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Why is the Danish oral health system for children and adolescents so successful? A comprehensive review

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Abstract:
The Danish oral health system is one of the most efficient in Europe. The purpose of this study is to analyse the elements that explain this efficiency by conducting a literature review. The literature review identified 27 sources that described the Danish oral health system. The data were analysed through a model inspired by the European Global Oral Health Indicators Development Project. The analysis highlighted some features of the Danish system; a preventive system based on a workforce of salaried oral health professionals working within schools. At the same time, there has been the development of a range of professions involved in patient care such as dental hygienists. Other policies such as free health care for children or the obligation of an annual visit have demonstrated very good results which are characterised by a drop of the DMFT at the age of 12 from 5.2 in 1975 to 0.4 today (2021). All these elements could represent interesting guidelines for stakeholders in France and other countries.

Key words: *Danish oral health system, DMFT, Denmark, oral health*

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Introduction

The World Health Organisation (WHO) defines health systems as all "organizations, people and actions whose primary intent is to promote, restore or maintain health. This includes efforts to influence determinants of health as well as more direct health-improving activities."[1]

Oral health is an important component of overall health.[2] Those evolutions of the perception of oral health worldwide over the past decades encouraged the WHO to identify the tackling of oral diseases as a major priority even in developed countries.[3,4,5] In addition, oral diseases have a significant impact on the economy of the general health care systems as they generate direct and indirect costs that continue to increase.[6,7] From the 1980s to nowadays, Nordic countries have all seen a positive development.[3,8] Over this period, Sweden moved up from 23rd to 3rd place, Finland from 31st to 6th place, Norway kept its 11th place and finally Denmark moved up from 34th to 14th place.[3,8] Singapore and Iceland are 2nd and 1st respectively. From an oral health point of view, when focusing on the number of decayed, missing or filled teeth at age 12 and 15 (DMFT) which are good indicators to determine the oral health status of a population, one country stands out, notably Denmark.[4,9,10,11]

Denmark is a country in Northern Europe and is one of the Scandinavian countries. The total area of the Danish territory is 43,094 km^2 with a total of 5.7 million inhabitants. The employment rate is the highest in Europe. According to the World Bank, Denmark's Gross Domestic Product is €350,104 billion and Denmark's GDP *per capita* in 2019 was approximately €50,000.[12] Moreover, according to Transparency International, which is a global civil society organisation leading the fight against corruption, Denmark is the least corrupt country in the world (the same rank as New Zealand).[13]

The basic principle of the Danish social and health care system, often referred to as the 'Scandinavian model' is that all citizens have equal rights to social security. In most cases, the costs of education and health care are fully covered. The health care system offers high quality services, the majority of which are financed by general taxation. This system is universal and is based on the principles of free and equal access to health care for the entire population.[14]

The objective of this work is to analyse the Danish oral health system in order to understand what makes it so successful. Thus, we will be able to identify elements that could inspire other countries in order to overcome the encountered issues of organisation, financing and costs.[15,16]

Material and methods

This study investigating the Danish oral health care system was based on a literature analysis. The information sought included numerical data such as index values or descriptive data. Our preferred sources were English language literature, with literature in Danish consulted if applicable.

Initially, a search list of selected oral health parameters was built in order to create a basis for this analysis.[5] These parameters were as shown in *Table 1:* costs of oral health services, oral healthcare providers, dentists' remuneration, and preventive oral health programmes and epidemiological monitoring.

Additionally, "dental health Denmark", "dental health care system Denmark", "dental health policy Denmark", "evaluation dental health system" and "evaluation oral health system" were used as keywords in several search engines for scientific articles published between 1970 and 2021. Search engines included Pub Med, SUPERNOVA (university library search engine), RESEARCH GATE and GOOGLE SCHOLAR. The term "dental" was also replaced by the term "oral" in all searches. All relevant information concerning the collection of oral health data was verified in these articles. Reports from international organisations, being for the most part short, were fully read before selection. Some articles were also identified from the bibliography of certain articles or documents already selected.

Results

Figure 1 represents the flow chart corresponding to the bibliographic searches performed. It describes the selection process of the articles and the number of articles selected at each step.

Finally, 28 references were selected, including 21 research articles, four scientific reports and two online databases. These references are organised by themes and summarised in *Table 2*.

Costs of oral health services

This indicator, as defined by the European Global Oral Health Indicators Project, aims to describe the organisation of oral health care financing, particularly from the point of view

Table 1: Framework for the analysis over health system (Adapted from Bourgeois *et al.*[5])

– Costs of oral health services
– Oral healthcare providers
– Dentist's remuneration
– Preventive oral health programs and epidemiological monitoring
– valuation of the evolution of the DMFT index at age 12 and 15 between 1975 and today

Figure 1: Flowchart

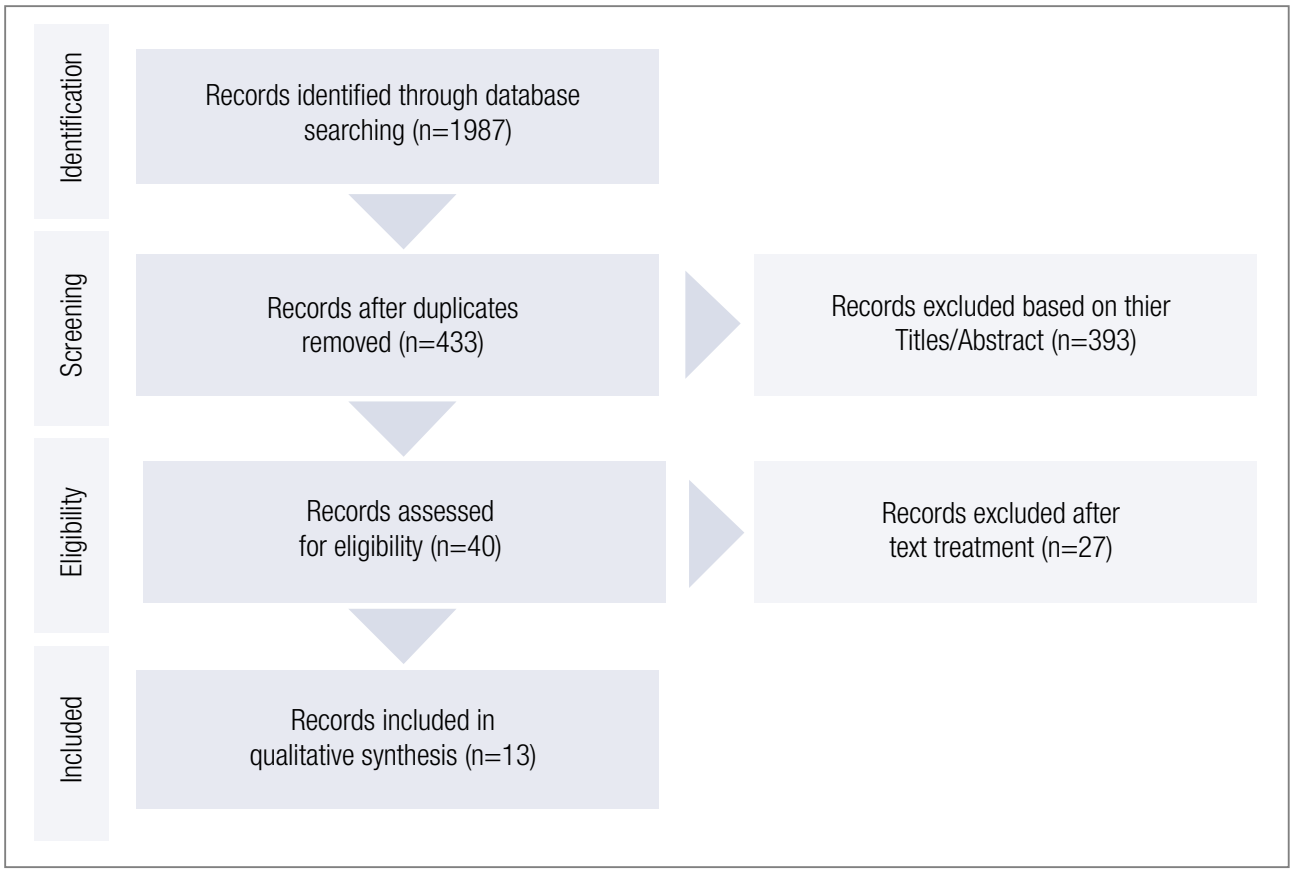


Table 2: Collected materials for the review, classified according to the oral health framework

Parts	Main author	Year	Sources
Costs of oral health services	*Widström E*[17]	2015	Article
	Danish gov.[14]	2016	Report
	Kravitz S[18]	2014	Report
	Rosing K[19]	2015	Article
Oral healthcare providers	*Kravitz S*[18]	2014	Report
	Eaton KA[20]	2019	Article
	Pedersen KM[21]	2005	Article
Dentist's remuneration	*Kravitz S*[18]	2014	Report
	Statistikbanken[22]	2021	Database
Preventive oral health programs and epidemiological monitoring	*PBOHE*[10]	2012	Report
	Widström E[17]	2015	Article
	Rosing K[23]	2019	Article
	Schwarz E[24]	1985	Article
	Poulsen S[25]	2009	Article
	Skeie M[26]	2014	Article
Evaluation of the evolution of the DMFT index at age 12 between 1975 and today	*Schwartz E*[24]	2014	Article
	Area Profile Project[27]	2021	Database
	SCOR system[28]	2019	Database
	Friis-Hasché E[29]	1994	Article

of the respective contributions of public financing, compulsory or voluntary insurance and direct contributions from households. To understand the financing patterns, it is necessary to understand at least the organisation of oral health care delivery in the country concerned.[5]

The organisation of oral health care delivery in Denmark can be seen as being marked by a dichotomy: on one hand, public care delivered by dentists and on the other, public providers to children and adolescents up to the age of 18 and to disabled, mainly elderly persons who cannot use the system for adults. This level is directly financed by 91 of the 98 municipalities, while on the other hand, care is delivered by private providers to persons 18+ years old. The latter have agreements with the five regions to contribute to the cost of oral health care for adult patients.[17]

The mission of public providers is to provide preventive and curative care to the populations described above. The care provided in this context is fully financed by public budgets at the municipal level and the providers are paid on a salaried basis.[14] The care also includes orthodontic treatment to children up to the age of 18. No direct financial participation in the care is required from the patient. In some cases, at the age of 16, citizens can choose to see a private practitioner and still be reimbursed by the municipality, in which case the patient must pay the costs in advance and is then reimbursed afterwards. Public expenditure at level 1 on health care in 2013 amounted to €288 million (*Figure 2*).[17]

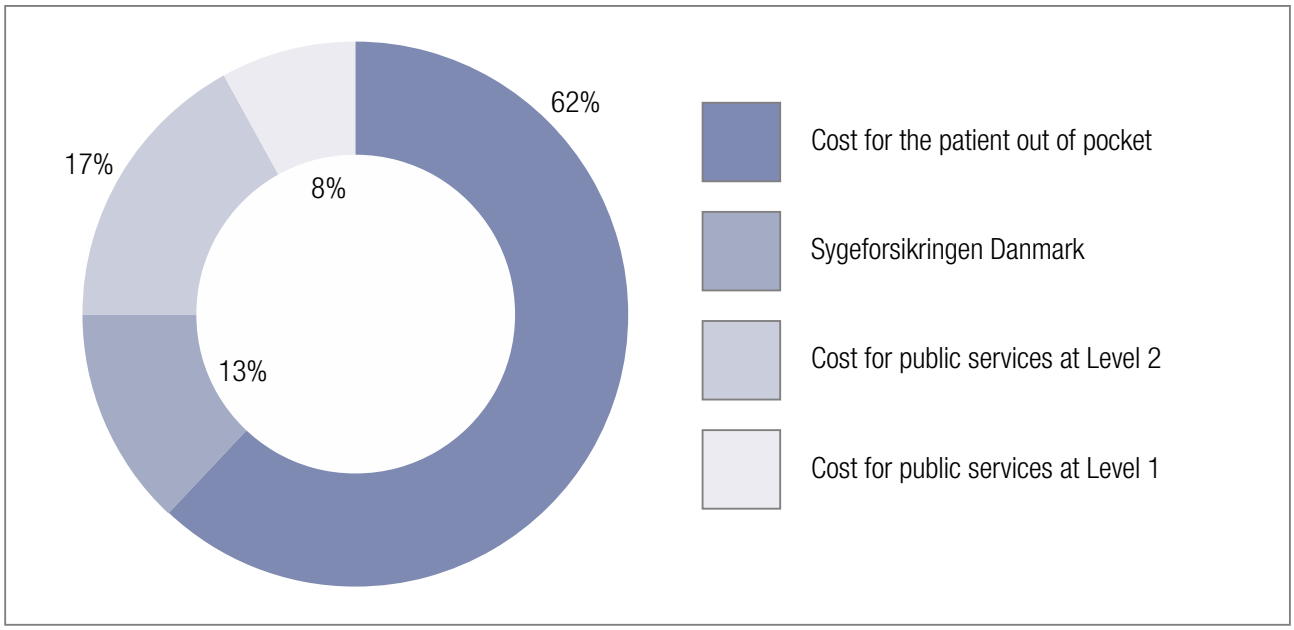
The financing of care provided by private providers is organised on a fee-for-service basis. This financing is mainly paid for by patients directly or through a voluntary insurance, Sygeforsikringen Danmark, to which 30% of Danish adults contribute and which finances adult care to approximately €133.[5] million per year.[17] A system of public subsidies exists, which allows partial coverage of the cost of care. The level of this coverage varies greatly according to the type of public (larger subsidies for patients under 25 years of age) and according to the type of care (larger subsidies for preventive or conservative care, smaller for prosthetic or orthodontic care). The amount financed by these state subsidies (level 2) in 2013 was €207 million.[17] There is also a system of exceptional assistance for patients in precarious situations to allow them access to dental care.[18] On average, the financing of private care in Denmark is thus provided by patients and supplementary insurance for 82.5% and by state subsidies for 17.5%. These amounts correspond respectively to €1.15 billion and €207 million (*Figure 2*).[19]

In total, including public expenditure, Sygeforsikringen Danmark insurance expenditure and household expenditure, current expenditure on oral health care in Denmark in 2013 amounted to €1.645 billion, an average expenditure of €283 per inhabitant per year.[17]

Oral health care providers

In Denmark, in addition to the dental profession, there are two possible specialisations; maxillofacial surgery and orthodontics. Dentists are not the only providers of oral health care, they are assisted or supplemented by dental hygienists,

Figure 2: Distribution of the current expenditure on oral health care in Denmark



dental assistants, dental technicians and clinical dental technicians.[18]

According to the most recent data, Denmark has 4,800 active dentists, which corresponds to one active dentist per 1,208 inhabitants.[20] Three quarters of the practicing dentists are women (M/F ratio: 26/74). 10% of the dentists in Denmark (480) are dentists who have graduated from another country. The studies to become a dental surgeon in Denmark take five years on top of, in two cycles corresponding to the bachelor's degree (3 years) and the master's degree (2 years). To be qualified as an orthodontist requires postgraduate education for three years. Dental education is fully financed by the government and free of charge for students.[21]

There are 1,751 dental hygienists. Most practices or clinics employ a dental hygienist. They can also practice on their own without the supervision of a dentist after completing a 3-year course (recognised only in Denmark). They can then make simple diagnoses and perform procedures such as subgingival scaling, x-rays and even fillings on the dentist's prescription.[20]

Although the exact number of dental assistants is not available, they likely outnumber dentists. The norm is for each practitioner to have a full-time chairside assistant.[18,20]

There are more than 1,100 dental technicians (2008), they manufacture dental prostheses and can work after two years of study combining theory and practice. Dental technicians work mainly in laboratories, hospitals, dental faculties or more rarely directly with dental surgeons.[18]

Finally, there are 565 Clinical Dental Technicians (2008). They must have completed a 4-year programme in a technician school where they have more practical education than a regular dental technician. They can, after obtaining a licence from the Health and Medical Authorities, practice independently with patients requiring removable total dentures. However, for partial removable prostheses, a treatment plan must first be drawn up by a dentist.[18]

Dentists' remuneration

In Denmark, one third of dentists work in the public sector, so they are employed by the municipalities for which they work. According to the Danish Dental Association, their annual income is estimated to be between 400,000 KR (Danish krone) and 500,000 KR (€53,000-€67,000). To this amount is added an additional pension depending on seniority. The other two thirds work in the private sector and are remunerated on a fee-for-service basis.[18] The incomes expressed in this sub-section are net incomes (after-taxes). The average income of dentists in Denmark is €62.26 euros per hour (463 KR) according to the Danish statistics bank Statistikbanken database.[22]

Oral health programmes and epidemiological monitoring

About 50 years ago, the oral health of young Danes was among the worst in Europe. However, since 1972, a very preventive approach has been put in place, so that the inclusion of prevention in dental care has become a legal obligation.[23] Since then, all municipalities have been required to provide facilities and equipment to allow free dental preventive care and education for young residents. Until 1981, this free dental care was only available to school children (7–16 year-olds). Then from 1982 to 1987 this programme was extended to include preschool children by starting with 6-year-old children. Finally in 1988, 17- and 18-year-old students were also included in this programme. Therefore, since 1989, this programme has covered all the citizens aged from the age of 3- to 18-years-old.[24] It is also noticeable that since 1994, the municipalities are additionally responsible for providing free dental care for dependent elderly people or people with disabilities that make them dependent.[17]

Access to primary oral health is made easier as the facilities and equipment needed to provide dental care are usually lo-

cated within schools. In each municipality a register of resident children is used to monitor the regularity of appointments. These appointments are mandatory. Repeated absences are reported to social services.[25] In addition, preventive messages are reinforced by everyday participants through the training of school personnel.[10]

Finally, since 1997, more than 99% of Danish children have had an annual visit to an oral health professional.[10] To date, Denmark is the country in Europe with the best DMFT index at age 12 years.[10] Close monitoring has existed since 1972 through the SCOR system, the central dental registry of the Danish Health Authority, which keeps reports on dental care problems in children and adolescents in Denmark.[26]

Evaluation of the evolution of the DMFT index at age 12 and 15 between 1975 and today

The Swedish database CAAP (Country/Area Profile Project) provides access to all DMFT 12 and 15 values recorded over time. This database is established in accordance with WHO recommendations, i.e. based on standardised and normalised data collection in order to be able to compare several countries or geographical areas with each other.[27] The graph in *Figure 3,* produced based on the data collected, compares the evolution of the DMFT indices at age 12 and 15 in Denmark from 1975 to nowadays.

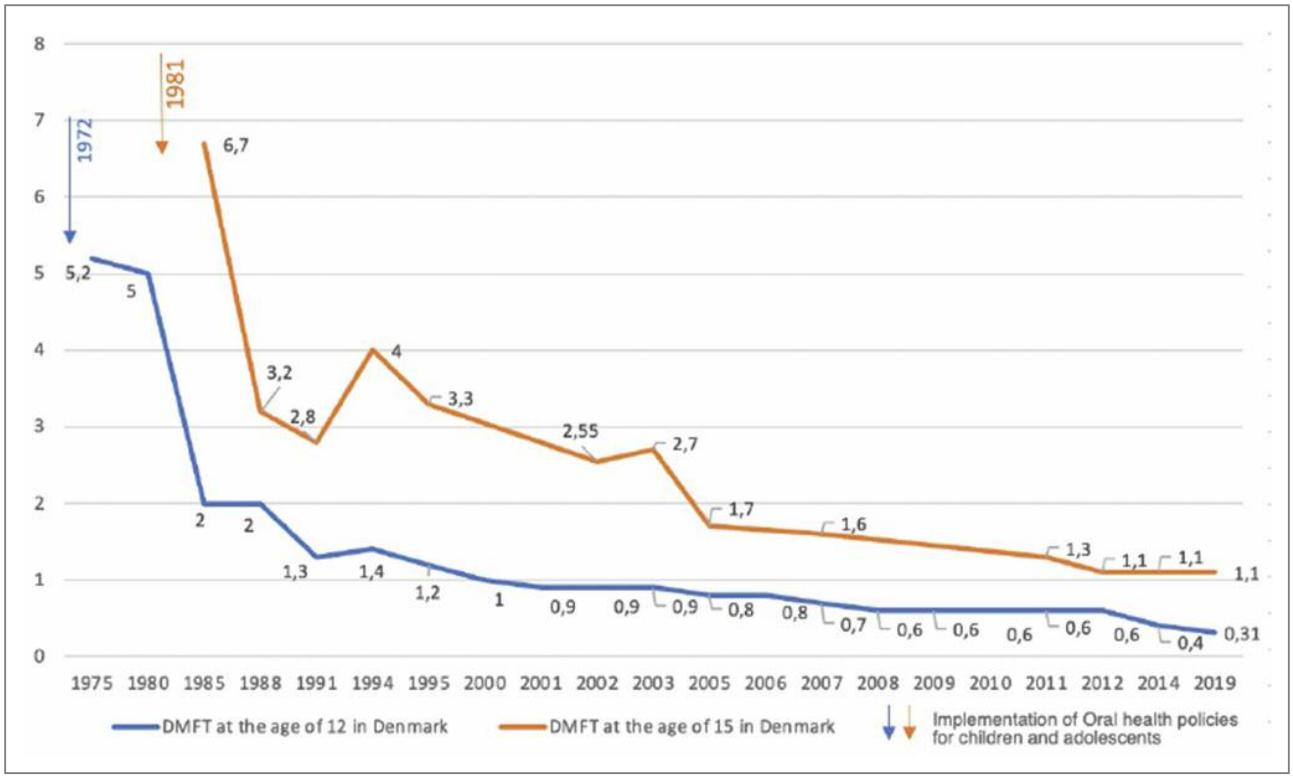
We collected 21 values of the DMFT at the age of 12 and 13 values of the DMFT at the age of 15 ranging from 1975 to 2019. Denmark has gone from a DMFT at the age of 12 index of 5.2 in 1975 to 0.31 today. The DMFT at the age of 15 fell from 6.7 to 1.1 in the same period. It means that the DMFT at the age of 12 and 15 respectively fell by 94.0% and 83.5%.[27,28] With regard to the DFMT at age 12, there is a drop of more than 3 points in this index from 1980 to 1985. This drastic fall corresponds to the implementation of the policy of free access and prevention. There is also a constant decrease, except between 1991 and 1994 when the DMFT 12 gained 0.1 point. A similar fall of 3.5 points is noticeable for the DMFT at the age of 15 between 1988 to 1991 which also corresponds to the extension of the policy of free access and prevention to all teenagers.[24,29]

Discussion

The objective of this work was to study the Danish oral health system to highlight what is efficient and what could help to improve certain aspects of other countries' oral health systems. The Danish oral health system, which had the worst results 45 years ago, has reached the first place in Europe for oral health with an approach oriented towards prevention and follow-up. Some aspects of the Danish oral health system highlighted in this study may be of a major interest for stakeholders.

The efficiency of the Danish health system and the quality of epidemiological monitoring ensure that extensive oral health data are available through the SCOR system. This has enabled the Danish Health Authority to monitor the status and development of oral health in Danish children and adolescents for more than 40 years. Moreover, in Denmark, the Child Dental Health Service has among others a very important outreach policy which means that it makes contact with the parents of new-born children to set up a visit. If the parents do not attend the visit (which is scheduled around the age of 1 year), they will be reported to the social services.[17,25] This policy ensures that close to 100% of children are enrolled in the service from very early age.[10] The specificity of these two aspects of obligation for the parents and outreach programme is very efficient. Indeed, when compared to other countries such as France where only

Figure 3: Evolution of the index of Decayed, Missing, and Filled Permanent Teeth (DMFT) at age 12 and 15 in Denmark



one of these two aspects exists (the outreach programme) the results are slightly different. Only 57% of French children are enrolled in the dental service and uniquely 17.5% thanks to the French programme of prevention "M'T dents".[30]

Access to prevention is another major point of the Danish prevention policy ensuring that minors benefit from free of charge oral health prevention and care. This policy has had very satisfactory results after its introduction in the 1980s. Indeed, in the five years following the beginning of this policy, the DMFT at the age of 12 index fell by more than 3 points and the DMFT at the age of 15 by 3.5.[29] Moreover, this access to care is facilitated by the presence of oral health professionals and adapted structures directly within the schools. Among those oral health care providers are dental hygienists who have a major role in the oral care organisation; both educational and caregiving, and are often the first oral health professionals in contact with patients.

The influence of the remuneration mode means that Danish dentists working in the public domain are employed by the municipalities. They represent one third of the dentists in Denmark. This allows for effective preventive care where fee-for-service cannot work for preventive procedures or access to care for dependent populations (disabled people, elderly people, etc.).

However, there are some limits, as the policies implemented are not the only factors that influence the variations of the results. Indeed, in Denmark, where the water is not artificially fluoridated, it has been proved and shown that the variations of this fluoride rate had an influence on the DMFT index. These variations (0.08 – 1.10 ppm fluoride concentration) can explain 30% of the inter-community variation of the DMFT index.[31] Also, some adjustment of preventive oral health activities strategy seems to be needed towards children and adolescents who suffers from social inequalities.[32]

Conclusion

This study has made it possible to analyse the Danish oral health system and to highlight several elements of its organisation which seem to make it possible to reduce the effects of oral pathologies, in particular an interventionist prevention policy based on the action of dedicated professionals. These elements should be of interest to decision-makers, in order to develop new effective oral health policies.

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