Global challenges in oral health

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Summary

The aim of this literature study is to present the challenges in oral health associated with: I) Social determinants and common risk factors as the main drivers of oral disease; II) Inequalities in oral health- disease burden, impact and access to care; III) Challenges in dental education- delivery of oral care and funding.

The main social determinants and common risk factors of oral health are related to socioeconomic status; educational level; health behaviours; mental health; culture-ethnicity-race; immigrant status; acculturation; social environment; social capital; and access to dental care. All the above indicate that a deteriorated/impoverished/vulnerable social status of the family or the individual in combination with the absence of public oral health policies will eventually result in unmet oral/dental need.

Oral health inequalities can be understood as differences in oral health status or in the distributions of health determinants between population groups which occupy different levels in the society. Thus, oral health inequalities are mostly experienced by underserved populations; indigenous; and rural populations either because these groups are settled in remote rural areas or because they cannot afford the high cost of dental treatment.

The challenges in contemporary and future dental education can be summarized in how the dental institutions will secure a sufficient funding for the promotion of research and how they will educate and train oral health-providers who will serve the public good.

The findings of this study highlight future challenges in oral health both in developed and developing countries. The impoverishment of the population worldwide; the constant migration of populations; and the failure of delivering an oral health-care system that includes underserved populations will undoubtedly increase the need for dental professionals capable of successfully delivering dental care, even under unfavourable conditions.

To conclude, the future oral health providers, health care administrators and oral health-decision makers need tools, competence and information in order to access, monitor and improve the oral health-needs of a growing and demanding global population.

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Contents

1 Introduction.

Oral health is a vital and integral part of general health something that seems to be forgotten and underestimated in a continually globalizing world. Consequently, this is a fact that has raised a lot of concern in the oral health scientific community during the last years.

In 2014, in an international symposium in Osaka it was depicted that dentistry in the 21st century is at a critical point. More specifically, it was highlighted that dentistry is being obliged to serve two different tendencies (1). On the one hand, the wealthy members of the society demand high-cost cosmetic treatments which most of the time are unnecessary (1). On the other hand, millions of people in developing countries have no access to dental care because they cannot afford the cost of necessary dental treatment, and probably they will never have an opportunity to see a dentist (1).

The symposium also criticized the fact that many developed countries are willing to increase the cost for national defense rather than creating oral health policies that will embark the poor who otherwise have no access to oral health care. It has also been raised criticism to the fact that many dentists offer sophisticated and costly cosmetic treatments with no health-giving impact instead of aiming to offer oral health care for the communal good in order to reduce the health inequalities (1).

Furthermore, in the symposium it was shown a growing interest towards the dental education in the globalized world. It was agreed that educating high-qualified oral health-care professionals demands high quality infrastructure and social support something that is difficult to achieve in developing countries (1). Therefore, improvements in global oral health (both in developed and developing countries) would be best achieved via an international cooperation aiming to train and educate modern skilled dental personnel, in the developing countries (1).

Nonetheless, the symposium concluded that dentistry should move from the traditional trend of “drill-fill-bill” as the main curative model, to a more affordable evidence-based preventive of disease model.

In 2017, another group of senior scientists - researchers, academics and intellectuals form various parts of the world made a declaration (calling it: *La cascada declaration*) about the crisis in dentistry. Their concern was on the future of dental care and dental education in a globalized world.

The “cascada” group depicted that the crisis in dentistry is based on:

a) There are oral health inequalities not only between developed-underdeveloped countries but also inside the same country. They observed that the improvements made so far in oral health are improvements related to living standards and not due to clinical interventions of oral health personnel (2);

b) The dental services in many countries are taken over by incorporations and insurance companies and they are not part a of a national health care system (2);

c) The cut-offs in public funds for universities will lead them to seek financial support from industries and consequently the academic research will lose its independence (2);

d) The international food and beverage corporations continue to promote the consumption of refined carbohydrates which are a major risk factor for dental and general disease (caries, diabetes) (2);

e) An increasing number of dental professionals who fail to deal adequately with oral health problems faced by the rural populations (2);

f) The most common oral diseases - dental caries and gum diseases are both reversible by only applying a provisional based treatment. However, they are still not overcome neither in developed nor in developing countries (2).

The “cascada” group concludes that a radical revision should be done concerning the education of the dental personnel. Among others, they suggest that dentistry should be a specialism of medicine; the great importance of a national based plan to control and prevent the most common oral diseases; an incensement of governmental financial foundation of the

social oral health and the financial support of universities concerning research and infrastructure (2).

In 2015, the FDI World Dental Federation through the publication of *Oral Health Atlas* made a call to global action concerning the "burden of oral disease" and how the oral disease is linked with social determinants and common risk factors; inequalities in oral health; prevention and management; challenges in oral health: education, migration, research; and the positioning of oral health in the global agenda.

The World Health Organization (WHO) gives a definition of oral health as:

> "a state of being free from mouth and facial pain, oral and throat cancer, oral infection and sores, periodontal disease, tooth decay, tooth loss, and other diseases and disorders that limit an individual's capacity in biting, chewing, smiling, speaking, and psychosocial wellbeing " (3 p. 13).

The recognition of oral health as an essential part of the right to health is constituted in the UN Universal Declaration of Human Rights and it is recognized by all nations.

Moreover, FDI defines as the "burden of oral disease" the untreated dental caries affecting44% of the population globally; severe periodontitis affecting 11% of the population; oral cancer which is among the 10 most common cancer types in the world; HIV patients suffer from oral diseases like oral fungal bacterial or virus infections; Noma, which is a disease mostly observed in the poorest areas of Sub-Saharan Africa, affects children under 6 years old with a rapid progression and destroys the soft and hard tissue of the mouth and face; congenital anomalies like cleft lip and/or palate (orofacial clefts – OFC) affect more than 12 in 10,000 newborns globally; Oral and craniofacial injuries either as a consequence of an accident or violence affects both children and grown up individuals and accounts for about half of the estimated total 8.5 million trauma deaths worldwide (3).

Considering all the above, FDI made a call for global action and depicted the need for the creation of a global agenda which will have as an objective the prevention and management of oral disease through simple and effective measures, both at individual and population levels.

As exposed above, the international oral health community has raised great concern about the future of dentistry and the provision of oral health in a globalized world where the challenges are increasingly demanding. The most developed countries in the world have not managed to overcome the most common oral diseases and many people still have no access to dental care in these countries, while the demand from the richest part of the society to a great extent is based on cosmetic treatment rather than therapeutic. On the other hand, the most affected populations seem to be the ones in the developing countries that lack the means for sufficiently educating oral health personnel and fail to provide to the poorest part of the population even a basic level of oral/dental care.

All the above-mentioned challenges greatly affect the oral health in a globalized world, and it is of great interest to study how they appear in the arthrography of the oral health community during the last 20 years.

The aim of this literature review is to concentrate on the study of the global challenges in oral health related with: I) Social determinants and common risk factors as the main drivers of oral disease; II) Inequalities in oral health- disease burden, impact and access to care; III) Challenges in dental education- delivery of oral care and funding.

The concept of “common risk factor approach” (CRFA) was first introduced in the 80’s from the World Health Organization in order to promote a more integrated approach to chronic disease. In the 2000 the concept was further applied to oral health and chronic oral conditions aiming to offer a theoretical basis for the link between oral and general health. The CRFA concept includes psychosocial and social environment variables, among others, in order to investigate their influence in chronical oral and dental conditions (4).

Inequalities or disparities in health are recognized as the differences that exist among specific population groups in accomplishing a full health potential, in incidence, prevalence, mortality, morbidity and other health conditions, that stem from the unequal positions that some groups occupy in the societal/communal level (5).

“La cascada”- group, in their call of action regarding the crisis in contemporary dentistry, expressed their concern about the future challenges in dental education and, consequently, the future of dental institutions regarding their curriculum and funding (2).

Subsequently, the objective of the current paper is a literature review of the arthrography between 1999 - 2019 concerning the three main challenges mentioned above I) Social determinants; II) Inequalities in oral health- disease burden and III) Challenges in dental education. Furthermore, this paper aspires to investigate which of these three challenges were of greater concern to the oral health community during the decade 1999 - 2009 in comparison with the decade 2010-2019. The aim of this comparison is to make any conclusions that they could relate the challenges in oral health with the demands of a continuously globalizing world.

2 Methods

A systematic literature search was carried out in PubMed (Medline) database.

Search strategy

a. Search in the PubMed database

For the initial a combination of free text and key words was used. The results of this search helped me evaluate the available literature on the topics under study. Continuously, based on the available literature and with help from the faculty librarian, I conducted the following search strategy:

i. Advanced search using MESH terms [(oral disease) AND (common risk)], retrieved 20 publications.

ii. Advanced search using MESH terms (oral health) AND (social determinants) NOT (inequalities)], retrieved 220 publications.

iii. Advanced search using MESH terms [(oral health) AND (inequalities) NOT (socioeconomic)], retrieved 113 publications.

iv. Advanced search using MESH terms [(dental education) AND (challenges)], retrieved 170 publications.

In total 523 publications were retrieved

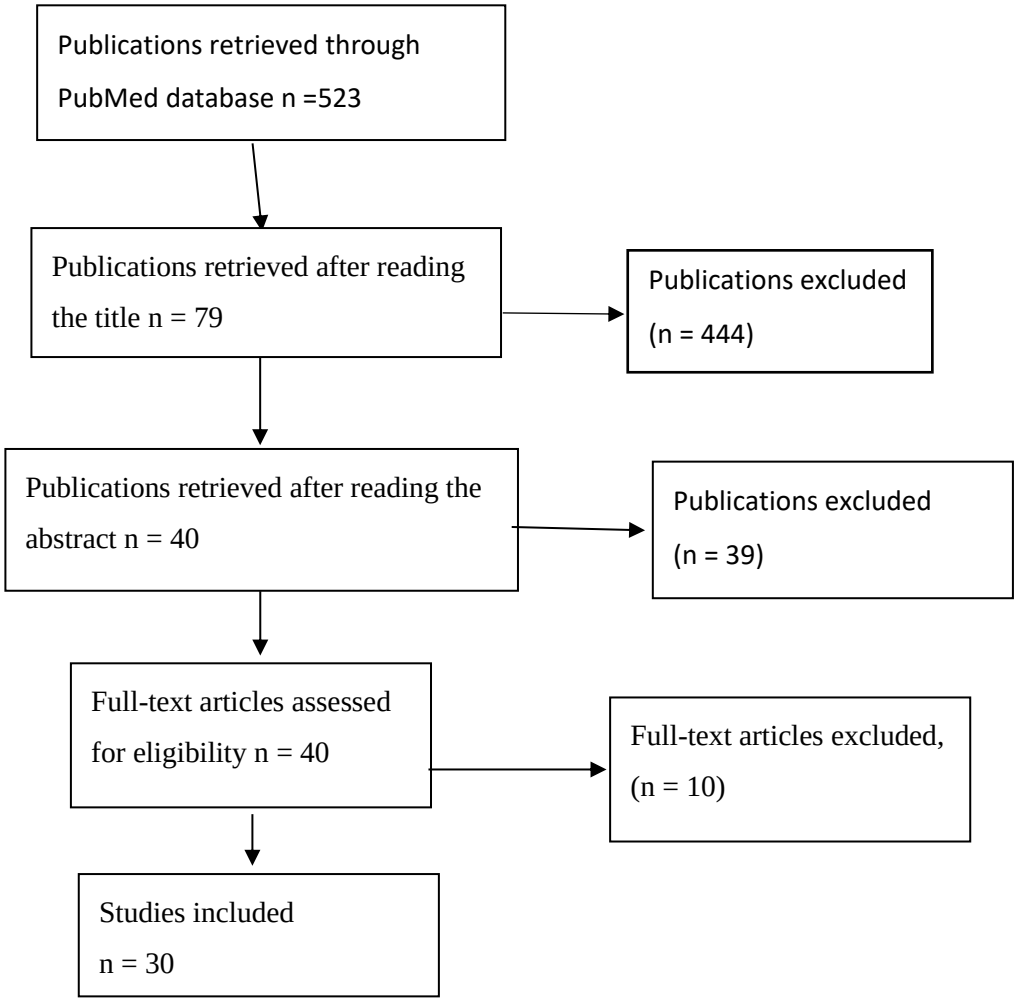
b. Selection criteria

The search was limited in human studies, published in English and in the period between February 1999 – February 2019.

To narrow down from the 523 publications first retrieved, the inclusion criteria were relevance to the topic of the investigation by reading first the title, then the abstract, and finally the whole text.

In this manner, 79 publications were retrieved after reading the title. Continuously, 40 publications still fit the criteria after reading the abstract and 30 after reading the whole text. Totally 30 publications were retrieved and used in the present study.

Twelve publications met the criteria of relevance with the topic: Social determinants and common risk factors as the main drivers of oral disease; 12 publications met the criteria of relevance with the topic: Inequalities in oral health- disease burden, impact and access to care; and 6 publications met the criteria of relevance with the topic: Challenges in dental education-delivery of oral care and funding.



3 Results.

The present chapter will present the results of the literature review divided in three main groups:1) Social determinants; 2) Inequalities in oral health; 3) Challenges in oral education. Each of these groups is further divided in subgroups which deal with different aspects of the main topic of each group.

I. Social determinants and common risk factors as the main drivers of oral disease.

The 12 publications on this topic are presented in two subgroups: a) 6 publications that investigate the social determinants associated with pediatric oral health; and b) 6 publications that investigate the social determinants associated with adults' oral health.

a. Social determinants and common risk factors in pediatric oral health.

1, Influences on children's Oral health: A Conceptual model

Fisher-Owens SA, Gansky SA, Platt LJ, Weintraub JA, Soobader MJ, Bramlett MD, Newacheck PW Influences on children's Oral health: A Conceptual model. Pediatrics. 2007 Sep;120(3):e510-20.

Objectives: Present a conceptual model of the variety of social determinants that influence children's oral health from the perspective of population health.

Type of study: Conceptual model-epidemiological study.

Methods: A conceptual model based on two axes: i) on earlier social epidemiological and population health studies that they linked health with social health determinants. For instance, determinants like physical environment of children, socioeconomic status, ethnicity, culture stress, health behaviours and health care system; ii) Review of major population studies and oral health literatures that conceptualize the factors influencing oral health.

Results: The model proposes 5 domains that classify the determinants of oral health in children: genetics and biology, social environment, physical environment, health-influencing behaviours and medical care, distributed to child level influences; family level influences; community level influences. Also, to be included is the aspect of time that depicts that children's oral health is a dynamic process.

Discussion: Pediatric oral/dental health is assessed by oral hygiene, dental caries, orofacial trauma and pain among others. The 5 domains mentioned above can influence oral/dental health either positively or negatively by the interaction of several social co-factors. These factors can be further divided in the family level and community level and they can be further examined under a perplex net of factors which are indirectly connected with oral/dental health. For example, family status and family function are determinants that lead to either higher or lower dental caries risk; low parental income and low education have a negative oral health impact; health status of the parents influence the way that children perceive the reliability of health care services; well organized community oral health environment, including campaigns that promote oral health either in school or in the neighborhood, have a positive influence in children's oral health;

Conclusions: The conceptual framework offered in this study aims to become the beginning of a new approach of improving children's oral health and the basis for studying children's oral health in a global perspective.

2, Social Determinants of Pediatric Oral Health.

Da Fonseca MA, Avenetti D. Social Determinants of Pediatric Oral Health. Dent Clin North Am. 2017 Jul;61(3):519-532.

Objective: Describe the social determinants that influence children's oral health and provide the basis for discussion for further research in the future.

Type of study: Overview article.

Methods: The theoretical framework for the current study derives from The World Health Organization definition of social determinants of health; the conceptual model proposed by Fisher-Owens et al.

Results: The 6 key areas of social determinants of Pediatric oral health are: socioeconomic status, family function and structure, health behaviours, social environment and social capital, culture, ethnicity, race and access to dental care and oral health providers available.

Discussion: Low socioeconomic status is related to poor oral health-related quality of life (OHRQOL) and limited access to dental services. Family function and structure is significant for oral health because in the family nucleus children acquire positive or negative oral habits. Health behaviours are influenced negatively or positively by culture. The connection between social environment/social capital and oral health is based in the interaction between many factors related to community and individual approach. Culture/ethnicity/race influence children's oral health when, for example, migrant children face many barriers to oral health education and access to dental care because they are afraid to reveal their immigration status. Access to dental care and workforce issues is related to the fact that many dentists (or Pediatric dentists) are gathered in urban areas and less in rural or more remote areas which exhibit the greatest need in terms of oral health care.

Conclusion: The authors underline the need for revaluating and correcting the policy systems in a way that children will not lose their dental care insurance, independently of their social and cultural background.

3, Neighbourhood and family social capital and parent-reported oral health of children in Iowa.

Reynolds JC, Damiano PC, Glanville JL, Oleson J, McQuistan MR. Neighborhood and family social capital and parent-reported oral health of children in Iowa.Community Dent Oral Epidemiol. 2015 Dec;43(6):569-77.

Objective: Investigate the relationship between family social capital, neighbourhood social capital (social determinants) and oral health of children in the state of Iowa in the USA.

Type of study: Cross sectional study.

Methods: Data source: A 2010 cross-sectional state health survey in Iowa based on parent-reported child oral health. n = 2186. Variables: evaluation of the child's oral health status, family social capital and neighbourhood social capital. Family level variables were accessed by using the following survey items: frequency of family meals and the frequency of attending in religious events.

Results: The neighbourhood social capital was greatly associated with child's oral health.

Discussion: Neighbourhood social capital is understood as the cohesion and protection that is felt within the neighbourhood. The family social capital, mainly family function and composition, was generally not associated with oral health status except of the frequency of family eating meals together. This is probably related with the fact that children and adolescents, when they have family dinners, tend to consume less refreshments and less sugar-rich food.

Conclusion: This study reinforces the importance of social determinants in oral health and demonstrates that when oral health interventions are designed, they should considerate multiple social factors rather than individual factors.

4, Sociodemographic determinants of spatial disparities in early childhood caries: An ecological analysis in Braunschweig, Germany.

Meyer F, Karch A, Schlinkmann KM, Dreesman J, Horn J, Rübsamen N, Sudradjat H, Schubert R, Mikolajczyk R. Sociodemographic determinants of spatial disparities in early childhood caries: An ecological analysis in Braunschweig, Germany.Community Dent Oral Epidemiol. 2017 Oct;45(5):442-448.

Objective: Study the social determinants of child dental caries experience in relation to sociodemographic characteristics in the city of Braunschweig, in Germany.

Type of study: Cross sectional study.

Methods: Data collection DMFT registration of children (n= 5527) between the age of 3-6 in a dental care centre in the metropolitan area of Braunschweig from 2009-2014.

Results: The overall DMFT decreased between 2009-2014 in Braunschweig, however it was detected a spatial cluster that presented an increase of DMFT. This cluster was identified in the centre of the city with a proportion of unemployed persons (8,5%) and persons with migration background (19,5%).

Discussion: The higher DMFT index among children from low income families with unemployed parents suggest high sugar intake combined with negative oral behaviours like absences of dental visits. Children with migrant background show negative oral behaviours by adopting the family's sociocultural behaviour and due to language/communicative problems with the oral health personnel in the dental centre.

Conclusion: The authors argue that by considering the sociodemographic disparities at district level the dental professionals will be able to detect and reach those individuals who are at risk. Consequently, they will easier design an individual prophylactic or therapeutic approach to dental care.

5, Social support and social network as intermediary social determinants of dental caries in adolescents.

Fontanini H, Marshman Z, Vettore M. Social support and social network as intermediary social determinants of dental caries in adolescents. Community Dent Oral Epidemiol. 2015 Apr;43(2):172-82.

Objective: Investigate the association between adolescents' dental caries and intermediary social determinants such as social support and social network.

Type of study: Cross-sectional study.

Methods: Participants: Public school students, n= 542, of the age of 12-14 in the city of Dourados, Brazil in 2012. Data collection: DMFT index and current dental caries registration;

Interviews in order to explore the perceived social support and the numbers of social networks from family and friends and covariates.

Results: The caries experience was 55, 2% and the current dental caries was 32,1%. The adolescents who perceived low levels of social support from family and low number of social networks were more likely to have a DMFT and current dental caries greater/equal to 1.

Discussion: The psychosocial factors like social support and social networks are closely related to dental caries among adolescents and they can impact adolescent's oral/dental health either directly or indirectly. The direct path suggests that oral disease can be affected by factors like well-being, self-efficacy, social integration and self-esteem while the indirect path suggests the adoption of destructive health behaviours (high sugar and alcohol consumption, smoking) when someone is socially neglected and lack family support.

Conclusion: Adolescent's oral health is closely related, and influenced either negatively or positively, by determinants like social support and networks, rather than merely biological factors.

6, Social inequalities in children's oral health-related quality of life: The Generation R Study.

Kragt L, Wolvius EB, Raat H, Jaddoe VWV, Ongkosuwito EM Social inequalities in children's oral health-related quality of life: The Generation R Study.Qual Life Res. 2017 Dec;26(12):3429-3437.

Objective: Study the association of family socioeconomic position (SEP) with children's Oral health-related quality of life (OHRQoL)

Type of study: Cross-sectional study (based in a population-based cohort study, Generation R study, carried in Rotterdam, Netherlands, in 2002-2006).

Methods: Participants: Children at the age of 10 years, n= 3871. Variables: OHRQoL; SEP included: paternal/maternal education level, employment status, income, benefit dependency and family consumption.

Results: Strong association between SEP and OHRQoL.

Discussion: Low OHRQoL was associated with paternal and maternal low educational level; with paternal unemployment, low household income, single-parent family. However, the strongest association between SEP and OHRQoL was shown between paternal unemployment and low OHRQoL. Moreover, children with low SEP may perceive suboptimal oral health even if their overall oral health is optimal, because family SEP and OHRQoL is a correlation of several factors.

Conclusion: Considering the link between low family SEP and low OHRQoL, oral health interventions and policies should focus on children from families of low socioeconomic position.

b. Social determinants and common risk factors in adult oral health.

1, Oral Health Disparities Across the Life Span.

Henshaw MM, Garcia RI, Weintraub JA. Oral Health Disparities Across the Life Span.Dent Clin North Am. 2018 Apr;62(2):177-193.

Objective: Identify the role of social determinants in oral health in the United States.

Type of study: Overview article.

Methods: Recollection of data from 6 surveys in the USA.

Results: 91% of the adult population between 20-64 years old have experienced dental caries and 27% has untreated caries. Periodontal disease has a prevalence of 57%, mostly among women. The prevalence of oral cancer has increased among young women between 18-44 years. The investigation of orofacial pain/TMD and socioeconomic/demographic disparities revealed that adults of the age of 45 years of lower socioeconomic status have a higher risk to experience orofacial pain.

Discussion: The most prevalent racial groups associated with untreated caries, edentulousness and orofacial pain or TMD were the Non-Hispanic blacks and Hispanic adults followed by the Non-Hispanic Whites. Low educational- and low income-level are the socioeconomic factors most often related to poor oral health. Among Hispanic adults the lack of language skills is another factor of unreported orofacial pain. Interestingly, the prevalence of oral cancer showed disparities only between gender and age. However, the survival rate after the diagnosis of oral cancer is related with racial and socioeconomic disparities reflected in lower survival rate among Non-Hispanic Black adults with 30% survival rate compared to 55-59% in Non-Hispanic Whites.

Conclusion: The authors express their concern about the increase of social disparities in the USA. They suggest that individual dentists should act through professional organizations and local community-based programs in order to improve access to oral health-services and reduce oral health disparities.

2, Determinants of Oral Diseases in the African and Middle East Region.

Chidzonga MM, Carneiro LC, Kalyanyama BM, Kwamin F, Oginni FO. Determinants of Oral Diseases in the African and Middle East Region**.** Adv Dent Res. 2015 Jul;27(1):26-31.

Objective: Identify the role of social determinants related with oral disease in the African and Middle East region (AMER).

Type of study: Literature review.

Methods: Data: Review of literature on social determinants.

Results: The social determinants related with oral disease in AMER are socioeconomic, demographic characteristics and behavioural risk variables.

Discussion: Dental caries and periodontal disease is associated with low income and education and health-compromising behaviours. Oral cancer is related to social and economic factors, culture, work environment, health care delivery systems and environmental toxicants. However, the data from AMER are limited but it is observed that oral cancer is becoming a rising health problem in the area. Oral manifestations of HIV/AIDS (oral candidiasis, atypical

oral ulcerations, lymphomas) are mostly associated with individuals of low-income, low education coming from rural areas. Noma is a disease affecting malnourished children in parts of Africa and it has also been related to HIV. It is strongly connected with severe poverty. Maxillofacial trauma occurs due to violent behaviours, alcoholism, harsh living conditions and is more often experienced among poor, low-income social groups both in developed or developing countries. Craniofacial anomalies (orofacial clefts and cleft lip/cleft palate), however, are not directly linked with socioeconomic factors.

Conclusion: The authors conclude with stressing the need for development of oral health policies in AMER as well as the integration of oral health into primary general health.

3, Oral health of foreign domestic workers: exploring the social determinants.

Gao X, Chan CW, Mak SL, Ng Z, Kwong WH, Kot CC. Oral health of foreign domestic workers: exploring the social determinants. J Immigr Minor Health. 2014 Oct;16(5):926-33.

Objective: Explore the social determinants that affect oral health among Indonesian domestic workers in Hong Kong.

Study type: Cross-sectional study.

Methods: Participants: random sample of Indonesian domestic workers, n= 122, working in Hong Kong for 12 months. Data collection: Questionnaires, caries experience as DMFT index and periodontal status as Community Periodontal Index (CPI).

Results: The 122 participants were women between 25-59 years. The 94% had dental caries with an average of 5,3 teeth. CPI=2 was found in 53%, while 39% had shallow periodontal pockets and 7% had deep periodontal pockets.

Discussion: Acculturation (competence in local language); good living conditions (workers having their own room): and social engagement were the social determinants that could be associated with either good or poor oral health. Namely, domestic workers that spoke the local language fluently , had a private room in the house where they were working, and participated in social events like religious ceremonies in their leisure time, had a lower

DMFT than those who did not speak the local language, had no private room, and in their free time met only with relatives living and working in Hong Kong. However, periodontal status could not be related to any of the above social determinants.

Conclusion: The findings of the study help us understand the complex social factors that influence oral/dental health among immigrants.

4, Tooth loss in middle-aged adults with diabetes and hypertension: Social determinants, health perceptions, oral impact on daily performance (OIDP) and treatment need.

Maia FB, de Sousa ET, Sampaio FC, Freitas CH, Forte FD. Tooth loss in middle-aged adults with diabetes and hypertension: Social determinants, health perceptions, oral impact on daily performance (OIDP) and treatment need. Med Oral Patol Oral Cir Bucal. 2018 Mar 1;23(2):e203-e210.

Objective: Investigate the social determinants which are related to tooth loss among middle-aged adults with diabetes and hypertension.

Study type: A cross-sectional study

Methods: Participants: randomly selected hypertensive and diabetic adults, n= 212, between 50-65 years from Santa Rita, Brazil. Data collection: missing tooth index independent of the reason, and questionnaires.

Results: Tooth loss was associated with co-variables such as last dental visit, reason for dental visit, self-perception of oral health, self-concept of oral treatment need and schooling.

Discussion: With an annual dental visit, the chance of losing a tooth dropped to 66%. Self-concept of oral treatment need was considered as a protective factor of tooth loss and confirms the importance of the positive/negative behavioural path namely under poor social conditions. Schooling/education level highlights the fact that low-education populations need more and clear instructions from the oral health-personnel. Nevertheless, it was not easy to

estimate how diabetes and hypertension affected tooth loss due to the several modifying factors related with these health conditions.

Conclusion: The investigators stress the need for the development of oral health policies for individuals of low socioeconomic status who are affected by chronic disease.

5, Common risk factors and edentulism in adults, aged 50 years and over, in China, Ghana, India and South Africa: results from the WHO Study on global AGEing and adult health (SAGE).

Kailembo A, Preet R, Stewart Williams J. Common risk factors and edentulism in adults, aged 50 years and over, in China, Ghana, India and South Africa: results from the WHO Study on global AGEing and adult health (SAGE). BMC Oral Health. 2016 Jul 27;17(1):29.

Objective: Correlation of edentulousness prevalence and common risk factors of edentulousness in adults of >50 years of age in China, Ghana, India and South Africa.

Study type: Epidemiological study

Methods: Recompilation of data from a World Health Organization longitudinal study: Study on global AGEing and adult health Wave 1, conducted between 2007-2010 and included adults older than 50 years, from China, Ghana, India, South Africa, Mexico and Russia (these two last countries were not included to the study). Data collection: Interviews and questionnaires. Study sample: China, N=11,692; Ghana, N= 4093; India, N=6409 and South Africa, N= 2985. Dependent variable was edentulousness.

Results: The prevalence of edentulousness was higher in India with 15,3% and lower in Ghana with 2.3%. China and South Africa had a prevalence of 8.9% and 8,7%, respectively.

Discussion: The lower prevalence of edentulousness in Ghana may be related to the fact that the vast rural population have no access to refined sugars. However, in China the prevalence of edentulousness is higher in rural populations but lower among high educated and high-income individuals. In South Africa, the prevalence of edentulousness is higher among individuals of secondary education or of high income. The highest prevalence of

edentulousness in India is due to negative oral behaviours, for instance, adults over 50 years prefer tooth extraction rather than other treatments.

Conclusion: The authors emphasize the need for developing oral health policies that will reduce the oral health inequalities.

6, Self-reported oral health among a community sample of people experiencing social and health inequities: cross-sectional findings from a study to enhance equity in primary healthcare settings.

Wallace B, Browne AJ, Varcoe C, Ford-Gilboe M, Wathen N, Long PM, Parker J. Self-reported oral health among a community sample of people experiencing social and health inequities: cross-sectional findings from a study to enhance equity in primary healthcare settings.BMJ Open. 2015 Dec 23;5(12):e009519.

Objective: Investigate the social determinant of self-reported oral health among people experiencing social and health inequalities, in two Canadian provinces.

Study type: Multiple case study

Methods: Data recollected from a large-scale study EQUIP research programme. Participants: Marginalised populations from two clinics in British Columbia and two in Ontario, n=567, adults over 18 years, English speaking. Data collection: Interviews. Variables: self-rated oral health, experiences accessing and receiving healthcare, standard self-reported measures of health, quality of life.

Results: Self-rated poor oral health was reported by 46.3% of the participants.

Discussion: Most of the participants reported financial and mental health-vulnerability, physical trauma and housing instability. In particular, the unemployed population of low education, which received a disability assistance at home, scored the highest prevalence of poor self-reported oral health. Also, the participants suffering of depression scored high on poor self-reported oral health.

Conclusion: The authors conclude that poor self-reported oral health is strongly related to financial- and mental health-vulnerability.

II. Inequalities/disparities in oral health - disease burden, impact and access to care.

The12 publications on this topic are presented in 3 subgroups regarding: a) 5 publications addressing oral health disparities among children; b) 3 publications comparing ethnic groups ; and c) 4 publications addressing rural populations.

a. Oral health disparities among children.

1, Oral Health Disparities in Children: A Canary in the Coalmine?

Watt RG, Mathur MR, Aida J, Bönecker M, Venturelli R, Gansky SA. Oral Health Disparities in Children: A Canary in the Coalmine? Pediatr Clin North Am. 2018 Oct;65(5):965-979.

Objective: Overview of children's oral disease in relation to disparities.

Type of study: Overview article

Methods: Data collected from the US National Health and Nutrition Examination Survey. International literature on oral health.

Results: The disease burden that mostly affects children in the USA is dental caries. These children are originally from low-income families or live below the poverty level.

Discussion: Access to oral health care services for these children is inadequate or completely absent in the USA but also in South America, Africa and Asia. The impact of oral health disparities in these children's life is mostly associated with long absence from school because of dental pain; lower school performance; poor self-esteem. All these factors affect their social life both in childhood and later in adulthood (job interviews, social events, friends).

Conclusion: Watt et al. underline that oral disease in childhood is a strong marker of social disadvantages.

2, Inequalities in oral health for children with disabilities: a French national survey in special schools.

Hennequin M, Moysan V, Jourdan D, Dorin M, Nicolas E. Inequalities in oral health for children with disabilities: a French national survey in special schools. PLoS One. 2008 Jun 25;3(6):e2564.

Objective: Evaluate and compare the oral health of children and adolescents with and without disabilities in France.

Type of study: Cross sectional study.

Methods: Data: National survey that evaluated oral health of children and adolescents between 6-20 years, attending 1,259 special schools (N=2,487, 6-12 years and N=4,772, 13-20 years). Regional survey from 1,772 mainstream schools attending children between 6-12 years without disabilities (N= 1,772), in the department of Puy de Done. Data collection: Dental caries DMFT index and interviews.

Results: Children and adolescents with disabilities presented poorer oral health and had a greater need for treatment and preventive oral care than their counterparts without disabilities.

Discussion: The adolescents with disabilities between 13-20 years had a poorer oral/dental status and had an urgent need for dental treatment, prevention and dental education (toothbrushing, use of fluorides). On the one hand, the performance of daily oral hygiene is insufficient or absent among people with disabilities. On the other hand, the lack of an oral health-insurance system for people with disabilities in France leads to neglected/untreated oral disease when the cost is unaffordable for the family.

Conclusion: The development of oral health policies is of a great importance for people with disabilities.

3, Addressing children's oral health inequalities: caries experience before and after the implementation of an oral health promotion program.

Tubert-Jeannin S, Leger S, Manevy R. Addressing children's oral health inequalities: caries experience before and after the implementation of an oral health promotion program. Acta Odontol Scand. 2012 May;70(3):255-64.

Objective: The evaluation of the dental status of children at the age of 5 years before and after the implementation of an Oral Health program (ORHPp) in 9 schools in Clermont-Ferrand, France.

Type of study: Randomized control trial; cross sectional study.

Methods: Participants: 5-year old children (n= 453) in 2003 and (n = 478) in 2009 from 21 public schools in Clermont-Ferrand, and Data collection: Questionnaires to the parents. Dental caries registration DMFT-index.

Results: In 2003 the children from the deprived/semi-deprived areas scored 3-5 times higher dental caries prevalence in primary dentition than their counterparts from the non-deprived areas. In 2009 and after the implementation of the ORHPp the caries prevalence did not show any significant change in those areas.

Discussion: After the implementation of the ORHPp, the overall caries prevalence was lower. However, in deprived/semi-deprived areas the mean DMFT index was higher in schools that did not have the ORHPp, while in schools that were benefited by the ORHPp there was not any significant reduction in the mean DMFT index. This fact indicates that the ORHPp failed to reduce the oral health inequalities between children coming from deprived/semi-deprived and non-deprived areas.

Conclusion: Tubert-Jeannin et al. conclude that Oral health Promotion programs need a multidisciplinary collaboration when designed in order to improve their effectiveness.

4, Water fluoridation and ethnic inequities in dental caries profiles of New Zealand children aged 5 and 12-13 years: analysis of national cross-sectional registry databases for the decade 2004-2013.

Schluter PJ, Lee M. Water fluoridation and ethnic inequities in dental caries profiles of New Zealand children aged 5 and 12-13 years: analysis of national cross-sectional registry databases for the decade 2004-2013. BMC Oral Health. 2016 Feb 18;16:21.

Objective: Investigate differences on dental caries index among Maori and Non-Maori children whether they live in areas with community water fluoridation (CWF) or not.

Type of study: A secondary national cross-sectional analysis

Methods: Participants: 5-year old children, n=417,318 of whom 22,5 % Maori. Children 12-13 years old, n= 471,333 of whom 19,9% Maori. Data collection: Dental caries DMFT index. CWF status was classified from the public water supply status of the school.

Results: Maori children living in non-CWF areas had higher mean DMFT index than Maori and non-Maori children living in CWF areas.

Discussion: Maori children either living or not in CWF areas scored higher mean DMFT index than their non-Maori counterparts living in non-CWF areas. The last years the enrolment fee to child oral health service has increased for all children, however, non-Maori children pay 11-14% less than Maori children for their enrolment to the service. Subsequently, many Maori children are excluded from the benefits of the service because Maori are the most financially deprived group in New Zealand.

Conclusion: The CFW may have been an effective public health measure but it has been ineffective in equalizing the oral health inequalities experienced by Maori children.

5, Oral health inequalities between young Aboriginal and non-Aboriginal children living in Ontario, Canada.

Lawrence HP, Binguis D, Douglas J, McKeown L, Switzer B, Figueiredo R, Reade M. Oral health inequalities between young Aboriginal and non-Aboriginal children living in Ontario, Canada. Community Dent Oral Epidemiol. 2009 Dec;37(6):495-508.

Objective: Investigate the oral health inequalities between pre-school Aboriginal children and their non-Aboriginal counterparts in Ontario, Canada.

Type of study: Cross-sectional study.

Methods: Participants: 3-5-year-old children attending JK in the Thunder Bay District. N= 416 (2003-2004); n= 687 (2004-2005); n=544 (2005-2006). 6-year old children living in 16-20 First Nations communities (SLZ). Data collection: Dental caries DMFT index.

Results: The Aboriginal children living off reserve had a mean DMFT index=5,9 while the non-aboriginal children had a mean DMFT= 1,5. However the Aboriginal children living in the reserve had a mean DMFT index=12,5.

Discussion: Significant differences were found among the Aboriginal children living off- and in the reserve, but their overall dental status was poorer in comparison of the non-Aboriginal children. This fact strongly indicates that the Aboriginal children are subjects to oral health inequalities irrespective of living in urban or rural areas.

Conclusion: The authors suggest that the paediatricians and other health providers who work in Aboriginal communities should be trained in order to carry out primary dental care interventions.

b. Oral health disparities among ethnic or other population groups.

1, The magnitude of Indigenous and non-Indigenous oral health inequalities in Brazil, New Zealand and Australia.

Schuch HS, Haag DG, Kapellas K, Arantes R, Peres MA, Thomson WM, Jamieson LM. The magnitude of Indigenous and non-Indigenous oral health inequalities in Brazil, New Zealand and Australia. Community Dent Oral Epidemiol. 2017 Oct;45(5):434-441.

Objective: Compare oral health inequalities between non-indigenous and indigenous populations in Brazil, New Zealand and Australia.

Type of study: Comparative cross-sectional study.

Methods: Data collection: data from the national surveys of Brazil, New Zealand and Australia. Brazil: participants n=37.519. New Zealand: n=6318. Australia: n= 273 indigenous

and n= 517 non-indigenous. Dental examination: Dental caries DMFT index, CPI and questionnaires.

Results: The indigenous populations irrespective of country of origin scored higher in the parameters: inadequate dentition, untreated dental caries, periodontal disease, and “fair” or “poor” self- rated oral health.

Discussion: The indigenous populations carry the burden of oral disease and suffer the magnitude of the inequalities in oral health in comparison to their non-indigenous counterparts that can access oral health services or pay health. The Australian indigenous populations have the greatest proportion of untreated caries, 80,4%, and the greatest prevalence of deep periodontal pockets (1/3 of the population) compared to their Brazilian and New Zealand indigenous counterparts. Moreover, many rural areas both in Brazil and Australia, mostly inhabited by indigenous groups, lack community water fluoridation among other services.

Conclusion: Oral health strategies/policies should be designed in a way that will include the indigenous populations to the community services.

2, Inequalities in Indigenous Oral Health: Findings from Australia, New Zealand, and Canada.

Jamieson LM, Elani HW, Mejia GC, Ju X, Kawachi I, Harper S, Thomson WM, Kaufman JS. Inequalities in Indigenous Oral Health: Findings from Australia, New Zealand, and Canada. J Dent Res. 2016 Nov;95(12):1375-1380.

Objective: Compare the extent of oral health inequalities among indigenous populations in Australia, Canada and New Zealand.

Type of study: Comparative cross-sectional study.

Methods: Data collection: National surveys: Australia: participants n= 14,123. Canada: participants n= 5,586. New Zealand: n=4,906. Dental caries DMFT index and Interviews.

Results: In all 3 countries indigenous populations had both poor clinical and self- reported oral health compared with the non-indigenous populations.

Discussion: The Aboriginals of Canada had a better clinical and self- reported oral health, followed by the Maori of New Zealand. The Aboriginals of Australia were the group that had the poorest clinical and self-reported oral health. The differences observed among the indigenous populations are closely related with the delivery of the dental care system in these 3 countries. In Australia the dental care is provided by the private sector; in Canada only 6% of the population is covered by public dental insurance; and in New Zealand the public insurance covers only emergencies.

Conclusion: The authors suggest that a greater effort should be made by the dental professionals and policy makers to develop national and international oral health policies that will include and not exclude indigenous populations.

3, Oral health needs assessment world-wide in relation to HIV. Themes: Oral health needs and inequalities, oral health promotion, co-ordinating research and enhancing dissemination in relation to HIV- a workshop report.

Koyio L, Ranganathan K, Kattappagari KK, Williams DM, Robinson PG. Oral health needs assessment world-wide in relation to HIV. Themes: Oral health needs and inequalities, oral health promotion, co-ordinating research and enhancing dissemination in relation to HIV- a workshop report. Oral Dis. 2016 Apr;22 Suppl 1:199-205.

Objective: Explore oral health inequalities among HIV-patients and oral health promotion.

Type of study: Recollection article of the most important moments from the 7th World Workshop on Oral Health & Disease in AIDS.

Results: HIV-patients suffering severe oral lesions do not receive the appropriate treatment because of the high cost of these therapies, which are not covered by any public insurance.

Discussion: The unaffordable cost of the oral treatment for HIV-patients makes many dentists decline to treat this patient-group because there is no oral health insurance that will

cover the cost, for instance in India. However, in countries such as South Africa, were the prevalence of HIV-patients is high, the dentists have successfully implemented oral infection-control standards in order to reduce the infection in the oral cavity for these patients.

Conclusion: The workshop concluded with the Hyderabad Declaration, a call for international collaboration in order to promote the oral health care for HIV-patients, free of prejudice, discrimination and neglect.

c. Oral health disparities among urban and non-urban populations.

1, The importance of substate surveillance in detection of geographic oral health inequalities in a small state.

Anderson L, Martin NR, Flynn RT, Knight S. The importance of substate surveillance in detection of geographic oral health inequalities in a small state. J Public Health Manag Pract. 2012 Sep-Oct;18(5):461-8.

Objective: Geographic inequalities in oral health regarding school children and adults, in the county of Hampshire in Canada

Type of study: Comparative Cross-sectional study

Methods: Data collection: Third Grade Oral Health (2004-2009) survey and NH Behavioral Risk Factor Surveillance System (2005) surveys. Participants: Adults, n= 12,935; children n=1,469 (2004), n= 8,215 (2005) and n=3015 (2009). Dental caries DMFT index, missing teeth index and Interviews.

Results: Among the 10 regions that make up the Hampshire county, the Coos region had a 64% (highest) prevalence of dental caries experience and 31% untreated caries among third grade children, versus 44% (lowest) and 12% respectively in the New Hampshire region. As for the adults in the Coos region, 29% were edentulous while the overall estimate of edentulousness in the Hampshire county was 12%.

Discussion: The results of the study clearly prove the existence of geographical based oral health inequalities within the same county combined with other social determinants of oral disease. Coos has the lowest household income and the lowest proportion of adults with high education, while only the 9% of the inhabitants of Coos have access to Community Fluoridated Water.

Conclusion: The authors conclude that remote, low-income, rural areas must bear the burden of oral disease due to the shortage of dental health professionals who are willing to establish and work in those areas.

2, Oral Health Inequalities between Rural and Urban Populations of the African and Middle East Region.

Ogunbodede EO, Kida IA, Madjapa HS, Amedari M, Ehizele A, Mutave R, Sodipo B, Temilola S, Okoye L. Oral Health Inequalities between Rural and Urban Populations of the African and Middle East Region. Adv Dent Res. 2015 Jul;27(1):18-25.

Objective: Highlight the oral health inequalities among urban and rural areas in the African and Middle East region (AMER).

Type of study: Literature review.

Methods: Search in PubMed, retrieved n=676 publications. Other publications that were not in PubMed but known to the authors were also included.

Results: The rural populations have poorer oral health compared to their urban counterparts due to poverty; absence of dental services; the use of local traditional healers, in 7 AMER countries (Ghana, Kenya, Mali, Senegal, Tanzania, Zambia and Zimbabwe).

Discussion: The rural populations have no access to piped water and subsequently no access to fluoridated water, while the majority cannot even afford buying oral hygiene remedies. The rural populations have limited knowledge on preventive dental care, so they adopt unconventional oral hygiene habits. In rural areas, accessibility and utilization of modern

dental services is either seldom or completely absent. The distribution of traditional healers is greater in rural areas due to the total absence of other health care providers.

Conclusion: Ogunbodede et al. conclude by expressing their concern about the complete exclusion of the rural populations from the oral health delivery system in the majority of the AMER, and they suggest the participation of more oral health providers in order to promote oral health in those areas.

3, Oral health disparities among adolescents from urban and rural communities of central Chile.

Giacaman RA, Bustos IP, Bazán P, Mariño RJ. Oral health disparities among adolescents from urban and rural communities of central Chile. Rural Remote Health. 2018 Apr;18(2):4312.

Objective: Compare the oral health status of adolescents from rural and urban areas from central Chile, Maule.

Type of study: Cross sectional study.

Methods: Data collection: random sample, adolescents aged 12, n= 552 and 15 years, n= 486. Parameters: Dental caries DMFT index and clinical attachment loss and community periodontal index (CPI) only for the 15-year-old.

Results: 12-year-old adolescents in urban areas have mean DMFT index=2,29 versus mean DMFT index=3,36 for their rural counterparts; 15-year-old adolescents in urban areas scored mean DMFT index=4,65 versus mean DMFT index=5,03 for their rural counterparts. There were not found significant differences regarding the CAL and CPI among 15-year-old adolescents in urban and rural areas. Regarding CAL, mean index=0-3mm among urban adolescents and 4-5mm among rural adolescents.

Discussion: The differences in oral/dental health among urban and rural adolescents are mostly a result of limited or absent access to Community water fluoridation in the rural areas of Chile.

Conclusion: The authors suggest that the lack of a national strategy for installing Community water fluoridation in the rural areas in Chile is a big obstacle in the prevention of dental disease among rural populations.

4, Dental health policies in Brazil and their impact on health inequalities.

Antunes JL, Narvai PC. Dental health policies in Brazil and their impact on health inequalities. Rev Saude Publica. 2010 Apr;44(2):360-5.

Objective: Evaluate the efficacy of certain dental policies in Brazil and demonstrate the oral health inequalities that emerged after the application of those dental health policies.

Type of study: Review article.

Methods: Data collection: sources from the Ministry of Health, and IBGE- Brazilian Institute of Geography and Statistics.

Results: The program of water fluoridation and the Dental public service system (SUS) failed to reach and benefit the most remote low-income rural areas.

Discussion: The community water fluoridation was introduced in Brazil in the 1950s, but it was not extended to the most rural and remote areas of the country. The creation of the Dental public service system (SUS) in 1998, which promoted universality, integration and equinity in oral /dental health proved unable to reduce the gap of oral health inequalities between rich-urban districts and rural/urban-poor districts. Another reason of failure of the SUS has been the limited incorporation of dentists in remote rural areas compared with their vast participation in urban areas.

Conclusion: The authors emphasize the need for interventions in oral health with a strategic plan that will benefit the whole population. Otherwise, these positive public health-interventions can result in policies that discriminate and exclude disadvantaged population groups.

III. Challenges in dental education.

It was retrieved 6 publications that investigate some of the challenges in dental education: a) 4 publications addressing challenges regarding the delivery of oral health care; and b) 2 publications focusing upon challenges in the funding of dental education.

a. Challenges in dental education regarding the delivery of oral health care.

1, Dental education and changing oral health care needs: disparities and demands.

Albino JE, Inglehart MR, Tedesco LA. Dental education and changing oral health care needs: disparities and demands. J Dent Educ. 2012 Jan;76(1):75-88.

Objective: Investigate how the dental education will prepare the dental students and future oral/dental health providers so that they will provide optimal oral/dental care to underserved groups.

Type of study: Overview article

Methods: The corpus is based on the *Surgeon general report of 2000*, in the USA.

Results: The challenges for the dental students/professionals can be resumed in four underserved patient groups: low income/education adults; children; patients with multiple health conditions and polypharmacy; patients with cultural and communicative challenges.

Discussion: The high poverty rate after 2010 hindered the access to oral/dental services for the low income/education families. Also, it has been observed that these dental patients find it difficult to understand the information given by the dental personnel. Due to that, the dental students should learn how to approach such population groups both in the classroom and in community-based educational settings. Moreover, the dental students should be trained in order to achieve proper communication techniques and treatment alternatives compatible with the elder's multiple needs. Pediatric oral health should be central in the dental curricula since children suffer the burden of dental caries. Cultural/language diversity among the patients stresses the need for cultural/language competent dental providers. Hence, an

interdisciplinary approach with case-based teaching would increase cultural awareness to the dental students.

Conclusion: The authors suggest that the different actors of dental education together with the dental professionals should raise awareness for the creation of oral health policies for the socially disadvantage populations.

2, Serving the public good: challenges of dental education in the twenty-first century.

Davis EL, Stewart DC, Guelmann M, Wee AG, Beach JL, Crews KM, Callan RS. Serving the public good: challenges of dental education in the twenty-first century. J Dent Educ. 2007 Aug;71(8):1009-19.

Objective: Explore the roles and the responsibilities of dental education in serving the public good and verify the grade that this object is succeed.

Type of study: Cross-sectional analysis

Methods: The study was carried out by one of the three groups of fellows in the American Dental Education Association Leadership Institute class of 2006. Participants (N=51): Leaders of institutions of higher education leaders of organized dentistry and public health. Study design: Interviews and questionnaires

Results: The responders all agreed that the dental education serves the public good, promotes oral health care, educates the public and provides access to dental care for all populations. Moreover, most of the responders agreed on the importance of preventing dentistry from becoming a profession serving only the wealthy populations.

Discussion: The future dental professionals will develop socially responsible behavior only by integrating in the dental curricula community-based programs in more remote areas. Furthermore, the dental students should be trained in order to acquire knowledge on cultural diversity and working with medical complex elderly patients. However, it is commonly agreed that the dental education fails to promote oral care to the public. One solution could be

the development of service-learning linking the academic coursework to the community service.

Conclusion: The authors conclude that more reforms in the dental curricula must be accomplished in order to educate socially aware and culturally competent dental professionals.

3, Overcoming structural inequalities in oral health: the role of dental curricula.

Foster Page LA, Chen V, Gibson B, McMillan J. Overcoming structural inequalities in oral health: the role of dental curricula. Community Dent Health. 2016 Jun;33(2):168-72.

Objective: Investigate the role of dental curricula in order to overcome the structural inequalities in oral health.

Type of study: Overview article.

Results: The dental curriculum has a major impact on the dental student's perception of their role as future dental professionals, hence, it is important that the dental curriculum arise social awareness.

Discussion: Many regard dentistry as a market-driven profession, thus some students choose it in order to improve their social position and living standard. Nonetheless, the creation of social aware dental students and socially responsible oral health providers should start with the integration of community programs in the dental curriculum. However, after the participation of dental students in a community-based program in the USA, many of the students perceived that low-income/poor populations were themselves responsible both for their situation and for improving their life. Some considered that poverty was a distant issue not related with oral health and that the government should deal with the situation. Others expressed their reluctance to work with underserved populations in the future. Consequently, the role of dental institutions in creating socially accountable dental professionals is of major importance.

Conclusion: It is a great challenge for the oral/dental educators to prepare socially responsible dental students and future dental professionals. Nonetheless, the greater challenge for the dental institutions is to create oral/dental professionals who will be willing to participate in actions for diminishing oral health inequalities.

4, Critical incidents, successes, and challenges of community-based dental education.

Mathieson KM, Gross-Panico ML, Cottam WW, Woldt JL. Critical incidents, successes, and challenges of community-based dental education. J Dent Educ. 2013 Apr;77(4):427-37.

Objective: Present the outcome of community-based dental education program organized by the Arizona School of Dentistry.

Type of study: Qualitative study.

Methods: Participants: 12 groups of 7-10 dental students. Data recollection: Questionnaires, recordings and notes.

Results: The students evaluated positively the program and stated that: they felt more self-confident in order to deliver complicated dental procedures; improved clinical knowledge and experience; obtained self-awareness regarding the sector of specialization after graduating

Discussion: The overall learning outcomes were positive for the students except for some students that experienced difficulties with communicating and treating patients with multiple needs. Another challenge that emerged during the rotation community-based program was the funding of travelling and housing. Thus, many of the students considered it a negative factor that they had to cover the cost themselves even if the program had a positive outcome in their improvement of clinical and communication skills.

Conclusion: The results of this report were taken under consideration and some adjustments were made concerning the rotation program. Nonetheless, the authors suggest that their findings could be informative for other dental institutions that already have, or are planning to insert in their curricula, rotation programs for dental students.

b. Financial challenges in dental education.

Financial challenges in dental education, both from the student's perspective and from the dental institution's perspective.

1, Advancing Dental Education in the 21st Century: Phase 2 Report on Strategic Analysis and Recommendations.

Formicola AJ, Bailit HL, Weintraub JA, Fried JL, Polverini PJ. Advancing Dental Education in the 21st Century: Phase 2 Report on Strategic Analysis and Recommendations. J Dent Educ. 2018 Oct;82(10):eS1-eS32.

Objective: Present the challenges facing dental education in the USA focusing in the funding of Dental Schools and the finance burden of dental students, and how these factors influence the present and future of dental education.

Type of study: Report.

Methods: In 2015, the project 'Advancing Dental Education in the 21st Century' was launched and assigned 37 articles and 6 executive summaries. Those are the corpus for Phase 2 of the project which presents the challenges in the dental education.

Results: The challenges facing dental schools: i) outdated financial and educational models; ii) The opening of 13 new dental schools since 1990, has created a high number of graduates; iii) shifting practice environment, from the traditional solo general/specialty practice to large medical organization; iv) insufficient support for research.

Discussion: The outdated financial models of dental education in the USA influences dental students as well. For instance, the financial burden for the fulfillment of integrated community-based programs fall entirely on the students. The insufficient support for research discourages dental students from participating in research programs/follow a research carrier after graduation. Consequently, most dental graduates prefer to work, rather than take additional grades, and continue with a specialization/research carrier.

Conclusion: The authors conclude by recommending changes in dental curricula; integration of dental education to the curricula of other health professions; reinforce the interest in research among dental students and a scientific upgrade of the dental institutions in order to serve their societal role.

2, Integrating a primary oral health care approach in the dental curriculum: a Tanzanian experience.

Mumghamba EG. Integrating a primary oral health care approach in the dental curriculum: a Tanzanian experience. Med Princ Pract. 2014;23 Suppl 1:69-77.

Objective: Part 1: Present a brief review on the integration of Primary Oral Health Care (POHC) in the curricula of different dental schools/universities. Part 2: Case study presenting the challenges in financing a primary oral health care program integrated to the dental curriculum of the Muhimbili University of Health and Allied sciences, Tanzania.

Type of study: Part 1: Literature review; Part 2: Case presentation

Methods: Recompilation of articles from PubMed; Cochrane; ScienceDirect; Scopus, Wiley-Blackwell Interscience; Sage and the Health InterNetwork Access to research Initiative (HINARI).

Results: The integration of a primary oral health care program in the dental curriculum of the 6^{th}, 8^{th} and 10^{th} semester of studies in the School of Dentistry in Tanzania depicts that the overall learning outcome was positive and encouraging for the success of the program.

Discussion: The participation in the program included field rotation of the dental students in community dental clinics. During their practice in the dental clinics the students, in addition to dental examination/treatment, had to give nutrition counselling, measure blood pressure, measure the weight and height of both mothers and children. Despite the positive feedback from students and health personnel, the government recommended retails to the budget of the program. Subsequently, the time distributed for the rotation program had to be reduced.

Conclusion: Mumghamba concludes that the challenges in integrating a POHC in the dental curriculum in a developing country like Tanzania are mainly financial. The retails of the country's overall budget influence, mainly the financial support appointed to education and subsequently scientific research.

To sum up, the main findings in this review have been:

I.Social determinants and common risk factors as the main drivers of oral disease;
Main findings:

a. Pediatric and adolescent oral health is the outcome of the interplay between biological and socioeconomic factors. The biological factors are studied to a great extent and, among others, try to explain oral disease via genetics. The socioeconomic factors related to oral disease/health are based on the study of family's socioeconomic status, function and structure; family's health behaviours; culture-ethnicity-race; social environment (neighbourhood, district); social capital; and access to dental care. All the above can influence oral health either positively or negatively through a complex system (Socioecological framework). The main oral disease among children and adolescents is dental caries;

b. Adults' oral health is closely related to the individual's socioeconomic status (income, social status), educational level, race, mental health, civil status, employment/unemployment and immigrant status. The higher the individual's position and education in society, the better the oral/dental health condition is. On the other hand, marginalized and disadvantaged members of the society (low income and low education; vulnerable mental health; unemployed; immigrants) experience severe oral disease more often. Interestingly, acculturation is a positive oral health determinant among immigrants of low socioeconomic status. The main oral diseases among adults are dental caries, periodontitis, tooth loss and edentulousness.

II.Inequalities in oral health- disease burden, impact and access to care;

Main findings:

a. Oral health problems are more frequent and severe among low-income or under the poverty percentage populations (adults and children). These populations have to bear the burden of oral disease (dental caries; periodontitis; edentulism; Noma, a disease prevalent only in sub-Saharan African countries; and oral manifestation of HIV/AIDS) because they cannot afford the high cost of dental care, thus they cannot access the dental care system;

b. Children/adolescents with disabilities more often have poor oral health because of the absence of oral health insurance policies addressing this group;

c. Ethnic population groups and rural populations experience impaired oral health because they mostly inhabit remote rural areas, thus, they are often excluded from community oral health programs (for example, WCF-programs). Furthermore, indigenous populations are among the most affected by the social determinants of oral health (low-income, low educational level).

d. Another aspect in the creation of oral health inequalities is the reluctance of oral health providers to work with underserved populations or to establish practice in remote and poor rural areas.

III.Challenges in dental education.

Main findings:

a. The challenges in contemporary and future dental education have originated from the continuously impoverishment of urban and rural populations; the multiple dental care needs of a continuously ageing population with multiple health conditions; cultural diversity; and the failure of oral health policy makers to effectively promote a public oral health system.

b. The revision of dental curricula with a successful implementation of community-based programs will help to raise social awareness among the future oral health professionals. This is another challenge facing dental education.

c. The funding of dental institutions is another major challenge. On the one hand, the institutions have less funds to invest in scientific research. On the other hand, the burden of student loans is unbearable for the dental students, hence, after graduation they are reluctant to participate in research programs, or establish as dental professionals in deprived areas.

4 Discussion.

The aim of this study was to systematically review the available literature between 1999-2019 in order to identify: I) Social determinants and common risk factors as the main drivers of oral disease; II) Inequalities in oral health- disease burden, impact and access to care; III) Challenges in dental education- delivery of oral care and founding . The literature search retrieved 30 publications of which n=4 retrieved between 1999-2009, and n=26 between 2010-2019. The studies retrieved were representative from the USA; Canada; Brazil, Chile; UK; France; Germany; Netherlands; Tanzania; Kenya; AMER; Hong Kong; India; Australia, New Zealand. This fact indicates the rising interest on the study of how social factors can affect oral health and oral disease; which population groups are mostly affected and how they experience the inequalities in oral health; and the challenges in educating and training the future oral health providers.

The four publications retrieved between the decade 1999-2009 investigate the topics of social determinants, *Fisher-Owens et al (6)*; inequalities in pediatric oral health, Hennequin et al *(7)*; Inequalities between indigenous and non-indigenous populations, Lawrence et al (8); challenges in dental education, *Davis et al (9)*. The twenty-six publications retrieved between the decade 2010-2019 cover almost all the aspects of the three topics proposed for investigation in the present study. This fact could indicate a turning point in the conceptualization of oral health and oral disease from the merely biological model towards the socioeconomic- sociological model of oral disease.

Fisher-Owens et al (6) conceptualized the influences of pediatric oral disease by combining the biological model of oral disease with psychosocial and environmental predictors (Socioecological framework) in order to depict the role of the social determinants as the main drivers of oral disease. Furthermore, in 2010, the WHO published a framework in order to inform and call into action with the aim to tackle the social determinants of health inequalities. Subsequently, a great part of the oral health scientific community turned its interest in the investigation of the sociological aspects of oral disease.

On the other hand, apart from the oral scientific community, some of the most striking events that happened in the decade 2000-2009 which could have influenced the

socioeconomic predictors related to oral health in the following decade were: the war in Afghanistan in 2001 and the war in Iraq in 2003, these two wars created a vast wave of refugees towards Europe and the USA (10); In 2005, the Hurricanes Katrina and Rita destroyed 275,000 homes, and 400.000 jobs were lost while hundreds of thousands of people were displaced, in the USA (10); During 2007-2009 the collapse of Wall Street in the USA was followed by a global financial recession and a financial market crisis (10). In 2011, the war in Syria created a refuge wave towards Europe, the USA and Canada. This could also be considered another important factor that influenced the socioeconomic predictors of oral disease. However, in the publications that is listed social determinants and inequalities in oral health as keywords / MeSH-terms there is little focus on the disease burden of war refugees. Most of the publications retrieved concentrate on the social determinants and oral health disparities among immigrant populations, indigenous populations, rural population, people with disabilities and HIV-patients. These particular populations are subjects to oral health inequalities because of their low educational-socioeconomic position; ethnic origin, geographical, regional or district differences.

I) Social determinants and common risk factors as the main drivers of oral disease;

The main social determinants and common risk factors of oral health are related to socioeconomic status; educational level; employment or unemployment; health behaviours; mental health; culture; ethnicity; race; immigrant status; social environment; social capital; geographical settlement and access to dental care. All the above determinants can effect either positively or negatively the oral health of children and adolescents. Moreover, when the family or the individual experiences a deteriorated/impoverished/vulnerable social status in combination with the absence of public oral health policies that will eventually result in unmet oral/dental need.

Fisher-Owens et al (6) conceptualize the Socioecological framework of pediatric oral health. The socioecological model proposes the correlation of children's oral health in three levels: a) child level: genetic endowment; physical and demographic attributes, race, ethnicity; health behaviors of the child, self-esteem and self-efficacy; b) Family level: family status and function; parental socioeconomic status and education; parental health status; family's health behaviors; social support and social net; culture; physical safety; c)

community level: social environment; physical safety in community level; physical environment; community oral health environment; dental and health care characteristics. Accordingly, *Da Fonseca&Avanetti (11)* concluded that the social determinants that can influence children's oral health either positively or negatively are: family's socioeconomic status, function and structure; health behaviours; social environment; social capital; culture-ethnicity-race and access to dental care.

Reynolds et al. (12) found out that the neighbourhood's coherence and sense of safety along with family dinners are two social determinants affecting children's oral health. *Meyer et al. (13)* reports that sociodemographic characteristics influence children's oral health within the same city recording high dental caries prevalence in districts with high rate of unemployment, low-income, low-education and immigrant background. *Fontanini et al. (14)* found out that the number and quality of social support and social networks influence the dental caries index among adolescents. *Kragt et al. (15)* investigated the relation between family's socioeconomic position and children's Oral health-related quality of life and found that children from families of low socioeconomic status reported poorer OHRQoL.

As for adults' oral health, *Henshaw et al (16)* in the USA and *Chidzonga et al. (4)* in African and Middle East region (AMER) found that socioeconomic, demographic characteristics, race and behavioural patterns are related to oral disease. For instance, the survival rate after oral cancer in the USA is lower among low-income Non-Hispanic Blacks, while in AMER Noma is correlated with malnourished poor children. The untreated oral manifestations of HIV/AIDS are common for low-income, low education rural populations in AMER. Orofacial pain is a condition that affect more often low-income populations in the USA and AMER. Dental caries, periodontal disease and edentulouesness are related to low-income and low education populations, while in the USA these conditions are linked also to racial disparities. On the contrary, *Kaleimbo et al. (17)* suggests that the prevalence of edentulousness in South Africa is higher among secondary education, high income, urban populations, arguing that these populations, despite the fact that they have better access to dental services, prefer extraction to other dental treatments. However, *Maia et al. (18)* suggests that edentulouesness is more often related to low education and low social conditions.

Gao et al (19) investigate the social determinants related to oral disease among Indonesian domestic workers in Hong Kong and concluded that acculturation (workers communication skills in the local language), privacy (having their own room) and social network were the key factors for lower dental caries index among this low socioeconomic population group.

Furthermore, *according to Wallance et al (20)* populations with financial, family, mental vulnerability or unemployed reported more often poor oral health and poor OHRQoL.

II) Inequalities in oral health- disease burden, impact and access to care

There are profound inequalities in oral health between populations with low and high income; children/adolescents with and without disabilities; ethnic and not indigenous population groups; and between rural and urban populations. The low income populations, people with disabilities, ethnic groups and rural populations are the ones that mostly experience severe and frequently untreated oral disease due to a variety or combination of factors like unfavorable family/financial/mental/physical conditions; race; and geographical disparities.

Watt et al (20) and *Tubert-Jeannin et al (21)* found that children coming from low-income families or close/under the percentage poverty level who live in deprived districts present a higher dental caries index. Moreover, *Hennequin et al (7)* depicted that children and adolescents with disabilities in France present higher dental caries index than children without disabilities. The investigators stress that the main reason to poor oral health among people with disabilities is the insufficient knowledge about daily oral hygiene regimes among their health personnel/family caretakers and the absence of satisfactory oral health care policies.

Schulter and Lee (22); *Lawerence et al.* (8); *Schuch et al (23)* ; *Jamieson et al. (24),* argue that the indigenous populations (children and adults) have poorer oral health than their non-indigenous counterparts (New Zealand, Canada, Australia and Brazil). Nonetheless, the Australian Aboriginal population score the highest prevalence of dental caries compared with

the Maori of New Zealand, the Aboriginals of Canada and the indigenous populations of Brazil.

Anderson et al (25); *Ogundodebe et al* (26) ; *Giacaman (27)*; *Antunes & Narvai (28)* argue that rural populations in remote and poor regions have worse oral/dental health than their urban counterparts due to limited or absent dental care services or lack of community water fluoridation (Canada, AMER, Chile, Brazil). *Koyio et al. (29)* argues that HIV patients are also one of the underserved groups in oral health due to the fact that the high cost of their oral treatment is not covered by any health insurance in most countries, thus the dentists are reluctant to treat them. Another factor of the untreated oral disease among HIV patients is the prejudice these patients experience from the oral health personnel. However, in South Africa (high prevalence of the disease) the oral infection-control approach for HIV-patients has been successfully implemented. Another remarkable example of the infection control-approach for HIV-patients is Norway that provides a full coverage for oral infection-control treatment through its national social insurance system, HELFO (30).

III) Challenges in dental education- delivery of oral care and funding

The challenges in contemporary and future dental education are closely related with the social determinants and the inequalities in oral health. The future oral health providers will have to confront the burden of oral disease of underserved populations, and they will have to serve a multicultural and multi-ethnic society. The dental institutions are challenged to revise their curricula and promote research programs with state funds.

Albino et al. (31); *Davis et al (9)*; *Foster Page et al.* (32); *Mathieson et al. (33)* argue that the challenges in contemporary and future dental education stem from the continuously impoverishment of urban and rural populations; the multiple dental care needs of a continuously ageing population with multiple health conditions; cultural diversity; and the failure to promote effectively public oral health. Hence, a revision of dental curricula seems to be of major importance in order to prepare and train competent oral health professionals able to successfully overcome these challenges.

Formicola et al. (34); *Mumghamba (35)* stress the fact that the dental institutions need to overcome a series of challenges regarding their funding in order to include community-based dental education and reinforce the research programs and the researchers in the dental universities. Moreover, an effective funding program for research and specialization programs would rise interest and motivation among dental students who are discouraged to participate in research or to continue with a specialization due to the high cost student loans.

Regarding the importance of updating the dental curricula towards a more patient/community-centre approach, *Chen et al. (36)*; *Mejia et al. (37)*; *Dharamsi et al. (38)* argue that this approach could only be accomplished by including the concept of social accountability in the dental curricula and by incorporating in the dental curricula a cultural-based oral health-service provision. *Dharamsi et al. (38)* underlines that the confusion regarding the concept of social accountability would create unwanted behaviours and attitudes among the dental professionals, when they will be asked to serve population groups with multiple medical/cultural/educational/financial needs.

Davis et al. (9); *Ogunbodede et al. (26)* ; *Schuch et al. (23)*; *Wallance et al. (20)* ; *Foster page et al. (32)* stress the need for incorporating community-based rotation programs both for dental students and for dental professionals in order to reinforce social awareness and social accountability. Furthermore, in order to increase awareness of the social determinants in oral health and the important social role of the oral health providers the dental education needs to be enhanced with subjects within sociology. The authors suggest that this approach could be the first step in order to overcome the challenges that the dental professionals meet when providing oral health in underserved/ vulnerable/rural populations in a multicultural society. This is especially important in regions and parts of the world where the ethnic groups are marginalized and suffer oral health inequalities.

According to *Watt (39)*; a lot of effort has been done regarding the promotion of more effective oral health strategies in the last 20 years. However, these strategies seem to have ignored the implication of social determinants that give rise to oral health inequalities. Therefore, they should be revised under the scope of the most critical social determinants that influence oral health and take under consideration the population’s needs at a local, regional, national and international level. In addition to oral health reforms, *Watt et al. (40)* suggest a

restriction of the commercial determinants of oral health, meaning the strong influence of the sugar industry in order to promote its products. The authors highlight the fact that any oral health strategy will be proved unsuccessful without legislative control of the sugar industry and its commercial actions. Also, it is important to prevent the attempt of the industry to influence oral health research, policies and organizations.

5 Conclusion

To sum up, in 2010 the WHO published a framework in order to inform about the social determinants of oral disease and their impact on vulnerable populations who are subjects to oral health inequalities. The WHO called to action oral health policy makers, oral health organizations, dental universities and individual oral health providers in order to work towards a solution. WHO's effort to rise social awareness should motivate every oral health provider to participate in actions and interventions for developing inclusive, accessible and responsive oral health policies, whether they are providing their services in a developed or developing country.

In the present study it was found that the main social determinants that have implications in pediatric and adolescent's oral health are related to the family's socioeconomic status; parental educational level; family's cohesion; family's health behaviours; culture-ethnicity-race; social environment (neighbourhood, district); social capital; and access to dental care. The social determinants associated with adults' oral health are: socioeconomic status; educational level; employment/unemployment; leisure; mental health; race; culture and immigrant status. According to the findings of the study, a deteriorated/impoverished/vulnerable social status of the family or the individual in combination with the absence of public oral health policies will eventually result in unmet oral/dental need.

Negative effects from oral health inequalities was found mostly being experienced by underserved populations who are impoverished/of low education/unemployed/experiencing mental and family vulnerability/ have an immigrant status. These populations are found in both developed and developing countries or even in the same city or district. Furthermore, indigenous populations and rural populations belong to the underserved populations either because they are settled in remote rural areas or because they cannot afford the high cost of dental treatment.

Concerning the education of dental professionals several challenges were disclosed. First there is a need for education about a growing number of deprived urban and rural populations; a continuously ageing population with multiple health conditions; cultural

diversity; deteriorating quality and efficacy of public oral health. Thus, a revision of the dental curricula and the integration of community-based programs seems to be the most expedient solution to the challenge of educating oral health professionals who will serve the public good. Secondly, emerging from the insufficient funding of the dental institutions is the lack of funds designated for scientific research on oral health conditions. Finally, the financial burden carried by dental students through an admittedly long and expensive education is a challenge. Due to this, after the fulfilment of their studies, many are reluctant to participate in poorly paid research programs or work in remote and/or deprived areas.

The findings of this study highlight the challenges in oral health that will eventually meet the future dental professionals, independently of where they will establish and work. As it was shown in the present study, these challenges emerge in both developed and developing countries and they can also occur in different districts within the same city. The impoverishment of the population worldwide; the constant migration of populations; and the failure of delivering an oral health care system that includes underserved populations will undoubtedly increase the need for dental professionals willing to deliver dental care, even under unfavourable conditions. The responsibility for educating and training the future dental professionals is conveyed to the dental institutions and its dental curricula. Most likely, the integration of community-based programs and the integration of subjects from humanistic studies may help develop more socially conscious oral health providers. Nonetheless, this proposed educational framework should be supported and supplemented by changes in the socioeconomic and political context. This means appropriate funding of the dental institutions; measures for the elimination of poverty worldwide; strategies and design of oral health policies and a public oral health system for everyone, independently of socioeconomic status, age, race, disability or geographical settlement.

The future oral health providers, dental schools, health care administrators and oral health-decision makers need new tools, competence and information in order to access, monitor and improve the oral health needs of a growing and demanding global population.

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Appendix

Author	Year, Country	Study type	Participants
1. Fisher-Owens et al.	2007, USA	Epidemiological study	-
2. Da Fonseca & Avanetti	2017, USA	Overview article	-
3. Reynolds et al.	2015, USA	Cross-sectional study	N=2186
4. Meyer et al.	2017, Germany	Cross-sectional study	N=5527
5. Fontanini et al.	2015, Brazil	Cross-sectional study	N=542
6. Kragt et al.	2017, The Netherlands	Cross-sectional study based in a cohort study	N=3871
7. Henshaw et al.	2017, USA	Overview article	-
8. Chidzonga et al.	2015, Zimbabwe	Literature review	-
9. Gao et al.	2014, Hong Kong, China	Cross-sectional study	N=122
10. Maia et al.	2018, Brazil	Cross-sectional study	N=212

Author	Year, Country	Study type	Participants
11. Kailembo et al.	2017, Tanzania	Epidemiological study	China, N=11,692; Ghana, N= 4093; India, N=6409 and South Africa, N= 2985.
12. Wallance et al.	2015, Canada	Multiple case study	N=567
13. Watt et al.	2018, USA	Overview article	-
14. Hennequin et al.	2008, France	Cross-sectional study	6-12 years with disabilities, N=2.487 13-20 years with disabilities, N=4.772 6-12years without disabilities, N=1.772
15. Tubert-Jeannin et al.	2012, France	Cross-sectional study-Randomized control study	2003, N = 453 in 2009, N = 478
16. Schluter and Lee	2016, New Zealand	Cross-sectional study	5 years, N=417.318,

Author	Year, Country	Study type	Participants
			12-13 years, N=471.333
17. Lawrence et al.	2009, Canada	Cross-sectional study	2003-2004, N=416, 2004-2005, N=687 2005-2006, N=544,
18. Schuch et al.	2017, Australia	Comparative Cross-sectional study	2010 Brasil, N=37.519 2009 New Zealand, N=6.318 Non-indigenous N=273, indigenous n=517, 2004-2006 Australia
19. Jamieson et al.	2016, Australia	Comparative Cross-sectional study	2004-2006 Australia, N=14.123 2007-2009 Canada, N=5.586 2009 New Zealand, N=4.906

Author	Year, Country	Study type	Participants
20. Koyio et al.	2016, Kenya	Recollection article	-
21. Anderson et al.	2012, Canada	Comparative Cross-sectional study	Adults N=12.935 Children N=1.469,
22. Ogunbodede et al.	2015, Tanzania	Literature review	N=676
23. Giacaman et al.	2018, Chile	Cross-sectional study	12 years, N=552 15 years, N=486
24. Antunes & Narvai	2010, Brazil	Review article	-
25. Albino et al.	2012, USA	Overview article	-
26. Davis et al.	2007, USA	Cross-sectional study	N=51
27. Foster Page et al.	2016, New Zealand	Overview article	-
28. Mathieson et al.	2013, USA	Qualitative study	N=120
29. Formicola et al.	2018, USA	Report	
30. Mumghamba	2013, Tanzania	Literature overview, case presentation	