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Strategies for caries risk assessment in children and adolescents at public dental clinics in a Swedish county

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Background. Since caries prevalence has decreased and become polarized, high-risk preventive strategies have been widely adopted. The underlying factors leading to assessment and management of caries risk are poorly understood.

Aim. The aim of this study was to identify the factors forming the basis for dentist's caries risk assessment in dental care for children and adolescents.

Design. From all 3372 children in a Swedish county identified as at high risk for developing caries, a sample of dental records from 432 children, aged 3–19 years, were randomly selected to be analysed in the study. Information about medical and social history, dental status, dietary habits, oral hygiene, and salivary data was obtained from the records.

Results. The results show that the only data registered in the majority of the dental records were dental status from the clinical examination and bitewing radiographs. In approximately half of the dental records, medical history and data concerning oral hygiene were registered. Dental history and dietary habits were noted in approximately 25% of the dental records, whereas other risk factors/indicators were occasionally registered.

Conclusions. Dentists mainly base their caries risk assessments on past caries experience, a reliable risk indicator for assessing the risk of being affected by caries again. In children with no experience of caries, knowledge of other risk factors/indicators needs to be available to perform a caries risk assessment. In this study, documentation of such knowledge was strongly limited.

Introduction

Improvement of dental health in children and adolescents has taken place in the last few decades in industrialized countries[1]. In Sweden, 22% of 12-year-old children had no experience of caries in 1985, as compared with 58% in 2005[2]. Although the caries prevalence has decreased, the distribution has become skewed within the population during the same period, and approximately 20% of children have considerable experience of caries[3].

When the prevalence of dental caries was high among Swedish children and adolescents during the 1970s and in the early 1980s, population-based preventive strategies based on toothbrushing and fluoride rinsing in schools were common and successful[4]. Since the caries prevalence decreased and became polarized, the population strategies to prevent oral diseases were abandoned in many Swedish counties in favour of an individual high-risk strategy[5]. The aims of the high-risk strategy were early identification of individuals at risk of future caries lesions and to design a preventive or curative programme with the purpose of stopping the progression of the caries disease for these individuals[6,7].

However, the cost effectiveness and scientific basis for an individual high-risk strategy have been questioned in recent years[8,9]. When caries incidence becomes low, the majority of caries lesions occur in a minority of individuals. Nevertheless, a large number of persons at a small risk still get more caries lesions than the small number at a high risk[10]. A report from The Swedish Council on Technology Assessment in Health Care shows that methods used to identify individuals at high risk for caries have low accuracy, whereas it is more reliable to identify individuals with low risk for developing caries[11].

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Clinicians handle diagnosis and treatment planning of caries in different ways, and the underlying factors leading to management of risk and choice of treatment strategies are poorly understood[12,13]. In addition, it is unknown to what extent the dentists comply with policies of the local authorities concerning dental care or what risk factors/indicators they use to form the basis of the risk assessment[14]. The aims of this study were to identify the factors forming the basis for dentists' caries risk assessment and to investigate whether they use caries risk assessment models in dental care for children and adolescents at the public dental service in Uppsala County.

Materials and methods

In 2000, dentists and dental hygienists at the public dental service in Uppsala County examined 39 231 individuals aged 3–19 years. The dentists identified 27 739 (70%) of children and adolescents as being at low, 8120 (21%) as uncertain, and 3372 (9%) as being at high risk for developing caries. The caries risk assessment was noted in the dental records.

The ethics committee, faculty of medicine, Uppsala University, Sweden, approved the study. From the individuals who were identified as being at high caries risk in 2000, a random sample of dental records from 678 children and adolescents aged 6–19 years were chosen from all public dental clinics in Uppsala County by choosing every fifth child from the group. The children and their parents were informed by a letter and could accept or refuse analysing of the dental records, after which 432 individuals (64%) accepted their dental records being used in the study. All dental clinics were informed, and agreed to participate in the study. From the dental records, data were collected retrospectively from 1998 to 2000. Data were collected from all documented information in the records such as written notes, status, and medical history during these 3 years. Data were registered in a protocol designed for the study. Figure 1 shows the protocol.

In the protocol, the child's age, sex, and caries risk assessment in 1998, 1999, and 2000 were noted. Information that could describe the facts that were the basis of the caries risk assessment

Name		**Social security number**			
Address		**Postal code**		**Locality**	
Clinic					
Therapist (initials)		**Dentist**	**Hygienist**	**Dental nurse**	
Age					
Sex					
Medical history		Yes	No		
Social history		Yes	No		
Dental history		Yes	No		
BW radiographs		Yes	No	Year	
Referral to specialist clinic					
		Yes	No	Year	Clinic
Caries risk assessment model					
		Yes	No		
Dental status		Yes	No		
Oral hygiene		Yes	No		
Analyses of dietary habits documented				Yes	No
Salivary secretion test		Yes	No		
Buffering capacity		Yes	No		
Microbiological analysis		Yes	No		
SM		Yes	No		
LB		Yes	No		
Cariogram		Yes	No		
Risk assessment	1998	Yes	No	Risk group ☐	
	1999	Yes	No	Risk group ☐	
	2000	Yes	No	Risk group ☐	

Fig. 1. The protocol designed for the study. SM, mutans streptococci; LB, lactobacilli.

was obtained from the dental records. A history was considered to be performed if any documented information about the child's medical, dental, and social background was found in the records. The form also included information about the child's dental status, oral hygiene, and dietary habits, and whether a saliva test was taken. Data for risk assessment concerning oral hygiene and dietary habits were accepted if any notes about oral hygiene and dietary habits were registered in the records. It was noted if bitewing radiographs were used in 1998, 1999, or 2000. In addition, information was registered about whether a caries risk assessment model was used by the therapists. A caries risk assessment model was considered to be used when a minimum criterion was fulfilled: a documented medical history, dental status, and dietary

analysis and, in addition, either information about the child's oral hygiene or social conditions and family characteristics (social history).

Two experienced dental therapists, a dentist and a dental hygienist, collected the data. Both inter-examiner and intra-examiner reliability tests were performed. For the inter-examination test, the investigators' registrations of 20 randomly selected dental records were compared. In the intra-examiner test, the same dental records were re-investigated by the same therapist and the concordance was analysed.

Statistical analyses

The statistical analyses were performed using several statistical tests. Assessment of intra-examiner and inter-examiner agreement was analysed by calculating the kappa coefficient. The agreement was considered excellent when the coefficient was 0.76–1.0, and moderate between 0.5 and 0.75. Frequency tables performed descriptive analyses, and Fisher's exact test was used for statistical analyses of the variation of frequency. The Fisher's exact test procedure calculates an exact probability value for the relationship between two dichotomous variables in small sample sizes. When equality of population medians among groups were compared, a Kruskal–Wallis test was used because this test does not make assumptions about normality and homoscedasticity. A P value < 0.05 was considered statistically significant.

Results

Inter- and intra-examiner reliability test

The tests included 20 randomized selected protocols with a total of 18 variables. Kappa coefficients were calculated as a measure of assessment agreement regarding all the variables. The inter-reliability test showed a kappa coefficient of 0.77–1 regarding 15 variables, indicating excellent agreement. One variable had a coefficient of 0.52, indicating moderate agreement. Kappa calculations for two variables could not be performed. The intra-reliability test for 15 variables had a kappa coefficient of 0.76–1, indicating excellent agreement. For two variables, the coefficient was between 0.69 and 0.73, indicating moderate agreement. Kappa calculation regarding the assessment of one variable could not be performed. Table 1 shows the mean kappa coefficient and range for both tests.

Table 1. Assessment of intra-examiner and inter-examiner agreement.

Reliability test	Xi kappa	Range
Inter-examiner	0.94	0.52–1
Intra-examiner	0.92	0.69–1

Table 2. Distribution of caries risk assessment in 1998 and 1999 for individuals assessed as high risk in 2000.

	1998		1999		2000	
Risk assessment	*n*	%	*n*	%	*n*	%
High risk	80	19	152	35	432	100
Medium	34	8	40	9	0	0
Low risk	31	7	36	8	0	0

Sampling of risk factors/indicators

The dental records of 218 (50.46%) boys and 214 (49.54%) girls between 6 and 19 years were studied. All the individuals belonged to the high-risk group at year 2000. Table 2 shows the distribution of risk groups in 1998–2000. The results show that the dentists assessed the caries risk for 34% and 52% of the studied children at year 1998 and 1999, respectively. Medical history was documented in 247 records (57%), dental history in 96 records (22%), and social history in 24 records (6%). The therapists used bitewing radiographs in 370 (86%) of the cases. Figure 2 shows the occurrence of the factors documented by the therapists in dental records in 1998–2000. A caries risk assessment model was used in 15% of the patients. Data concerning oral hygiene were more often found in boys' records ($P < 0.05$, Fisher's exact test); no other difference between sexes was found.

With the purpose of comparing the risk assessment processes between dental clinics, data from dental records sampled in the same clinic were combined. Dental status and bitewing radiographs were the only variables used

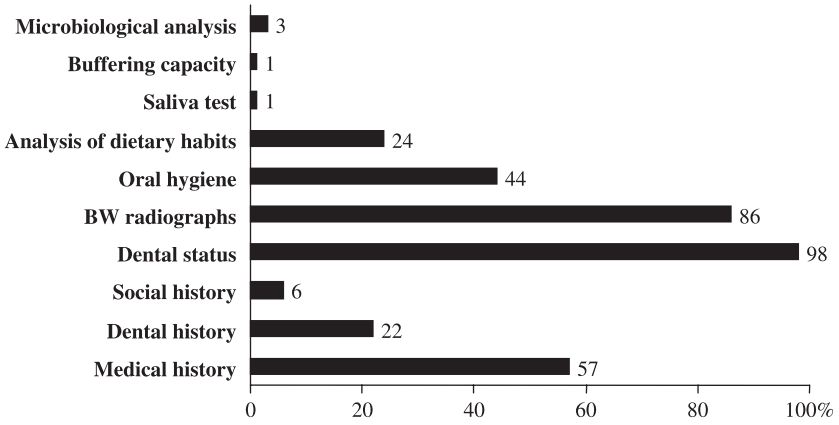

Fig. 2. Distribution (%) of factors assembled for caries risk assessment.

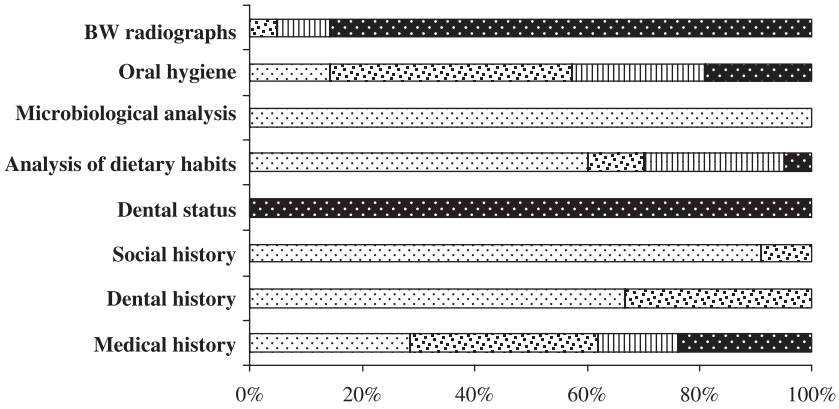

Fig. 3. Distribution of factors used for caries risk assessment among the dental clinics ($n = 21$). Percent of clinics with: ⊡, registration in 0–25% of the dental records; ⊠, registration in 26–50% of the dental records; ▥, registration in 51–75% of the dental records; ■, registration in 76–100% of the dental records.

to a large extent at all clinics. Medical history and oral hygiene were well-documented at approximately 20% of the clinics. Other factors such as dietary habits, dental history, social history, and microbiological analysis were poorly documented factors among the dental clinics. Figure 3 shows the distribution of factors used for risk assessment among the dental clinics. The results show large variations between the clinics.

Discussion

This study investigates the collection of several risk factors/indicators essential for assessment of caries risk. The study shows that the only data registered in the majority of the dental records were dental status from the clinical examination and bitewing radiographs. In approximately half of the dental records, medical history and data concerning oral hygiene were registered. Dental history and dietary habits were noted in approximately 25% of the dental records. Other risk factors/indicators were occasionally registered. The caries risk factors/indicators, however, were registered more often than in a Finnish investigation, where diet had only been assessed in 7% of the records and oral hygiene habits in 14%[15].

From the dental status, in addition to initial and manifest caries, knowledge about past caries experience can be determined. In several studies, past caries experience has been mentioned as a valid predictor of caries risk in children[11,12,16]. Past caries experience, however, indicates that the individual already suffers or has suffered from caries disease (i.e. the risk stage has already been passed). As a risk factor, past caries experience has no ability to indicate an individual's risk of being affected by caries the first time, but is a reliable factor for assessing the risk of being affected by caries again if sufficient preventive measures are not taken. In this study, dental status was registered in 98% of the cases, indicating that this variable

was the main source of information when assessing caries risk, a decision in line with a report from the Swedish Council on Technology Assessment in Health Care[11].

A history is essential when caries risk is to be assessed. Information about medical and social conditions is particularly valuable in young children, when no knowledge about past caries experience is available. Immigrant background, the parents' level of education, number of siblings, sleeping habits, etc., are factors associated with caries risk[17–19]. In spite of this, a social history was only found in 6% of the dental records.

In the early 1990s, the dental health care authorities in Uppsala County switched from a population-based strategy to a combination of population-based and modified high-risk strategy. The modified high-risk model implies that each subject is assigned to one of three groups with respect to caries. The aim of this strategy was individualization of treatment and recall activity based on a caries risk assessment model which may result in more effective use of dental resources and lower costs for treatment of caries disease.

The registration of caries risk factors/indicators varied largely between the dental clinics. Registration of dental status was found in all patients in all clinics. Bitewing radiographs were also found in a majority of the dental records at most of the clinics. The performance of medical history and registration of oral hygiene varied most between the clinics. Twenty-five per cent of the clinics had registered a medical history in more than 75% of the dental records, whereas 28% of the clinics had registration in less than 25% of the records. One possible explanation could be that some clinics had adopted policies that structured the examination and risk assessment of children and adolescents to a greater extent. Another explanation could be that training in risk assessment differed between the clinics, although that the switch in preventive strategy in 1997 was preceded by an extensive education in caries risk assessment and individual preventive measures. However, it cannot be excluded that the dentists assembled information of medical, dental, and social conditions from the children and adolescents, but they never noted the information in the dental records.

Ideally, the identification of high-risk children should occur early enough to prevent onset of the disease instead of after it has been established. In accordance with the report from The Swedish Council on Technology Assessment in Health Care, medical and social history, information on dietary habits, and microbiological analysis are relevant knowledge in addition to previous caries experience when caries risk will be assessed. In this study, none of these factors except previous caries experience were sufficiently documented by the therapists. If an individual high-risk approach will be used as preventive strategy, this study indicates a need for a structured, standardized clinical examination process to secure that all relevant information becomes available when caries risk assessment is performed and preventive measures are planned.

What this paper adds

- This study shows that the dentists in Uppsala County mainly base their caries risk assessment on past caries experience.

Why this paper is important to paediatric dentists

- In children with no experience of caries, knowledge of other risk factors/indicators, such as social history and dietary habits, needs to be available to perform a risk assessment. This study indicates a need for more education to stress the importance of these factors when assessing caries risk.

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