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Sociobehavioural risk factors in dental caries – international perspectives

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Abstract – Diseases probably have their roots in a complex chain of environmental and behavioural events which are shaped by broader socioeconomic determinants. Most studies of sociobehavioural risk factors in dental caries have been carried out in industrialized countries, but such reports from low- and middle-income countries have been published in recent years. World Health Organization international collaborative studies and other international studies of social factors in dental caries using the same methodology provide empirical evidence of social inequality in oral health across countries and across oral health care systems. The paper highlights the challenges to dental public health practice, particularly the importance of risk assessment in estimating the potential for prevention. In future public health programmes, systematic risk factor assessment may therefore be instrumental in the planning and surveillance of oral health promotion and oral disease intervention programmes.

Key words: dental caries; dental public health; risk assessment; sociobehavioural risk factors

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People – individuals or whole populations – are exposed all their lives to almost limitless risks to their health. In the *World Health Report 2002* (1), the World Health Organization analysed the evidence available on selected risks to health and the burden of disease they impose on a number of developed and developing countries. Risk is defined as the probability of an adverse outcome, or a factor that raises this probability (1). No risks occur in isolation, and many have their roots in complex chains of events spanning long periods of time. Each event has its cause and may have many causes. The chain of events leading to an adverse health outcome can be both proximal and distal; proximal factors act directly or almost directly to cause diseases, while distal factors are further back in the causal chain and act via a number of intermediary causes (Fig. 1). The factors that lead to the development of disease at a given point in time are likely to have their roots in a complex chain of environmental events that may have begun years previously, events which in turn being shaped by broader socioeconomic determinants. Society and culture, for example, are linked to certain behavioural patterns or lifestyles, which in turn influence outcomes via physiological processes. Clearly, these are risks over which an individual has at least some control and risks that mostly or entirely rest at the population or group level.

It is essential to public health that the whole of the causal chain is considered in the assessment of risks to health. An appropriate range of policies, strategies and approaches to disease prevention can be generated only if a range of risks is assessed. Figure 2 presents a conceptual framework for assessing sociobehavioural risks to oral health (2). At the population level, oral health outcomes are related to distal socioenvironmental factors and characteristics of the oral health services available. In addition to the use of oral health services, proximal modifiable risk behaviours such as oral hygiene practices, dietary habits, tobacco use and excessive consumption of alcohol are considered. Outcome dimensions comprise oral health status,

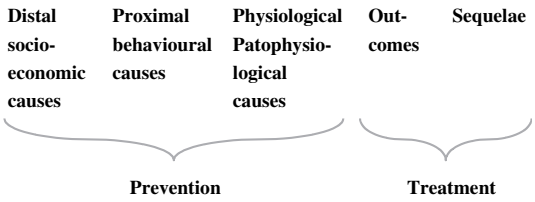

Fig. 1. Causal chains of exposure leading to disease and implications for intervention (1).

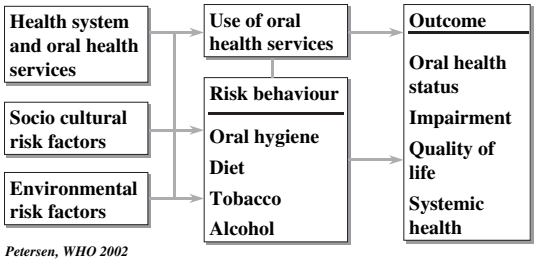

Fig. 2. The risk factor approach in promotion of oral health as suggested by the WHO (2).

impairment of function and reduced quality of life, and the negative impact of poor oral health on systemic health. The purpose of the present paper is to provide an overview of findings from international studies on the mechanism of sociobehavioural factors in oral disease, with a focus on dental caries. Experiences from studies using comparable research designs and methods are emphasized.

The empirical evidence

Over the past decades a large number of research reports have shown that dental caries is linked to social and behavioural factors (3–5). Figure 3 applies the general conceptual framework as outlined in Fig. 2 to the analysis of risk factors in dental caries. The model is based on the evidence available on potential sociobehavioural risks of dental caries and some widely used outcome measures are listed.

Most studies on sociobehavioural risk factors in dental caries have been carried out in industrialized countries. Such reports from low- and middle-income countries have been published in recent years, probably in response to the growing prevalence rates and severity of dental caries experience in these countries. In 1997, the WHO published a comprehensive document which described and analysed the oral health status of children and adults in selected countries (6). The primary objective of the so-called WHO International Collaborative Studies (ICS-I or -II) was to compare oral

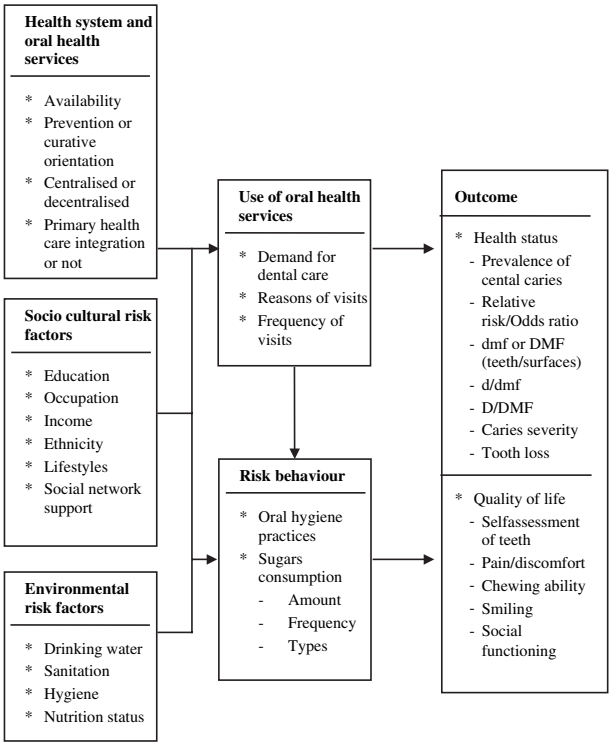

Fig. 3. Risk factor model including distal and proximal factors for analysis of dental caries, applied from the WHO (2).

health care systems and their impacts on oral health status. Secondly, the data provide a unique opportunity to analyse important sociobehavioural determinants of oral disease, as information on living conditions, oral health-related behaviour and quality of life was also collected. The study was truly international in scope and sought to analyse the oral health situation in countries with different oral health systems ranging from demand-based private oral health care delivery systems (e.g. Japan, USA) to public oral health care systems (e.g. Poland, at the time of study).

Across countries and oral health systems, the existence of a social gradient in dental caries prevalence was found as measured by the association in dental caries indicators and socioeconomic status (Figs 4–6). The effect of educational background on measures of dental caries was observed for all countries but was found to be particularly strong when the disease prevalence was high. Additional analyses focussed on the effects of occupational and behavioural factors on clinical outcome measures. Multivariate regression analyses were performed in order to control for effects of socioeconomic status; low scores of DT and MT were found in adults when respondents had preventive dental care habits and when they had

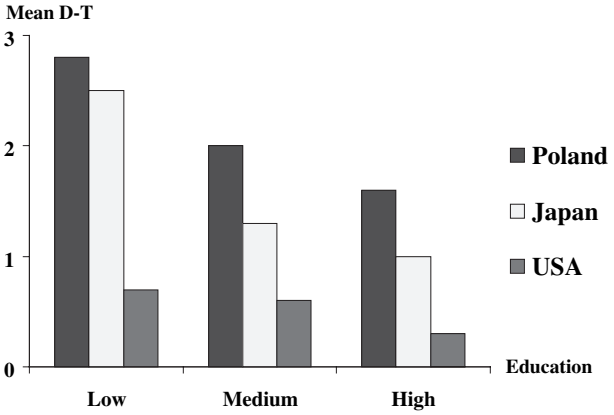

Fig. 4. Mean DT of 12–13-year olds by level of education of parents in certain industrialized countries (16).

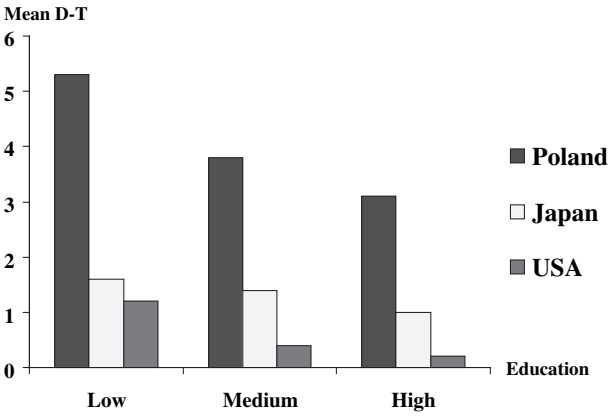

Fig. 5. Mean DT of 35–44-year olds by education in certain industrialized countries (6).

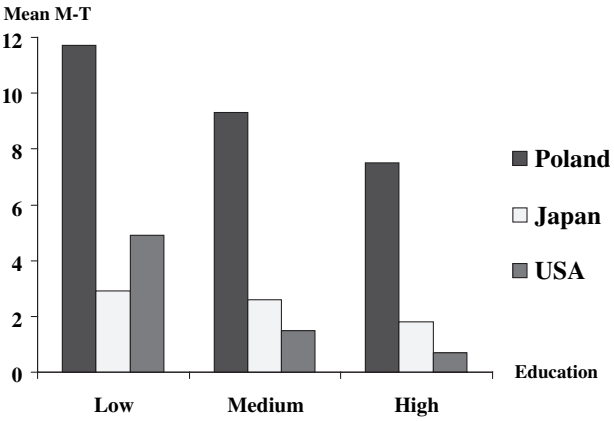

Fig. 6. Mean MT of 35–44-year olds by education in certain industrialized countries (6).

dental flossing on a regular basis (6). The ICS-II study (6) also demonstrated that sociobehavioural factors impact quality-of-life measures related to the experience of dental caries (Figs 7 and 8). The quality-of-life indicators considered were symptoms such as pain, discomfort, self-assessment of

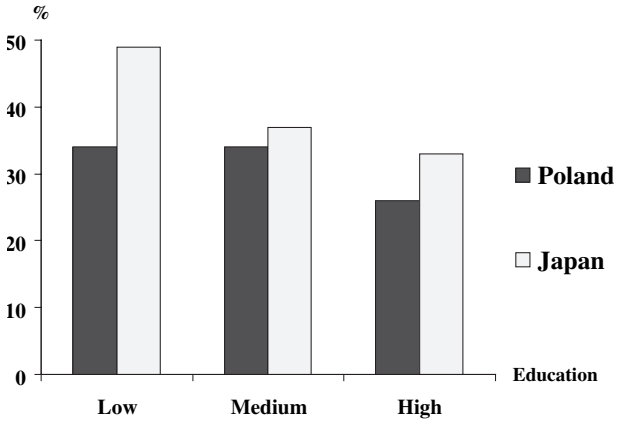

Fig. 7. Percentage of 12–13-year olds who dislike appearance of their teeth by level of education of parents in certain countries (6).

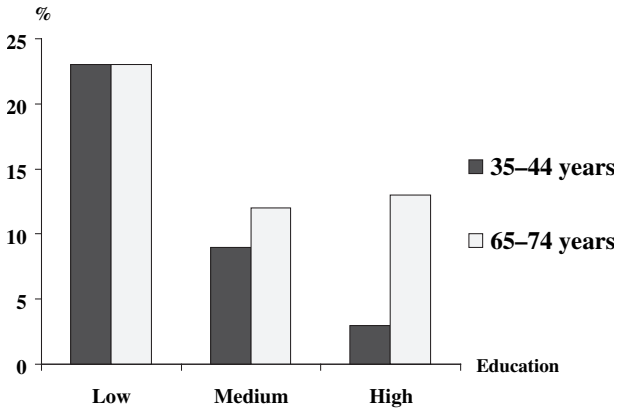

Fig. 8. Percentage of adults who dislike appearance of their teeth by education (USA) (6).

poor or very poor oral health, dislike of appearance of teeth, avoidance of laughing or smiling, or being unable to chew. Among adults, groups with the lowest scores on quality of life were: women; urban residents; persons with low income and unskilled workers; persons with irregular dental visits and perceptions of barriers to care; persons considering poor teeth a serious problem; persons with negative attitudes and practices in relation to oral hygiene and persons with high numbers of missing teeth.

The WHO ICS-II study (6) focussed on oral health and disease determinants in selected industrialized populations. As for general health, social inequality in oral health appears to be universal, even in countries with a long tradition of oral health promotion, preventive oral care, outreach dental health services and high utilization rates. Such a tradition exists in Scandinavia. In Denmark, for example, a recent national oral health survey (7) of adults demonstrated that despite a reduction in the percentage of edentulous 65–74-year olds

during the years 1994 to 2000, the social gradient remained constant over time despite that substantial proportions of the elderly took part in public dental care programmes in childhood and attended private dental practitioners regularly in adult life. Currently, nearly all Danish children take part in the comprehensive oral health care programme provided by the public dental health services (8). Children are offered preventive and curative services free of charge; in addition, school and community-oriented oral health promotion is organized, based on the active involvement of parents and other key persons. Table 1 illustrates how the socioeconomic status of parents greatly affects the risk of dental caries in young children, despite the fact that they are covered by comprehensive public oral health programmes. Moreover, multivariate analyses revealed these higher odds of dental caries in cases of frequent consumption of sugary items (8). Such behavioural factors also play an important role in understanding different dental caries risks observed across cultures or ethnic groups in several industrialized countries (9) (Fig. 9).

Most studies on relationships between sugar intake and dental caries have been carried out in industrialized countries and where the population, to a larger extent, is exposed appropriately to

Table 1. Logistic regression analysis of risk factors on odds of dental caries among 6-year-old Danish children

Risk factor	Odds ratio (OR)
Parent's education	
School grades 7–9	2.5**
School grade 10	1.3
High school	0.9
University level	–
Family income	
Low	2.1**
Moderate	1.3
High	–
Frequency of sugar intake	
High	2.1*
Moderate	2.5**
Low	–
Frequency of sugary drinks	
High	1.6*
Moderate	1.0
Low	–
Pocket money for sweets	
High	1.6*
Moderate	1.0
Low	–

Additive index scores on sugar consumption classified into levels high, moderate and low (8).
*$P < 0.05$; **$P < 0.01$.

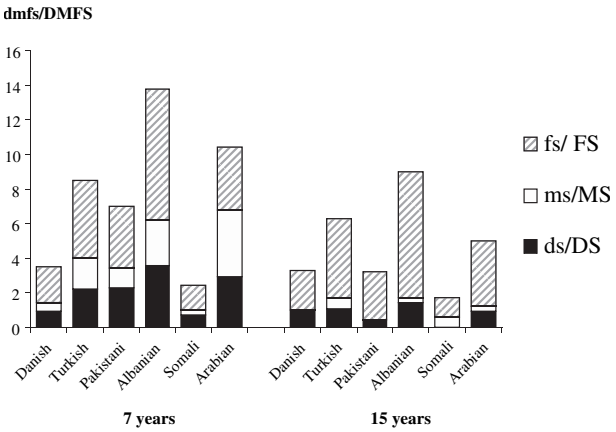

Fig. 9. Dental caries experience (dmfs/DMFS) in 7- and 15-year olds living in Denmark by ethnic group (9).

fluorides (10). In a meta-analysis of cohort studies, case–control studies and cross-sectional surveys, Burt and Pai (11) showed somewhat moderate or weak effects of sugar on dental caries incidence or prevalence rates. In many developing countries of Africa and Asia, the exposure to fluoride is low and recent sociobehavioural studies on child populations in these regions show that sugar consumption plays an important role in dental caries risk. These studies form a series of cross-sectional surveys where the same basic methods were applied (8). Table 2 summarizes the evidence from such studies conducted in some developing countries (12–17) as regards the effects of certain risk factors on odds for dental caries.

It is worth emphasizing that, in several developing countries, oral health services are generally not available at the local community level. As a result of the shortage of dental manpower and economic constraints, services are centralized and mostly offered from regional hospitals in urban centres. In addition to the limited primary oral health care, poor access to safe drinking water and sanitation impair general and oral hygiene. In contrast to the situation in the majority of industrialized countries, use of oral health services in developing countries is prompted primarily by the experience of pain because of tooth decay; therefore, the odds of dental caries and missing teeth are generally high among those who attend to dental care.

The challenges to dental public health practices

The scientific literature provides substantial evidence of effects of sociobehavioural risk factors in

Table 2. Summary of effects of sociobehavioural risk factors on odds of dental caries (OR) as measured in comparable studies carried out in certain countries of Africa, Asia and the Middle East

Risk factor	Madagascar (12)	Tanzania (13)	China (16, 17)	Thailand (15)	Saudi Arabia (14)
Level of education in parents	X			X	X
Location/urbanization	X	X	X	X	
Ethnic group				X	
Toothcleaning habits	X		X	?	
Dental visits		X	X	X	
Consumption of sweets	X	X	X	X	X
Consumption sugary drinks	X				
Dental attitudes	X			X	

dental caries. Focussing on risks to health is the key to preventing disease and risk factor assessment may measure the potential of prevention (1). Systematic risk assessment may estimate the potential of prevention by the analysis of:

Prevalence of risk	The proportion of the population who are exposed to a particular risk, e.g. the prevalence of daily consumption of sugary food
Relative risk	The likelihood of an adverse health outcome in people exposed to particular risk, compared with people who are not exposed.
Population attributable risk	The proportion of disease in a population that results from a particular risk to health
Attributable burden	The proportion of current disease burden that results from past exposure
Avoidable burden	The proportion that is avoidable if current and future exposure levels are reduced to those specified by some alternative, or counterfactual, distribution

The term 'risk factor' does have a negative connotation, but ideally 'risk assessment' should include a range of protective and hazardous factors. Thus, in relation to oral health, risk analysis focuses on the protective benefits of oral hygiene practices and consumption of fruits/vegetables as well as the negative impacts of consumption of sugary foods and tobacco use.

In dental public health, however, the tradition of risk assessment is still somewhat weak, the emphasis being particularly on behavioural risk factors rather than socioenvironmental factors in oral disease. Risk assessment practice in public health has developed in recent years from its roots in the study of environmental problems and the steps generally involved in environmental risk assessment can be applied to the analysis of health risks. Accordingly, environmental risk assessment exercises comprise, in principle, four elements: (i) hazard identification; (ii) exposure assessment; (iii) dose–response assessment and (iv) risk characterization (1). Environmental risk assessments of likely oral health effects, together with consideration of costs, technical feasibility and other factors, can be used to set priorities for environmental management. Many factors are implicated in prioritizing strategies to reduce risks to health, e.g. the extent of the disease burden posed by different risk factors, the availability of cost-effective interventions and societal values and preferences are particularly important. Compared with other health sectors, safe and effective means are available for prevention of dental caries (18). The approaches to prevention of dental caries and other oral diseases comprise population-oriented activities as well as high-risk strategies in relation to certain individuals or target groups (Fig. 9) (19). The strengths of population-directed strategies are that they are radical and powerful in relation to underlying causes of disease whereas limitations are the lower acceptability, and economic and political obstacles. As regards high-risk strategies, the principal strengths are that intervention is appropriate to the individual and no interference is taking place with individuals not at special risk. The limitations of the high-risk strategy relate to the poor power of prediction of risks, labelling of individuals and low cost-effectiveness of intervention.

Concluding remarks

The risk factors responsible for several chronic diseases are common to most oral diseases, and the common risk factor approach is a new public health strategy for the effective prevention of oral disease (1, 2). In future public health programmes,

systematic risk factor assessment may therefore be instrumental in the planning and surveillance of oral health promotion and oral disease intervention programmes. Risk analysis is a political enterprise as well as a scientific one, and the public perception of risks also plays a significant role in risk analysis. Most general health and oral health-related risk assessments carried out to date have typically used only attributable risk estimates, basically addressing the question: 'What proportion of the current disease burden is caused by the accumulated effects of prior exposure?' However, a more policy-relevant question is: 'What are the likely future effects of partial removal of current exposure?' Two key developments are therefore needed: an explicit focus on future effects and on less-than-complete risk factor changes. The WHO Global Oral Health Programme is currently involved with such risk analysis in several countries of different regions as part of its initiative to strengthen oral health promotion and disease prevention and to integrate oral health into national health programmes.

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