AVOLA

ETERNUS QUIA PURUS

FOCUS ON PREVENTION

AVOLA INTERNAL REPORT

37 Pages

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1 The prevalence of oral disease

The white paper “Time to take gum disease seriously”, which was authorised by the EFP and published by the Economist Intelligence Unit last year, reports that periodontitis is the sixth-most prevalent health condition globally. Severe periodontitis affects approximately 11% of the world’s population, equating to around 743 million individuals.[1] The prevalence of milder forms of periodontitis are even more common, affecting at least half of the global population. Gingivitis is even more prevalent, affecting an estimated 90% of the world’s population.[2] If we group gingivitis and periodontitis under gum disease, it then becomes the most widespread disease globally, along with dental caries.[3]

As for Europe, it is hard to create a valid “oral health index”. There is currently no systematic collection of oral health data in Europe, and as a result there are no consistent epidemiological data. Moreover, the official definition of oral health as determined by the FDI World Dental Federation General Assembly is a relatively new one. According to this definition oral health encompasses “the ability to speak, smile, smell, taste, touch, chew, swallow and convey a range of emotions through facial expressions with confidence and without pain, discomfort and disease of the craniofacial complex” [4]. It was also agreed upon that oral health is a vital component of overall health and psychosocial well-being.

The available data still paint a bad picture. According to figures from the Institute for Health Metrics and Evaluation, oral disorders in the form of untreated dental caries, periodontal diseases, and edentulism, are the most widespread group of diseases in the EU. As per this data, half of the European population suffers from one of these oral health conditions (see image 1). According to additional info by the WHO, the European Region had the highest prevalence of major oral disease cases across all six WHO regions worldwide, with 50.1% of the adult population suffering from some kind of oral disease.[5] The prevalence of oral diseases was highest in Eastern European countries, with 60.6% of cases in Croatia and 58.6% in Slovenia. In contrast, Ireland, Spain, and the UK reported a relatively low prevalence of oral diseases (around 44%) according to IHME's 2022 report.

[1] James SL, Abate D, Abate KH, Abay SM, Abbafati C, Abbasi N, et al. Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. The Lancet. 2018;392(10159):1789-858.

[2] Chapple IL, Van der Weijden F, Doerfer C, Herrera D, Shapira L, Polak D, et al. Primary prevention of periodontitis: managing gingivitis. Journal of clinical periodontology. 2015;42:S71-S6.

[3] Wong LB, Yap AU, Allen PF. Periodontal disease and quality of life: Umbrella review of systematic reviews. Journal of periodontal research. 2020.

[4] Glick M, Williams DM, Kleinman DV, Vujicic M, Watt RG & Weyant RJ (2016). A new definition for oral health developed by the FDI World Dental Federation opens the door to a universal definition of oral health. Journal of the American Dental Association, 147(12):915–17. Available at: https://doi.org/10.1016/j.adaj.2016.10.001 (accessed 23 March 2023).

[5] World Health Organization. (2023, April 20). WHO Europe calls for urgent action on oral disease as highest rates globally are recorded in European region. Retrieved from https://www.who.int/europe/news/item/20-04-2023-who-europe-calls-for-urgent-action-on-oral-disease-as-highest-rates-globally-are-recorded-in-european-region.

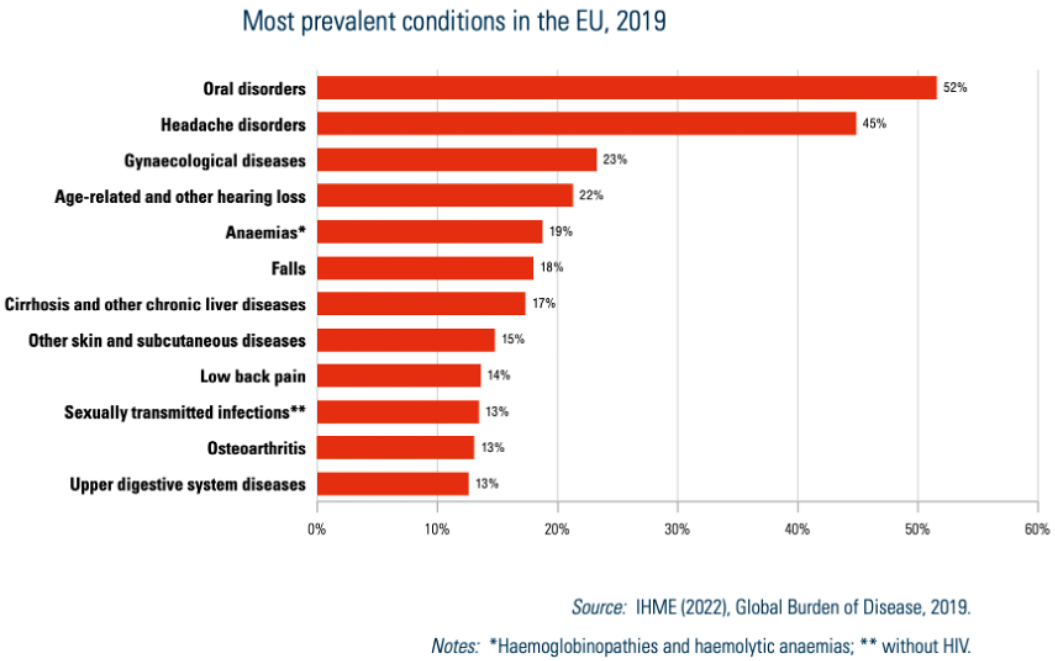
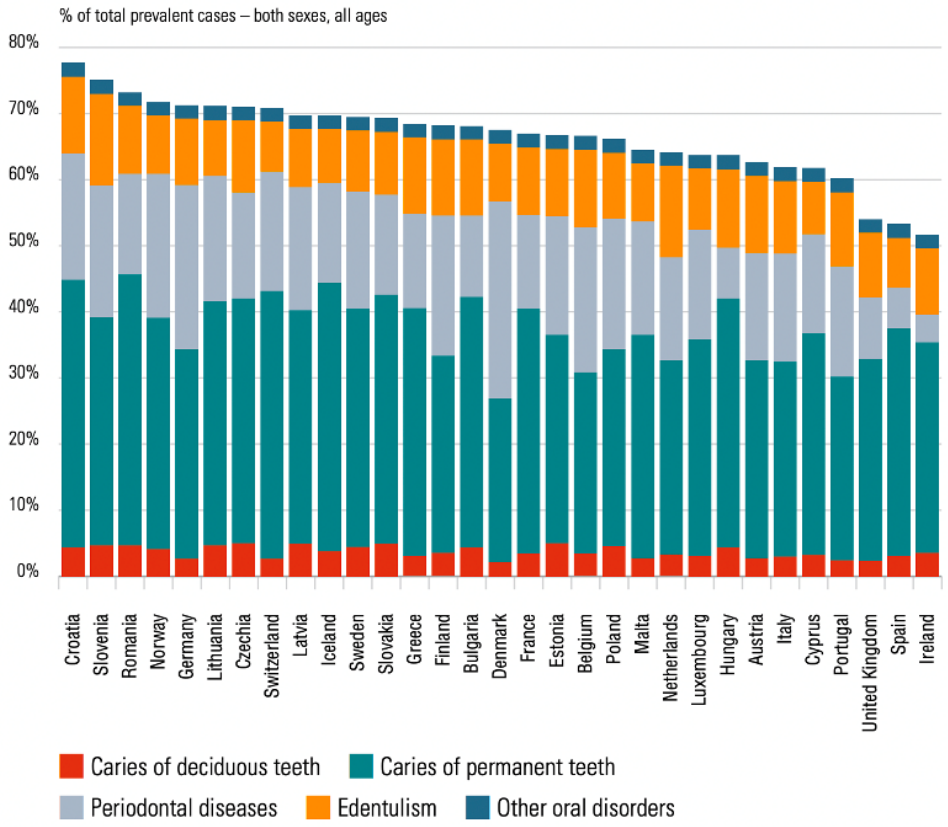


Image 2 shows a breakdown of oral disease in Europe into individual conditions. Europe's figures include the highest prevalence of caries of permanent teeth across all WHO regions, which at 33.6% of the European Region's population represented almost 335 million cases in 2019. According to a 2019 report by the Platform for Better Health in Europe, severe periodontitis affects over 10% of the European population. The prevalence of periodontitis rises to 70-85% among those aged 60-65 years. These trends suggest a decline in periodontal health among the EU population, primarily due to the growing number of people retaining their teeth into old age and an increase in the prevalence of diabetes. Unfortunately, information on gingivitis prevalence is not systematically available per country, as epidemiological data on periodontal diseases in Europe is of subpar quality.[6]

[6] Patel R (2012). The state of oral health in Europe. Report Commissioned by the Platform for Better Oral Health in Europe. Available at: http://www.oralhealthplatform.eu/wp-content/uploads/2015/09/Report-the-State-of-Oral-Health-in-Europe.pdf

Age-standardized prevalence of oral diseases in Europe in %, 2019



Source: IHME (2022), Global Burden of Disease, 2019.

Patients can easily prevent the development of gum disease by reducing plaque biofilm build-up. The key to achieving this is dental professionals providing them with proper training and instruction on home care. Moreover, most periodontal cases (95%) can be diagnosed and managed by primary care general dental practitioners.[7] There seems to be little progress in the prevention and management of periodontitis, and even in regions with advanced healthcare services like Western Europe, a number of challenges have allowed its prevalence to remain unchanged for the past 25 years.[8]

[7] Sanz M, Herrera D, Kebschull M, Chapple I, Jepsen S, Beglundh T, et al. Treatment of stage I–III perio-dontitis—The EFP S3 level clinical practice guideline. Journal of Clinical Periodontology. 2020;47(S22):4-60.

[8] Economist Intelligence Unit. (2019, October). Take gum disease seriously: The societal and economic costs of periodontitis. Procter & Gamble. https://impact.economist.com/perspectives/sites/default/files/eiu-efp-oralb-gum-disease.pdf

2 Challenges

2.1 Lack of preventative policy

The 'treat over prevent' model, is the go-to strategy in oral care, and it is one that has failed to remedy the global challenge of oral diseases. Oral diseases suffer from inadequate funding for prevention and treatment, especially in low- and middle-income countries where the treatment costs often exceed available resources. In many countries, care-delivery models and financing for oral health are often more restricted than for other medical care. However, more public funding in the prevention of periodontitis would lead to a return on investment and more healthy life years.

2.1.1 Oral health expenditure in the EU

Oral diseases rank third among the costliest health domains in the EU, just behind diabetes and cardiovascular diseases.[9] It is estimated that in 2018 oral diseases accounted for € 90 billion in direct costs in treatment expenditure in the then 28 EU member countries, behind diabetes (€ 119 billion) and heart diseases (€ 111 billion)[Fehler! Textmarke nicht definiert.]. Across European OECD countries, oral healthcare represented 30% of health expenditure in 2020[10.] Despite this, as a share of total health expenditure, costs for dental treatment accounted for 5.1% of health spending across the 23 countries with available data in 2019. To put things in perspective: this number is below average expenditure for pharmaceuticals and medical devices.[Fehler! Textmarke nicht definiert.]

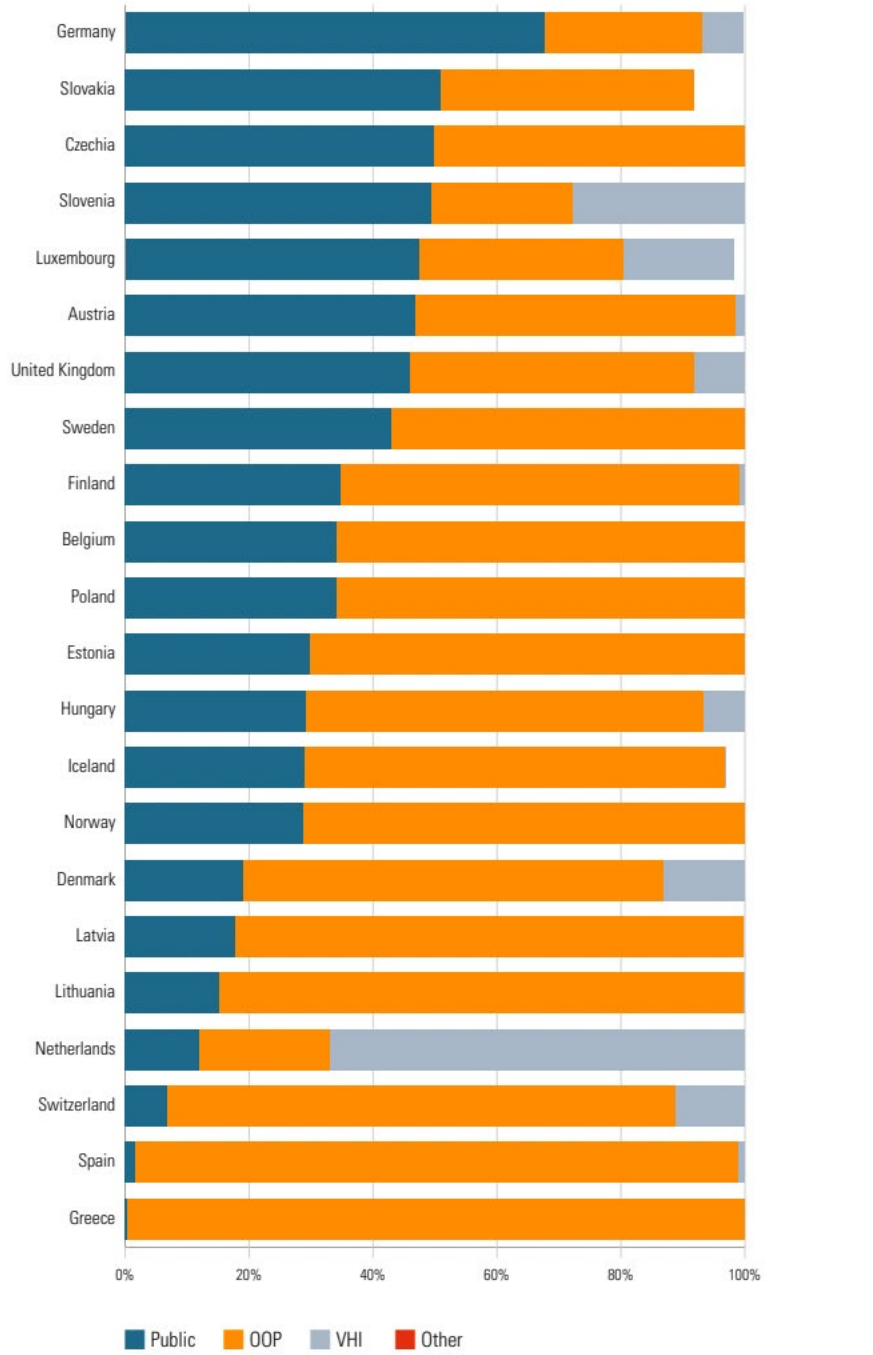
The most important factor for the analysis of dental care expenditure when it comes to public health is the source of funding. In almost all EU countries, public coverage for dental care is more limited than for other health care sectors, with restricted service packages - except for children in most countries - and higher levels of cost-sharing[11]. Generally, dental care is funded to a greater extent by private patient payments than other areas of health care. In 2019 private spending accounted for more than half of total dental care expenditure in almost all countries. In Spain, Greece, the Netherlands and Switzerland virtually all dental care expenditure comes from private sources (see chart 3). In these countries adult dental care is generally not part of the basic package of public health insurance, although some care may be provided for certain population groups. Only in Germany and Slovakia do public sources fund more than half of dental care spending, with 68% and 51% respectively.

[9] Peres MA et al. (2019). Oral diseases: a global public health challenge. The Lancet, 394(10194):249–60. Available at: https://doi.org/10.1016/S0140-6736(19)31146-8 (accessed 8 March 2022).

[10] OECD. Health at a glance 2016: Europe. State of the health in the EU cycle. OECD Publishing Paris; 2016.

[11] OECD/EU (2018), Health at a Glance: Europe 2018: State of Health in the EU Cycle, OECD Publishing, Paris. https://doi.org/10.1787/health_glance_eur-2018-en

Out-of-pocket, voluntary health insurance and public spending for dental care as % of total dental expenditure, 2019

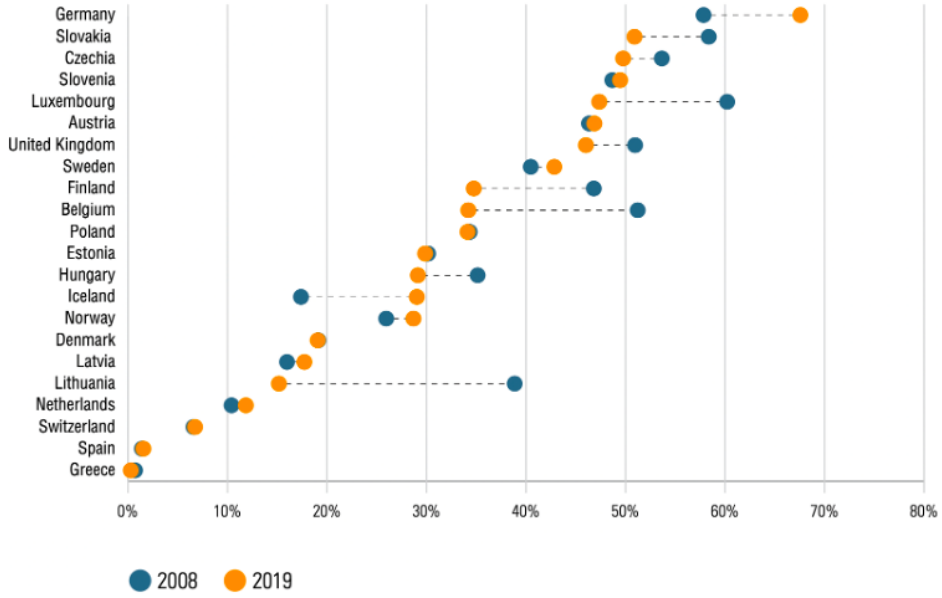


Source: OECD Health Statistics, 2021.

Notes: Other for Iceland and Slovakia refer to expenditures of non-profit institutions serving households (NPISH). Data for Switzerland refer to 2010 and for the UK to 2013.

On average public spending accounted for 31% of total dental care spending in 2019 across 22 countries for which data were available. The share of public spending on dental care in 2019 had remained relatively stable over the last 10 years, but there was a slight decrease down from 34% in 2008. Public dental care expenditure as a share of total dental spending did fall significantly in a few countries such as Belgium, Finland, Lithuania and Luxembourg (see chart 4).

Public spending on dental care as a % of total dental expenditure, 2008 and 2019



2.1.2 The cheapest prevention is the most effective: improved home care

An EFP-commissioned study by the Economist Intelligence Unit calculated that a preventative approach based on the early diagnosis and treatment of gingivitis via improved home care is the ideal scenario when it comes to limiting health expenditure, return on investment, and extra healthy life years.

The study modelled the economic cost for several scenarios for France, Germany, Italy, the Netherlands, Spain, and the UK. According to the study, preventing periodontitis by addressing gingivitis through better oral homecare would be the ideal one, leading to a rise in healthy life years for all modelled countries, but most substantially in Germany, with an increase of 5.7 million years in total. This scenario also leads to a substantial return on investment, from 36 billion Euros in Italy to 7.8 billion Euros in the Netherlands over a 10-year period.

An alternative preventative scenario aimed to diagnose 90% of periodontitis cases and manage them. This scenario translates into an incremental increase in healthy life years for all countries compared to baseline, from 7 million in the Netherlands to 1.8 million in Spain. Interestingly, the Netherlands is the only country where this scenario leads to more healthy life years than the first scenario. This scenario comes with an incremental increase in costs for all countries, from 290 billion in Italy to 60 billion in Spain, but despite these cost increases there is a positive ROI in all countries.

These results highlight how integral individual level prevention through home care is to good oral health, in terms of being cost-effective to society and preventing periodontitis, which is difficult and costly to treat. Secondly, this approach would improve the affordability of dental care, or eliminate the need for it compared to baseline. Lastly, preventing the progression of gingivitis to periodontitis could prevent health conditions that share risk factors with periodontitis such as diabetes and heart conditions, and save costs there too.

2.2 Socioeconomic factors

The oral cavity has been described as “a marker of people’s social position and future disease risk”. Socioeconomic factors tie in directly with the problem of limited public funding for oral health. Dental care is the main area of out-of-pocket spending in health, reflecting the fact that public coverage for dental care is generally lower than that for other health sectors, and more than two thirds of dental care spending is paid out-of-pocket or by voluntary health insurance.

Due to the lack of public funding, socioeconomic factors become the greatest barrier for good oral health. On average, 6.1% of low-income people in the EU reported having some unmet needs for dental care, compared with 0.7% those with a high income.[13] These differences are higher than those reported for other forms of medical care. The problem of upfront costs and limited coverage of dental care frequently lead to financial hardship for richer households who are able to pay out-of-pocket, but result in unmet needs for poorer households because they forgo or delay seeking care. This in turn makes the needs of low-income households more expensive in case they do opt for treatment.

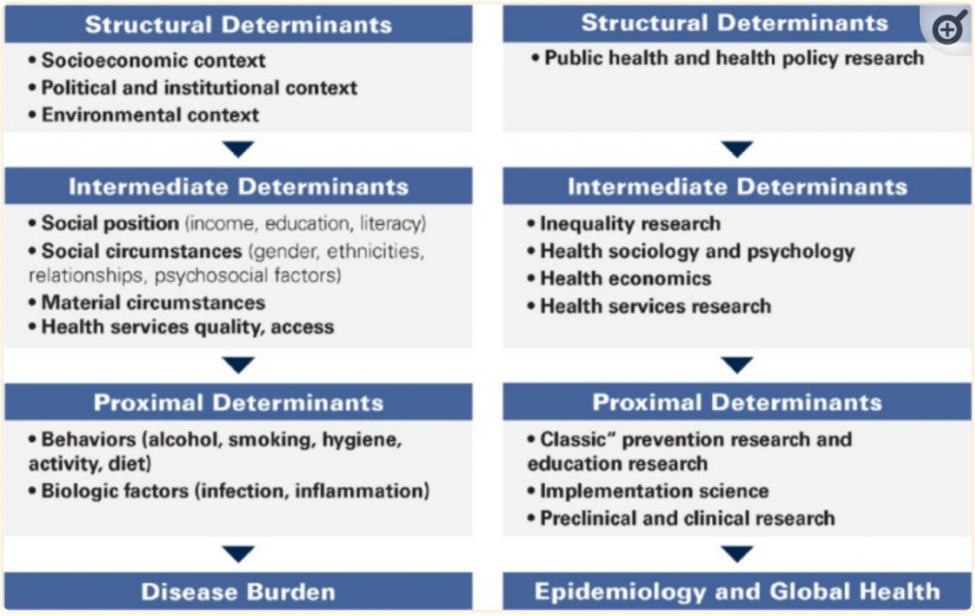


Figure.

The pathway to (unfair) disease distribution (left) and research levels (right) suited to address the underlying structural or procedural causes (adapted from Watt and Sheiham 2012).

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2.2.1 Upfront costs limit access

International surveys show that in countries which do not (or only partially) cover dental care in their public benefits basket, out-of-pocket spending and unmet needs for dental care due to financial reasons are higher than in countries where dental care is included in the benefits basket for the general population. Based on data from EU-SILC, 3% of individuals in 31 surveyed countries experienced unmet dental care needs due to financial reasons in 2019. In certain countries, such as

[12] Schwendicke F, Giannobile WV. Research for Prevention of Oral/Dental Diseases: How Far Have We Come? J Dent Res. 2020 Jan;99(1):5-7. doi: 10.1177/0022034519889054. PMID: 31859587; PMCID: PMC6927065.

Portugal, Latvia, and Greece, where dental care is not covered, the percentage of people avoiding dental visits due to expenses was approximately 10%, higher than in other countries.

Generally, countries with limited or no dental care coverage in their statutory benefits for adults, such as Denmark, Iceland, Norway, Romania, Spain, and Switzerland, had higher rates of unmet dental care needs. In contrast, countries with more comprehensive dental care coverage through health insurance, such as Austria, Croatia, the Czech Republic, Germany, Luxembourg, Finland, Malta, and Slovenia, had lower rates of unmet needs.[13] In a UK survey conducted by the National Association of Citizens Advice Bureaux, 43% of patients stated that they had avoided a dental check-up in the preceding 12 months as they could not afford it.[8] The Netherlands, where dental care is mostly not funded by the state for adults over 18, had one of the lowest percentages of people with unmet dental care needs. The reason may be the large proportion of the population with additional voluntary health insurance that partially covers dental care, as well as the country's National Health Authority regulating the prices for dental treatment. Still, coverage of treatment for periodontitis is especially low throughout the EU. In countries such as Spain and Italy, most if not all periodontitis treatment is paid for out-of-pocket or via private insurance. Periodontitis treatment for a low-income family is therefore rendered almost unaffordable.

2.2.2 Distribution of dentists

There are inequalities in the availability and distribution of dentists exist within countries, which can worsen the unequal access to dental services based on income level, especially for rural communities. The number of dentists has increased significantly in several countries, largely due to privatization and cross-border care. Despite a three-fold difference in the number of dentists per population across European countries, the imbalances within countries are often even more pronounced as dentists are mainly situated in urban areas. This results in limited access to dental care in rural regions where patients face extended travel and wait times, compounded by lower incomes. Providing high-quality and reasonably-priced dental care services, particularly preventive care for disadvantaged and low-income individuals, as well as for the general population, is a significant public health issue.

2.2.3 Lifestyle

Lastly, lower socioeconomic status is associated with poor oral hygiene and an unhealthy diet characterised by high sugar consumption, as well as increased consumption of tobacco, and alcohol (FDI World Dental Federation, 2015). These factors have a direct impact on the prevalence of periodontitis and associated non-communicable diseases.

Modifying behaviours is a simple yet powerful policy message for addressing these issues. The success of both gingivitis and periodontitis treatment heavily depends on individual levels of engagement and the potential for behaviour change. There is widespread consensus that self-performed oral hygiene is one of the most important factors in the prevention of periodontitis. Despite this, there is a general lack of knowledge how to effectively clean teeth and gum. A survey carried out in Portugal, Romania and Sweden showed that 74.9% of adolescents were not aware of the fact that tooth brushing can prevent periodontal disease.[14]

[13] Winkelmann J, Gómez Rossi J, van Ginneken E. Oral health care in Europe: Financing, access and provision. Health Syst Transit. 2022 Jun;24(2):1-176. PMID: 35833482.

[14] Graça SR, Albuquerque TS, Luis HS, Assunção VA, Malmqvist S, Cuculescu M, et al. Oral health knowledge, perceptions, and habits of adolescents from Portugal, Romania, and Sweden: A comparative study. Journal of International Society of Preventive & Community Dentistry. 2019;9(5):470.

Interventions that are community-based and aimed at reducing socio-economic disparities while improving oral health could involve improving oral health literacy and parental knowledge, skills, and self-efficacy regarding preventive oral health behaviour and nutrition. Collaboration between primary care providers for children, elementary schools, and preventive dental care services may be beneficial in educating and engaging people. Additionally, policy measures at the community level are necessary.

2.3 Lack of interdisciplinary collaboration

Links have been established between periodontitis and over 50 non-communicable diseases. As such, there is a need for improved integration between dental and general healthcare. Sharing information across disciplines can improve patient care and contribute to dental and general health research, as certain conditions share common risk factors. Additionally, integration can promote shared responsibility across healthcare disciplines to address unmet oral health needs in marginalized and vulnerable communities. As for now, it is possible to refer from dentistry to secondary care, but there is no joined up thinking.

The WHO's Oral Health resolution in May 2021 is an important step in recognizing the significant and unequal global burden of preventable oral diseases. This builds on a previous resolution from 2007 that established the integration of oral health care into primary care and emphasized a collaborative care approach. The integrated approach recognizes that key risk factors for oral diseases are shared with other non-communicable diseases, which often coexist in the same individual, and that dentist-centred oral health care models and technology-driven interventions fail to sufficiently promote prevention and reduce the burden and inequalities of oral disease.

Pilot projects to reverse the situation do exist. A rare example of interdisciplinary collaboration is the German Diabetes Association’s checklist for general health practitioners, which include oral care instructions. In the UK, the NHS has improved its networks of communication between general and dental health aims to establish an Integrated Care System (ICS) for the whole of England from April 2021.

Several issues trouble a smooth running of integrated care systems. One is the different price system of different healthcare branches. In the UK too, the high and ambiguous cost of dentistry has been a major issue. In addition, a lack of digitalisation of patient data persists, despite dentists and physicians agreeing that sharing information in this way would be extremely useful. This would not only translate into more efficient treatment and prevention, but also in a lower cost due to a reduced number of contacts with different health professionals and less double work.

3 Players and stakeholders

The activities of the private sector that impact people's health, either positively or negatively, are known as commercial determinants of health. Through various business actions and societal engagements, the private sector can affect a broad range health outcomes.[15] The clash between these economic actors and public health initiatives aimed at preventing non-communicable diseases is one of the most significant obstacles to health promotion. The dental profession and policymakers should increase pressure on those corporations with the most influence and power to sustain oral health inequalities, such as the sugar, alcohol and tobacco industries. What follows is a summary of the stakeholders and players involved in the preventative oral health discussion in Europe.

3.1 Organisations

European Public Health Association (EUPHA)
EUPHA is a collective organization that encompasses public health institutes and associations in Europe. EUPHA was established in 1992 with only 15 members representing 12 countries. Currently, EUPHA has grown to include 82 members from 47 countries, consisting of 44 national public health associations, 27 institutional members, 9 individual members, and 2 global members.

Membership list: https://eupha.org/about_members.php?members=all

European Public Health Alliance (EPHA)
EPHA is a European non-profit association, with 89 national public health NGOs as its members, based in 21 European countries. The EPHA is a member of the Social Platform as well as the Health and Environment Alliance (HEAL). EPHA monitors policy making within EU institutions and promotes awareness among citizens and NGOs about health-related policy developments. They also train and support NGOs to engage with the EU, participate in policy debates, and encourage collaboration between organizations to promote public health.

Membership list: https://epha.org/our-members/

The International Union for Health Promotion and Education (IUHPE)
A global professional non-governmental organisation dedicated to health promotion around the world. For more than 65 years, IUHPE has operated an independent, global, professional network of people and institutions committed to improving the health and wellbeing of the people through education, community action and the development of healthy public policy.

EuroHealthNet
Differences in health outcomes among social groups and populations are referred to as health inequalities. Health inequities are unjustifiable and preventable differences in health outcomes between and within countries. EuroHealthNet is a non-profit alliance of organizations, agencies, and statutory bodies working towards a healthier Europe by advocating for health equity and equality within and between European countries. This partnership aids its members to promote public health through policy and project development, networking, and communication support.

Membership list: https://eurohealthnet.eu/list-of-members/

[15] World Health Organization. (2021, January 12). Commercial Determinants of Health. https://www.who.int/news-room/fact-sheets/detail/commercial-determinants-of-health

European Health Forum Gastein
Established in 1998, the European Health Forum Gastein initially served as an independent platform for European health policy exchange. The organization now strives to provide a forum for promoting health policy exchange, equity, and solidarity both in the EU and globally. The EHFG annual conference attracts around 900 leading experts, decision-makers, and community members from the public and private sectors, academia, and civil society.

Membership list (2022): https://www.ehfg.org/partners

Movement Health 2030
Working with governments, entrepreneurs, health providers, and patients, the Movement Health 2030 prepares health systems for the demands of the future and supports them regionally in adopting the necessary innovation to create change that best serves patients' needs, including health literacy, data sharing, policy and setting up a local network. Their mission: to open up access to quality healthcare for all people, now and in the future.

Regional advisors: https://www.movementhealth2030.com/en/advisors

Association for Dental Education in Europe (ADEE)
Founded in 1975, the ADEE is an autonomous European association that represents academic dentistry and dental educators. Its contributions have been significant in improving the quality of education, advancing the professional development of dental educators, and promoting research in the education and training of oral health personnel.

Membership list (2022): https://adee.org/about-us/members-directory

Pan-European Commission on Health and Sustainable Development
The WHO Regional Office for Europe has assembled a group of exceptional individuals known as the Pan-European Commission on Health and Sustainable Development. This interdisciplinary team, consisting of renowned life scientists, economists, former heads of state and government, heads of health and social care institutions, as well as business and financial leaders, is independent and aims to reconsider policy priorities in the context of pandemics.

Membership list: https://www.who.int/europe/groups/pan-european-commission-on-health-and-sustainable-development/members-of-the-pan-european-commission-on-health-and-sustainable-development

European Association of Dental Public Health (EADPH)
The EADPH promotes dental public health, defined as the science and art of preventing oral diseases and promoting oral health for populations and individuals. The association hosts an annual meeting where researchers, practitioners, and policy makers exchange information, as well as Special Interest Groups meetings. The EADPH also collaborates with the journal Community Dental Health, which includes a news page for members to share relevant information.

The Council of European Chief Dental Officers (CECDO)
The CECDO offers a forum for discussing oral health matters that affect European member states. It offers advice to National Governments, to the Commission and others on matters affecting European oral health. Its philosophy is preventative and aimed at reducing inequality.

The Lancet Commission on Oral Health

Efforts such as the Lancet series on oral health16 have emphasised the need for preventative policies to address the root causes of oral diseases and move away from a treatment-focused and technology-driven approach. To address the policy neglect and system failure of oral diseases, the Lancet Commission on Oral Health was launched in 2020 to provide evidence-based analysis and policy recommendations for the transformation of current oral health care systems.

3.2 Industry

The European Federation of Pharmaceutical Industries and Associations (EFPIA)

The European Federation of Pharmaceutical Industries and Associations (EFPIA) is an organization that represents the biopharmaceutical industry in Europe and is self-proclaimed as the "voice" of this industry. It has direct membership from 37 national associations, 39 top pharmaceutical companies, and an increasing number of small and medium-sized enterprises (SMEs).

Membership list: https://www.efpia.eu/about-us/membership/

Association of the European Self-Care Industry (AESGP)

The AESGP is the Association of the European Self-Care Industry, a non-profit organisation that represents the manufacturers of non-prescription medicines, food supplements, “self-care” or “consumer healthcare” medical devices in Europe.

Membership list: https://aesgp.eu/our-members

Association for Soaps, Detergents and Maintenance Products A.I.S.E.

A.I.S.E., or the International Association for Soaps, Detergents, and Maintenance Products, serves as the authorized representative organization for this industry in Europe, which also encompasses biocidal hygiene products. Its membership comprises 29 national associations, 17 corporate members, and 11 value chain partners across Europe. The A.I.S.E. network represents more than 900 European companies that provide cleaning and maintenance products and services, both for household and professional use.

Membership list: https://www.aise.eu/about-aise/members-list.aspx

The Platform for Better Oral Health in Europe

This is a joint initiative of the Association for Dental Education in Europe (ADEE), the Council of European Chief Dental Officers (CECDO), the European Association of Dental Public Health (EADPH), the Oral Health Foundation, and the Pan-European Region of the International Association for Dental Research (PER-IADR).

Its work is supported by Align Technology inc, Colgate-Palmolive Company, Dentsply Sirona and Haleon. Its goal is to create a common European approach towards improved oral health education, promotion, and access to care in Europe. The Platform was created to respond to the Call to Action for Better Oral Health in Europe handed over to then Health Commissioner John Dalli by several Members of the European Parliament in 2010. The Platform’s "Why Oral Health Matters" Manifesto has been aimed at increasing awareness of the importance of oral health for overall health and its significance for public health.

[16] Watt, R. G., Daly, B., Allison, P., Macpherson, L. M., Venturelli, R., Listl, S., ... & Sweeney, N. (2019). Ending the neglect of global oral health: time for radical action. The Lancet, 394(10194), 261-272. doi: 10.1016/S0140-6736(19)31133-X

3.3 Useful contacts

3.3.1 Public health experts

Prof. Martin McKee: health policy
Professor of European public health at the London School of Hygiene and Tropical Medicine. research director of the European Observatory on Health Systems and Policies, a partnership of universities, national and regional governments, international agencies and was President of the European Public Health Association between 2014 and 2016. In September 2021 he was elected as President Elect of the British Medical Association

Prof. Ilona Kickbusch: health promotion
Specialties: health promotion and global health. She is currently adjunct professor at the Graduate Institute of International and Development Studies, Geneva and director of the Global Health Programme.

Prof. Stephan Van Den Broecke: health promotion, health psychology
Professor of Health Psychology at the Université Catholique de Louvain, Belgium. He has coordinated national and international research projects in the areas of health promotion, preventive behaviour change, chronic disease self-management, health inequalities, public health capacity building and health literacy. Occasional advisor for the European Commission and the World Health Organisation, and Executive Board member of the International Union for Health Promotion and Education (IUHPE).

Kristine Sørensen: health literacy
Founder of the Global Health Literacy Academy, president of the International Health Literacy Association, and executive chair of Health Literacy Europe. She is a Supertrends expert and member of European Health Futures Forum. Her educational background is in medicine, public health and global health diplomacy. She works with international organizations, governments, academia, industry and civic society to improve health literacy for all.Among others the World Health Organization, Council of Europe, and McKinsey.

Bogi Eliasen: health promotion
Bogi Eliasen sits on the Movement Health Global Board, which offers expert insights into healthcare inequality and helps to steer Movement Health 2030 towards ensuring fairer access to better healthcare for all. Bogi is a knowledge broker whose expertise lies in combining various fields of knowledge.

Dorli Kahr-Gottlieb: health policy
The current Secretary General of the European Health Forum Gastein (EHFG). She was involved in developing the first Austrian Master of Public Health programme at the Medical University of Graz and worked for the European Public Health Association (EUPHA), where she oversaw the coordination of the European Public Health Conference.

Ave Pold: health promotion
Global Health researcher at Heidelberg University. Promotes oral health by promoting interdisciplinary collaboration.

Caroline Costongs: health promotion, health policy
Director of EuroHealthNet, the European Partnership for improving health, social equity and wellbeing, based in Brussels. Caroline leads a multi-disciplinary team working on European Union and

(sub)national policy, research and capacity building addressing health inequalities and the social determinants of health.

Milka Sokolović: health policy
Director General of EPHA, the European Public Health Alliance, supporting their work to improve public health, and strengthen people's voices in the policy debates.

Prof. Orkan Okan: health literacy expert
Prof. Okan's field is a researcher in the field of health literacy at the Technische Universität München. His focus is on interdisciplinary research on health literacy in childhood and adolescence, especially regarding schools and further educational contexts. Prof. Okan also links health literacy research with contemporary societal issues and challenges such as digitalization, media and infodemiology.

Prof. Richard Watt: health inequality and health prevention and promotion
Richard Watt is Professor of Dental Public Health in the Department of Epidemiology and Public Health, UCL and Director of Research for Central North West London NHS Foundation Trust. He researches health inequalities and social determinants and develops and evaluates effective oral health improvement interventions.

3.3.2 Medical professionals

Dr. Daniela Weiler: oral and systemic health (nutrition)
Medical Oncology at the Tumour Centre of the Lucerne Cantonal Hospital and a specialist in nutritional medicine.

Dr. Kyle Ash: oral and systemic health (oncology)
Dentist, lecturer and founder of a dental practice specialising in treating cancer patients.

Dr. Uli Randoll: Matrix Rhythm Therapy
From the standpoint of the Matrix Concept, illnesses such as diabetes and chronic pain arise on the cell biological level, as processes which have become derailed, i.e. have gone "off track". Matrix Rhythm Therapy aims at restoring the normal physiological conditions above all through vibrational therapy.

Dr. Herbert Pick: orthodontics
KOL for Curaprox Baby. Inspired the Curaprox dummies for healthy jaw development and occlusion.

Michel-Angelo Sciotti: enzyme specialist
Sciotti works as an enzyme specialist and innovation scientist at the University of Applied Sciences of Northern Switzerland.

Dr. Christoph Ramseier: periodontal risk management
Lecturer at the University of Bern. Expert in periodontitis risk management.

Prof. Johannes Einwag: fluoride
Head dental practice of ZFZ Stuttgart, director of the Zahnmedizinisches Fortbildungszentrum Stuttgart (ZFZ) and director of the Gesellschaft für Präventive Zahnheilkunde GPZ e.V.

Dr Gaetano Isola: periodontitis and nutrition
Periodontist based in Catania. Has studied the link between periodontitis and nutrition.

Prof. Niklaus Lang: biofilm expert
Former President of the International Team of Implantology (ITI) and the Swiss Society of Periodontology (SSP). Editor-in-chief of Clinical Oral Implants Research. Researcher in the field of implant dentistry, periodontology, aetiology and pathogenesis of peri-implantitis and oral microbiology.

Prof. Corrado Paganelli: university dean
Corrado Paganelli's main interests are dental public health, orthodontics and dental materials. Corrado is the dean of the dental school – University of Brescia. Treasurer of The Council of European Chief Dental Officers (CECDO).

Prof. Prathip Phantumvanit: WHO consultant
President of the Center for Assessment and Accreditation for Dental Practitioners in Thailand as well as the elected board member of Thai Dental Council and Chair of the National Oral Health Strategy Committee. He also serves as the WHO Advisory Expert Panel on Oral Health since 1988 and is currently Vice-chairman of Public Health Committee of the World Dental Federation (FDI). His research interest has been on the fluoride for caries prevention as well as appropriate restorative and preventive care for primary teeth caries.

Dr. Tihana Divnić Resnik: periodontology professor and iTOP expert
Senior Lecturer in periodontology at the University of Sydney.

Prof. Jörg Meyle: periodontology expert
Former EFP president and EFP treasurer. Former chairman of the Deutsche Gesellschaft für Parodontologie.

Prof. Nikos Mattheos: implant and periodontology expert
Periodontist, Researcher, Academic, Implantologist, Digital Entrepreneur, Amateur teacher

Prof. Guglielmo Campus: preventative oral health expert
Endowed Professor of Preventive Dentistry and Oral Epidemiology of the Lutz Zürrer Foundation. The purpose of the Foundation is to promote preventive dentistry by supporting research and the clinic of the departments responsible for preventive dentistry, periodontology and cariology at the dental training institutions of the Universities of Bern, Geneva and Zurich.

Prof. Annamari Nihtila: oral biology
Secretary General of the Finnish Dental Society Apollonia. Oral biology and periodontology expert and lecturer at the University of Lyon.

Prof. Ottolenghi: maxillofacial surgery and head of faculty
Head of Faculty at Sapienza University of Rome. Professor of maxillofacial Surgery.

Prof. Rita Villena: pediatric dentistry and caries prevention
Dr. Villena has been conducting research in the field of Prevention and Pediatric Dentistry for the past 20 years, with special interest in infancy, she is also a clinician working together with pediatricians in private practice since 2000. Chair of the Pediatric Dentistry Department at San Martin de Porres University in Lima, Peru since 2010. Member of the technical group of the Peruvian Ministry of Health. International speaker. General co-coordinator of the Dental Caries Research Observatory for Children and Adolescents of the Latin American Region – IADR.

Prof. Claudio Fernandes: prosthodontics
Professor of Prosthodontics at the Dental School of Fluminense Federal University (UFF).

3.4 Foundations

Careum
Careum is a Swiss foundation that aims to improve the education and training of healthcare professionals, as well as promote research and innovation in healthcare.

Robert Bosch Stiftung
The Robert Bosch Stiftung is a German foundation that supports a variety of fields, including healthcare, with a focus on social and health issues, as well as science, education, and international relations.

Novo Nordisk Fonden
The Novo Nordisk Foundation is a Danish foundation that primarily supports scientific research and education in healthcare and life sciences, as well as initiatives to improve the quality of life for people with chronic diseases.

The King's Fund
The King's Fund is a UK-based foundation that works to improve health and care in England by conducting research, influencing policy, and supporting the development of leadership and organizational capabilities in the healthcare sector.

Affordable Health Initiative
The Affordable Health Initiative is an initiative launched by the Bill and Melinda Gates Foundation that aims to improve access to affordable healthcare for people in low- and middle-income countries. The initiative focuses on developing and scaling innovative approaches to healthcare delivery and financing.

According to the foundation, education has a greater impact than treatment when preventing healthcare concerns; therefore parents, schoolteachers and children all attend health-promotion classes based around self-esteem, healthy food and prevention. The Affordable Health Initiative currently runs in five schools in Brazil and is applying for funding to run the initiative in poorer communities in the UK.

3.5 Insurance providers

International Association of Mutual Benefit Societies (AIM)
AIM serves as a global umbrella organization for federations of health mutuals and health insurance entities, boasting 48 members hailing from 26 countries spanning Europe, Latin America, Africa, and the Middle East. All AIM members are non-profit organizations that provide healthcare coverage to roughly 240 million individuals, in addition to supplying obligatory and/or supplementary health insurance services, with some also overseeing health and social insurance provisions. These members are either mutuals or health insurance funds that function without shareholders, utilizing all surpluses to benefit their members and maintaining the solidarity principle between members.

The members: https://www.aim-mutual.org/aim-members/

3.6 Associations and lobby groups contributing to NCD in Europe

A list of relevant players in the "white industry" [17]

European sugar lobby - key actors

1. Caobisco
2. European Breakfast Cereal Association (CEEREAL)
3. Comité Européen des Fabricants de Sucre (CEFS)
4. Committee of the European Sugar Users (CIUS)
5. European Snacks Association (ESA)
6. European Food Information Council (EUFIC)
7. FoodDrinkEurope (FDE)
8. International Food and Beverage Alliance (IFBA)
9. International Life Sciences Institute Europe (ILSI Europe)
10. Specialised Nutrition Europe (SNE)
11. Union of European Soft Drinks Associations (UNESDA)
12. World Sugar Research Organisation (WSRO)

Key actors in the EU regarding alcohol

The Brewers of Europe, The European Spirits Organisation (CEPS), The Comité Européen des Entreprises Vins (CEEV), FoodDrinkEurope, and – despite the name - European Forum on Responsible Drinking (EFRD), …

European Smoking Tobacco Association (ESTA)

The European Smoking Tobacco Association (ESTA) represents the interests of European manufacturers, distributors and importers of rolling tobacco, pipe tobacco, chewing tobacco and nasal snuff tobacco. More than 40 companies are members, including several subsidiaries of British American Tobacco (BAT) and Imperial Brands (previously Imperial Tobacco), as well as national trade bodies from across the European Union.

Others lobbying in the EU are Philip Morris, Reemtsma, the European Association of Tobacco Growers (UNITAB), European Smokeless Tobacco Council (ESTOC), …

[17] Corporate Europe Observatory. (2017). A Spoonful of Sugar: How the Food Lobby Fights Sugar Regulation in the EU. https://corporateeurope.org/sites/default/files/a_spoonful_of_sugar_final.pdf

4 Science

Three important developments stand out when it comes to the current state of science behind oral health from a holistic, preventative point of view: expanding knowledge of the composition of the oral microbiome, the link between oral and systemic health, and the role of nutrition in supporting good oral and systemic health by mediating a healthy substrate for oral symbiosis. The following list of relevant studies is divided into those three categories.

4.1 Studies

4.1.1 Oral microbiome composition

The number of studies on Pubmed including the search term “oral microbiome” in 2022 (2562) have increased 176 per cent compared to 5 years before in 2017 (926). The human oral microbiome ranks second only to the gastrointestinal microbiota in terms of species diversity and complexity, and the connection between the two is currently an increasingly important field of research. The oral microbiome includes bacteria, archaea, fungi, and viruses. Accumulation of plaque biofilm in the oral cavity can lead to a complex inflammatory and immune response and is the primary cause of periodontitis. Our growing knowledge of composition of the oral microbiome enables us to understand its connection to periodontitis other systemic diseases.

1 The Human Oral Microbiome

Dewhirst, Floyd & Chen, Tuste & Izard, Jacques & Paster, Bruce & Tanner, Anne & Yu, Wen-Han & Lakshmanan, Abirami & Wade, William. (2010). The Human Oral Microbiome. Journal of bacteriology. 192. 5002-17. 10.1128/JB.00542-10.
3339 citations on Pubmed, 2534 on Researchgate
https://www.researchgate.net/publication/45287804_The_Human_Oral_Microbiome

This study aims at making a great number of unnamed oral microbiome taxa available. Findings are updated on eHOMD (www.homd.org), an online taxonomy project that provides a provisional naming scheme for these currently unnamed taxa, based on the 16S rRNA sequence phylogeny, so that strain, clone and probe data from any laboratory can be directly linked to a stably named reference scheme. The study appeared in October 2010 edition of the Journal of Bacteriology.

2 The oral microbiome in health and disease

Wade WG. The oral microbiome in health and disease. Pharmacol Res. 2013 Mar;69(1):137-43. doi: 10.1016/j.phrs.2012.11.006. Epub 2012 Nov 28. PMID: 23201354.
1331 citations on Pubmed, 940 on Researchgate
https://pubmed.ncbi.nlm.nih.gov/23201354/

This broad study discusses the oral microbiome, including bacteria, viruses, fungi, protozoa, and archaea, and its connections with bacterial disease. The oral bacterial community consists of around 1000 species, with many still uncultured. The human oral microbiome database (HOMD) is a resource that provides information on oral bacterial taxa and genome sequences. Oral microbiomes are highly specific at the species level, but overall, the human oral microbiome shows few geographical differences. Caries and periodontitis are not infectious diseases in the classical sense, as they result from a complex interaction between the commensal microbiota, host susceptibility, and environmental factors such as diet and smoking. Redundancy exists among the oral microbiota, and a focus on functional diversity may be needed to fully understand host-microbiome interactions.

3 The oral microbiome - An update for oral healthcare professionals

Kilian M, Chapple IL, Hannig M, Marsh PD, Meuric V, Pedersen AM, Tonetti MS, Wade WG, Zaura E. The oral microbiome - an update for oral healthcare professionals. Br Dent J. 2016 Nov 18;221(10):657-666. doi: 10.1038/sj.bdj.2016.865. PMID: 27857087.
983 citations on Pubmed, 755 on Researchgate
https://pubmed.ncbi.nlm.nih.gov/27857087/

The oral microbiome, which harbours over 700 species of bacteria and is the second most diverse microbial community in the body. Perturbations of the oral microbiome through modern lifestyles can lead to dysbiosis, disrupting the finely-tuned equilibrium of the oral ecosystem and causing conditions such as caries, gingivitis, and periodontitis. Maintaining a balanced oral microbiome is important for maintaining or restoring oral health, and the article provides an update on our current knowledge of the oral microbiome in health and disease.

4 The subgingival microbiome in health and periodontitis and its relationship with community biomass and inflammation

Abusleme L, Dupuy AK, Dutzan N, Silva N, Burleson JA, Strausbaugh LD, Gamonal J, Diaz PI. The subgingival microbiome in health and periodontitis and its relationship with community biomass and inflammation. ISME J. 2013 May;7(5):1016-25. doi: 10.1038/ismej.2012.174. Epub 2013 Jan 10. PMID: 23303375; PMCID: PMC3635234.
944 citations on Pubmed, 743 on Researchgate
https://pubmed.ncbi.nlm.nih.gov/23303375/

This study researches the subgingival microbiome and its role in healthy patients and those with chronic periodontitis. The researchers used 454-pyrosequencing of 16S rRNA gene libraries and quantitative PCR to analyze the microbiome of 22 subjects with chronic periodontitis and compared them with those of 10 healthy individuals. They found that bleeding sites had a higher bacterial load but no significant difference in microbiome diversity compared to non-bleeding sites. Communities in periodontitis differed from those in health, with higher diversity and biomass. The transition from health to periodontitis involved a shift in community structure with newly dominant taxa emerging, without replacement of primary health-associated species. The study provides a framework for understanding the development of periodontitis and the association between inflammation, community biomass and structure, and disease progression.

5 Oral microbiome: Unveiling the fundamentals

Deo, Priya & Deshmukh, Revati. (2019). Oral microbiome: Unveiling the fundamentals. Journal of Oral and Maxillofacial Pathology. 23. 122-128. 10.4103/jomfp.JOMFP_304_18.
490 citiations on Pubmed, 370 on Researchgate
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6503789/

Previous limitations in studying the oral microbiome have been overcome with the use of next-generation sequencing and bioinformatics. Understanding the oral microbiome in health and disease can lead to targeted therapies and personalized medicine. This review article discusses the complexities of the oral microbiome and its importance in health.

6 Deep sequencing of the oral microbiome reveals signatures of periodontal disease

Liu B, Faller LL, Klitgord N, Mazumdar V, Ghodsi M, Sommer DD, Gibbons TR, Treangen TJ, Chang YC, Li S, Stine OC, Hasturk H, Kasif S, Segrè D, Pop M, Amar S. Deep sequencing of the oral microbiome reveals signatures of periodontal disease. PLoS One. 2012;7(6):e37919. doi: 10.1371/journal.pone.0037919. Epub 2012 Jun 4. PMID: 22675498; PMCID: PMC3366996.
436 citations on Pubmed, 336 on Researchgate
https://pubmed.ncbi.nlm.nih.gov/22675498/

This study investigates the global genetic, metabolic, and ecological changes associated with periodontitis, a disease caused by pathogenic bacteria in the oral microbiome. The researchers

used high-throughput sequencing to analyze subgingival plaque samples from periodontitis patients and healthy individuals. They discovered that the oral microbiome in dysbiosis is enriched in virulence factors and adapted to a parasitic lifestyle. The diseased samples share a common structure that is not found in completely healthy samples, suggesting that the disease state occupies a narrow region within the space of possible configurations of the oral microbiome. The study demonstrates the power of whole-metagenome sequencing approaches in characterizing the genomes of key players in the oral microbiome.

7 The oral microbiome in health and disease and the potential impact on personalized dental medicine

Zarco MF, Vess TJ, Ginsburg GS. The oral microbiome in health and disease and the potential impact on personalized dental medicine. Oral Dis. 2012 Mar;18(2):109-20. doi: 10.1111/j.1601-0825.2011.01851.x. Epub 2011 Sep 9. PMID: 21902769.
494 citations on Pubmed, 386 on Researchgate
https://pubmed.ncbi.nlm.nih.gov/21902769/

This study discusses the importance of the oral microbiome in maintaining overall health and how disruptions in its balance can lead to disease, both locally and systemically. The fields of microbiomics and metagenomics are highlighted as important tools for identifying and understanding the microbiome's activity during health and disease, leading to the development of more effective therapeutic and diagnostic techniques and personalized medicine.

8 Insights into the human oral microbiome

Verma D, Garg PK, Dubey AK. Insights into the human oral microbiome. Arch Microbiol. 2018 May;200(4):525-540. doi: 10.1007/s00203-018-1505-3. Epub 2018 Mar 23. PMID: 29572583.
395 citations on Pubmed, 315 on Researchgate
https://pubmed.ncbi.nlm.nih.gov/29572583/

The human oral cavity contains a diverse microbiota of both cultivable and uncultivable microorganisms, with the eHOMD database containing information on approximately 772 prokaryotic species. 16S rDNA profiling has categorized the oral bacteria into six phyla, and altered oral microflora has been observed in several diseases. Advances in metagenomics and next-generation sequencing techniques have provided extensive information on oral microbial diversity, which can be used to develop microbiome-based biomarkers for early diagnosis of oral and associated diseases. There is also significant interest from apex companies in the oral microbiome for its diagnostic and therapeutic potential. This review provides an overview of various aspects of the human oral microbiome.

9 Dental biofilm infections - an update

Larsen T, Fiehn NE. Dental biofilm infections - an update. APMIS. 2017 Apr;125(4):376-384. doi: 10.1111/apm.12688. PMID: 28407420.
331 citations on Pubmed
https://pubmed.ncbi.nlm.nih.gov/28407420/

Dental biofilm can vary in composition depending on local ecological factors. If left undisturbed, it can cause various dental diseases such as dental caries, pulpitis, periapical periodontitis, gingivitis, chronic or aggressive periodontitis, and peri-implantitis. Regular removal of the dental biofilm through personal and professional means is essential to prevent and treat these infections. In addition, bacteria from the dental biofilm can spread to other parts of the body and cause systemic disease.

10 A practical guide to the oral microbiome and its relation to health and disease

Krishnan K, Chen T, Paster BJ. A practical guide to the oral microbiome and its relation to health and disease. Oral Dis. 2017 Apr;23(3):276-286. doi: 10.1111/odi.12509. Epub 2016 Jul 4. PMID: 27219464; PMCID: PMC5122475.
318 citations on Pubmed, 225 on Researchgate
https://pubmed.ncbi.nlm.nih.gov/27219464/

This study discusses the complexity and uniqueness of the oral microbiome, which contains about 50-100 billion bacteria representing 200 predominant bacterial species, of which less than one-third have not yet been grown in vitro. It highlights that the oral microbiome has specific associations with oral health and disease and may serve as biomarkers for non-oral diseases. Additionally, oral microbial profiles may have potential use to assess disease risk. The review aims to educate the reader on the essential features of the oral microbiome.

11 The oral microbiome and human health

Yamashita Y, Takeshita T. The oral microbiome and human health. J Oral Sci. 2017;59(2):201-206. doi: 10.2334/josnusd.16-0856. PMID: 28637979.
248 citations on Pubmed, 188 on researchgate
https://pubmed.ncbi.nlm.nih.gov/28637979/

This study explores the relationship between the bacterial composition of salivary microbiota and periodontal disease. The study found that the predominance of the genera Prevotella and Veillonella in the salivary microbiota is attributable to periodontal disease conditions, while the predominance of the genus Neisseria indicates healthy periodontal conditions. The study also found that high bacterial richness in the salivary microbiota was significantly associated with poor oral health, as indicated by decayed teeth, periodontitis, and poor oral hygiene. Additionally, a greater relative abundance of group I bacteria, which include Prevotella and Veillonella species, was associated with poor oral health, high body mass index, and old age. These findings suggest that the composition of the salivary microbiota reflects oral and systemic conditions.

12 The Oral Microbiota Is Modified by Systemic Diseases

Graves DT, Corrêa JD, Silva TA. The Oral Microbiota Is Modified by Systemic Diseases. J Dent Res. 2019 Feb;98(2):148-156. doi: 10.1177/0022034518805739. Epub 2018 Oct 25. PMID: 30359170; PMCID: PMC6761737.
236 citations on Pubmed, 192 citations on Researchgate
https://pubmed.ncbi.nlm.nih.gov/30359170/

The study highlights that systemic diseases like diabetes, rheumatoid arthritis (RA), and systemic lupus erythematosus (SLE) increase the risk and severity of destructive periodontal diseases caused by bacteria. These diseases are linked to a decrease in bacterial taxa associated with health and an increase in taxa associated with disease. In animal models, diabetes and other diseases increase inflammation and alter the pathogenicity of the oral microbiome. IL-17 is identified as a key mediator in this process, and successful treatment with anti-inflammatory drugs can partially reverse the oral microbial dysbiosis.

13 The Oral Microbiome in Health and Its Implication in Oral and Systemic Diseases

Sampaio-Maia B, Caldas IM, Pereira ML, Pérez-Mongiovi D, Araujo R. The Oral Microbiome in Health and Its Implication in Oral and Systemic Diseases. Adv Appl Microbiol. 2016;97:171-210. doi: 10.1016/bs.aambs.2016.08.002. Epub 2016 Sep 21. PMID: 27926431.
224 citations on Pubmed, 171 on researchgate
https://pubmed.ncbi.nlm.nih.gov/27926431/

The oral microbiome plays a crucial role in determining the balance between health and disease in the body, both locally and systemically. The different types of microorganisms in the mouth (such as bacteria, viruses, and fungi) interact with each other and with the host, and these

interactions evolve throughout a person's life. In some instances they can lead to dental caries, periodontal diseases, endodontic infections, oral cancer, adverse pregnancy outcomes, cardiovascular diseases, diabetes and other systemic infection and non-communicable diseases. Understanding how the oral microbiome functions and interacts with the host may provide insights into the etiology and progression of these diseases.

14 Can oral bacteria affect the microbiome of the gut?

Olsen I, Yamazaki K. Can oral bacteria affect the microbiome of the gut? J Oral Microbiol. 2019 Mar 18;11(1):1586422. doi: 10.1080/20002297.2019.1586422. PMID: 30911359; PMCID: PMC6427756.
199 citations on Pubmed, 185 on Researchgate
https://pubmed.ncbi.nlm.nih.gov/30911359/

Oral bacteria can translocate to the gut and change its microbiota and possibly the immune defense. The ectopic displacement of oral bacteria particularly occurs in severe systemic diseases, but also in patients with "chronic" periodontitis. Porphyromonas gingivalis, which creates dysbiosis in the subgingival microbiota and immune defense may also cause dysregulation in the gut, which in turn causes systemic disease. The fact that "chronic" periodontitis may affect the gut microbiota could imply that consideration might in the future be given to a coordinated approach to the treatment of periodontitis and gastrointestinal disease. This area of investigation is currently in its infancy, and represents yet another pathway for oral bacteria to cause systemic diseases.

15 The oral microbiome: Role of key organisms and complex networks in oral health and disease

Sedghi L, DiMassa V, Harrington A, Lynch SV, Kapila YL. The oral microbiome: Role of key organisms and complex networks in oral health and disease. Periodontol 2000. 2021 Oct;87(1):107-131. doi: 10.1111/prd.12393. PMID: 34463991; PMCID: PMC8457218.
140 citations on Pubmed, 114 citations on Researchgate
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8457218/

This study explores the complex microbial environment in the oral cavity, including the factors that shape the oral microbiome throughout life, such as genetics, environment, diet, oral hygiene practices, medications, and systemic factors. The oral microbiome is highly dynamic, with diverse microbial communities inhabiting distinct substrata and microenvironments. The study examines the challenges that the oral cavity faces and the potential for oral microbial dysbiosis that can lead to dental and periodontal diseases. The review covers both in vitro and culture-independent approaches to understanding the complex polymicrobial communities within the oral cavity and the factors that influence the dynamics of the oral microbiome, which contribute to states of oral health or disease.

16 Oral Microbes, Biofilms and Their Role in Periodontal and Peri-Implant Diseases

Lasserre JF, Brecx MC, Toma S. Oral Microbes, Biofilms and Their Role in Periodontal and Peri-Implant Diseases. Materials (Basel). 2018 Sep 22;11(10):1802. doi: 10.3390/ma11101802. PMID: 30248991; PMCID: PMC6213094.
137 citations on Pubmed, 94 on Researchgate
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6213094/

This study review discusses the ongoing increase in periodontal and peri-implant diseases despite advances in understanding the causes and biofilms involved. The review highlights the role of keystone pathogens in causing dysregulation of host homeostasis and biofilm lifestyle in periodontitis and peri-implantitis. It also discusses current treatment principles and their limitations, leading to the need for new strategies to be developed to overcome these limitations.

17 Microbial Community-Driven Etiopathogenesis of Peri-Implantitis

Belibasakis GN, Manoil D. Microbial Community-Driven Etiopathogenesis of Peri-Implantitis. J Dent Res. 2021 Jan;100(1):21-28. doi: 10.1177/0022034520949851. Epub 2020 Aug 12. PMID: 32783779; PMCID: PMC7754824.
86 citations on Pubmed, 68 on Researchgate
https://pubmed.ncbi.nlm.nih.gov/32783779/

Next-generation sequencing technologies have allowed for a more comprehensive understanding of the microbial communities in the peri-implant niche, and have revealed that shifts from health to disease are characterized by an increase in diversity and a depletion of commensals, along with an enrichment of periodontal pathogens.

18 Quantitative Molecular Detection of 19 Major Pathogens in the Interdental Biofilm of Periodontally Healthy Young Adults

Carrouel F, Viennot S, Santamaria J, Veber P, Bourgeois D. Quantitative Molecular Detection of 19 Major Pathogens in the Interdental Biofilm of Periodontally Healthy Young Adults. Front Microbiol. 2016 Jun 2;7:840. doi: 10.3389/fmicb.2016.00840. PMID: 27313576; PMCID: PMC4889612.
77 citations on Pubmed, 65 on researchgate
https://pubmed.ncbi.nlm.nih.gov/27313576/

In this study, ten billion bacteria were collected on average from each interdental site. Of the 19 major periodontal pathogens, bacteria of red and yellow Socransky complexes constituted the majority. Red complexes such as Porphyromonas gingivalis, Tannerella forsythia and Treponema denticola are recognised as the most important pathogens in adult periodontal disease, and they constituted 8.08% of the bacteria analysed. P. gingivalis was detected in 19% of the healthy subjects and represented 0.02% of the interdental biofilm. P. gingivalis alone can induce alveolar bone loss, and in combination with T. denticola and T. forsythia, periodontal disease is likely to develop. In other words, even the interdental biofilm of healthy individuals is composed of bacteria that could initiate periodontitis.

19 Clinical and Bacterial Markers of Periodontitis and Their Association with Incident All-Cause and Alzheimer's Disease Dementia in a Large National Survey

Bourgeois D, Bravo M, Llodra JC, Inquimbert C, Viennot S, Dussart C, Carrouel F. Calibrated interdental brushing for the prevention of periodontal pathogens infection in young adults - a randomized controlled clinical trial. Sci Rep. 2019 Oct 22;9(1):15127. doi: 10.1038/s41598-019-51938-8. PMID: 31641199; PMCID: PMC6805917.
30 citations on Pubmed, 29 citations on Researchgate
https://pubmed.ncbi.nlm.nih.gov/31641199/

This study examined the effect of daily interdental prophylaxis using calibrated interdental brushes (IDBs) on interdental biofilm and periodontal health in young, clinically periodontally healthy adults. The study found that the use of IDBs reduced the quantity of total bacteria and bacteria associated with periodontal disease, while increasing bacteria associated with periodontal health. Additionally, interdental inflammation decreased with IDB use. The study suggests that daily use of calibrated IDBs can improve periodontal health in young adults.

20 The role of oral microbiome in periodontitis under diabetes mellitus

Qin H, Li G, Xu X, Zhang C, Zhong W, Xu S, Yin Y, Song J. The role of oral microbiome in periodontitis under diabetes mellitus. J Oral Microbiol. 2022 Jun 3;14(1):2078031. doi: 10.1080/20002297.2022.2078031. PMID: 35694215; PMCID: PMC9176325.
Recent study
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9176325/

While the impact of diabetes mellitus on periodontitis through hyperglycemia and inflammatory pathways is well documented, the effects of diabetes mellitus on oral microbiota are still not fully understood. Recent studies using next-generation sequencing technology suggest that it can alter

the biodiversity and composition of the oral microbiome, which may be an additional mechanism increasing the severity of periodontitis. This study reviews the role of oral microbiome in periodontal health and disease, and summarises the oral microbial shifts under diabetes mellitus.

4.1.2 Oral health and systemic health

Periodontitis is associated with over 50 non-communicable diseases, including cardiovascular disease, diabetes, cognitive decline, Alzheimer's disease, dementia, adverse pregnancy outcomes, cancer, rheumatoid arthritis, and respiratory disease. The link between periodontitis and these diseases is due to shared underlying pathways and risk factors. This number of studies linking oral and systemic health has been steadily increasing over the last years. Last year (2022) saw 1,446 studies of this kind, a huge increase from the 808 studies in 2017. The link between the oral microbiome and the gut microbiome are a new and especially promising field of study.

1 Periodontitis and diabetes: A two-way relationship

Preshaw PM, Alba AL, Herrera D, Jepsen S, Konstantinidis A, Makrilakis K, Taylor R. Periodontitis and diabetes: a two-way relationship. Diabetologia. 2012 Jan;55(1):21-31. doi: 10.1007/s00125-011-2342-y. Epub 2011 Nov 6. PMID: 22057194; PMCID: PMC3228943.
1,756 citations on Pubmed, 1,170 citations on Researchgate
https://pubmed.ncbi.nlm.nih.gov/22057194/

The study discusses the bidirectional relationship between periodontitis and diabetes. People with diabetes have a threefold increased risk of periodontitis, and the severity of periodontitis is linked to the degree of hyperglycemia. There is evidence of a two-way relationship, where diabetes increases the risk of periodontitis and periodontal inflammation negatively affects glycemic control. Severe periodontitis increases the risk of macroalbuminuria, end-stage renal disease, and cardiorenal mortality in diabetic individuals. Treatment of periodontitis can lead to reductions in HbA(1c) levels, and promoting oral and periodontal health should be a part of diabetes management.

2 Periodontitis and cardiovascular diseases: Consensus report

Sanz M, Marco Del Castillo A, Jepsen S, Gonzalez-Juanatey JR, D'Aiuto F, Bouchard P, Chapple I, Dietrich T, Gotsman I, Graziani F, Herrera D, Loos B, Madianos P, Michel JB, Perel P, Pieske B, Shapira L, Shechter M, Tonetti M, Vlachopoulos C, Wimmer G. Periodontitis and cardiovascular diseases: Consensus report. J Clin Periodontol. 2020 Mar;47(3):268-288. doi: 10.1111/jcpe.13189. Epub 2020 Feb 3. PMID: 32011025; PMCID: PMC7027895.
705 citations on Pubmed, 444 on Researchgate
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7027895/

This is a review that reports the proceedings of the workshop by the EFP and the World Heart Federation (WHF), which has updated the existing epidemiological evidence for significant associations between periodontitis and CVD, the mechanistic links and the impact of periodontal therapy on cardiovascular and surrogate outcomes. This review also takes into account the potential risk and complications of periodontal therapy in patients on anti thrombotic therapy and formulates recommendations for dentists, physicians and for patients visiting both the dental and medical practices.

3 Scientific evidence on the links between periodontal diseases and diabetes: consensus report and guidelines of the joint workshop on periodontal diseases and diabetes by the international Diabetes Federation (IDF) and the European Federation of Periodontology (EFP)

Sanz M, Ceriello A, Buysschaert M, Chapple I, Demmer RT, Graziani F, Herrera D, Jepsen S, Lione L, Madianos P, Mathur M, Montanya E, Shapira L, Tonetti M, Vegh D. Scientific evidence on the links between periodontal diseases and diabetes: Consensus report and guidelines of the joint workshop on periodontal

diseases and diabetes by the International diabetes Federation and the European Federation of Periodontology. Diabetes Res Clin Pract. 2018 Mar;137:231-241. doi: 10.1016/j.diabres.2017.12.001. Epub 2017 Dec 5. PMID: 29208508.
655 citations on Pubmed, 287 citations on Researchgate
https://pubmed.ncbi.nlm.nih.gov/29208508/

This study examines the epidemiological and mechanistic associations between diabetes and periodontitis, as well as the impact of effective periodontal therapy on metabolic control. It found strong evidence linking periodontitis to dysglycemia and insulin resistance, and higher HbA1C levels in periodontitis patients with diabetes. Mechanisms linking the two diseases involve elevated levels of certain molecules and oxidative stress. Periodontal therapy is safe and effective in reducing HbA1C levels in people with diabetes. The study recommends consensus guidelines for early diagnosis, prevention, and co-management of diabetes and periodontitis.

4 Clinical and Bacterial Markers of Periodontitis and Their Association with Incident All-Cause and Alzheimer's Disease Dementia in a Large National Survey

Beydoun MA, Beydoun HA, Hossain S, El-Hajj ZW, Weiss J, Zonderman AB. Clinical and Bacterial Markers of Periodontitis and Their Association with Incident All-Cause and Alzheimer's Disease Dementia in a Large National Survey. J Alzheimers Dis. 2020;75(1):157-172. doi: 10.3233/JAD-200064. PMID: 32280099.
95 citations on Pubmed, 72 on Researchgate
https://pubmed.ncbi.nlm.nih.gov/32280099/

This study investigates the associations of periodontal pathogens with incident all-cause and Alzheimer's disease (AD) dementia as well as AD mortality among middle-aged and older adults. Clinical periodontal and bacterial markers were studied in relation to AD and all-cause dementia incidence and to AD mortality using data from the third National Health and Nutrition Examination Surveys. The results showed that AD incidence and mortality were consistently associated with certain periodontal pathogens among older adults. The study provides evidence for an association between periodontal pathogens and AD, which was stronger for older adults.

5 Association between periodontal diseases and cardiovascular diseases, diabetes and respiratory diseases: Consensus report of the Joint Workshop by the European Federation of Periodontology (EFP) and the European arm of the World Organization of Family Doctors (WONCA Europe)

Herrera D, Sanz M, Shapira L, Brotons C, Chapple I, Frese T, Graziani F, Hobbs FDR, Huck O, Hummers E, Jepsen S, Kravtchenko O, Madianos P, Molina A, Ungan M, Vilaseca J, Windak A, Vinker S. Association between periodontal diseases and cardiovascular diseases, diabetes and respiratory diseases: Consensus report of the Joint Workshop by the European Federation of Periodontology (EFP) and the European arm of the World Organization of Family Doctors (WONCA Europe). J Clin Periodontol. 2023 Mar 19. doi: 10.1111/jcpe.13807. Epub ahead of print. PMID: 36935200.
Too recent
https://pubmed.ncbi.nlm.nih.gov/36935200/

This study investigates the connection between periodontal and systemic diseases and the role of dentists and family doctors in managing non-communicable diseases and promoting healthy lifestyles. The findings indicate that periodontitis is linked to several diseases such as cardiovascular diseases, diabetes, chronic obstructive pulmonary disease, obstructive sleep apnea, and COVID-19 complications. The study suggests that family doctors and dentists should work together to detect periodontitis in primary care centres and cardiovascular diseases or diabetes in dental settings. The study highlights the need for closer collaboration between oral health professionals and family doctors in the early detection and management of NCDs and promoting healthy lifestyles.

6 Oral infections and cardiovascular disease

Kholy KE, Genco RJ, Van Dyke TE. Oral infections and cardiovascular disease. Trends Endocrinol Metab. 2015 Jun;26(6):315-21. doi: 10.1016/j.tem.2015.03.001. Epub 2015 Apr 16. PMID: 25892452.
224 citations on Pubmed,
https://pubmed.ncbi.nlm.nih.gov/25892452/

This study review examines the relationship between oral infections, particularly periodontitis, and the risk of atherosclerotic cardiovascular disease (CVD). The review highlights that longitudinal studies have shown an increased risk of CVD in individuals with periodontitis, possibly due to systemic exposure to oral bacteria triggering inflammatory processes. The authors emphasize the importance of understanding the role of the oral microbiome in CVD to develop new preventive and treatment approaches.

7 The Bacterial Connection between the Oral Cavity and the Gut Diseases

Kitamoto S, Nagao-Kitamoto H, Hein R, Schmidt TM, Kamada N. The Bacterial Connection between the Oral Cavity and the Gut Diseases. J Dent Res. 2020 Aug;99(9):1021-1029. doi: 10.1177/0022034520924633. Epub 2020 May 28. PMID: 32464078; PMCID: PMC7375741.
127 citations on Pubmed, 114 citations on Researchgate
https://pubmed.ncbi.nlm.nih.gov/32464078/

The human body is home to over 100 trillion microorganisms, with the oral cavity and gastrointestinal tract hosting the most diverse and abundant microbial communities. Advances in sequencing technologies have helped to identify the precise microbial landscape of these areas. Although the resident microbiota in the mouth and gut are largely distinct, there is evidence to suggest that oral bacteria can translocate to the gut through hematogenous and enteral routes, potentially exacerbating gastrointestinal diseases such as irritable bowel syndrome, inflammatory bowel disease, and colorectal cancer. The exact role of oral bacteria in the gut is still unclear, but this study reviews recent findings on their dissemination and possible contribution to gastrointestinal disease pathogenesis, as well as potential factors that allow oral bacteria to colonize the gut.

8 Periodontitis, Edentulism, and Risk of Mortality: A Systematic Review with Meta-analyses

Romandini M, Baima G, Antonoglou G, Bueno J, Figuero E, Sanz M. Periodontitis, Edentulism, and Risk of Mortality: A Systematic Review with Meta-analyses. J Dent Res. 2021 Jan;100(1):37-49. doi: 10.1177/0022034520952401. Epub 2020 Aug 31. PMID: 32866427.
108 citations on Pubmed, 91 on Researchgate
https://pubmed.ncbi.nlm.nih.gov/32866427/

This systematic review aimed to investigate whether people with periodontitis or edentulism are at increased risk of all-cause and cause-specific mortality. The review included 57 studies involving over 5 million participants and found that periodontitis was associated with an increased risk of all-cause mortality and mortality due to cardiovascular diseases, cancer, coronary heart disease, and cerebrovascular diseases. Edentulism was also associated with an increased risk of all-cause mortality and mortality due to cardiovascular diseases, cancer, pneumonia, coronary heart disease, and cerebrovascular diseases. The study concludes that periodontitis and edentulism are associated with an increased risk of all-cause and cause-specific mortality.

4.1.3 Oral health and nutrition

Although pathogenic biofilm is considered a "necessary cause" of periodontitis, on its own it is insufficient in causing the disease, and a consequent destructive immune-inflammatory response is crucial. Various other factors, including nutrition, can also contribute as "component causes". Nutrients obtained through diet are essential for sustaining life as they provide both macronutrients, which serve as energy sources, and micronutrients, which act as cofactors regulating the functionality of enzymes involved in anabolic and catabolic processes within human cells. Micronutrients, such as those present in our diet, can also regulate gene transcription factors, including the proinflammatory nuclear factor kappa B and the anti-inflammatory nuclear factor (erythroid-derived 2)-like 2 which are crucial in the development of periodontal disease. Given our greater understanding of the oral microbiome's composition and its associations with systemic health, the impact of diet and nutrition in the development of periodontal disease is becoming clearer in turn.

1 Diet, nutrition and the prevention of dental

Moynihan P, Petersen PE. Diet, nutrition and the prevention of dental diseases. Public Health Nutr. 2004 Feb;7(1A):201-26. doi: 10.1079/phn2003589. PMID: 14972061.
1,027 citations on Pubmed
https://pubmed.ncbi.nlm.nih.gov/14972061/

This study recommends the ideal diet and nutrition for the prevention of oral disease. Nutrition affects craniofacial development, oral cancer, and oral infectious diseases, and malnutrition can worsen periodontal and oral infectious diseases. Dental caries and enamel erosion are primarily caused by the local action of diet in the mouth, with sugars being a major culprit. Epidemiological studies show that consumption of starchy staple foods and fresh fruit are associated with low levels of dental caries. Fluoride reduces caries risk but does not eliminate dental caries, and countries should implement feasible fluoride programs. It is important to limit the frequency and amount of free sugars intake to prevent dental caries. National health authorities should formulate country-specific goals to reduce the consumption of free sugars to no more than 10% of energy intake and limit the frequency of consumption of free sugars to a maximum of four times per day.

2 Interaction of lifestyle, behaviour or systemic diseases with dental caries and periodontal diseases: consensus report of group 2 of the joint EFP/ORCA workshop on the boundaries between caries and periodontal diseases

Chapple IL, Bouchard P, Cagetti MG, Campus G, Carra MC, Cocco F, Nibali L, Hujoel P, Laine ML, Lingstrom P, Manton DJ, Montero E, Pitts N, Rangé H, Schlueter N, Teughels W, Twetman S, Van Loveren C, Van der Weijden F, Vieira AR, Schulte AG. Interaction of lifestyle, behaviour or systemic diseases with dental caries and periodontal diseases: consensus report of group 2 of the joint EFP/ORCA workshop on the boundaries between caries and periodontal diseases. J Clin Periodontol. 2017 Mar;44 Suppl 18:S39-S51. doi: 10.1111/jcpe.12685. PMID: 28266114.
450 citations on Pubmed
https://pubmed.ncbi.nlm.nih.gov/28266114/

Periodontal diseases and dental caries are the most common diseases of humans and the main cause of tooth loss. Both diseases can lead to nutritional compromise and negative impacts upon self-esteem and quality of life. As complex chronic diseases, they share common risk factors, such as a requirement for a pathogenic plaque biofilm, yet they exhibit distinct pathophysiologies. Multiple exposures contribute to their causal pathways, and susceptibility involves risk factors that are inherited (e.g. genetic variants), and those that are acquired (e.g. socio-economic factors, biofilm load or composition, smoking, carbohydrate intake). This study takes diet into account when it comes to the development and prevention of periodontal disease and caries.

3 Nutrition and oral health

Gondivkar SM, Gadbail AR, Gondivkar RS, Sarode SC, Sarode GS, Patil S, Awan KH. Nutrition and oral health. Dis Mon. 2019 Jun;65(6):147-154. doi: 10.1016/j.disamonth.2018.09.009. Epub 2018 Oct 4. PMID: 30293649.
109 citations on Pubmed, 62 on Researchgate
https://pubmed.ncbi.nlm.nih.gov/30293649/

The associations between oral health conditions, dietary practices and nutritional status, and general health status are complex with many interrelating factors. Inadequate nutrition can affect the oral health including dental caries, periodontal diseases, diseases of oralmucosa and infectious diseases. Compromised oral health can alter food choices and negatively impact food intake leading to suboptimal nutritional status which can lead to chronic systemic diseases. Recognizing and treating oral health and nutrition problems are important in improving health and quality of life.

4 Effect of micronutrient malnutrition on periodontal disease and periodontal therapy

Dommisch H, Kuzmanova D, Jönsson D, Grant M, Chapple I. Effect of micronutrient malnutrition on periodontal disease and periodontal therapy. Periodontol 2000. 2018 Oct;78(1):129-153. doi: 10.1111/prd.12233. PMID: 30198127.
95 citations on Pubmed
https://pubmed.ncbi.nlm.nih.gov/30198127/

This study discusses how dysbiotic microbial plaque biofilm alone is not sufficient to cause periodontal disease. Other factors, including individual genetic predisposition, lifestyle, and environmental factors, also play a role. The study examines the impact of vitamin and mineral deficiencies on periodontal health and disease, as micronutrients can regulate gene transcription factors involved in inflammation. The study focuses on the role of vitamins A, B complex, C, D, and E, coenzyme Q10, and minerals including calcium, magnesium, iron, zinc, potassium, copper, manganese, and selenium in human physiology.

5 Nutrition as a Key Modifiable Factor for Periodontitis and Main Chronic Diseases

Martinon P, Fraticelli L, Giboreau A, Dussart C, Bourgeois D, Carrouel F. Nutrition as a Key Modifiable Factor for Periodontitis and Main Chronic Diseases. J Clin Med. 2021 Jan 7;10(2):197. doi: 10.3390/jcm10020197. PMID: 33430519; PMCID: PMC7827391.
65 citations on Pubmed
https://pubmed.ncbi.nlm.nih.gov/33430519/

This study reviews the relationship between nutrition and periodontal disease, as well as chronic diseases. The Western diet, high in sugar and saturated fat and low in fiber, polyols, and polyunsaturated fats, increases the risk of periodontal and chronic diseases. Conversely, a healthy diet, such as the Mediterranean, DASH, vegetarian, and Okinawa diets, which are low in sugar, high in fiber, and have a high omega-6-to-omega-3 fatty acid ratio, reduces the risk of these diseases. Micronutrients like vitamins D, E, K, and magnesium are unclear, while others like vitamins A, B, C, calcium, zinc, and polyphenols have been shown to prevent periodontal diseases. Probiotics and prebiotics may also promote periodontal health. Changes in periodontal health can serve as a warning signal to control dietary quality and reduce the risk of developing chronic diseases later on.

6 Association between diet and periodontitis: a cross-sectional study of 10,000 NHANES participants

Wright D.M., McKenna G., Nugent A., Winning L., Linden G.J., Woodside J.V. Association between diet and periodontitis: A cross-sectional study of 10,000 NHANES participants. *Am. J. Clin. Nutr.* 2020;112:1485–1491.
27 citations on pubmed
https://pubmed.ncbi.nlm.nih.gov/33096553/

This study aimed to investigate the relationship between diet and periodontitis, a major cause of tooth loss, using advanced statistical techniques for dietary pattern analysis. The study used data from 10,010 participants in the US NHANES from 2009-2014 and found that a diet rich in salad, fruit, vegetables, poultry, seafood, and plain water or tea to drink was associated with lower periodontitis extent. This study suggests that treelet transformation may be a useful approach for calculating dietary patterns in nutrition research.

7 Dietary Factors Affecting the Prevalence and Impact of Periodontal Disease

Santonocito S, Polizzi A, Palazzo G, Indelicato F, Isola G. Dietary Factors Affecting the Prevalence and Impact of Periodontal Disease. Clin Cosmet Investig Dent. 2021 Jul 9;13:283-292. doi: 10.2147/CCIDE.S288137. PMID: 34267556; PMCID: PMC8276823.
14 citations on Pubmed
https://pubmed.ncbi.nlm.nih.gov/34267556/

This study reviews the impact of diet, nutrients, and micronutrients on periodontal health and disease. It finds that a balanced intake of complex carbohydrates, vegetable proteins, omega-3 fatty acids, minerals, and vitamins has a positive effect on periodontal inflammation, while an unbalanced intake of refined carbohydrates, non-vegetable proteins, proinflammatory saturated fatty acids, and vitamins and minerals can increase inflammation. The study concludes that a healthy and balanced diet can have anti-inflammatory and protective effects on periodontal health, and recommends that patients with oral and periodontal disease should be encouraged to adopt a correct lifestyle and diet.

8 The Role of Vitamin C and Vitamin D in the Pathogenesis and Therapy of Periodontitis-Narrative Review

Ustianowski Ł, Ustianowska K, Gurazda K, Rusiński M, Ostrowski P, Pawlik A. The Role of Vitamin C and Vitamin D in the Pathogenesis and Therapy of Periodontitis-Narrative Review. Int J Mol Sci. 2023 Apr 5;24(7):6774. doi: 10.3390/ijms24076774. PMID: 37047746; PMCID: PMC10094883.
Too recent
https://pubmed.ncbi.nlm.nih.gov/37047746/

This study review examines the role of vitamins C and D in the pathogenesis and treatment of periodontitis, a common disorder affecting the bone and soft tissues of the periodontal complex. The authors suggest that vitamin C is involved in synthesizing collagen and that deficiency in vitamin C could lead to damage to the periodontal ligaments. Vitamin D, on the other hand, decreases the expression of proinflammatory cytokines in gingiva and regulates the proper mineral density of teeth. The review highlights that vitamin C and D supplementation has been associated with improved outcomes in the treatment of periodontitis.

4.2 Journals

What follows is a list of the most important dental journals based on the number of citations in the three-year-period 2018-2021. Journals that are not included were considered to have too few citations to be considered as having a big enough impact. Journals irrelevant to Curaden's mission were still left in for sake of overview, but were scrapped.

1 Clinical Oral Investigations: 5471 citations

The Clinical Oral Investigations journal serves as a diverse and global platform for the dissemination of research in all areas of oral medicine. It features original scientific articles and invited reviews that offer the latest findings from basic and clinical studies in oral and maxillofacial science and medicine. The publication aims to provide international readers with an understanding of the applicability of new research to modern practices. The topics covered in the journal include but are not limited to maxillofacial and oral surgery, prosthetics and restorative dentistry, operative dentistry, endodontics, periodontology, orthodontics, dental materials science, clinical trials, epidemiology, pedodontics, oral implant, preventive dentistry, and oral pathology.

2 Journal of Dental Research: 4331 citations

The Journal of Dental Research (JDR) is a scientific publication that undergoes peer-review process and aims to share novel findings and insights in the fields of dental, oral, and craniofacial clinical research. It covers a broad range of topics within these areas to disseminate new knowledge and information.

3 Journal of Clinical Periodontology: 4086 citations

Published by John Wiley & Sons, the Journal of Clinical Periodontology is a peer-reviewed medical journal that focuses on periodontology and releases new issues every month. The journal was initiated in 1974 by various periodontology societies in Europe, including the British, Dutch, French, German, Scandinavian, and Swiss societies, and is officially affiliated with the European Federation of Periodontology.

4 Journal of Periodontology: 3926 citations

Established in 1930 as the official publication of the American Academy of Periodontology, the Journal of Periodontology (JOP) publishes original papers of the highest scientific quality to support practice, education, and research in the dental specialty of periodontics.

5 BMC Oral Health: 3422 citations

BMC Oral Health is an open access, peer-reviewed journal that considers articles on all aspects of the prevention, diagnosis and management of disorders of the mouth, teeth and gums, as well as related molecular genetics, pathophysiology, and epidemiology.

6 Journal of Dentistry: 2703 citations

Elsevier publishes the Journal of Dentistry, which is the leading international dental journal in the field of Restorative Dentistry. It has an open access mirror journal called The Journal of Dentistry: X, which shares the same editorial team, submission system, and peer review process as the main journal.

7 Archives of Oral Biology: 2392 citations

Archives of Oral Biology is a scientific journal that publishes high-quality research papers related to the orofacial region, including developmental biology, molecular genetics, microbiology, neuroscience, and forensic dentistry. The journal also publishes expert reviews and articles on

methodology advancements. It will only consider clinical papers if they make a significant contribution to understanding a disease process.

8 Oral Diseases: 2392 citations

Oral Diseases is an international journal focused on head and neck disorders, edited by leading experts in the field. The journal aims to bridge the gap between dentistry and medicine through high-quality research that includes clinical, epidemiological, and basic science studies. The journal covers various medical specialties, including dermatology, gastroenterology, hematology, immunology, infectious diseases, neuropsychiatry, oncology, and otolaryngology. The journal welcomes hypothesis-driven research with positive and negative results and emphasizes etiology, pathogenesis, diagnosis, prevention, and treatment.

9 International Journal of Oral Science: 2008 citations

The International Journal of Oral Science seeks to publish all aspects of oral science and interdisciplinary fields. The journal publishes high quality, independently peer-reviewed research and review material.

10 Clinical Implant Dentistry and Related Research: 1814 citations

The journal Clinical Implant Dentistry and Related Research focuses on advancing scientific and technical developments in clinical implant dentistry and related subjects, and aims to disseminate new information to clinicians, researchers, teachers, and students studying osseointegrated implants in the oral and maxillofacial areas. The journal publishes original research and reviews on clinical and basic science aspects of osseointegrated implants, bone biology, bone grafts, and bone substitutes. Topics covered by the journal include but are not limited to these subjects.

11 Journal of Oral Pathology & Medicine: 1788 citations

12 British Dental Journal: 1750 citations

A peer-reviewed journal for the dental community, published by Springer Nature on behalf of the British Dental Association. It aims to inform its readers about key issues in dentistry and features scientific papers that focus on clinical research, as well as research insights and summaries.

13 Periodontology 2000: 1725 citations

Periodontology 2000 is a collection of specialized publications aimed at periodontists and general practitioners with a focus on periodontics. The editorial board selects noteworthy experts and important themes for each monograph.

14 Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology: 1688 citations

The journal Clinical Implant Dentistry and Related Research focuses on advancing scientific and technical developments in clinical implant dentistry and related subjects, and aims to disseminate new information to clinicians, researchers, teachers, and students studying osseointegrated implants in the oral and maxillofacial areas. The journal publishes original research and reviews on clinical and basic science aspects of osseointegrated implants, bone biology, bone grafts, and bone substitutes, but also includes research regarding the tissues that surround implants.

15 Journal of Periodontal Research: 1238 citations

The Journal of Periodontal Research is an international research periodical that aims to publish original clinical and basic investigations, review articles, brief communications, and reports of scientific meetings related to periodontology and related sciences. It publishes six issues per year.

16 Journal of Oral Microbiology: 769 citations

The Journal of Oral Microbiology is an open-access publication that focuses on publishing original research on oral health and oral infectious diseases. The journal covers topics such as microbiome and genomics, host-pathogen interactions, and molecular microbiology of systemic diseases.

17 Oral health & preventive dentistry: 413 citations

This journal is an essential source of up-to-date information on scientific developments in oral health and the prevention of caries, periodontal diseases, oral mucosal diseases, and dental trauma. It is a valuable resource for a range of professionals, including clinicians, general practitioners, teachers, researchers, and public health administrators. The journal publishes peer-reviewed articles that cover critical topics such as oral hygiene, oral epidemiology, oral health promotion, and public health issues. These articles may include clinical and basic science research reports or reviews, providing timely and indispensable information to its readership.

18 Journal of International Society of Preventive and Community Dentistry: 359 citations

The Journal of International Oral Health"(JIOH) is a bimonthly print and online journal publishing research articles after full peer review. All articles are published, without barriers to access, immediately upon acceptance. The journal is an open access, international, peer-reviewed journal of dentistry published by ISPCD.

5 Best practices in oral health campaigns

To promote oral health, it is key to utilise a combination societal and individual public health efforts. A failure to integrate both would worsen oral health disparities. As such, the prevention of periodontitis, which is a prevalent disease in deprived areas, requires a focus on universal treatment as delivered by health professionals, while also taking into account the particular social, cultural and environmental contexts in which this prevention takes place. Examples would be community-based oral health support workers in schools or nurseries (for preventing caries) and health centers (for preventing gum disease), or parental-supervised tooth-brushing with parents.

Best practices in oral health promotion and prevention can take various forms, but most of them come down to one or more of the following themes: general health education, educating professionals, health promotion, integrating oral health promotion into general health promotion programmes, policy changes which promote better oral health, the provision of care services, or programmes specifically designed at addressing oral health inequalities. What follows is a short list of successful examples.

1 Apollonia 2020 (Austria: general health education, health promotion)

Apollonia 2020, which is still ongoing despite its name, is a program funded by the Lower Austria health insurance authorities with the objective of increasing the proportion of caries-free children. The program involves health education through regular visits from dental health educators to kindergarten groups and elementary school classes. Kindergarten children receive daily brushing and are examined by "patron dentists" every two years. Additionally, schoolchildren in first and fourth grades of elementary school undergo examinations. The financial sustainability and cost-effectiveness of the program are assessed annually. Since its inception, the proportion of caries-free 6-year-old children has risen from 44% in 2006 to 53% in 2014.

2 Childsmile (UK: health promotion, public policy, service provision, addressing public health inequalities)

Childsmile is run by the Scottish government and offers an NHS dental service that is child-oriented and available to all, utilizing a combination of private and public dental providers. In 2005, the introduction of Childsmile was accompanied by a government objective to have 60% of P1 children free from noticeable tooth decay by 2010. This target was part of the Dental Action Plan, which was also responsible for the creation of Childsmile. The National Dental Inspection Programme (NDIP) was employed to evaluate progress towards this goal. The National Dental Inspection Programme takes place in schools throughout Scotland, with participation mandated by government legislation.

Childsmile officially started in 2006 against a background of the poor oral health and extensive oral health inequalities observed in children in Scotland, with the aim of improving the oral health of all children and with emphasis on the more deprived groups in society. Childsmile consists of three distinct components extending from birth to adolescence:

- A core programme – including universal daily toothbrushing in all nurseries and targeted toothbrushing in primary schools;
- A targeted nursery and school fluoride varnish programme; and
- A universal practice programme aimed at newborn children, The project is government funded, and has been evaluated. Findings clearly demonstrate that the cost of the programme is significantly lower than the cost savings as a result of the reduction in treatment needs for participating children.

- The project has been a huge success, and a great example of combining societal and individual efforts to promote health. A study by Public Health England concluded that the effectiveness of the supervised brushing, water fluoridation and provision of toothbrushes and toothpaste in the nurseries resulted in savings of around £3 million over a one-year period, and a demonstrated reduction in oral health inequalities. Moreover, the National Dental Inspection Programme has reported significant and ongoing enhancements in oral health for P1 and P7 children in Scotland since the implementation of the national toothbrushing programme in 2001, according to the National Dental Inspection Programme's findings in 2016 and 2017. Specifically, the proportion of P1 children with no visible caries has grown from 45% in 2000 to 69% in 2016.

3 GERODENT (Belgium: education professionals, general health education, integrating oral health promotion into broader general health programmes)

Gerodent is an oral health care project which has implemented a preventive and curative oral health care program in a network of 40 nursing homes in Belgium (Flanders) since 2010. This program includes : 1. the implementation of the guideline «Oral health care Guideline for Older people in Long-term care Institutions» (OGOLI) and the daily oral health care protocol derived from the guideline; 2. the education of nurses and nursing aides, including hands-on training; 3. the introduction of oral care aides in the different wards of the nursing homes and one oral health coordinator per nursing home; 4. regular visits of a mobile dental team to support the nursing staff and to deliver preventive and curative oral health care. Evaluation has shown that after five years an increasing attention to oral health care can be observed but permanent efforts are needed to ensure this progression continues. A cost-effectiveness evaluation study of the programme is currently being planned.

4 Hou je mond gezond! (The Netherlands: general health education)

Hou je mond gezond! is a nationwide educational project for oral health. Central to the educational project is a visit, free of charge, by a dentist, dental hygienist, dental or dental prevention assistant to a primary school class or playgroup or an introductory visit by a primary school class to a dental practice. During the lesson on tooth brushing, the volunteer oral healthcare professional tells the pupils about the mouth and teeth, cleaning the teeth, cavities, tooth erosion and the dangers of snacking. More than 19,165 toothbrushing lessons have already been given to approximately 575,000 children in all the provinces of the Netherlands. Evaluation has shown that three quarters of the oral healthcare professionals and 70% of the teachers expect the pupils to brush their teeth better after a Hou je mond gezond! toothbrushing lesson.

5 Mouth Cancer Action Month (UK: educating professionals, general health education, health promotion)

In November each year, the Mouth Cancer Foundation and the Oral Health Foundation collaborate to support Mouth Cancer Action Month. The campaign, led by the British Dental Health Foundation, strives to increase awareness of mouth cancer and its associated risk factors, while promoting early detection to enhance survival rates. To achieve its objectives, the campaign employs public relations and media strategies, as well as outreach through dental practices, to emphasize the importance of recognizing risk factors such as smoking, alcohol, and human papilloma virus (HPV). Under the banner "If in Doubt Get Checked Out," the campaign seeks to educate the public about the signs and symptoms of mouth cancer that should prompt a visit to the dentist. The progress of the campaign is monitored through continuous evaluation during and after the event, revealing a positive impact that increases year after year.

- Alliance for a Cavity-Free Future (whole of Europe: Educating professionals, public policy)

The Alliance for a Cavity-Free Future (ACFF) is working towards the stretch goal that every child born across Europe in 2026 and thereafter should stay cavity-free during their lifetime. ACFF has brought together leading experts from across the academic and public health landscape of Europe who have committed to work in collaboration. One goal of the Pan-European Chapter is ensuring that appropriate caries prevention and management can be implemented across Europe. The Collaborative Council of the Pan-European Chapter has overseen the setup and execution of varying projects since 2013, from Europe-wide surveys to TV Advertisement campaigns, education system reform to symposia held jointly between organisations on the epidemiology of caries across Europe.

6 Danish National Public Health Programme (Denmark : service provision, Public policy, Addressing oral health inequalities)

Approximately 40 years ago, Danish children oral health was among the poorest in Europe. However, a targeted and proactive approach to deliver preventive care within the public oral health care service has had significant results. Between 1974 and 2000, the average DMFT scores in 12-year-old Danish children fell by 78% from 4.8 to 0.98. By 1997, more than 99% of Danish children received oral health care every year.

Denmark now has a very effective publicly funded national oral health promotion program, which requires the inclusion of oral health promotion and disease prevention in the development of oral health programs for a diverse range of groups, such as expectant mothers, children of all ages, adults, the elderly, those with special needs, and the economically disadvantaged. The program has been evaluated and shown to have a positive impact on the oral health status of the Danish population. Additionally, all municipalities in Denmark are obligated to establish local clinical facilities that provide free and comprehensive oral health care, including health education and prevention, to all children and adolescents from birth to 18 years of age who reside in the municipality. These clinics are typically located in or near primary schools.

A sophisticated register of all children residing in the municipality is utilised to monitor attendance to the clinic. The initial visit to the clinic is organised by the local oral health service. A letter is posted home to inform parents that their child is now entitled to free dental care. Preventative efforts are directed at the individual through tailored advice and guidance. However, significant emphasis is also placed upon reinforcing these messages within other health, social and education environments through staff in day-care centres, teachers, health visitors and paediatricians.

7 Delivering Better Oral Health (UK: educating professionals)

The DBOH toolkit, an evidence-based resource aimed at improving oral health and preventing oral disease, was created by Public Health England in collaboration with partners such as the Department of Health, NHS England, and BASCD. It offers clear guidance and interventions for dental teams and other healthcare workers to promote oral health. The toolkit has had significant impacts since its initial publication in 2007, including changes in toothpaste formulation, increased usage of fluoride varnish, and integration into dental school curricula. It has also informed commissioners and facilitated the development of prevention-focused contracts.

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