

INTERNATIONAL PERSPECTIVES ON CORRELATION OF SOCIO-BEHAVIORAL RISK FACTORS WITH DENTAL CARIES

Daniela Manuc^{1,2}, Simona Bulgaru³, Luminita Smaranda Iancu^{4,5}

1. University of Medicine and Pharmacy "Carol Davila" București, România
2. Ministry of Public Health, București, România
3. Institute of Public Health București, România
4. University of Medicine and Pharmacy "Gr. T. Popa" Iași, România
5. Institute of Public Health Iași, România

Abstract. Diseases have as determinants the complex chain of environmental and behavioral events which are shaped by broader socioeconomic ones. Most studies of socio-behavioral risk factors of dental health 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 (WHO), international collaborative studies and other international studies related to 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 programs, systematic risk factor assessment may be therefore used as an instrument in the planning and surveillance of oral health promotion and oral disease intervention programs.

Key words: dental health, public health, programs, health needs, health determinants

Rezumat. Determinanții bolilor se regăsesc în lanțul complex de evenimente comportamentale și din mediul înconjurător care sunt modelate de determinanții socio-economici. Majoritatea studiilor efectuate cu scopul depistării factorilor de risc socio-comportamentali în apariția cariilor dentare au fost susținute în țările industrializate, dar în țările în curs de dezvoltare s-au realizat asemenea rapoarte în ultimii ani. Studiile internaționale de colaborare ale Organizației Mondiale a Sănătății (OMS) și alte studii efectuate cu scopul determinării factorilor sociali în apariția cariilor dentare, utilizând aceeași metodologie, au rolul de a asigura în diferite țări evidențele empirice ale diferențelor sociale din sănătatea orală, raportate la sistemele de îngrijire a sănătății orale. Acest articol urmărește punerea în evidență a problemelor dificile survenite în practica sănătății publice dentare, cu accent deosebit pe importanța evaluării riscurilor apărute în estimarea potențialului de prevenție. Prin urmare, pe viitor, în programele de sănătate publică, ar putea fi instrumentată evaluarea sistematică a factorilor de risc în planificarea și supravegherea promovării sănătății orale și a programelor de intervenție în combaterea bolilor orale.

Cuvinte cheie: sănătate dentară, sănătate publică, programe, nevoi de sănătate, determinanți ai sănătății

INTRODUCTION

People are exposed to almost limitless risks to their health. In the World

Health Report 2002, the WHO analyzed the available evidence on selected risks to health and the burden

INTERNATIONAL PERSPECTIVES ON CORRELATION OF SOCIO-BEHAVIORAL RISK

of disease that they impose to a number of developed and developing countries (1). 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 one or more 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).

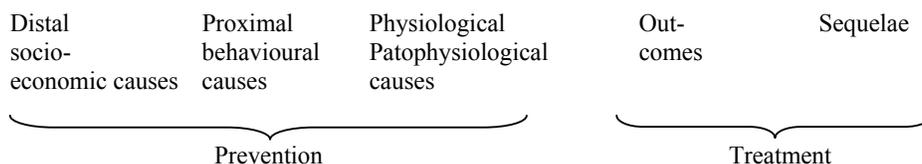


Fig. 1. Causal chains of exposure leading to disease and implications for intervention (1)

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, and which in turn being shaped by broader socioeconomic determinants. Society and culture are linked to certain behavioural patterns or lifestyles, which in turn influence outcomes *via* physiological processes. These are risks over which an individual has at least some control and risks that

mostly or entirely are attributable to the rest of the population or certain groups of population.

It is essential to public health that the whole of the causal chain is considered in the assessment of risks for 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 socio-behavioural risks to oral health (2).

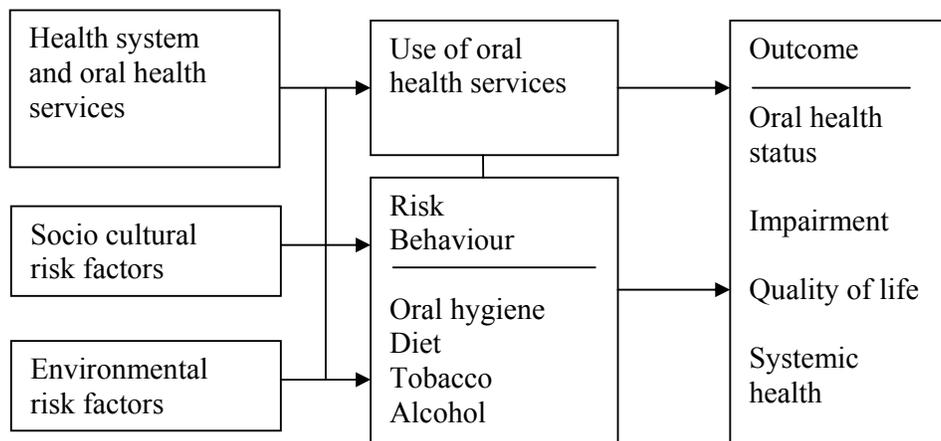


Fig. 2. The risk factor approach in promotion of oral health as suggested by the WHO (2)

At the population level, oral health outcomes are related to distal socio-environmental factors and characteristics of the available oral health services. 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, 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 socio-behavioural factors within oral disease, focusing on dental caries. Experiences from studies using comparable research designs and methods are emphasized.

Empirical evidence

Mentioning the study of older adults in Tanzania, „Clinical and socio-behavioural correlates of tooth loss”, it was considered that the proportion of older people is growing faster than any other age groups throughout the world (3). By 2050, 2 billion people will be aged 60 years and above of whom 80% will be residents of developing countries. Globally, poor oral health in older people is particularly considered as a high level of tooth loss, which in turn influences general health in terms of weight loss, eating problems and social handicaps related to appearance and communication.

Table 1 shows the percentage distribution of participants’ socio-demographic, clinical and behavioural characteristics in urban Kinondoni and rural Kibaha/Bagamoyo districts. In addition to the data presented in Table 1, it was found

INTERNATIONAL PERSPECTIVES ON CORRELATION OF SOCIO-BEHAVIORAL RISK

that decayed teeth and mobile teeth were more prevalent in lower- than in higher family wealth groups ($p < 0.001$). Dental attendance patterns were more frequent in higher than lower family wealth groups (88.2% versus 68.7%, $p < 0.001$). Having 2 or more decayed

teeth and 2 and more mobile teeth were most prevalent in females and males, respectively. Missing teeth due to caries and other reasons did not vary with the educational level of the participants (not in Table 1).

Table 1. Socio-demographic factors and oral health status indicators among older people in urban Kinondoni and rural Kibaha/Bagamoyo districts of Tanzania (3)

		Kinondoni % (n)	Kibaha/ Bagamoyo % (n)	p- value
Sex:	<i>Male</i>	42,7 (218)	50,0 (260)	
	<i>Female</i>	57,4 (292)	50,0 (260)	0,021
Age:	<i>50-59 years</i>	50,3 (257)	37,9 (197)	
	<i>60-69 years</i>	28,8 (147)	30,0 (156)	
	<i>70+ years</i>	20,9 (105)	32,1 (167)	0,001
Wealth index:	<i>1 – least poor</i>	45,4 (232)	4,4 (23)	
	<i>2</i>	40,1 (205)	8,8 (46)	
	<i>3</i>	11,2 (57)	35,0 (182)	
	<i>4 - poorest</i>	3,3 (17)	51,7 (269)	0,001
Education:	<i>none</i>	36,1 (184)	53,4 (277)	
	<i>at least primary school</i>	63,9 (325)	46,6 (242)	0,001
Tobacco use:	<i>yes</i>	15,1 (77)	30,6 (159)	0,001
Reason dental attendance:	<i>when problem</i>	87,3 (446)	71,4 (370)	0,001
Dental attendance:	<i>≥ one time</i>	21,1 (108)	24,2 (126)	0,231
High blood pressure:	<i>yes</i>	26,2 (134)	6,7 (35)	0,506
Decayed teeth:	<i>≥ 2 teeth</i>	46,0 (235)	55,4 (288)	0,050
Tooth mobility:	<i>≥ 2 teeth</i>	16,2(83)	22,7 (118)	0,050
Brushing:	<i>daily</i>	71,8 (367)	71,5 (372)	0,920
	<i>moderate</i>			
Plaque:	<i>/abundant</i>	44,1 (224)	47,2 (244)	0,175
Chewing:	<i>only soft foods</i>	25,0 (129)	36,2 (189)	0,001

A large number of research reports have shown over the past decades that dental caries are linked to social and behavioural factors (4-8). Figure 3 applies the general conceptual framework as outlined in Figure 2 to the analysis

of risk factors in dental caries. The model is based on the available evidence on potential socio-behavioural risks of dental caries and some widely used outcome measures are listed.

Socio-behavioural risk factors in dental caries

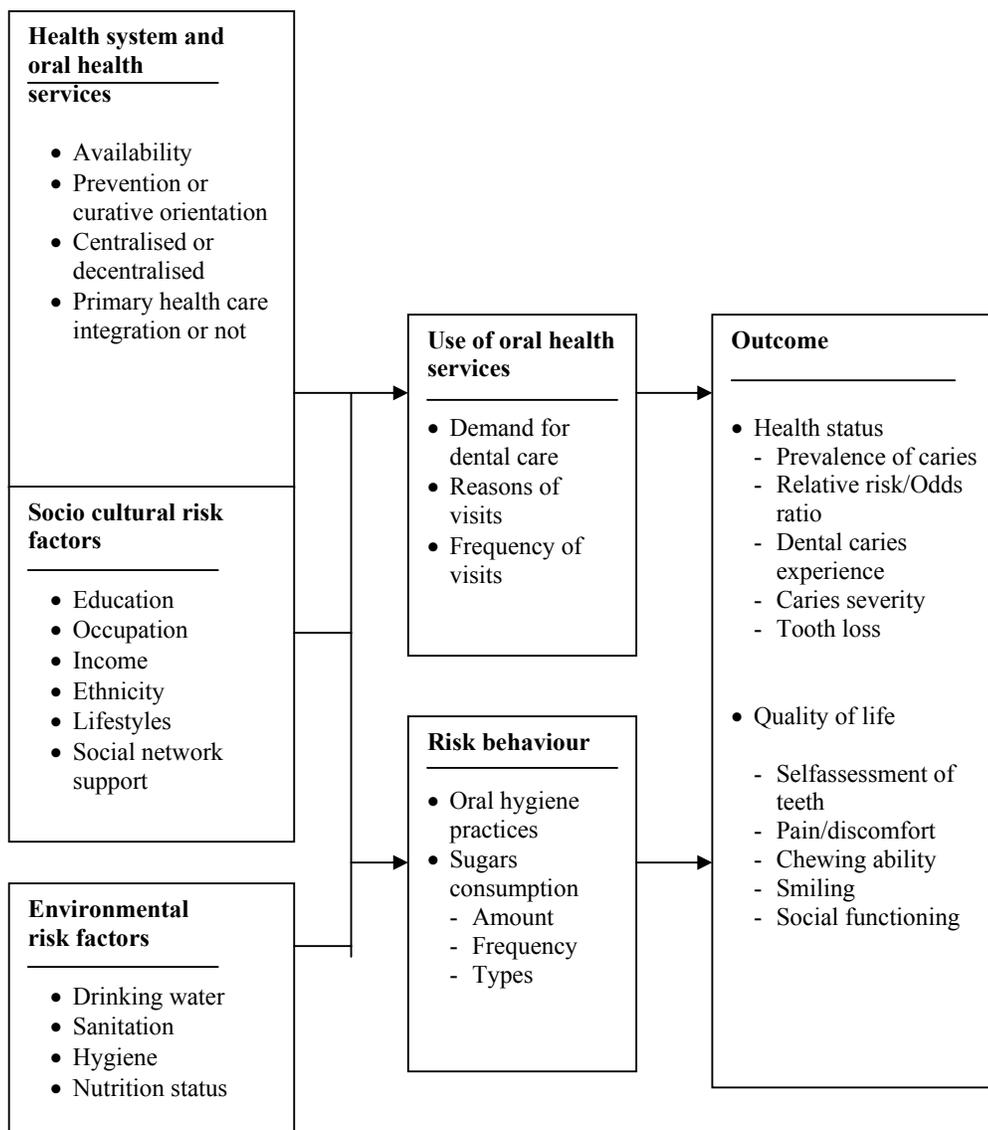


Fig. 3. Risk factor model including distal and proximal factors for analysis of dental caries, applied from the WHO (2)

INTERNATIONAL PERSPECTIVES ON CORRELATION OF SOCIO-BEHAVIORAL RISK

Most studies on socio-behavioural 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. Such a study was completed in Romania, in 1993, in two big cities: Iasi and Bucharest, and continued in 2003 following the attains of the WHO objectives for the year 2010 (5,6). The aim of the study was to establish the relations of partnership with factor's (schools) and with parents; identification of ability

for realization and maintain the condition for children oral hygiene; behaviour's change school and family for oral health; the estimate of knowledge level assimilate by teachers and children as regards to prevent dentistry affections. Figure 4 shows the attitude of mothers and schoolteachers regarding cavity prevention and brushing, visit to the dentist, the use of fluorine, the avoiding consumptions of sugar. We observe that mothers maintain the same opinions in close percent for 10 years 87 % - 1993→ 89 % - 2003; regarding visiting the dentist 76% - 1993→ 76% -2003.

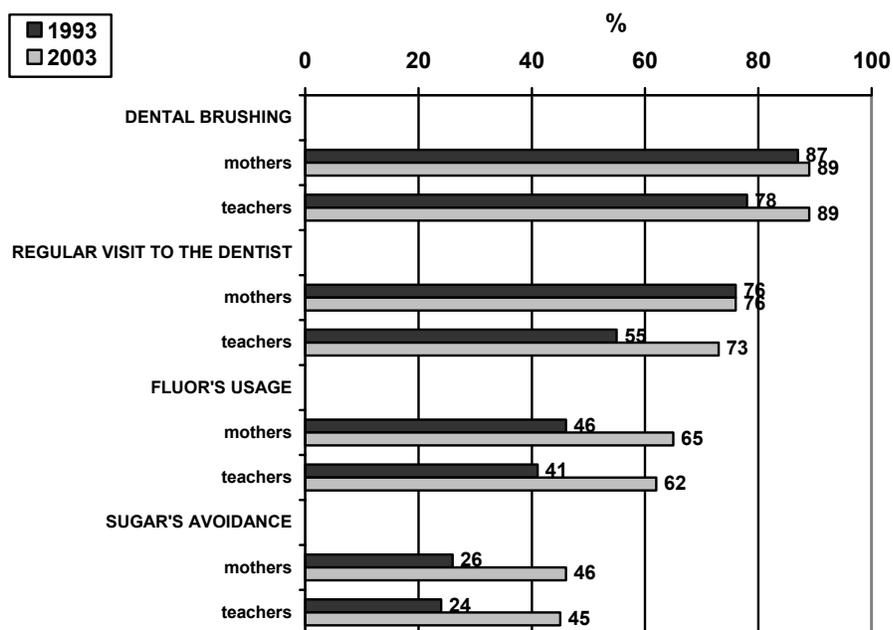


Fig. 4. Mothers and schoolteachers answer regarding cavity prevention (6)

The percentages are higher in school-teachers. They sustain in 1993 in 78% that brushing prevents cavities, and the percent rose to 89% in 2003. They considered in 1993 in 55% that regulates visits to the dentist can prevent cavities, and in 2003, the percentage rose to 73%. It is known that visiting the dentist is a benefit for the children, and their dental health.

Important rises appear when using fluorine and avoiding sugar proving an educational level concerning oral health. Cavity prevention is made by using fluorine- the percentage varied in 10 years, in Romania, in mothers and schoolteachers from 46→65% and 41→62% respectively.

In 1997, the WHO published a comprehensive document which describes and analyses the oral health status of children and adults in selected countries (9). The primary objective of the so-called WHO International Collaborative Studies

(ICS-I or -II) was to compare oral health care systems and their impacts on oral health status. Secondly, the data provide a unique opportunity to analyze important socio-behavioural determinants of oral diseases, 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 analyze 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).

The existence of a social gradient in dental caries prevalence was found across countries and oral health systems as measured by the association in dental caries indicators and socioeconomic status (fig. 5).

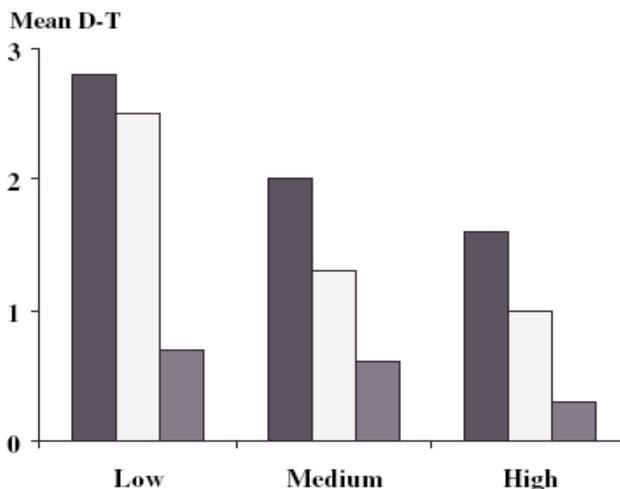


Fig. 5. Mean DT of 12-13-year olds by level of education of parents in certain industrialized countries (19)

INTERNATIONAL PERSPECTIVES ON CORRELATION OF SOCIO-BEHAVIORAL RISK

Dentists played an insignificant role in improvements of oral health, indicating that dental diseases are readily prevented without dentists. The major improvements are due to external factors. Dental care accounted for about 3% of reduction in caries in 12 year-olds whereas broad socio-economic factors (including or excluding fluoridated toothpastes) explain 65% of this reduction. The improvements in periodontal health are due to decreases in smoking, and improvements in self-care using anti-plaque and calculus toothpastes (10).

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 focused 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 dental flossing on a regular basis (9). The ICS-II study also demonstrated that socio-behavioural factors have an impact on quality-of-life measures related to the experience of dental caries (9).

The quality-of-life indicators were considered as symptoms such as pain, discomfort, self-assessment of 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 focused on oral health and disease determinants in selected industrialized populations (9). 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. Currently, nearly all Danish children take part in the comprehensive oral health care program provided by the public dental health services (11). 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 2 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 programs.

Moreover, multivariate analyses revealed these higher odds of dental caries in cases of frequent consumption of sugary items (12). Such behavioural factors also play an important role in understanding different dental caries risks observed across cultures or ethnic groups in several industrialized countries (12) (fig. 6).

Sociobehavioural risk factors in dental caries

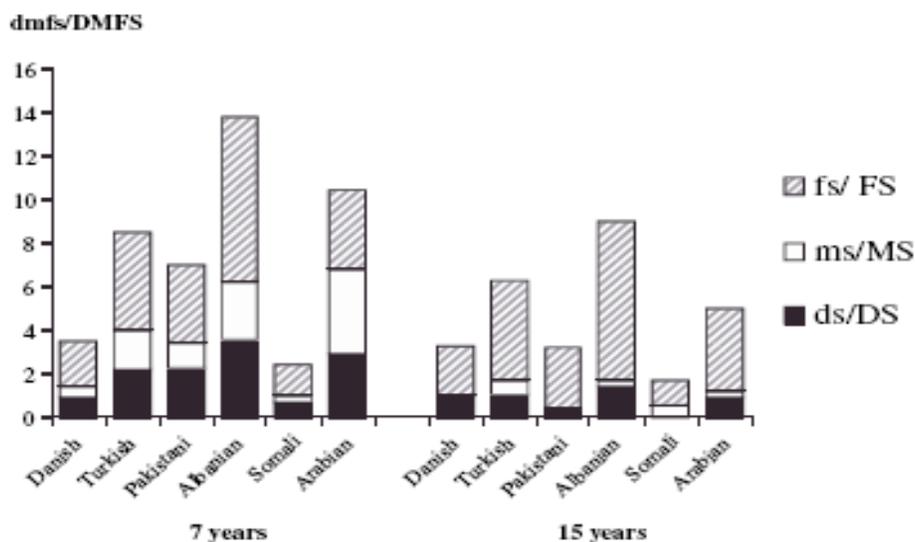


Fig. 6. Dental caries experience (dmfs/DMFS) in 7- and 15-year olds living in Denmark by ethnic group (21)

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 fluorides (13). In a meta-analysis of cohort studies, case-control studies and cross-sectional surveys, Burt and Pai showed somewhat moderate or weak effects of sugar on dental caries incidence or prevalence rates (14). In many developing countries of Africa and Asia, the exposure to fluoride is low and recent socio-behavioural 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 (11). Table 3 summarizes the evidence from such studies conducted in some developing countries, as regards the effects of certain risk factors on odds for dental caries (15-20).

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

INTERNATIONAL PERSPECTIVES ON CORRELATION OF SOCIO-BEHAVIORAL RISK

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.

Table 2. Logistic regression analysis of risk factors on odds of dental caries among 6-year-old Danish children (11)

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 sugar 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 *p < 0.05; **p < 0.01.

Table 3. Summary of effects of socio-behavioural risk factors on odds of dental caries (OR) as measured in comparable studies carried out in certain countries of Africa, Asia (2)

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	
Touthcleaning habits	X		X	?	
Dental visits		X	X	X	
Consumption of sweets	X	X	X	X	X
Consumption sugary drinks	X				
Dental altitudes	X			X	

The challenges to dental public health practices

Dental public health represents a new nonclinical speciality which refers to dental health care evaluation and dental health promotion in order to meet the population needs. The scientific literature provides substantial evidence of effects of socio-

behavioural risk factors in dental caries. Focusing on risks to health is the key of disease prevention. Risk factor assessment may measure the potential of prevention (1). Systematic risk assessment may estimate the potential of prevention by the analysis of (1):

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

INTERNATIONAL PERSPECTIVES ON CORRELATION OF SOCIO-BEHAVIORAL RISK

The term 'risk factor' does not 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.

The tradition of risk assessment is still somewhat weak in dental public health, however, the emphasis being particularly on behavioural risk factors rather than socio-environmental 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: (a) hazard identification; (b) exposure assessment; (c) dose-response assessment and (d) 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 (fig. 6) (21). 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.

CONCLUSIONS

The results of this study are consistent with tooth loss prevalence, extent of tooth loss and reduced occluding support being a consequence of disease-, behaviour-, and social related risk indicators as well as their interactions. Tooth loss due to caries and due to other reasons was closely but differently related to disease and socio-behavioural factors. Not going to a dentist was associated with retention of carious teeth and with tooth loss due to reasons other than caries, whereas loss of occluding support impacted on chewing ability. Efforts to preserve more natural teeth of the ageing population should focus on the prevention and treatment of caries and periodontal diseases. Outreach emergency oral health care should be strengthened through education of dental care providers to equip them with means to treat and retain teeth.

REFERENCES

1. World Health Organization. *The World Health Report 2002: Reducing risks, promoting health life*. Geneva: WHO; 2002.
2. Petersen PE: *The World Oral Health Report 2003: continuous improvement of oral health in the 21st century – the approach of the WHO Global Oral Health Programme*. Community Dent Oral Epidemiol 2003;31(Suppl 1): 3–24.
3. Irene A Kida, Anne N Astrom, Gunhild V Strand, Joyce R Masalu: *Clinical and socio-behavioral correlates of tooth loss*. BMC Oral Health 2006, 6: 5 doi: 10.1186/1472-6831-6-5
4. Richards ND, Cohen LK, editors. *Social sciences and dentistry. A critical bibliography*. The Hague: A Sijthoff, 1971.
5. Petersen Poul Erik, Danila Ioan, Samoila Anca: *Oral health behavior, knowledge and attitudes of children, mothers and schoolteachers in Romania in 1993*. Acta Odontol Scand 53 (1995).
6. I. Danila, Adina Evgheniokos, P.E. Petersen, A. Stan: *Oral health-teachers behaviour change – as a major factor of progress*. J Med Prev, Iasi, 1995, 3 (1-2).
7. Cohen LK, Bryant PS, editors: *Social sciences and dentistry: a critical bibliography*. Vol. II. London: Quintessence Publ Co.; 1984.
8. Chen M: *Oral health of disadvantaged populations*. In: Cohen LK, Gift H, editors. *Disease prevention and oral health promotion. Socio-dental sciences in action*. Copenhagen: Munksgaard; 1995.
9. Chen M, Andersen RM, Barmes DE, Leclercq M-H, Lyttle SC: *Comparing Oral Health Systems. A Second International Collaborative Study*. Geneva: World Health Organization; 1997.
10. Aubrey Sheiham: *Strategies for oral health care*. Euro Observer 2005, Volume 7, Number 3.
11. Petersen PE: *Oral health behaviour of 6-year-old Danish children*. Acta Odontol Scand 1992; 50: 57–64.
12. Sundby A, Petersen PE: *Oral health status in relation to ethnicity of children in the Municipality of Copenhagen, Denmark*. Int J Pediatric Dent 2003; 13: 150–7.
13. Moynihan P, Petersen PE: *Diet, nutrition and the prevention of dental diseases*. Publ Health Nutr 2004; 7: 201–26.
14. Burt B, Pai S: *Sugar consumption and caries risk: a systematic review*. J Dent Educ 2001; 65: 1017–23.
15. Petersen PE, Poulsen VJ, Ramahaleo J, Ratsifaritara C: *Dental caries and dental health behaviour situation among 6- and 12-year old urban schoolchildren in Madagascar*. Afr Dent J 1991; 5: 1–7.
16. Petersen PE, Nyandindi U, Kikwilu E, Mabelya L, Lembariti BS, Poulsen VJ: *Oral health status and oral health behaviour of schoolchildren, teachers and adults in Tanzania*, Technical Report. Geneva: World Health Organization; 2002.
17. Al-Tamimi S, Petersen PE: *Oral health situation of schoolchildren, mothers and schoolteachers in Saudi Arabia*. Int Dent J 1998; 48: 180–6.
18. Petersen PE, Hoerup N, Poomviset N, Prommajan J, Watanapa A: *Oral health status and oral health behaviour of urban and rural schoolchildren in southern Thailand*. Int Dent J 2001; 51: 95–102.
19. Peng B, Petersen PE, Fan MW, Tai BJ: *Oral health status and oral health behaviour of 12-year-old urban schoolchildren in PR China*. Community Dent Health 1997; 14: 238–44.

INTERNATIONAL PERSPECTIVES ON CORRELATION OF SOCIO-BEHAVIORAL RISK

20. Zhu L, Petersen PE, Wang HY, Bian JY, Zhang BX: *Oral health knowledge, attitudes and behaviour of children and adolescents in China*. Int Dent J 2003;53: 289–98.
21. Batchelor P, Sheiham A: *The limitations of a “high risk” approach for the prevention of dental caries*. Community Dent Oral Epidemiol 2002; 30: 302–12.