaria and cholera are still common in some developing countries, these are now accompanied by noncommunicable diseases such as cardiovascular disease, cancer, diabetes, and depression – the so-called “double burden” of disease (WHO, 2002a). Unfortunately, many countries have failed to keep pace with these demographic and epidemiological changes and are not prepared for the expected future scenarios. As a result, current public health policies and community services may not meet the health care needs of older adults.

Given the expectation of continuing global population ageing in this century, maintaining maximum individual and population health throughout the lifespan is a significant challenge. Oral health – despite being integral to the individual's general health and quality of life – is often neglected in comprehensive approaches to the promotion of general health. Indeed, oral health care is often considered in isolation by national health authorities.

Effective information-sharing between oral health and other health professionals is most important for efficient health care and public health. The availability of international comparative data is instrumental to oral health surveillance. In close collaboration with the Oral Health Programme (ORH) at WHO Headquarters, the Ageing and Health Programme (AHP) of the WHO Centre for Health Development (WHO Kobe Centre, WKC) therefore planned oral health research and related activities, with special reference to older and ageing populations. The aims were to raise awareness of oral health as an essential factor in general health, to bridge the gap between oral health and other important areas, research and policy, to stimulate the development of proper community practices, and to facilitate comprehensive research and the collection of systematic oral health information.

Oral Health Programme at WHO Headquarters

The World Oral Health Report 2003 (Petersen, 2003a) outlines the global burden of oral disease and the principles for disease control and health promotion in the 21st century, laying particular emphasis on the following points:

- Oral health is integral and essential to general health.
- Oral health is a determinant factor for quality of life.
- Oral health and general health are strongly associated.

A number of common risk factors such as poor dietary practices, tobacco use, and excessive alcohol intake are primarily responsible for the interrelationship between several oral diseases and noncommunicable chronic diseases. The link between oral health and general health is particularly pronounced in older people. Improving the oral health of older people is an important component of the WHO ORH Global Strategy; approaches to this goal are detailed in a recent publication (Petersen & Yamamoto, 2005).

Globally, important mechanisms for improving oral health would involve strengthening oral health policy development; national capacity-building within oral health care for the underserved; education and training for service and care for the elderly; and research into the oral health of older people. However, the challenges vary from country to country and from region to region: the differences are particularly marked between developed and developing countries. In a number of countries, ORH has initiated demonstration projects for older people in order to gain experience within oral disease control, prevention of chronic noncommunicable diseases, health promotion, and quality of life improvement.

ORH provides analysis-for-policy and analysis-of-policy information that is fundamental to the integration of oral health into national and community health programmes. Initiatives include state-of-the-science analysis of the interrelationships between oral and general health, and the establishment of global data banks for surveillance of risk factors common to oral and general health. The Programme will implement the strategies for better health through oral health of older people in collaboration with various partners, including WKC.

WKC approaches to ageing and oral health issues

WKC views ageing as a lifelong process that begins at the time of conception and convened its first international meeting under the title “Ageing and health: a global challenge for the 21st century” in Kobe in November 1998. Deliberations at that meeting made an important contribution to the discussions of the United Nations International Year of Older Persons in 1999. At the second United Nations World Assembly on Ageing (WAA2), held in 2002 in Madrid, Spain, WKC and other WHO offices were leading contributors; the WHO document for the Assembly, Health and ageing, presented a policy framework based on a life-course perspective and a determinants of health approach. WKC contributed to the formulation of the WAA2 outcome document, International Strategy for Action on Ageing, by organizing the Valencia Forum ahead of the Assembly.

WKC regards oral and dental health as a vital element of general health status and is paying particular attention to increasing public awareness and responding to the demand for information on healthy ageing and longevity. Focusing on well-being and quality of life, WKC is working in collaboration with civil society groups and local communities in Japan. For instance, with the accent on oral health, the International Symposium on Good Oral Health in Ageing Societies: Filling the Gap between Dental Health and Life Expectancy was co-organized with the Japan Dental Association and brought some 200 dental and other health professionals together in Tokyo on 2 June 2001. The symposium was intended to promote awareness and provide information on advanced technologies and new knowledge with regard to the prevention, treatment, and service aspects of oral health throughout life (WHO, 2002b).

A second symposium on Good Oral Health in Ageing Societies: to Keep Healthy Teeth for Your Healthy Life – was held in Kobe on 10 November 2001 in collaboration with the dental associations of Hyogo and Kobe (WHO, 2002c). Inviting around 500 members of the general public to attend, WKC's aim was again to promote awareness and to facilitate better policy-making with regard to oral health in ageing societies.

In an attempt to collate a wealth of scattered information, the Global review on oral health in ageing societies was published as a technical report in 2002 (WHO, 2002d).

It is vital to emphasize systematic approaches to oral health and general health improvement in an ageing society. Holistic or comprehensive health approaches are needed and guidelines must be set on development of oral health systems for an ageing society. Capacity-building based on both the life-course perspective and quality of life will help countries and communities to respond more effectively to the current and future burden of oral disease through adequate public policies.

With these important concerns in mind, WKC convened a meeting on Oral Health in Ageing Societies: Integration of Oral Health and General Health from 1 to 3 June 2005. Thirty health professionals from twelve WHO Member States across all WHO regions were invited, in addition to representatives from the WHO Secretariat. The aims and objectives of the meeting were the following:

- To discuss the preliminary outcomes of global state-of-the-science research on the relationship between oral health and general health from the perspective of an ageing population.
- To identify appropriate comprehensive and integrated approaches to health improvement through public health initiatives, based on multidisciplinary actions.
- To assess the feasibility of integrated oral health strategies for development of best-practice models based on evidence and experience from different WHO Member States.
- To discuss the proper formulation of oral health policy and common risk factor approaches in oral health promotion and disease prevention in ageing societies.
- To discuss the continuous development of a global database for surveillance of oral health and risk factors.

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- To promote and re-emphasize oral health as a critical component of holistic health.
- To produce a summary report of the meeting to be distributed to all participants, public health administrators, decision-makers, and other relevant groups in policy development for better health.

2. SUMMARY OF OPENING SESSION AND PRESENTATIONS

In his opening remarks, **Dr Wilfried Kreisel**, Director, WKC, emphasized the importance of oral health in ageing societies. He stated that one of the key changes would be to improve response to local concerns and needs by using international knowledge and experience and to delineate local and national findings for global application. Presentations and discussions were expected to stress systematic, integrated approaches to oral and general health in ageing societies while bridging the gap between research and policy from life-course and quality-of-life perspectives.

After an overview of meeting objectives by **Dr Poul Erik Petersen and Dr Hiroshi Ueda**, all participants briefly introduced themselves. Chairpersons and rapporteurs were elected and the meeting agenda was adopted.

Dr Gary Andrews presented the profile of global ageing – challenges to health – from a multidisciplinary point of view. After reviewing research issues and information imperatives for health and well-being in an ageing world, he pointed out that a limited number of overarching themes could be identified through examination of the major priority areas in ageing. Dr Andrews emphasized that information gathering and research are fundamental to countries' formulation of comprehensive responses to worldwide population ageing.

Drs Petersen and Ueda then outlined WHO's global strategies and approaches for improving the oral health of older people. They emphasized the global burden of oral disease in older people and common risk factors for oral diseases and noncommunicable chronic diseases. They pointed out that common risk factors may lead to relationships between oral and general health in terms of cause and effect and co-morbidity; however, for certain health conditions, interrelationships at biomedical level are still unclear. Common risk factor approaches in the promotion of oral health and disease prevention were presented, and Dr Petersen outlined the overall WHO policies and strategies for oral health with special focus on the ageing society, which are based on the available evidence of global trends in oral health and on available oral disease data.

In a keynote address, **Dr Daniel Kandelman** presented a state-of-the-science account of the relationship between oral health and general health status in ageing societies. Examining what is known and not known and looking at possible cause-effect relationships through a systematic literature review, his presentation provided an overview of the impact of oral health on general health – and of general health on oral health. His analysis, too, was given from the perspectives of life-course and quality of life. Concluding his presentation, Dr Kandelman stressed the importance of translating knowledge into solutions.

Following the keynote address, country case reports were presented, providing an exchange of experience and introducing a range of different approaches to oral health improvement. **Dr Nobuhiro Hanada** recounted the history of national health promotion in Japan, with a focus on oral health at different stages of life. He made particular mention of the 8020 Campaign, the objective of which is for all adults to keep 20 natural teeth until age 80; it was introduced by the Japanese Ministry of Health, Labour and Welfare in 1989. Emphasizing the importance of oral health in ageing societies, Dr Hanada noted that the Japanese National Survey of Dental Diseases has been conducted every six years since 1957.

One of the best-known studies in Japan – the Niigata Elderly Health Study, which is targeting a sample of 70- and 80-year-olds – was introduced by **Dr Hideo Miyazaki**. The study is based on a longitudinal survey scheme operating from 1998 to 2008. In addition to outlining programme outcome, Dr Miyazaki illustrated diagrammatically the relationships between oral health conditions, disease measures, health behaviours, general health conditions, and quality of life.

Dr Kenji Wakai then outlined the LEMONADE Study, a longitudinal study among dentists in Japan that examines the associations between oral health and incidence and/or mortality of serious chronic diseases from a medical point of view. With support from many bodies in addition to the Ministry of Health, Labour and Welfare, the study will follow up participants for 5–10 years. The study comprises a large sample and a variety of risk and health indicators, and outcomes will be available soon.

The status of community oral health care for the elderly in China was introduced by **Dr Ling Zhu**. She explained the different roles of private dental care and community dental services and described the challenge of providing appropriate services for the elderly. Dr Zhu emphasized the relevance of primary health care and prevention-based approaches in community health care. An important recommendation was to provide health education to the elderly and to improve the quality of health care providers with government support.

Next, **Dr Hari Parkash** presented an overview of oral health issues among elderly populations in India. He stressed the vulnerable health and social situations of these populations, notwithstanding the respect in which they traditionally held, pointing out that India expects a rapidly growing proportion of older people. Highlighting the barriers to providing oral health care among the elderly, Dr Parkash stated the importance of strengthening the involvement of government, institutions and nongovernmental organizations.

Dr Helen Whelton informed delegates of the focus on integrated oral health care for the elderly in Ireland. She pointed out the poorer oral health-related quality of life of older people compared with younger and of the less well-off compared with others. Her recommendations included integrating oral health care with other services accessed regularly by the elderly, adoption of a common risk factor approach, prevention of oral diseases in the early stages of life, and participation by dentists in primary health care teams.

In an extensive review of the oral health situation in the Eastern Mediterranean Region and with a special focus on oral health status among the elderly in Jordan, **Dr Lamis Rajab** observed the general lack

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of epidemiological data and information about oral health systems in relation to the elderly among the countries of the Region. Existing data indicate that poor oral health appears to be a major public health problem among older people. In Dr Rajab's opinion, the undergraduate dental curriculum should include essential aspects of geriatric dentistry and information about the oral health–general health relationship.

Dr Enosakhare S. Akpata described oral health issues among the elderly in Nigeria. He reported that, in principle, oral health policy in Nigeria integrates oral health care with general health using primary health care and multisectoral approaches, but that there are significant constraints to implementation of the policy. Dr Akpata ended his presentation by calling for more research into the growing burden of poor oral health and the links between oral health and general health among the elderly.

Dr Ronald Ettinger introduced the example of integrated multidisciplinary teaching/service in geriatric dentistry in the United States of America. He outlined a university programme with a health promotional component, a concept that might be applied universally to dental schools. He focused on the changing perceptions of oral health and how it relates to general health and quality of life, replication of effective evidence-based training programmes, increasing the size and capacity of the workforce, and the need for collaboration between oral health professionals, health care providers, and others.

Several meeting participants emphasized multidisciplinary approaches in connection with oral health in ageing societies. **Dr Cyril Enwonwu** identified nutritional characteristics and associated medical and biophysical factors as essential dimensions of oral health in the elderly. He pointed out the poor health conditions – loss of teeth, low nutritional status, and communicable and noncommunicable diseases – that prevail among the elderly in poor countries.

In her presentation, **Dr Anne Pak-Poy** emphasized that oral health among the elderly is fundamental to quality of life throughout the life-course. Programmes aimed at improving the oral health of the elderly should consider quality-of-life assessment as part of short- and long-term strategies and for building community and health workforce capacity. Dr Pak-Poy also introduced two demonstration programmes in South Australia that identify life-course checkpoints for older people both living in the community and in residential care. Development of an oral health assessment tool for medical general practitioners to use in residential aged care facilities was discussed.

Dr Murray Thomson talked of inequity in health. He pointed out that the association between social position, oral health, and general health may vary during the life-course and that it may not be possible to capture the extent of inequity by measuring a single variable. From a systematic literature search, Dr Thomson found that information on inequity was scarce in many countries and parts of the world and also that most countries had not examined or reported on the relationship between oral and general health among the elderly. Countries that had examined this relationship reported social inequalities in oral health among older people and proposed public health solutions for better health for all ages.

Dr Ok-Ryun Moon discussed promotion of oral health for the elderly from the perspective of community health care. Pointing out that oral health tends to have a low priority in public health and that there is little

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recognition of the fact that oral health is integral and essential to human well-being, he emphasized the importance of comprehensive community health care approaches. Dr Moon advocated the implementation of such programmes for oral health among the elderly and demanded evaluation studies on the effectiveness of community oral health programmes in reducing risk factors and improving general health.

Dr Jos van den Heuvel's presentation focused on the feasibility of comprehensive and integrated oral health approaches in different ageing societies and the challenges involved in identifying target groups of older people. Dr Van den Heuvel conveyed the recommendations of the Council of European Chief Dental Officers, particularly on integrated oral health care for institutionalized populations, and alluded to oral health expenditures in European countries.

Dr Poul Erik Petersen and Dr Hiroshi Ogawa reviewed the use of indicators for surveillance of oral health and risk factors in ageing societies. WHO has developed and monitors a comprehensive Global Oral Health Database. The presenters discussed the importance of WHO's Oral health surveys: basic methods manual (WHO, 1997) for assessing the oral health status of population groups and the significance of oral health information systems for intercountry comparisons and national surveillance (Petersen et al., 2005). In recent years, integrated databases linking oral health to databases for chronic diseases and common risk factors have been developed, including tools for data collection (STEPS) within the frame of the WHO Global InfoBase (Petersen et al., 2005). Drs Petersen and Ogawa predicted that, by incorporating information on risk factors, a revision of WHO's Oral health surveys: basic methods would assist the development of oral health systems that will strengthen control of determinants of health and reduce disparities in oral health between different socioeconomic groups within countries and inequalities across countries. Integrated oral health and general health surveillance will help policy-makers and public health administrators to build effective national and community health programmes, including programmes for older people. In addition, Drs Petersen and Ogawa outlined the importance of the International Collaborative Studies (ICSs), which may help to assess the effectiveness of oral health systems and the role of sociobehavioural factors in oral health (Chen et al., 1997; Petersen, 2005a).

The presentation given by **Dr Kaumudi Joshipura** covered a variety of policy issues in relation to the gaps in research on interrelationships between oral and general health, clinical and public health practices including health promotion, prevention and educational programmes, translation of knowledge and technology transfer to less developed areas, financing of oral health care, and multidisciplinary approaches for integrated health care. Areas where these gaps might be reduced were identified, including the role of oral health professions in improving nutrition, which might reduce the incidence of certain noncommunicable diseases. Several challenges in capacity-building for oral health improvement in older people were also presented for further consideration.

With medical expenditure in oral health as his research focus, **Dr Mitsugu Kanda** introduced the Hyogo 8020 Survey – the result of collaborative work with WKC – and its outcomes. The survey includes residents of 70 years and over who visited both a dental clinic and a medical facility in Hyogo Prefecture, Japan, including more than 30 000 residents with more

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than 70 000 medical claims. From national medical insurance claims and information on the number of remaining teeth, the Hyogo Dental Association found – as expected – that medical expenditure was highest for the group with fewest remaining teeth. They also found some disease-based relationships between the number of remaining teeth and medical expenditure among the elderly.

3. DISCUSSION

This section outlines observations that were based on background documents for the meeting, on the individual papers presented by the participants, and on the plenary discussions.

A worldwide demographic transition is taking place as the proportion of older people in the population grows faster than that of any other age group. This poses tremendous challenges to health and social policy planners, particularly because disease patterns will shift concurrently with the demographic change. Chronic diseases such as cardiovascular disease, hypertension, cancer, and diabetes are especially prevalent in old age and may have a significant impact on quality of life. Moreover, the burden of oral disease is high in older adults. Globally, poor oral health among older people is primarily seen in high levels of tooth loss, dental caries, prevalence of periodontal disease, xerostomia (dry mouth), and oral precancer/cancer – conditions that have a major bearing on quality of life. Several oral health conditions are associated with chronic diseases, and the links between oral health, general health, and quality of life are pronounced in old age.

Research on the links between oral health and general health has focused primarily on the following associations:

General health	Oral health
Mental diseases, including dementia and Parkinson disease	■ High levels of caries experience ■ Tooth loss ■ Periodontal disease/impaired or neglected oral hygiene ■ Experience of pain ■ Chewing difficulties ■ Poor function of dentures
Visual impairment	■ Dental caries ■ Gingival bleeding ■ Reduced ability to maintain oral health
Xerostomia related to systemic disease, head and neck radiations, or multiple/regular use of medications	■ Dental caries/root caries ■ Candidosis ■ Impaired mastication, swallowing and speech
Inadequate nutrition (impaired immune response)	■ Periodontal disease ■ Tooth loss ■ Poor oral hygiene ■ Masticating function and swallowing ■ Taste perception ■ Oral dryness ■ Oral pain ■ Oral cancer
Weight loss	■ Edentulousness

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Respiratory diseases: ■ chronic obstructive pulmonary disease ■ aspiration pneumonia	■ Poor oral hygiene ■ Periodontal disease ■ Difficulty swallowing
Cardiovascular disease: ■ coronary heart disease ■ stroke	■ Tooth loss ■ Severe periodontal disease (bone loss, deep pockets)
Diabetes mellitus (type 1, type 2)	■ Severe periodontal disease

Over the past decade, epidemiological and clinical studies have been undertaken to improve understanding of the associations between oral and systemic diseases (**see Annex 3**). Various biological mechanisms have been suggested, including the entry of mediators or oral inflammatory conditions, such as gingivitis and periodontitis, into the circulatory system, contributing to systemic inflammation, which has in turn been associated with systemic disease. Causal inference is a major concern to current research as there are still significant gaps in knowledge about the associations between oral and general health.

The criteria to be applied for evaluating the strength of evidence supporting a causal relationship comprise the following (Rothman & Greenland, 2004):

- **Specificity.** A specific agent is found to produce a specific effect.
- **Strength of the association.** Refers to the magnitude of the ratio of incidence (“relative risk”) or some analogous measure. The association may be weak or strong. A strong association serves to rule out hypotheses that the association is due to some weak unmeasured confounder or some modest source of bias.
- **Dose-response relationship.** As the degree of exposure increases, so does the gradient of associated risk.
- **Time sequence.** The exposure of interest precedes the occurrence of systemic disease by a period of time consistent with the proposed biological mechanism.
- **Biological plausibility.** A known biological mechanism may explain the pathophysiological link between a risk factor and the disease in question.
- **Consistency.** Similarity of results obtained in a number of studies conducted in different populations by different investigators, preferably using different methods.
- **Independence from confounding.** The degree to which the association is judged to be independent of potential confounders or known risk factors for the disease.

In recent years, much research has focused on the common risk factors approach to the understanding of associations between oral disease and chronic disease. Several chronic diseases and oral diseases or conditions share risk factors such as the use of tobacco, excessive consumption of alcohol, poor diet and nutritional status, all of which are significantly

affected by socioenvironmental factors.

Findings from current research and use of the strength-of-evidence criteria for causal links between oral health and general health indicators led the meeting to the following conclusions:

- The available scientific evidence is particularly strong for a direct relationship between diabetes and periodontal disease and also suggestive of a relation between periodontal disease and diabetes control.
- The evidence of a direct relationship between periodontal disease and cardiovascular diseases and between periodontal disease and respiratory diseases is less convincing. Evidence is limited by the lack of consistency and by the fact that most studies have used a cross-sectional rather than a longitudinal design or have inadequate control for confounding factors. Appropriate analysis with adequate adjustment for age, tobacco use, and other factors suggests that observed associations between periodontitis and cardiovascular disease could be coincidental rather than causal.
- The impact of xerostomia - dry mouth - on health of the oral cavity has significant biological plausibility. One problem lies in distinguishing the effects of medications on dry mouth from those of the underlying health condition. There is sound evidence that dry mouth negatively affects oral function and quality of life.
- Biological and behavioural factors are implicated in the complex two-way relationships between inadequate nutrition and weight loss on the one hand and poor oral health status on the other. Diet and nutrition in old age are affected by changes in the immune system, by tooth loss and the status of the oral cavity, and by environmental factors. The evidence is strong that medications can provoke malabsorption of vitamins and minerals essential for health.
- Psychosocial factors and common risk factors may be involved in the association between poor mental health and visual impairment and poor oral health.
- Men and women may need to be examined separately since biophysiological change and experience may be sex-specific.

Improvement of oral health and general health in older people

Poor oral health among older people is compounded by poor general health, and the growing disease burden is an important public health issue for countries worldwide. The epidemiological literature shows that, while certain industrialized countries may have some information available about oral health and general health, such data are rare for developing countries – particularly the predominantly rural nations of Africa, the Eastern Mediterranean countries, and the most populous countries of China and India.

The available evidence indicates that there are profound oral health disparities among older people across and within regions and countries, and that such disparities relate primarily to living conditions and to the availability and accessibility of oral health services.

Institutionalized and homebound elderly people have poorer oral health than the active elderly. Some positive trends in dentate status are seen in many industrialized countries where the adults who will become the next cohort of elderly people preserve more natural teeth and functional dentition. Remarkably, however, even in countries with advanced public health services and overall improvements in health in general, social inequality appears to persist in the oral health of older people. Importantly, the association between social position, oral health, and general health varies during the course of life; the global challenges in addressing issues of inequality and inequity in old age are particularly marked in relation to health and health care.

Strategies and areas of action

Recently, WHO has called for action to promote better health in older people through public health initiatives, age-friendly primary health care, integrated prevention, and multidisciplinary approaches (WHO, 2002e, 2004a). Important mechanisms in oral health promotion and disease prevention relate to the strengthening of health policy development, national capacity-building in health care for the underserved, education and training in service and care for older people, and research for health (Petersen, 2003a; Petersen & Yamamoto, 2005). The challenges vary from country to country and region to region, however, and differences between developed and developing countries are particularly marked.

The meeting participants considered recommendations for action for improved oral health and general health under four principal headings as outlined in **Figure 1**.

Figure 1. Action for improved oral health and general health in ageing societies

Policy development for oral health–general health ■ Goals and targets ■ Life-course perspective
Health systems capacity-building ■ Settings for health ■ Integrated chronic disease prevention and health promotion ■ Common risk factors ■ Community orientation and outreach care
Oral health care delivery ■ Target groups and age-friendly services ■ Training for service and care
Research for oral health, general health, and quality of life ■ Research priorities and operational research ■ Oral health information systems

Policy development

Oral health problems are often neglected, and in most countries – particularly developing countries – there has been a consequent failure to formulate oral health policies. Only a few countries have clearly stated policies expressed in terms of operational goals and targets specifically for oral health promotion and care in older people. Oral health policies should be an integral part of national and community health policies and should link to policies in such areas as education, nutrition, cancer prevention, tobacco and alcohol control, rehabilitation, and social/health insurance or financing of health care. Policies for oral and general health need to be formulated on the basis of a life-course perspective, with an emphasis that is both temporal and social – looking back at the life experience of the individual or of a cohort or across generations for clues to current patterns of health and disease.

Chronic diseases and related oral health conditions will not only be the leading causes of disability throughout the world by the year 2020 but will also – if not successfully managed – become the most expensive problems faced by health care systems. In this respect, they pose significant threats to all countries. At present, the costs of dental treatment amount to about 0.5–1.0% of gross domestic product in many industrialized countries; by contrast, budgets for oral health care in most developing countries are severely limited.

Significant experiences of policy development in relation to oral health are available from a number of industrialized countries. Oral health policy for the ageing society in Japan has developed as a consequence of Healthy Japan 21 and the 8020 Campaign. Elsewhere, the Council of European Chief Dental Officers has developed policy recommendations for strengthening integrated patient health care, diet and nutrition, and for financing health care for older people, including oral health care.

In some African countries, for example Nigeria, oral health policies are formulated to integrate oral health care with general health care; policy implementation, however, is constrained by a lack of financial and human resources. Similar barriers to the provision of oral health care to older people are encountered in India.

Meeting participants emphasized the importance of strengthening advocacy for action, legislation, and goal-setting and planning of programmes for better oral health – general health in old age. At country level, this process may be prompted by different concerns, such as social justice, welfare, human rights, quality of life, disease burden and cost of treatment, or control of avoidable cancer.

Programmes and health systems capacity-building

Public health planners and administrators are encouraged to use the common risk factors approach to integrate interventions for oral health in old age into general health programmes. A benefit of this approach is the focus on improving health conditions for the whole population, as well as for high-risk groups, thereby alleviating inequities. WHO recently launched two global strategies for the prevention of chronic disease, the Global Strategy for Control and Prevention of Noncommunicable Diseases (WHO, 2000) and the Global Strategy on Diet, Physical Activity and Health (WHO, 2004b). Both strategies set guidelines for the implementation of integrated disease prevention, and must incorporate oral health.

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Prevention of tobacco-related diseases has been strengthened significantly since the ratification by countries of the WHO Framework Convention for Tobacco Control (WHO, 2003). In response to this initiative, special activities for prevention of tobacco-induced oral diseases, such as periodontal disease, tooth loss, and oral precancer/cancer, are recommended by the WHO Oral Health Programme (Petersen, 2003b; Petersen, 2003c; Petersen & Ogawa, 2005) and by the World Dental Federation/World Health Organization, based on involvement of oral health professionals in tobacco cessation programmes (FDI/WHO, 2005). In 2005, the World Health Assembly urged countries to develop and reinforce cancer control programmes encompassing prevention, early detection, diagnosis, treatment, rehabilitation, and palliative care (WHO, 2005b). This is particularly relevant to avoidable cancers such as oral cancer, which is relatively common in old age (Petersen, 2005b).

The ageing population may be categorized into three broad functional groups – the functionally independent, the frail, and the functionally dependent. The burdens of oral disease and chronic disease are heaviest among frail and functionally dependent elderly people. Public health programmes should therefore apply appropriate strategies to different groups of older people. Where active, functionally independent older people are concerned, outreach activities may target settings or social environments such as clubs, recreational centres, community centres, or libraries. Older people are less likely than younger people to have received health education early in life, and mass communication and healthy lifestyles programmes must therefore focus on enhancing awareness of the importance of oral and general health and on helping to translate knowledge into practice. For institutionalized and homebound elderly people (i.e. the frail and functionally dependent), the involvement of caregivers may be the key to programme success, as trained nurses and carers play important roles in general and oral hygiene and in diet and nutrition.

Australia's National Oral Health Plan 2004–2013 emphasizes the oral health of older people. Strategies comprise support for at-home oral hygiene, improved affordability of dental care, transport, and assessment on entry to residential care, including question-based oral health assessment in existing community systems. In demonstration projects for community living older people, patients enjoyed a markedly improved quality of life after treatment and intervention.

It is important to ensure the orientation of health care services towards prevention and to deliver care that is appropriate for the diverse needs of the large and growing heterogeneous older population. Oral health systems should overcome any obstacles that prevent or hinder older people's access to and use of health services. For example, the cost – or perceived cost – of treatment may deter socioeconomically disadvantaged older people from visiting a dentist; this problem could be reduced by the creation of age-friendly payment systems.

A growing number of industrialized countries, including Ireland and the Scandinavian countries, are in the process of integrating oral health care for older people with other services accessed by elderly. These programmes focus primarily on frail and functionally dependent elderly people and seek to maximize the potential for multidisciplinary care. Physicians may have a significant role in incorporating oral health concerns in regular routine examinations, for example oral cancer

screening or control of diabetes, referring patients to a dentist when necessary. Equally, dentists may play important roles in the early diagnosis of systemic disease and nutritional deficiencies, referring patients to physicians when necessary for systemic disease management and counselling.

Meeting participants expressed concern about the situation in most developing countries. The barriers to oral health care and primary health care faced by all age groups are particularly high because of the shortage of dental personnel and other health professionals. Community models for outreach services and multidisciplinary provision of essential health care must be implemented urgently to improve health in the low-resources communities of Africa and Asia. Community health care work in the Republic of Korea has provided useful experiences. The community health care concept is based on needs-driven packages of health services in the locality of residence for older people; it incorporates social care, quality of life, and oral health. Similar demonstration programmes established in China link community-oriented oral and general health promotion to control of chronic diseases and integrate oral health services with public health services for the elderly.

Finally, participants discussed the issue of traditional medicine in general and oral health care. Traditional medicine may be an important basis for health care, particularly in communities where the availability or access to formal health services is low.

Training for service and care

The meeting noted that, in several industrialized countries, training in geriatric dentistry has long been included in the curriculum for dental students and practitioners. Such training is oriented largely towards the biomedical and clinical aspects of care rather than the sociological and behavioural factors of ageing, illness, and care. Understanding the economic and psychosocial dimensions of poor oral health and poor general health in terms of functional impairment and the negative impact on quality of life is also fundamental to provision of adequate health care, communication, and health education. By contrast, curricula in most schools of dentistry/stomatology in the African, Asian, and Eastern Mediterranean regions have yet to incorporate geriatric dentistry or medicine.

There was general consensus that systematic education of both oral and medical health professionals on oral health – general health relationships needs to be strengthened, and that both categories of health professionals should be trained in multidisciplinary approaches to holistic, comprehensive health care as well as in prevention and community-oriented health promotion. This enhanced training in social science dimensions of health care is essential if health systems are to meet the needs and expectations of older people in the future. These perspectives were similarly emphasized in a WHO policy document, *Towards age-friendly primary health care* (WHO, 2004a).

The University of Iowa in the USA has gained experience from interdisciplinary geriatric education programmes that include undergraduate and postgraduate training, modelled on the WHO Ottawa Charter for Health Promotion. Theoretical and clinical courses focus on the health of frail, functionally dependent, cognitively impaired, and terminally ill persons and are integrated with geriatric medicine,

psychiatry, and nursing.

Training physicians in oral screening will be instrumental in controlling disease and meeting the health care needs of older people. The shortage of oral and general health professionals in most developing countries makes it vital that training for service and care focus on primary health workers and other health professionals. Primary health workers may have contact at local community or village level with older people suffering from poor oral and general health, and it is critical that they have the necessary background to provide essential health care and to refer patients for specialized care when appropriate.

Globally, caregivers are instrumental in promoting the health of older people. Meeting participants emphasized the role of caregivers in improving self-care capacity in oral and general health and providing for healthy diet and nutrition amongst elderly. Where oral health services and primary health care are available, caregivers may also help disadvantaged older people to overcome the barriers to effective use of these facilities. However, caregivers and other personnel, such as ancillary staff of institutions or nursing homes, often demonstrate an alarming lack of knowledge about the oral health of older persons. Systematic training of these key groups is critical to successful integration of oral health into general health improvement initiatives for older people.

Research for oral health-general health

Strengthening of research into oral health-general health should focus on biomedical, clinical, and epidemiological aspects. The increasing biomedical research on oral health-general health interrelationships can provide a better understanding of pathophysiological disease mechanisms. Epidemiological research needs to be strengthened considerably to allow assessment of cause-effect relationships, and longitudinal studies on oral health-general health, with appropriate control of potential confounding factors, are badly needed. The Niigata Elderly Study, being carried out between 1998 and 2008 by Niigata University, Japan, promises much: the data from this longitudinal study comprise information about general health, risk factors, and oral health.

The international geriatric research community and the International Association for Dental Research are increasingly interested in research into the oral health of older people. The *Elder's Oral Health Summit*, held in Boston, USA, in September 2004 focused particularly on "What do we need to know?" and stressed the need for research in the following areas:

- overcoming barriers to providing care for underserved people;
- developing an evidence base to identify appropriate dental services for frail and functionally dependent older adults;
- increasing knowledge about disparities in oral health and access to dental care among the poor and racial and ethnic minorities.

Meeting participants emphasized the urgent need for operational research on the health status of older people, particularly in developing countries, in order to inform policy- and decision-makers. Such information should be complemented by data on sociobehavioural risk factors and quality of life.

WHO's Global Oral Health Database includes essential information for surveillance of oral health status; its data are based on standard methodology for oral health surveys (WHO, 1997). Meeting participants recommended that WHO consider the oral health needs of older people and general health aspects when revising the manual *Oral health surveys: basic methods*.

Most recently, WHO has developed the Global InfoBase – an integrated data system for chronic disease surveillance that incorporates common risk factors and oral health status (Petersen et al., 2005). This system allows for analysis of links between chronic disease, oral disease, and common risk factors at aggregate country level. It may be used not only in public health surveillance but also in health systems research. Countries are recommended to adopt similar data information systems at national level, incorporating health information relevant to older people.

The meeting also suggested replication of the International Collaborative Studies of Oral Health Care Systems (ICS Studies) (Arnljot et al., 1985; Chen et al., 1997) to cover developing countries as well. A future global study may assist in oral health systems analysis, including evaluation of oral health intervention programmes for older people.

The need to build and strengthen research capacity as an effective, efficient, and sustainable strategy for enabling countries to benefit from knowledge for better health was stressed recently by WHO (WHO, 2004c). The WHO Oral Health Programme has highlighted the need for more research on oral health-general health relationships, common risk factors, and quality of life in older people (Petersen, 2005c). Translation of available knowledge into clinical and public health practice is particularly encouraged as poor and disadvantaged population groups worldwide have yet to benefit as fully as possible from advances in health sciences.

4. CONCLUSIONS AND RECOMMENDATIONS

Research on oral health-general health relationships has grown considerably over the past decade. Background documents and presentations and discussions at the meeting gave rise to the following conclusions:

- The available scientific evidence is particularly strong for a direct relationship between diabetes and periodontal disease and also suggestive of a relation between periodontal disease and diabetes control.
- The evidence of a direct relationship between periodontal disease and cardiovascular diseases and between periodontal disease and respiratory diseases is less convincing. Evidence is limited by the lack of consistency and by the fact that most studies have used a cross-sectional rather than a longitudinal design or have inadequate control for confounding factors. Appropriate analysis with adequate adjustment for age, tobacco use, and other factors suggests that observed associations between periodontitis and cardiovascular disease could be coincidental rather than causal.
- The impact of xerostomia - dry mouth - on health of the oral cavity has significant biological plausibility. One problem lies in distinguishing the effects of medications on dry mouth from those of the underlying health condition. There is sound evidence that dry mouth negatively affects oral function and quality of life.
- Biological and behavioural factors are implicated in the complex two-way relationships between inadequate nutrition and weight loss on the one hand and poor oral health status on the other. Diet and nutrition in old age are affected by changes in the immune system, by tooth loss and the status of the oral cavity, and by environmental factors. The evidence is strong that medications can provoke malabsorption of vitamins and minerals essential for health.
- Psychosocial factors and common risk factors may be involved in the association between poor mental health and visual impairment and poor oral health.
- Men and women may need to be examined separately since biophysiological change and experience may be sex-specific.

Meeting participants considered several recommendations for action towards improved oral health and general health in relation to:

- policy development for oral health and general health;
- health systems capacity-building;
- oral health care delivery;
- research for oral health, general health, and quality of life

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They emphasized the importance of strengthening advocacy for action, legislation, goal setting, and planning of programmes for better oral health–general health in old age. They also expressed concern about the situation in most developing countries where access to oral health services and primary health facilities are limited. For all countries, it was strongly recommended that oral health systems be effectively oriented towards disease prevention and health promotion and that systems better match the needs of older people, including the functionally independent, the frail, and the functionally dependent.

Meeting participants stressed the need for training of health professionals for better service and care, based on multidisciplinary and holistic approaches, and pointed out the instrumental role of caregivers globally in promoting the health of older people.

In the opinion of meeting participants, strengthening of quality research into oral health–general health relationships is needed. Translation of knowledge into clinical and public health practice is particularly important as poor and disadvantaged population groups world-wide have yet to benefit as fully as possible from advances in health sciences. This is especially applicable to the oral health of older people in most countries.

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Organization Centre for Health Development.

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ANNEX 1

Meeting programme

Day 1 – Wednesday, 1 June 2005

09:00 – 09:30	Registration	
09:30 – 09:40	Welcome and opening remarks	Dr Wilfried Kreisel, Director, WKC
09:40 – 10:15	Objectives of the meeting	Dr Poul Erik Petersen, ORH/HQ (Dr Hiroshi Ueda)
	Introduction and election of Chairperson and Rapporteurs	
	Adoption of the agenda	Chairperson
10:15 – 10:20	Photo session	
10:20 – 10:40	<i>Coffee/tea break</i>	
10:40 – 12:00	Session 1 – Profile of global ageing: challenges to health	Dr Gary Andrews
	Session 2 – Introduction to WHO global strategies and approaches for the improved oral health of older people	Dr Poul Erik Petersen (Dr Hiroshi Ueda)
	Discussion	
12:00 – 13:30	<i>Lunch break</i>	
13:30 – 14:40	Session 3 – State-of-the-science on the relationship between oral health and general health status in ageing societies: what is known and not known	Dr Daniel Kandelman
	Discussion	
14:40 – 18:00	Session 4 – Country case reports	
	(1a) Japan	Dr Nobuhiro Hanada
	(1b) Niigata Elderly Study, Japan	Dr Hideo Miyazaki
	(1c) Longitudinal Study among Dentists in Japan	Dr Kenji Wakai
	(2) China	Dr Ling Zhu
	(3) India	Dr Hari Parkash
	(4) Ireland	Dr Helen Whelton
	(5) Jordan	Dr Lamis Rajab
	(6) Nigeria	Dr Enosakhare S. Akpata
	(7) USA	Dr Ronald Ettinger
	Discussion (with coffee/tea break)	

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Day 2 – Thursday, 2 June 2005

09:00 – 09:20	Feedback from Day 1	Chairperson/Rapporteurs
09:20 – 12:00	Session 5 – Essential dimensions of oral health in the elderly	
	(1) Medical and nutritional	Dr Cyril Enwonwu
	(2) Quality of life and life-course	Dr Anne Pak-Poy
	(3) Inequity in health	Dr Murray Thomson
	(4) Community health care	Dr Ok-Ryun Moon
	Discussion (with coffee/tea break)	
12:00 – 13:30	Lunch break	
13:30 – 14:20	Session 6 – Global diversity in ageing societies: the feasibility of comprehensive and integrated oral health approaches in different ageing societies and identification of target groups of older people	Dr Jos van den Heuvel
	Discussion	
14:20 – 15:30	Session 7 – Indicators and surveillance of oral health and risk factors in ageing societies	Dr Poul Erik Petersen Dr Hiroshi Ogawa
	Discussion	
15:30 – 15:50	Coffee/tea break	
15:50 – 16:40	Session 8 – Bridging the gaps: research and policy, clinical and public health practices, multidisciplinary approaches	Dr Kaumudi Joshipura
	Discussion	
16:40 – 17:30	Session 9 – 8020 Survey in Hyogo Prefecture, Japan	Dr Mitsugu Kanda

Day 3 – Friday, 3 June 2005

09:00 – 10:00	Review of Days 1 and 2	Chairperson/Rapporteurs
10:00 – 11:30	Session 10 – Recommendations	Facilitators: Dr Poul Erik Petersen and Dr Hiroshi Ueda
11:30 – 12:00	Session 11 – Next steps toward oral health in ageing societies	
12:00 – 12:30	Closing session	
	Closing remarks	Dr Wilfried Kreisel
	Close of the meeting	Chairperson

ANNEX 2

List of participants

Temporary Advisers

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Ms Yoko Inoue, Secretary
Ms Merisa Romero, Secretary
Ms Kazumi Ueda, Secretary

WHO, Geneva, Switzerland

Dr Poul Erik Petersen, Chief, Oral Health Programme
Dr Hiroshi Ogawa, Oral Health Programme

ANNEX 3

Background discussion paper

Interrelationships between oral health and general health of older people

Professor Daniel Kandelman
Faculty of Dental Medicine
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Professor Poul Erik Petersen
World Health Organization, Geneva, Switzerland

Dr Hiroshi Ueda
WHO Kobe Centre, Kobe, Japan

1. The global demographic transition and the elderly population

The global population is increasing at an annual rate of 1.2%, while the population of those 65 years or older is increasing at a rate of 2.3% (UN, 2002). About 600 million people are currently aged 60 years or older and this number is expected to double by 2025 (WHO, 2002). By 2050, there will be two billion elderly people, 80% of them living in developing countries. The United Nations estimates that persons older than 80 years will comprise 20% of the world's elderly population (UN, 2003). In China, more than 1.2 billion people (or approximately 10% of the total population) are 60 years or older; this proportion is expected to increase in the next decades, and a significant proportion of the older population will live in rural areas. In India, the percentage growth of the population aged 60 years or older is much higher than that of other age groups. Life expectancy at birth was only 32 years when the country achieved its independence 50 years ago, whereas the figure has risen to more than 62 years. In the United States, the age group showing the greatest increase in numbers is the centenarians (people aged 100 years and over). In Japan, the ageing population is changing rapidly with the proportion of adults 65 or older at 17.2% in 2000 growing to 28.9% in 2025 (UN, 2002).

The growing proportion of the elderly is attributed mainly to the decrease in mortality rates among older people and to overall declines in birth rates. In addition, progress in health care and the implementation of public health measures have extended life expectancies worldwide.

The demographic transition challenges health authorities, particularly with regard to the burden of disease and its impact on quality of life of the elderly persons. Indeed, the increase in life expectancy does not necessarily progress in parallel with improved quality of life. In Sweden, for instance, the total number of people suffering from physical and mental disorders is increasing and becomes more difficult to control (Heyden, 1998). Poor oral health affects people's quality of life with respect to eating, social appearance and communication. The rise in life expectancy without improvement in quality of life has a direct impact on health expenditures and is becoming a key public health issue in the more developed countries. It may also become a major burden for countries with high population densities and emerging economies, such as China and India.

The WHO Health Report 2002 (WHO, 2002) identifies some major global risks of disease, disability and death in the world today. The impact of different risks of losing healthy life years is aggravated with ageing, because of lower individual resistance, growing burden of chronic diseases, and poor socio-environmental and nutritional conditions. Although most persons can now look forward to living longer, the risk of developing at least one chronic disease (such as hypertension or diabetes) increases with age; this reflects more a cumulative effect of a life-long exposure to risk factors and is not related to chronological age *per se* (WHO, 2002). The trend currently observed in the population at large is more obvious with older persons, whose age-associated physiological changes may deprive them of their mobility and independence (and to a much greater extent if they are also ill with chronic diseases).

The purpose of this report is to review the literature on the inter-relationships between oral health and general health, with special reference to elderly populations. The impact of poor oral health on quality of life is analyzed and the implications for oral health care are discussed.

2. Psychosocial function, general health and oral health

Many physiological changes take place as part of ageing, such as decreasing vigour and skilfulness, as general metabolism slows down. Hearing and sight, smell and taste can all be impaired to some degree. General body physiology is affected, along with organ functions, including reduction in heart strength, reduction of ventilatory capacity of the lungs, slower nerve transmission in the brain, decreased muscle mass, and increased risk of endocrine problems. Activities involving locomotion can also be impaired due to loss of elasticity in supporting structures (Avlund et al., 2001). Changes in oral function remain minor as long as oral health is preserved. The situation can be quickly compromised, however, if optimal oral health is not maintained.

In an attempt to identify target groups for which oral health services can be rendered, older people have been classified into three categories according to psychosocial function:

1. the functionally independent older adult
2. the frail older adult
3. the functionally dependent older adult

Individuals in the first group can remain largely independent even in the light of greater demands for general health care. Individuals in the next two groups invariably need assistance in maintaining even the most basic levels of personal care. The third group includes those individuals requiring special care at home or in institutions. In most developing countries, family and social support structures are eroding due to a variety of factors, and frail older individuals are consequently at high disease risk (International Conference on Rural Ageing Oral Health, 2001). Finally, in older persons, socio-economic factors such as low income, low education and weak social support have been shown to be closely related to functional impairment in oral health (Kandelman et al., 1986; Petersen & Nörtov, 1989; Shah & Sundaram, 2003). Petersen and Nörtov (1989) found that inactive lifestyle and weak family network are highly associated with poor oral and general health and dental care habits among old age pensioners. Recent studies have indicated a direct relationship between reduction in functional capacities and poorer personal oral hygiene, as well as declining use of dental services (Avlund et al., 2001; Petersen & Nörtov, 1989;

Chalmers, 2003, Österberg et al., 1990; Norlén et al., 1991).

2.1 Mental diseases

The incidence of psychiatric illness is particularly high in the elderly, because of the increased prevalence of dementia with age (Katona & Robertson, 1995). A study assessing the oral health of psychiatric elderly in-patients in South Wales (Lewis et al., 2001) demonstrated a higher prevalence of edentulism than in the general population of the respective age group, as well as relatively poor oral hygiene and a higher DMF score. This confirms previous findings in Denmark (Hede & Petersen, 1992). Depression and periodontitis are both common problems in older adults, and psychosocial stress may induce neglect of oral hygiene (Genco et al., 1999). Furthermore, resistance to periodontal therapies has been reported in people suffering from psycho-social problems (Axteillus et al., 1998). Persson et al. (2003) reported that depression was not associated with a greater risk of periodontitis in older adults, but was associated with tooth loss and chronic disease conditions associated with pain. Poor mental health status was considered as a risk factor in a six-year prospective cohort study of tooth loss and edentulism among institutionalised elderly people (Shimazaki et al., 2003).

Dementia and particularly Alzheimer's disease are frequent among older people, and prevalence rates increase with age (Katona & Robertson, 1995; Henry & Smith, 2005). The progressive loss of intellectual function and memory inevitably leads to deterioration in oral health unless the family or institution are able to assist in oral health care.

A recent study of patients with Parkinson disease (PD) described data on oral health conditions and related factors in people aged 60-69 and 70+ years (Nakayama et al., 2004). It was reported that PD patients often complained of chewing difficulties (taking into account that many of them were edentulous) and swollen gums. Almost half of the patients could not brush their teeth or clean their dentures properly. Complaints about chewing difficulties were most frequent among PD patients with dyskinesia and oral dyskinesia. In addition, problems related to poor function of dentures (i.e. loosening or poor denture retention) were due particularly to lack of muscle coordination and rigid facial muscles. PD patients also appeared to have a high risk of losing their teeth because of the use of anticholinergics or monoamine-oxidase inhibitors, and poor oral health due to xerostomia. Dysphagia is known to be a common symptom in many PD patients (Johnston et al., 1995), and can promote aspiration pneumonia, especially when oral hygiene is neglected. Daily toothbrushing and cleaning of dentures may be impaired due to resting tremors, akinesia and bradykinesia.

2.2 Visual impairments

Visual impairments can be included among chronic disease conditions associated with poor oral health in old age. The main age-related impairments are cataracts, macular degeneration, retinal detachment and glaucoma. Blindness is also linked with diabetes retinopathy, trachoma and leprosy (Schembri & Fiske, 2001). Although the pattern of dental disease in persons with disabilities is shown to be similar to their peers without disabilities (Taylor et al., 1986), visual impairment can affect an elderly person's ability to maintain oral health and to recognize signs of oral

disease such as dental caries or gingival bleeding.

2.3 Xerostomic conditions

Xerostomia is quite prevalent in older people, and roughly thirty percent of the elderly people are affected by dry mouth conditions (Schein et al., 1999; Närhi, 1994, Locker, 1993; Ship et al., 2002). Traditionally it was believed that salivary function decreased as a result of the ageing process (Bergdahl & Bergdahl, 2000), but, in healthy adults, age-associated changes in salivary composition and flow are minimal. Recent research demonstrates that xerostomia may be due to the effect of systemic diseases (such as diabetes, Sjögren's syndrome, AIDS) and their treatment, mental disorders, head and neck radiations, or multiple use of medications. One review listed more than 400 different medications implicated in xerostomic conditions, the most common being antidepressants, antipsychotics, anticholinergics and antihistamines (Screbny & Schwartz, 1997).

Further studies are needed in order to better explain the relationship between medications and dry mouth (Dawes 1987; Atkinson & Wu, 1994; Thomson, 2005); meanwhile, the high consumption of multiple medications remains an important etiological factor. The important issues of duration of exposure and the relationship of salivary hypofunction and medications in the unhealthy elderly are largely untested (Atkinson & Wu, 1994), as are the subjective complaints of dry mouth only being correlated with a 50% decrease in salivary flow (Dawes, 1987).

Elderly persons' quality of life can be compromised by dry mouth, as it affects mastication, swallowing and speech, and may increase the risk of microbial infection, root caries and candidosis (Slade et al., 1998). Reduced salivary flow may disturb the normal protective mechanisms for teeth and mucosa, therefore requiring more attention in the provision of adequate oral care.

2.4 Nutrition and oral health

The relationships between oral health status, dietary practices, nutritional status and general health status are complex (Knapp, 1989, Walls et al., 2000). Inadequate nutrition affects oral health, and poor oral health conditions affect food choice. Diet and nutrition are related to oral health, and, more specifically, to oral cancer and dental diseases in older persons (Moynihan & Petersen, 2004). A diet deficient in vitamins, minerals, proteins and calories can impair the immune system and promote weakness (Pla, 1994). Lack of appetite among the elderly is common, especially in individuals suffering from anorexia, nausea, vomiting or xerostomia resulting from medication; food intake is reduced and even more among the chronically ill with diseases reducing the metabolic status. A Swiss study (Dormenval et al., 1995) confirmed the relationship between clinical parameters of malnutrition, serum albumin level and some indicators of oral health (dental status, oral hygiene, masticatory function and salivary secretion rate) among elderly hospitalised patients.

The Florida dental care study (Schoenberg & Gilbert, 1998) assessed the dietary implications of oral health decrements among Afro-American and white older adults, and provided evidence that oral health decrements and

the accompanying functional disability impacts on their day-to-day lives. Chewing, taste perception, swallowing, comfort with appliances must be considered to be among the leading causes of poor nutritional status in older persons. Poor general health status, dehydration, drugs and oral dryness directly influence the appetite, diet and nutrition status of older people (Dormenval et al., 1995). The importance of chewing capacity has been well established in relation to nutrition status as the number and distribution of teeth will influence the ease of chewing (Leake et al., 1994, Walls et al., 2000). More refined studies have further demonstrated that the number and distribution of teeth in opposing pairs were the most pertinent factors (Leake et al., 1994). The choice of foods becomes largely dependent on the ability to consume them with satisfaction (Carlos & Wolfe, 1989). Foods were rejected when too hard to chew, and some were discarded. The attitude of the elderly in selecting foods is therefore strongly influenced by the ability to chew rapidly and effectively (Sheiham et al., 1999). The status of the teeth and or prosthesis is an important determinant in food selection, dietary fibre consumption (Laurin et al., 1992) and gastro-intestinal disorders (Mumma & Quinton, 1970).

Chewing function in the elderly is often compromised as the loss of teeth and the dependence on dentures become more extensive with advancing age (Petersen et al., 2004). Individuals living in institutions are over-represented in this category and require considerably more supervision and help from personnel adequately trained in this area (Sheiham et al., 1999).

2.5 Weight loss

Studies of hospitalized and institutionalized older adults suggest a relationship between poor oral health and subsequent weight loss (Sullivan et al., 1993; Blaum et al., 1995). A recent one-year follow-up study (Ritchie et al., 2000) among adults 70 years or older identified edentulousness as an independent risk factor for weight loss. It has been shown that debilitating diseases influence the attitude of elderly persons in relation to the protection of oral health, when involuntarily, due to lack of alertness they neglect to apply preventive measures and let dental caries and periodontal problems arise in their mouth.

2.6 Osteoporosis

Osteoporosis is a degenerative chronic disease which affects the entire skeleton and is mainly prevalent in older women. Cross-sectional studies have demonstrated an association between osteoporosis and periodontal status (Mohammad et al., 1996; Wactawski-Wende et al., 1996; Persson et al., 2002). Other studies have suggested that periodontitis may be aggravated in people with osteoporosis, but those failed to detect such a relationship in the early stages of osteoporosis (Taguchi et al., 1995; Birkenfeld et al., 1999).

2.7 Oro-facial pain

Elderly people may be vulnerable to chronic pain because of the ageing process, and/or their general status. Self-report of chronic pain seems to increase up to but not beyond the seventh decade of life; chronic pain in

older people is more often experienced in major joints, the back, legs and feet (op.cit. Helme & Gibson, 2001). Chung et al. (2004), in a study among Korean elders, recognized that oro-facial pain is an important problem in geriatric health; older people reported a higher number of disability days because of their pain than the general population.

3. Impact of dental diseases on general health

3.1 Dental disease and respiratory diseases

Respiratory diseases are responsible for significant morbidity and mortality in human populations. The upper part of the respiratory tract is in close contact with the oral cavity through the oropharyngeal area. The oral cavity is constantly irrigated by the flow of saliva, a vehicle for many species of oral flora. Under normal conditions, the movement of saliva has a cleansing and protecting action on teeth and oral mucosa, and it helps to maintain a stable equilibrium between the diverse components of the oral flora. However, this equilibrium may be rapidly disturbed when conditions are favouring dental plaque accumulation and periodontal infections, both associated with poor oral hygiene. This situation occurs to a large extent among elderly persons in connection with the marked physiological changes they undergo, especially those depriving them of their mobility and independence (Limeback, 1988; Russell et al., 1999; Scannapieco & Mylotte, 1996).

Recent studies have suggested an association between poor oral hygiene and respiratory infection (Scannapieco, 1999; Hayes et al., 1998; Mojon et al., 1997). The relationship of poor dental health and respiratory diseases has been studied to a large extent on people living in nursing homes and chronic care-facility institutions; these individuals are generally more at risk of contracting respiratory infections. Severe respiratory diseases include chronic obstructive pulmonary disease (COPD), chronic bronchitis, emphysema and aspiration pneumonia. Lower respiratory infections may begin as a contamination of the lower airway epithelium by micro-organisms present in aerosolized droplets, or by aspiration of the bacteria from oral secretions. Oral bacteria are thought to play a role in the exacerbation of COPD, and in aspiration pneumonia (Scannapieco, 1999).

3.2 Aspiration pneumonia

Pneumonia is a disease frequently contracted by elderly people, and it accounts for the majority of admissions to hospitals from nursing homes. Studies have shown that some of these patients were at high risk of lung infections due to the content of virulent organisms in their oral fluids when aspiration was done in the oropharynx (Scannapieco & Mylotte, 1996; Langmore et al., 1998; Russel et al., 1999). This is a common situation in chronic-care patients whose defence mechanisms (cough reflex mainly) are diminished. Although the respiratory tract infections are commonly linked to streptococcus pneumoniae, sources from the gastro-intestinal tract and the oral cavity have also been identified. Respiratory pathogens are commonly found among species of microbes present in dental plaque and periodontal pockets, and are thought to be responsible for lower lung infections (Sumi et al., 2002). Aspiration pneumonia—an infection caused by oropharyngeal secretions, food and/or gastric contents aspirated into the lungs—is common among debilitated older people and patients in intensive care units (Loesche & Lopatin, 2000). A relationship between aspiration pneumonia and periodontal disease has been reported in certain

studies (Schreiner, 1979; Donowitz & Mandell, 1990; Finegold, 1991; Scannapieco & Mylotte, 1996) where the responsible bacterial species usually found in periodontal pockets have been traced back to the lower respiratory tract. Although the list of those agents is getting longer, the identification of the critical species involved is still a matter of debate.

If *F. nucleatum* is considered an important aetiological factor, it implies that poor oral health status may be strongly related to aspiration pneumonia. Cases where swallowing difficulties (dysphagia) were present provided additional evidence highlighting the importance of oral sources of bacteria as a causative for aspiration pneumonia (Langmore et al., 1998). Researchers who followed residents living in nursing homes observed over one year that inadequate oral care and difficulty swallowing (when combined) were significant predictors of radiologically confirmed pneumonia (Quagliarello et al., 2005).

3.3 Oral health conditions, dental infections and cardiovascular diseases

Data on oral health status in older people with cardiovascular diseases are scarce, as the research interest in this relationship has been directed more towards younger adults. Over twenty years ago, attention was drawn to a relationship of dental infections with coronary heart disease and cerebral infarction alongside other independent risk factors including age, hypertension, diabetes and smoking (Mattila et al., 1993). More recent studies have also pointed to an association between dental disease and cardiovascular diseases (Loesche & Lopatin, 2000; Beck et al., 1996; Beck et al., 2001).

3.3.1 Poor oral health conditions

A relationship between poor dental health and coronary heart disease was reported in a few studies (De Stefano et al., 1993; Joshipura et al., 1996; Beck & Offenbacher, 2001), in which tooth loss and moderate-to-severe periodontal disease were significantly associated with coronary heart disease (CHD). Joshipura et al. (2003) evaluated - in a six-year follow-up study of 51529 male health professionals - the relationship between tooth loss, periodontal disease and CHD, and suggested diet and infection as potential mediators of this association. Oral disease has been suggested an important factor in the pathogenesis of cardiovascular and cerebrovascular diseases, as oral infection was found to be a risk factor for atherogenesis and thromboembolic events (Beck et al., 1996). However, the mechanisms involved have not yet been clarified.

3.3.2 Periodontal disease and cardiovascular disease

A state-of-the-science review (Beck et al., 2001) indicated that nine studies suggest that the chronic infection inherent in periodontitis may be associated with cardiovascular events (Beck et al., 1996; Loesche et al., 1998; Mattila et al., 1989; Mattila et al., 1993; Grau et al., 1997; Kweider et al., 1993; Genco et al., 1999; De Stefano et al., 1993; Wu et al., 2000). In a cohort study (Beck et al., 1996), bone loss and pocket depth scores in periodontal disease appeared as a risk factor in coronary heart disease and stroke. Another survey (Beck & Offenbacher, 2001) established the

relationship of periodontitis with a non-invasive measure of atherosclerosis; it was observed that this association may indicate that periodontitis plays a role in the pathogenesis of atheroma formation (Beck et al., 2001). Periodontal conditions have also been related to carotid calcification in older persons (Persson et al., 2002). Three studies (Mattila et al., 2000; Hujoel et al., 2000; Howell et al., 2001), however, did not support the association between periodontal disease and CHD, and their authors concluded that there is not enough evidence to state that periodontal infection is directly related to cardiovascular disease. It was recommended that new biological studies be initiated, focusing on periodontal disease processes and infection mechanisms. Moreover, cardiovascular disease (such as coronary heart disease and ischemic stroke) should be evaluated separately, as the latter is more consistently associated with chronic infections (Grau et al., 1997; Mattila et al., 1989). Finally, because cardiovascular disease and dental disease share so many risk factors and/or indicators, these studies should be cautiously interpreted. Senescence of the immune system has been considered as an important parameter in periodontitis among older individuals, and in their concomitant increase in the prevalence of diseases of the immune system (Siskind & Weksler, 1982; Walford et al., 1981).

3.3.3 Missing teeth and cardiovascular disease

From a questionnaire sent to health professionals, Joshipura et al. (1996) reported a higher risk of coronary heart disease for people with 10 or fewer teeth than among those with 25 or more teeth. Similar evidence was also obtained in a Finnish clinical study (Paunio et al., 1993) based on a representative sample of males aged 45-64 years. In this national health survey, the number of missing teeth proved to be an additional significant risk factor for ischemic heart disease. In a recent study, Joshipura (2003) confirmed that periodontal disease and fewer teeth may be associated with a greater risk of ischemic stroke. Loesche and Lopatin (2000) have carefully assessed the interaction between oral health and medical diseases in older individuals. Missing teeth again seemed to be “uniquely associated with coronary heart disease”. Edentulous individuals appear at greater risk for coronary heart disease and death (Loesche & Lopatin, 2000); the possible explanations for this are complex, as many related factors (such as inflammation and chronic infection) are present in the oral environment up to the time of tooth loss. In addition, these risk factors are invariably related to lifestyle and adverse health behaviours and beliefs. It could be expected that being edentulous should decrease the risk related to chronic dental infections and periodontal diseases, but the potential benefit from being edentulous is probably negated by changes in eating habits which may lead to poor nutrition (Hunter et al., 1981) or change in dietary preferences which would predispose an individual to a high-fat diet which predisposes to cardiovascular diseases (Loesche & Lopatin, 2000). Two cross-sectional studies (Mattila et al., 1989; Syrjänen et al., 1989) have suggested that dental disease may be an important risk indicator for both cardiovascular disease events and acute attacks of myocardial infarction, emphasizing the complex interrelationships existing between chronic dental infection, coronal and root caries, poor oral hygiene, periodontal disease and tooth loss. These researchers used pantomographic information and the Total Dental Index which takes into account the prevalence of decay, periodontal disease, missing teeth and infections (Mattila et al., 1989, Syrjänen et al., 1989). Their findings suggested that the latter index appeared more important than some classical risk factors such as diabetes, hypertension, smoking or

cholesterol levels.

3.4 Oral health condition and diabetes

The relationship between diabetes and periodontal disease has been established in a meta-analysis of data from four studies demonstrating a significant association between diabetes mellitus (Type 1 and Type 2) and periodontal disease (Papapanou, 1996). L  e (1993) even considered periodontal disease as the sixth complication of diabetes mellitus, and Grossi and Genco (1998) proposed the concept of a two-way relationship between periodontal disease and diabetes mellitus. Indeed, it has been shown that the risk and severity of periodontal disease is dependent upon diabetics' glycemic control. Thorstensson and Hugoson (1993) found that, among adults more than 40 years of age, long-duration insulin-dependent diabetics had severe periodontal disease which increased in severity with the duration of diabetes. The evidence available suggests that, because of the senescence of the immune system and the greater risk of poor oral hygiene, diabetes in old age may be a risk factor common to heart disease and periodontal disease (Dennison et al., 1996; Thorstensson et al., 1996).

3.5 Root surface caries and general health

The prevalence of root surface caries is high in older populations. Few studies have examined the possibility of a relationship between oral health (Scheinin et al., 1994) or general health risk predictors (Takano et al., 2003; Lawrence et al., 1995) and the presence of root caries. As suggested by Loesche & Lopatin (2000), root caries is considered part of the Total Dental Index being a good risk predictor of cardiovascular disease, but it is presently difficult to establish a strong relationship between root caries and specific chronic disease associated with old age.

3.6 Oral cancer and precancer lesions

Cancers of the oral cavity and pharynx show significantly high rates of morbidity and mortality as compared to other types of cancers. Mortality rates from oro-pharyngeal cancers remain high, with an overall 5-year survival rate of only about 53% (Greenlee et al., 2000). Older people have the greatest risk for the development of oral cancer and premalignant lesions, and most cases occur in the age group above 60 years. The major risk factors are smoking and alcohol consumption (Silverman & Gorsky, 1990; Silverman, 1992; Lewin et al., 1998; Pajukoski et al., 1999; Thomas et al., 2003; Epstein et al., 2005).

Decline in various defence mechanisms, the presence of common risk factors (smoking, alcohol) related to oral and general health, and limited psychological and socioeconomic support have a significant impact on the cancer survival rate of elderly people (Kowalski et al., 1994; Epstein et al., 2005). Precancerous lesions such as leukoplakia and lichen planus are frequent in older people (1-7%), and associated with low socio-economic status (Reichart, 2000).

4. Oral health, general health and quality of life (QOL) of older adults

As indicated in the preceding sections, the increased life expectancy is unfortunately associated with multiple oral and systemic diseases and, ultimately, impairment of older adults' quality of life (QOL). The concept of quality of life in health recognizes the value of an individual's health with the broader psychological and social aspects of his life (Sarment & Antonucci, 2002). This model requires that health care providers must shift from a narrow disease focus to a broad psychosocial approach.

Conceptualizing quality of life requires assessing not only factors such as discomfort or pain and oral health functions (mastication and speech), but also emotional and social functions (appearance, self-esteem) and perceived needs with regard to general and or oral health.

QOL is particularly affected by dentate status, including the use of partial and complete dentures. In recent years, much research has demonstrated the impact of oral and general health on the quality of life in older populations (Petersen & Nörtov, 1989; Slade et al., 1996; Sarment & Antonucci, 2002; McGrath & Bedi, 2004; Petersen et al., 2004).

Pain, discomfort, mucosal infections, xerostomic conditions related to multi-medications and toothloss can deteriorate QOL, as the problems will impair self-esteem, daily life and well-being. Chronic dry mouth has a profound impact on essential aspects of life such as speaking, ingestion of foods and the wearing of dental prostheses (Cassolato & Turnbull, 2003). As demonstrated in the preceding sections, poor oral health is frequently related to systemic diseases in a two-way relationship, and compromised chewing and eating abilities will impact on nutritional status (Walls et al., 2000). Social relationships also play an important role, as they optimize the well-being of older adults. Slade et al. (1998) defined a model of social relations which helps to understand the individual's personality, behaviour and social network, and their influence on oral-health-related quality of life (OHRQOL). Petersen et al. (1989) established an index of lifestyle activity in old age pensioners of a Danish community; they found a significant relationship between poor dental health conditions and low lifestyle activity. In addition, indices for the measurement of health support related to involvement of social networks (such as family, friends or neighbours) were constructed, and the study showed that isolated older people have the poorest dental health status, and low use of health services (Petersen et al., 1989).

Over the past decades, a variety of QOL instruments have been introduced for use in health care (Kane & Kane, 1994; Bowling, 1995). Such instruments appear to be more useful for assessment of impact of use of health services and for quantifying the effects from a patient perspective rather than in biological or physiological terms. Assessing oral-health-related quality of life in medically compromised elderly people, Locker et al. (2002) found that selected health indicators were significantly associated with those measures, suggesting that oral disorders have significant effect on the well-being and life satisfaction of the individuals. Findings from an Ontario study of the oral health of older adults suggested that self perceived poor oral health and poor quality of life co-exist in the same subgroup (Locker et al., 2000). Gift et al. (1998) found that the perception of general health and epidemiological indicators of oral health status are significant factors in understanding oral health behaviours and oral-health-related quality of life. MacEntee et al. (1997) observed that three factors are usually most important for an older adult's oral health related quality of life assessment: lack of pain, ability to maintain proper hygiene and a disease free mouth.

A variety of OHRQOL measures have been proposed in the literature (Jones, 1998). Their potential uses in geriatric dentistry (Jones, *op. cit.*) include population applications and uses with individuals for political, theoretical and practical reasons. Existing instruments have been mainly designed for cross-sectional rather than for longitudinal studies (Slade et al., 1998). White (1998) suggests that currently available OHRQOL instruments have limited applicability in dental clinical care settings.

A state-of-the science conference on assessing oral health outcomes through measuring health status and quality of life emphasized the need to include quality-of-life assessments of oral health outcomes (Slade et al., 1998). The available quality-of-life instruments are multi-dimensional, and have been found to be very useful, particularly in geriatric dentistry. However, there is a need for further research in defining the categories of OHRQOL because: (a) little experience is available from their use in long-term studies; and (b) adaptation of the instruments to the specific objectives of the surveys is needed (i.e. social impact of oral health conditions, perceived objective needs of the individual, improvement of dental care services).

Many studies have demonstrated the important impact of oral and general health conditions on older adults' quality of life. The assessment remains complex because of the multiplicity of factors influencing OHRQOL. Most recently, WHO emphasized the need for incorporating quality-of-life measures in evaluation of community-based oral health promotion (Petersen & Kwan, 2004).

5. Impact of demographical, social and cultural factors on dental health and on seeking dental care

Although data on oral health status are scarce, particularly in the developing countries of Africa, Asia and Latin America, the available evidence shows profound oral health disparities among older people across and within countries (Petersen & Yamamoto, 2005 *op.cit.*). These disparities mainly relate to living conditions and the availability of services for seniors, and differences between rural and urban areas.

As early as two decades ago, Canadian surveys (Leake, 1972; Martinello, 1976; Kandelman et al., 1982) reported differences in dental needs and oral health conditions of the home-bound, nursing home or institutionalized older adults. At about the same time, a review of the Swedish literature (Nordenram & Bohlin, 1981) on older people's dental health demonstrated a higher frequency of edentulousness among institutionalized elderly people than among those living at home. Slade et al. (1990) observed that institutionalized older persons were more than twice as likely to be edentulous than non-institutionalized persons.

Socioeconomic and education level constitute important determinants of oral and general health conditions (Petersen, 1990). The World Health Organization International Collaborative Studies ICSII (Chen et al., 1997; Petersen, 2005b) has underlined the importance of social inequality in oral health across and within countries. Epidemiological studies conducted over the past 20 years or so show that inequalities in oral health are even more pronounced among older adults. Surveys carried out in the United Kingdom (Walker & Cooper, 2000) in Quebec, Canada (Brodeur et al., 1982) and in Denmark (Petersen et al., 2004) demonstrated that the social gradient in tooth loss and dentate status remained stable over time, and

similar gradients by income, education or social class were also observed with respect to the utilization of professional dental services. In older populations, an association between dental health behaviour and dental health status has also been documented (Petersen, 1983; Ambjörnsen, 1986; Petersen, 1990; Österberg et al., 1990; Walker & Cooper, 2000). On the other hand, a Japanese survey (Ikebe et al., 2004) used the oral health impact profile (OHIP-14) to evaluate the impact of oral disease on oral-health-related quality of life in a group of independently-living elderly persons in an urban area of Japan, and no significant relation between the measures of oral and general health and socio demographic variables was found.

Previous studies have confirmed that dental caries experience in older adults varies by socio-economic status (Walker & Cooper, 2000; Krustup & Petersen, 2006a), whereas the social gradient in periodontal health status is somewhat weaker (Shah & Sundaram, 2003; Krustup & Petersen, 2006b). Poor periodontal status in disadvantaged population groups is compounded by tooth loss, wearing of removable dentures, experience of chronic diseases and high tobacco consumption.

6. Concluding remarks on the interrelationships between oral health and general health

Over recent years, epidemiologic and clinical studies have been undertaken to understand the association between oral and systemic disease (Genco et al., 1999; Hujoel et al., 2002; Tuominen, 2003). Several biological mechanisms have been suggested, including that whereby inflammatory mediators from oral inflammatory conditions (such as gingivitis and periodontitis) can enter the circulation and contribute to the burden of systemic inflammation (which in turn has been associated with systemic disease). The present paper has attempted to outline the current evidence on oral health/general health associations. However, causal inference is a major concern in reviewing that evidence. The criteria to be applied for evaluating the strength of evidence comprise: (1) specificity (i.e. a specific agent is found to produce a specific effect); (2) strength of the association; (3) dose-response relationship; (4) time sequence; (5) biologic plausibility; (6) consistency in results, and (7) independence from confounding factors. The evidence for oral health/general health relationships is particularly strong for the two-way association between diabetes and periodontal disease (Taylor, 2001), while that for other relationships is more circumstantial, being based on cross-sectional rather than more appropriate longitudinal study designs.

The common risk factor approach to the understanding of associations between chronic disease and oral disease has gained much research attention in recent years. Several chronic diseases and oral diseases relate to common risk factors such as use of tobacco, excessive consumption of alcohol, poor diet and nutrition status. Reports are available showing that bivariate associations between certain chronic diseases and oral disease may be ascribed to the effect of confounding factors (Hujoel et al., 2002; Tuominen et al., 2003). Appropriate analyses with adequate statistical adjustment for age and tobacco use suggest that the observed associations between periodontitis and systemic disease (such as cardiovascular disease) could be coincidental rather than causal (Hujoel et al., 2002).

7. Translating knowledge into solutions

The growing numbers of elderly people represent a great challenge to health authorities in most countries. First, the demand for expensive dental care will increase for active older persons; second, public health authorities will have to face the growing burden of oral disease associated with the new chronic disease profile of ageing societies. In addition, the state of general and associated oral health conditions have a direct influence on older people's quality of life and lifestyle (Petersen & Nörtov, 1989; Sarment & Antonucci, 2002).

WHO goals for better oral health of older people have not yet been addressed by countries worldwide, and reducing social inequalities in oral and general health as well as improving accessibility to oral health services remain key issues (Petersen, 2005a; Petersen & Yamamoto, 2005).

The ageing of the population will undoubtedly require multiple actions by public health authorities, and decisions must be based on an understanding of how the determinants of active ageing influence the way that individuals and populations age (WHO, 2002). As the risk factors responsible for chronic systemic diseases are common to most oral diseases, the common risk factor approach may therefore be instrumental in the planning and surveillance of oral health promotion and oral disease intervention programme (Petersen, 2003; Petersen & Yamamoto, 2005). Health and oral health policies will also have to consider the life-course perspective in order to preserve good oral and general health and maintain quality of life.

The negative impact of poor oral health conditions on the general health and quality of life of older adults is an important public health issue; WHO recommends that countries develop national public health programmes, based on integrated prevention and health promotion, and establish measurable goals for improving the oral health for the elderly (Petersen, 2003).

The recommendations for action are based on the following premises:

- Changing demographic structures
- Changing oral health needs, accessibility and demand for oral health services
- New understanding on general - oral health interrelationships and their impact on quality of life
- Growing economic burden to countries due to cost of treatment, care and intervention programmes.

Actions must be taken at several levels:

- Strengthening health promotion and integrated disease prevention
- Oral health education to caregivers, older adults and their families
- Education to older adults and creation of healthy environments
- Operational research in public health and epidemiological research on oral health - general health links and common risk factors
- Oral health systems capacity building, based on age-friendly primary health care
- Improvement of social security and health insurance coverage for older adults.

Greater attention to the oral health status of elderly people (and particularly those who are institutionalized) may reduce the prevalence of oral cancer

in the older adult population. Early detection and referral of oral cancer are critical steps as they will affect success of treatment and survival rates.

Developing comprehensive policies on ageing in order to improve health and oral health of the older adults will constitute a real challenge to oral health care providers and particularly to the dental profession (Kandelman, 2001; Petersen & Yamamoto, 2005). Failure to deal with this important demographic imperative and rapid changes in disease patterns and inter-relations would have behavioural, socio-economic and political consequences everywhere (WHO, 1998; WHO, 2002).

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**ORAL HEALTH IN AGEING SOCIETIES:
INTEGRATION OF ORAL HEALTH AND GENERAL HEALTH**

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