Effect of dental caries and treatment strategies on oral and general health in children

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Introduction
Introduction

Caries prevalence
Despite great improvements, dental caries is still one of the most prevalent infectious diseases of the world as it affects 60-90% of the school-aged children and the vast majority of adults [64, 86]. The development of the caries problem has taken various pathways in different countries and communities. In recent decades, a substantial decline in dental caries prevalence has been noted in the majority of industrialized countries due to a number of public health measures, including effective use of fluoride, changing lifestyles and living conditions [46, 57, 62, 66, 67]. This decrease in caries prevalence, however, seemed to have reached its plateau in some of the industrialized countries, and stabilized, turned to an increase or changed into a pattern of polarisation, with more of the disease occurring in a smaller proportion of the population [17, 30, 33, 72]. With regard to these different patterns in caries prevalence, it must be emphasized that dental caries as a disease in children has never, and nowhere, been eradicated, but only controlled to a certain degree [62, 63].

The burden of oral diseases, including dental caries, is particularly high for disadvantaged and poor population groups in both developing and developed countries. Although caries prevalence used to be much lower than in the industrialized countries [7, 69, 85], an increase is observed in developing countries, particularly as a result of urbanisation, growing sugar consumption and inadequate exposure to fluoride [16, 38, 51, 57, 64, 66, 86]. Access to oral care is often limited and the priority of dental health care is generally low due to the existence of major problems in communicable diseases, environmental hazards, and nutritional inadequacies. Although oral diseases are a major public health problem, oral health care in these countries is often highly underrepresented within the total health care system.

Oral health goals
The World Health Organisation (WHO) aims at achieving an acceptable level of oral health for all people. In 1982, the WHO, in collaboration with the International Dental Federation (FDI), has formulated six goals for oral health to be achieved by the year 2000 [37]. One of the most important goals was that the mean number of decayed, missing or filled teeth (DMFT) should not exceed 3.0 at the age of 12 years and that 50% per cent of the 5- to 6-year-olds should be caries free. Despite great improvements in the oral health status of populations across the world, these goals appeared not to be feasible to every country [59]. Nonetheless, the oral health goals have stimulated awareness of the importance of oral health in general [35]. Recently the WHO formulated a new document containing new goals, objectives and targets to be achieved by the year 2020 [62, 63]. More emphasis is placed on the appreciation that an acceptable level of oral
health should be interpreted differently by each country in the light of its social and economic characteristics, health status and morbidity patterns of its population and state of development of its health system [57, 66]. Therefore, the goals and objectives in this new document are more population-based and their formulation is guided by the principles of disease prevention and health promotion. The targets are constructed without absolute values and are not intended to be prescriptive. The framework is primarily designed to encourage health policy-makers at regional, national and local levels to set standards for oral health in consideration of local realities, i.e. the epidemiology of oral diseases and the socio-environmental conditions [53, 62, 63].

**Oral Health Care**

In order to achieve the new goals, oral health care should be more integrated within Primary Health Care (PHC) programs. Originally, within the framework of PHC, oral health care programs were not included. However, in the last decade, a number of PHC models, with oral health integrated at various phases of implementation, were developed [9, 54, 73, 81]. The speed of integration remains low and unsteady despite the epidemic dimension of oral diseases, the suggested oral-systemic link of some chronic diseases, and the increased demand and need for prevention based health care [53].

The global Oral Health Program (OHP) is currently one of the priority programs of the WHO. Based on the common-risk factor approach, the OHP puts emphasis on oral health promotion and disease prevention with focus on disadvantaged population groups in developed and developing countries and gives priority to the integration of oral health within general health programs [60-65]. Essential to this, however, is the establishment of priorities in oral health care.

The WHO Collaborating Centre for Oral Health Care and Future Scenarios in Nijmegen, established by the WHO in 1996, was charged with the task of compiling a report on the establishment of these priorities. This resulted in the Basic Package of Oral Care (BPOC). The BPOC represented a fusion of concepts and approaches that were considered to be effective, acceptable, feasible and affordable for most disadvantaged communities [27]. The BPOC aimed at integrating basic oral care into the existing primary health care systems and at increasing the level of preventive and curative oral treatment. The essential components of BPOC are: Oral Urgent Treatment (OUT), Affordable Fluoride Toothpaste and Atraumatic Restorative Treatment (ART).

Though aiming at integration, the report did not present a strategy for implementation of oral care within PHC while each local situation demands tailor-made solutions with respect to available funds, personnel and services. Each country or community should develop its own BPOC, based on perceived needs and existing environmental conditions.

Within the concept of BPOC, in case of pain, extraction of the perpetrating tooth (OUT) is indicated and otherwise, cavitated teeth are suggested to be restored by means of ART. ART is a minimal invasive treatment method whereby soft, demineralised carious tooth tissue is removed using hand instruments only, followed by restoration of the tooth with an adhesive restorative
material, often glass-ionomer cement. Because neither electricity nor running water is required for this treatment approach, ART can be applied in almost any setting [25, 26]. However, the report does not elaborate the question whether or to what extent invasive dental treatment of the primary dentition is indicated. For example, leaving primary teeth unrestored is not included in the BPOC. This highly minimal invasive treatment option should not be left out of sight when current literature is addressed [41, 42, 50, 76]. Before tailor-made BPOC’s can be introduced and before oral health care can be implemented in primary health care programs, it is necessary to open the discussion concerning the question to what extend and how the primary dentition should be treated. Further, the supposed effects of dental decay on the general health of the patient should be elucidated whereas these play a key role whenever it concerns the establishment of the priority of oral health care within the general health care programs.

**Dental treatment of the primary dentition**

Dental treatment of the primary dentition is currently under debate among dental professionals. There is a lot of discussion about the best treatment strategy that should be applied to the diseased deciduous dentition [24, 39, 42, 50, 68, 76]. The lack of consensus on indications for restoration and extraction of diseased deciduous teeth exists due to constantly changing definitions and extensive scientific achievements. New knowledge of caries progression rates has led to substantial modification of restorative intervention thresholds and further handling of the disease. New diagnostic tools for caries lesion detection, caries risk assessment and focussed preventive treatments have decreased the need for early restorative interventions [12, 21, 22, 58, 84]. Overall, dentists are encouraged to prefer a more conservative and biological approach rather than an invasive approach. Regardless of the strategy that is preferred or applied, the purpose of dental treatment should be unambiguous and comprises four items: prevention of new dental decay, arrestment of existing carious lesions, prevention of pain and discomfort for children, and prevention of early loss of deciduous teeth.

These clinical aims cannot always be met at the same time and their relative priority might vary under different circumstances. The possible side effects of a certain dental treatment can be to such an extent that other strategies are preferred. For example, when the often cited space changes induced by premature loss of a primary molar are expected to occur but cannot be treated adequately with orthodontic equipment, more conservative methods might be preferred. Treatment decisions are not only guided by clinical considerations but also by attendance patterns, parent’s wishes, behavioural skills, socio-economic background, available budgets, adequate material and qualifications of the personnel [34, 36, 70, 77-80].

Though a strategy can not be decided upon unanimously, the overall assumption exists that treatment of dental decay in the primary dentition is necessary with regard to the expected
effects of oral diseases on the patient’s general health and well-being [23]. However, the true impact or extent of these effects has not been properly addressed as yet.

**Impact of oral disease**

Dental caries, and the associated pain and infection, may have a number of detrimental effects. Interference with nutrition, loss of sleep, behavioural disturbance, and poor aesthetics [23] are only a few possibly occurring symptoms that can give rise to physical, social and psychological effects that influences the day-to-day living of the patient [28, 45, 48, 49, 75, 82, 83].

An improvement of the quality of life of children would definitely request for a central role of dental treatment within a health care system. However, due to a lack of consistency in the definition and measurement of the construct "quality of life", literature shows a fragmented vision of its relation with oral health [49, 56].

Assessment of systemic effects of oral diseases from a purely biomedical point of view has been described less ambiguously. Particularly from the field of periodontology, an association has been described between certain systemic conditions, such as cardiovascular diseases, respiratory diseases, diabetes mellitus, low birth weight and preterm birth, and periodontal diseases [8, 18, 28, 29, 43, 44, 52]. Several pathways are suggested to explain this association [28, 43]. Bacteraemia, bacterial endotoxins, cytokines, and other inflammatory mediators could play a direct or indirect role. Diet may be an additional mediator for several of these outcomes. However, there are several common risk factors for oral and systemic diseases that might play a confounding role in the analysis of their relation. Therefore, a careful interpretation is required.

Though numerous studies have investigated the relation between periodontal and systemic disease, systemic effects of dental caries have not been equally investigated on a biomedical level. However, similar outcomes may be expected. Dental caries is, just as periodontitis, a chronic infectious disease. It has been well established that immune factors play an essential role in the etiology of chronic multifactorial diseases [6, 15, 65, 74]. Moreover, systemic responses to *Streptococcus Mutans* and infected dental pulps have been described [31, 32, 40]. It thus might be suggested that dental caries may induce a systemic immune response that may especially occur when caries progresses into pulpal inflammation [19, 71].

One of the difficulties that are encountered when establishing the effects of dental decay on general health is the lack of a suitable tool to diagnose physical health properly. Health is a multidimensional concept which renders its measurement challenging and prone for deficiencies.
Assessment of children’s height and weight is well established as a valid clinical indicator for their general health and well being [11, 14]. Studies concluded that infectious diseases can interfere with body growth [10, 13, 47]. Therefore, given the fact that dental caries is one of the most prevalent infectious diseases worldwide [62], it can be hypothesized that the possible systemic effects of dental caries could be reflected in a deviant growth pattern. Indeed, an association between rampant caries and body growth was described in the literature [1-5, 20, 55, 75]. The aetiology of the relation between dental caries and body growth could be explained by the fact that toothache and infection alter eating and sleeping habits, dietary intake and physiological processes that are essential for normal growth [1, 5, 75].

Rationale and aim of the study
The literature relating oral disease to increased risk of systemic diseases provides additional motivation for achieving and maintaining good oral health. If body growth in children is indeed adversely affected by dental decay, the global increase in caries prevalence should raise major concerns, especially in those countries where access to oral health services is limited and where dental health care is of low priority. However, the evidence regarding the oral-systemic associations is not unanimous, and the associations may or may not be causal. Further exploration of the oral-systemic relationship, including a systemic immune response to dental caries, is therefore indicated in order to establish the priority of oral health care within the general health care programs.

The aim of this thesis was to establish the relation between dental caries and general health in children of a defined population in Suriname. Primary outcome measures are systemic immune response and body growth.

The results of this study could play a decisive role in the question if and how oral care should be implemented in primary health care programs. In other words: what dental treatment should minimally be performed in order to prevent adverse influences of the dental decay on the general health of the patient.
Outline of the thesis

Chapter 1
The first chapter comprises an epidemiological survey that was carried out in Suriname. Before the entire project could be launched, it was important to determine the oral health status of the children, living throughout the area where the research was planned to be performed. The interior of Suriname was chosen as the goal area for the project, based on the need for dental care that was expressed by the Director of the Medical Mission and on the positive attitude of the Government, regarding the current study. The epidemiological survey concerned four different areas in the Suriname rainforest. The intervention study-project was, mainly for practical reasons, conducted in only two of these regions.

Chapter 2
Different dental treatment strategies were performed in the current study. Two of these strategies included Atraumatic Restorative Treatment (ART), whereas this was, given the outreach circumstances, the restorative treatment of choice. Chapter 2 outlines the suitability of this restorative treatment strategy for the target population. ART claims to be atraumatic for both patient and the tooth in question. A preliminary study in Indonesia was performed to compare the discomfort that was experienced during ART with the discomfort that was experienced during dental treatment with other minimal invasive restorative methods whereby rotary instruments were used.

Chapter 3
In chapter three, the survival of the ART restorations, performed during the course of this study in Suriname, is described. The success of different treatment modalities, that include ART (chapter 4), should be evaluated in the light of these survival rates. Because ART is non-electricity dependent and has relatively low maintenance costs, it is ascribed as the preferred restorative treatment method in countries or areas that contend with tight budgets for primary (oral) health services. However, although the costs are low, the effect of any treatment must be acceptable and reliable in order to enable its indication.

Chapter 4
In chapter four, the effect of four different dental treatment strategies on the oral health of the study population, is established. The results of this part of the project are important and should be considered in any situation where due to situational, economical, psychological or practical circumstances, choices have to be made regarding the most suitable treatment option with optimal prognosis under the given conditions.
Chapter 5
The effects of dental decay and dental treatment are supposed to go beyond the oral cavity. Chapter five discusses the oral-systemic relationship focussing on the body growth of the Surinam children that participated in this project. Assessment of children’s height and weight is generally established as an indicator for their general health and well being.

Chapter 6
In chapter six a pilot study is described where three systemic factors, acute phase proteins associated with chronic infections, and antibodies to Mutans Streptococci were associated to dental caries. The study was performed in Indonesia and the results were applied to the Surinam project.

Chapter 7
Chapter seven discusses the relationship between caries, the formation of abscesses and fistulae, and the concentration of acute phase proteins and other systemically induced immune factors. The hypothesis that caries treatment improves general health and results in reduced levels of acute phase proteins CRP and AGP is tested. Since study population lives in the inlands of Surinam, it is expected that they can suffer from other infectious diseases due to parasites. To control for these events, the concentration of serum neopterin is tested. The genetic sensibility regarding for abscesses or fistulae formation as a result of severe caries, is also explored.

General Discussion
In the general discussion, the separate parts of the overall project are evaluated in the light of the existing literature and translated into clinical implications that can be applied or should at least be considered in daily dental and primary health care practices.
References


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