Caries experience and treatment response among groups of Finnish, German and Russian children. A retrospective study between 1995 and 1989

S. HONKALA*, E. HONKALA**, E. KUZMINA***, T. SMIRNOVA***, G. MEYER****, C. SPLIETH****

ABSTRACT. Aim This study was designed to describe caries experience and treatment response in groups of children in three countries - Finland, Germany and Russia - with different systems of public dental care. Materials and methods Information concerning permanent teeth (carious and filled surfaces, type of restorative treatment and applied sealants) was collected retrospectively from existing dental records of 12-year-old children who had been treated in dental practices over six years, retrospectively between 1995 and 1989. Prior to conducting the study, research meetings were held among all participating personnel to standardise data collection and terminology as much as possible. Statistics The analysis of variance (ANOVA) was used to test the difference between the means of the various types of data derived from the three countries. Results Sealants were most commonly used in Finland at a rate of 5.0/child and 3.3 in Germany, but only for a few children in Russia (0.1). Caries increments (cumulative figure of primary and secondary caries surfaces over the six follow-up years of the study) differed very much between these countries. It was very high in Russia (7.4) and in Germany (5.3), but low in Finland (1.6). All the caries surfaces were filled in Finland and in Germany; in Russia, the cumulated number of filled surfaces was smaller than the respective number of caries surfaces (6.4/7.4). The most commonly used restorative filling material was amalgam in Germany and in Russia, but composite or glass ionomer cements in Finland. Conclusion The cost effectiveness of sealant application programs should be considered as exemplified by the Finnish dental care system. The data showed a need for preventive programs in Germany, and this has actually been emphasised since 1993. In Russia, there is an urgent need to implement preventive programs for 6-year-old children and also to provide the necessary restorative treatment.

KEYWORDS: Dental caries, Children, Preventive dentistry, Retrospective study

Introduction
Dental care of children in Finland. After implementation of the Primary Health Care Act in Finland [Law 66/1972], health centres gradually succeeded in offering free preventive and curative dental care for children and adolescents. Consequently, until 1992 the costs of dental care for all persons under the age of 19 years was covered by the Government [Tala, 1992]. Compliance for regular dental check-ups has been very high - over 90% - during the school years [Milén et al., 1988; Honkala et al., 1997] and socio-economic differences in utilization have been abolished [Honkala et al., 1997]. The National Board of Health has advised dental professionals to instruct and to motivate patients to maintain an adequate level of home care and to perform professional preventive measures, such as topical fluoride and sealant applications [National Board of Health, 1985]. Already by 1983, individual recall intervals were recommended. Since 1974, dental records have routinely been completed in health centres and the summaries reported to
health care systems [National Board of Health, 1989]. Therefore, national annual caries statistics data have been available since that time. The decline of caries has been remarkable and still continues. In 1975, the DMFT (decayed, missing and filled teeth) figure for 12-year-olds was 6.9, in 1982 4.0 [Widström, 1995], and in 1997 1.1 [World Health Organization, 1997].

**Dental care of children in Germany.** After World War II, East Germany and West Germany were independent states and developed different economic, social and health care systems. In East Germany, beginning very early after the end of the war, prevention of dental caries became a national goal, and measures for assessing group prevention were started. The government at that time was responsible for implementing an universal health care system without individual payment [Gerber, 1980], and the community and school dental clinics were established. In 1972, legislative efforts resulted in a government bill on oral health promotion for children and adolescents. This included annual dental examinations, systematic and topical fluoridation, oral hygiene instructions every 6 months, and the education of teachers in oral health promotion [Ministerium für Gesundheitwesen, 1979]. Pit and fissure sealants were not used in East Germany at a national level until 1989, because these materials were not available [Künzel, 1996].

In West Germany, 93% of the population was insured by a social medicine system [WHO, 1986], which provided adequate restorative treatment to the entire population. Just recently, prevention has become a part of the procedures covered by the agencies. Development of regional group prevention programs based on systemic and topical fluoridation, diet counselling, and supervised tooth brushing, since the 1980s, increased the awareness of oral health and promoted reduction in caries [Gülzow, 1990]. In West Germany, fissure sealants were included in dental care in 1992, and in the year after that, sealants were introduced as a part of a National Oral Health Program and became items of treatment that were free of charge. Before that, the use of sealants in West Germany was minimal [Della Volpe, 1989].

Caries epidemiology at a national level developed very late in both parts of Germany. In 1990, East and West Germany united, and soon after that, in 1990 and 1992, caries prevalence was monitored with the same diagnostic criteria and calibration by two representative surveys in old West and old East Germany States [Dünninger and Pieper, 1991; Einwag, 1993]. In East Germany, at a national level, caries prevalence was stable (DMFT value of 3.3 among 13 and 14-year-olds) from the 1970s to the 1980s, and only at the end of the 1980s were there indications for a slight caries reduction [Einwag, 1993]. In West Germany, caries prevalence increased after the Second world war until 1973, reaching up to 8.8 DMFT among 13 and 14-year-olds [Arnloj, 1985]. During the 1980s, there was a significant reduction down to 5.1 DMFT for the same age groups [Dünninger and Pieper, 1991]. Since 1994, regular regional surveys of 6-, 9- and 12-year-olds with calibrated examiners have been established [Pieper, 1996].

**Dental care of children in Russia.** In Russia, the Department of Dentistry of the Ministry of Health is responsible for developing policies for oral health care and for collecting and distributing information all over the country [Ministry of Health of USSR, 1988]. Free oral health care should be available to everyone. The basic institutions providing the public dental health services to the population are specialized dental policlincs, dental departments of general polyclinic and dental clinics in factories and schools [Kuzmina, 1997]. In each district of Moscow the public dental health services are delivered by municipal district polyclinics, which provide health care either for children or for adults [Kuzmina, 1997]. No specific preventive measures have been implemented, and fissure sealants have not been commonly used in Russia [Honkala et al., 1992]. Due to limited resources in some parts of Moscow dentists screen children for treatment only when they are about 6 and 11 years old [Kuzmina et al., 1995]. In the former Soviet Union, 12-year-old children were screened in 1984 and in 1986. These investigations showed enormous variation in mean DMFT indices between different states, varying from 1.0 in Armenia to over 6.0 in the Baltic States [Møller, 1990a]. In one recent study, groups of 12-year-old children were examined in 23 districts of Moscow and in 22 towns in the Moscow region, and dental caries levels varied from low (DMFT 1.7-2.3) to moderate (2.7-3.9) [Kuzmina et al., 1994].

The aim of this study was to describe caries experience and treatment responses over a six year period among groups of children in three different countries with different dental care systems, in Finland, Germany and Russia.

**Materials and methods**

Research planning meetings were organised in Greifswald, Germany, and in Moscow, Russia, to agree on the principles of data collection and the form to be used. One dentist in each country...
collected information from the dental records of 12-year-old children retrospectively to the age 6, from 1989 to 1995. The data included information about application of fissure sealants (present or not), primary and secondary caries surfaces, filled surfaces with different materials (amalgam, composite/glass ionomer, temporary filling), endodontic treatment (root filling, pulpotomy), and extractions due to caries. Only permanent teeth were considered. FDI standards were used for numbering of the tooth and surfaces. An additional research meeting was held in Moscow after collection of the pilot data in order to check any confusion about collection of the information required and employment of the data forms. Ethical clearance for the use of patient records was provided by the responsible authorities in all countries (the city of Helsinki, Department of Health and the Ministry of Social Welfare and Health in Finland, University of Greifswald in Germany and the Moscow Medical Stomatological Institute in Russia).

In Finland, the study was carried out in the capital area, the city of Helsinki, in one health district belonging to the public system of dental health care. The North-East district of Helsinki was selected because in this area the proportion of children is very high, and it was assumed that the sample of 12-year-olds could be drawn from one single district. According to health centre statistics, the differences in the oral health of children between different districts under the city health board were very small. Only those children who had been examined in that district during 1989-1995 were included in the study (Table 1). Immigrant children were identified by name and were excluded from the study. The total sample was 199, corresponding to 5% of the 12-year-old Finns in the city of Helsinki.

In Germany, there exist several different types of clinics, which provide dental treatment for children. In order to achieve a sampling as representative as possible practices of the various regions (Greifswald, Vorpommern area; Duisburg, Ruhr, Black Forest areas and Nienburg, Lower Saxony) with different caries prevalence [Pieper, 1996] proportionally were chosen. Two of the practices were preventively oriented (middle sized city and metropolitan), two other practices conventional (rural and small town), one paediatric practice (rural), and one university clinic (middle sized town). The total sample size was 196 children.

In Russia, information on 193 children was collected from three standard polyclinics with paediatric dental patients in the capital area of the City of Moscow (districts of Sverdlovsky, Kirovsky, Krasnopresnensky). None of these children had had annual examinations and dental check-ups had been performed for only six children in 1989. Therefore, the data of that year were excluded from the analysis.

The caries and treatment information were collected from the patient records on identical forms in each country. The data were then entered into a computer and analysed by an SPSS program in Finland. The means for different variables were used for comparisons, and differences in the means were tested with an analysis of variance (ANOVA). Total DMFT indices were calculated from the annual treatment records. Caries increment was described by the cumulative figures (the sum of annual indices) for primary and secondary carious surfaces (DS). The cumulative figures for surfaces restored due to primary and secondary caries were used as additional information for performed restorative procedures.

### Results

Sealants were most often used in Finland (mean 5.0/child) and in Germany (3.4/child), but only for a few children in Russia (0.1/child) (Fig. 1). In Finland, the sealants were mostly applied for 6-, 7- and 12-year-old children while in Germany for 10- and 12-year-olds.

During the whole six year follow-up period, 55% of those Finnish children examined and 23% of German children remained caries free, but all the Russian children studied had some carious surfaces. The DMFT figures for 12-year-olds were quite low.

<table>
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<th>Year</th>
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<td>1995</td>
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**Table 1** - Number and percentages of children examined in each retrospective follow-up year, from 1989 to 1995 (from the age of 6 to 12 years) in Finland, Germany and Russia.
in Finland (mean 0.5), moderate in Germany (2.4) and in Russia (2.7).

The annual caries increment (cumulative figure of caries surfaces) also differed very much between the different countries (p<0.001). It was very high in Russia (7.4) and in Germany (5.3), but low in Finland (1.6) (Table 2). In Germany, the annual caries increment was greatest at the age of 12 years (1.3), but in Russia it was highest at the age of 7 years (2.3). In Finland, caries increment increased slowly during the whole follow-up period (0.1-0.4). In Germany, 21 first permanent molars were extracted due to caries; in Finland and Russia none. All the caries surfaces were restored in Finland and Germany (Fig. 2). In Russia, the cumulated number of restored surfaces was smaller than the respective number of caries surfaces (6.4/7.4). The most commonly used filling material was amalgam in Germany (67%) and in Russia (72%), but composite or glass cements were mostly used in Finland (95%). In all countries root canal fillings were rarely performed there being only eight in Germany, one in Finland and none in Russia.

**Discussion**

The main finding of this study was that the children in Finland received much more preventive treatment than their counterparts in Germany and Russia. Regular dental check-ups evidently were not so well implemented in practice in Germany and in Russia than in Finland. It could be assumed that the Russian children in this study had more caries than non-regular attending children in these countries. The coverage of dental care seemed to be especially low at the age of 6 years in Russia, and between 6 and 10 years of age in Germany. Russia appeared to be having difficulties in organising both restorative treatment and preventive dental care. One earlier study concluded that in Germany the amount level of restorative therapy, measured as the mean number of filled surfaces for 5- and 12-year-olds, has indicated more treatment than in seven other European Union countries [Bolin et al., 1996]. This may to some extent be explained by the prevailing different treatment policies regarding extractions, restorations and use of fissure sealants.

In this study, among Finnish and German children almost all caries surfaces were filled, which might also indicate a risk of over-treatment. The amount of filled surfaces was highest in Germany at the ages of 6, 9, 10
and 12 years, and in Russia at the ages of 7, 8 and 11 years. Specific prevention or follow-up of caries lesions was evidently low in all these countries.

The mean caries increments found in this study coincided well with other representative epidemiological studies from these countries [Einwag, 1993; Kuzmina et al., 1994; Widström, 1995]. In Finland, the caries increment seemed to be low, but slightly increasing according to age. Children in Germany participating in this study had the same distribution patterns of dental caries as recent nationally representative surveys [Pieper, 1996]. Previous data from Moscow indicate that caries prevalence in the permanent dentition of children and adolescents is moderate, but slowly increasing [Kuzmina, 1997]. Also in this study it was moderate. In Moscow, the level of untreated caries lesions among the children has been shown to be high. The mean F-index among Russian children has been 1.8 among 14-year-olds, while the mean DMFT has been 3.5 [Kuzmina et al., 1995].

According to the current treatment principles, the mean figures for filled surfaces should be clearly lower than the number of carious surfaces [Elderton, 1993]. In addition to initial caries lesions, also a significant proportion of dentine caries lesions should be left untreated in order to allow prevention to work. Unfortunately, dentists employed at the polyclinics in Russia often have limited knowledge of caries prevention, and they are more oriented towards restorative treatment than prevention [Kuzmina, 1997]. On the other hand, the quality of dental materials in most public clinics is poor [Kuzmina, 1997]. However, in this study there were more carious than treated surfaces.

In 1985, caries experience was shown to be higher among the Soviet (Moscow and Leningrad) than among the Finnish (Helsinki and Kuopio) children at the ages of 7 and 9 years, but not any more among 12-year-olds [Honkala et al., 1992]. In the present study, caries experience was higher among Russian children than among Finnish children in all age groups, which might indicate an increase in caries experience among Russian children and a continuous decrease among Finnish children during this 5 years follow-up period. In Helsinki, the proportion of caries free children was higher than that in the whole country in 1991 (56% versus 30%) [Widström, 1995]. All children in Moscow had some carious lesions already at the age of 7 years. This proportion is much higher than in a previous study carried out in another Moscow polyclinic at the same time [Ekstrand et al., 2000]. However, the polyclinic of this present study was implementing an effective preventive experimental program. Most of the fillings had been completed already by the age of 7 years. Therefore, to implement preventive care in Russia, it would be especially important to arrange regular check-ups for 6-year-olds.

In Finland, the application of fissure sealants for children has been a standard preventive procedure since the beginning of the 1980s. According to one study [Vehkalahti et al., 1990], none of the 15-year-old adolescents studied in Helsinki had any sealants left on their teeth in 1976; but ten years later, in 1986, 21% of the occlusal surfaces of the first molars and 20% of the second molars were sealed at the age of 15 years. Much higher prevalence figures for sealants were reported from cities other than Helsinki, such as 63% of the 7 to 10-year-olds in Espoo [Nordblad and Larmas, 1985], 60% in Kuopio and 80% in Varkaus among 7-year-olds [Kolmakow, 1989]. In our study, only four Finnish children had not received any fissure sealants. This comprehensive sealant programme could no longer be cost-effective in Finland.

Application of sealants should be based on an assessment of caries risk [British Society of Paediatric Dentistry, 2000]. At the same time, preventive methods other than sealants have also been used quite comprehensively in Finland [Tala, 1992]. Every second child gets oral hygiene instructions and every fourth instructions for restrictions of sugar products [Honkala et al., 1991]. In the old East German towns, 18-42% of the children had an average of 3.1 to 4.2 sealants on their teeth at the beginning of 1995 [Künzel, 1996]. In old West Germany the use of sealants was rarer and only about one tenth of the consumption in other countries, such as in the UK or USA [Della Volpe, 1989].

However, the National Health Program for the united Germany, introduced in 1993, seemed to have a very clear and positive effect on sealants applications. In Moscow, only few children received sealants in the population studied. The public dental service in Russia is not yet able to organise a comprehensive program of caries prevention, even in the capital area. Of course it would also be important to implement other preventive methods in Russia. There is already evidence that such measures could be effective [Ekstrand et al., 2000]. It would be important to change the restorative treatment response into a preventive approach. In Russia the main challenge in the future seems to be the transformation of oral health care from a disease-oriented system to a health-oriented one [Møller, 1990b].

The samples in this study were selected only from a few clinics from these three countries, because this
retrospective data would not have been possible to collect from the representative samples from all these countries, as such records did not exist in Greifswald and in Moscow. Therefore, the dentist in each country aimed at collecting patient records from the standard clinics of schoolchildren and that these data could give descriptive information on caries and treatment. The patients’ records were completed according to the criteria of caries diagnostics in each country.

This kind of information is very difficult to collect from different countries. As the sample was not randomized, the generalization for Germany has to be discussed. The participants of this study were patients in dental practices under the National Health System, which covers 90% of the German population. Larger studies found slightly higher caries prevalence in patients of dental practices than in randomized epidemiological surveys [Dünninger and Pieper, 1991]. On the other hand, children and adolescents with insufficient compliance of dental visits show higher caries values than regular attendees, which mostly seek preventive visits [Einwag et al., 1996]. As the children of this study had the same distribution patterns of dental caries as other representative surveys [Pieper, 1996], the sampling bias seems to be of minor importance.

**Conclusion**

In conclusion, in Finland the cost-effectiveness of sealant application programs could be reconsidered. In Finland and Germany, possible risks of excessive restorative treatment should be taken into account. Preventive programs should still be emphasized in Germany and the National Health Program, introduced in 1993, did have a clear effect on dental check-ups and on use of sealants. In Russia, both preventive and restorative dental cares require more attention.

**References**


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