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Intra-oral distribution of caries in South Australian children

Australian Research Centre for Population Oral Health, The University of Adelaide, South Australia.*

Introduction

The Child Dental Health Survey (CDHS), a national surveillance survey of child oral health, is one of the longest running national health data collections in Australia. Commencing in 1977 under the auspices of the then Commonwealth Department of Health, the annual survey has documented an appreciable improvement in Australian children's caries experience. In 1977, for example, 12 year old children had on average 4.8 decayed, missing or filled teeth,[1] but by 2001 this was less than one decayed missing or filled teeth on average.[2]

There are several reasons for the improvement in children's oral health in Australia, however, increased exposure to fluoride is an important factor. The introduction of both public water fluoridation and fluoridated toothpaste by the early 1970s has been a public health boon. In the most recent national CDHS report, 52.6 per cent of 6 year olds and 59.7 per cent of 12 year olds had no caries experience in their deciduous and permanent dentition respectively.[2]

Accompanying the improvement in child caries experience has been a change in the tooth surfaces most susceptible to decay. Sheiham considers it a straightforward rule that "as caries prevalence falls, the least susceptible sites (proximal and smooth surfaces) reduce by the greatest proportion, while the most susceptible sites (occlusal) reduce by the smallest proportion".[3,4] Indeed, the trend towards a greater proportion of caries experience being in pit and fissure surfaces rather than smooth and approximal surfaces was responsible for the endorsement of fissure sealants as a public health measure.[5] There is also evidence that exposure to fluoride results in reduced smooth and approximal surface caries leading to proportionally more caries experience being pit and fissure caries.[6] Using data from the early 1990s, Slade *et al*. reported that approximal surfaces accounted for approximately 40 per cent of the untreated decay in deciduous surfaces, but that the majority of caries experience in the permanent dentition occurred as fillings in pit and fissure surfaces of permanent first molars.[7]

Surface-level indices of caries were originally proposed about half a century ago[8] and are now the international standard for a number of oral health surveillance collections.[9,10] While CDHS reports have traditionally described tooth-level caries experience, there is a move by States and Territories towards the collection and reporting of surface-level data. For example, in South Australia, surface-level data are routinely collected on all children attending the School Dental Service. This allows for a detailed examination of the intra-oral distribution of caries in these children.

Methodology

Data were obtained on children aged 3–15 years old who received an examination with the School Dental Service (SDS) of the South Australian Dental Service (SADS) in 2003. The South Australian SDS provides preventive and restorative services to primary and secondary school students at both government and non-government schools. Some service provision to preschool children is also provided. Courses of care with the SDS are free to primary school students. However, secondary school students without a valid health care card are required to contribute a co-payment for service.

All data were collected by either trained dentists or dental therapists using an integrated computer-based management and charting system. Dental staff were not calibrated but receive similar instructions in the detection and assessment of caries. The data were then made available to the Australian Institute of Health and Welfare's Dental Statistics and Research Unit (AIHW DSRU) located in the Australian Research Centre for Population Oral Health (ARCPOH) at The University of Adelaide. Data in this analysis are unweighted and reflect the population of children seen within the SDS during the year.

Tooth surfaces were categorized as pit and fissure surfaces, approximal surfaces or smooth surfaces. Pit and fissure surfaces were defined as occlusal surfaces of permanent molars and premolars, lingual surfaces of permanent maxillary molars, buccal surfaces of permanent mandibular molars, lingual surfaces of deciduous maxillary second molars and buccal surfaces of deciduous mandibular second molars. Approximal surfaces were defined as mesial and distal tooth surfaces while the remaining surfaces were classified as free smooth surfaces. Deciduous caries experience was examined for children aged between 3 and 10 years of age while permanent caries experience was examined for children aged between 7 and 15 years of age. Caries experience was measured by a count of the number of tooth surfaces decayed, missing due to caries, or filled due to caries in the deciduous dentition (dmfs index) or the number of tooth surfaces decayed, missing due to caries, or filled due to caries in the permanent dentition (DMFS index).

*Prepared by Jason M Armfield and A John Spencer.

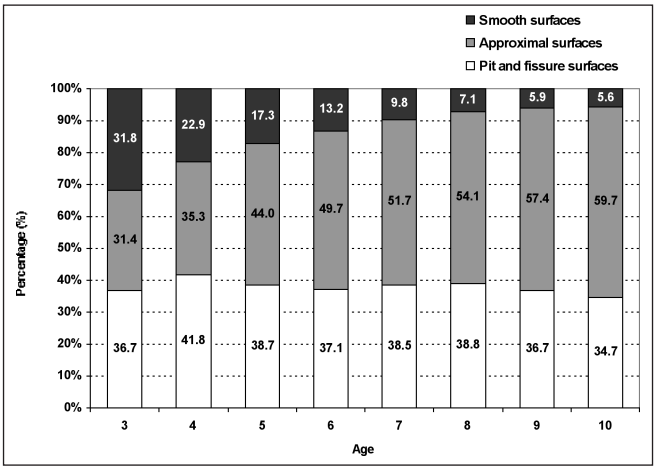

Fig 1. Distribution of deciduous decayed surfaces by tooth surface types in South Australia, 2003.

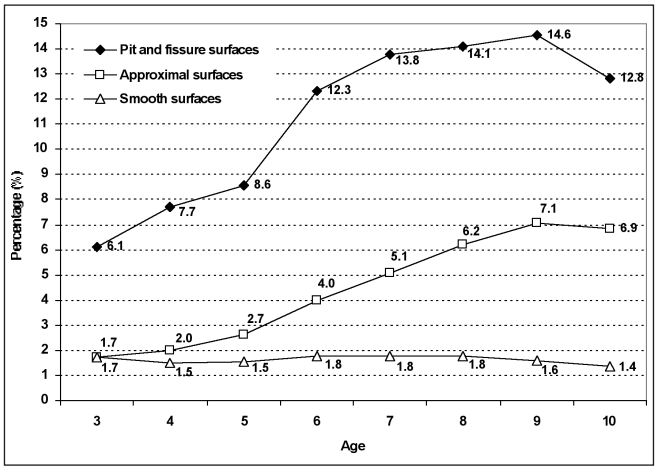

Fig 3. Percentage of deciduous pit and fissure, approximal and smooth surfaces with caries experience (dmf) in South Australia, 2003.

Results

Data on 82 405 children aged 3–15 years old were used for the analyses. About one in five children presented during 2003 with a health care card or pensioner concession card and the majority of children were classed as being medium risk with 20.5 per cent of children being classified as high risk and 23.6 per cent as low risk of developing future caries.

Figure 1 presents the percentages of deciduous decayed surfaces by surface type. Interestingly, across the age range 3–10 years the percentage of decayed surfaces as pit and fissure surfaces remains relatively consistent, only ranging from 41.8 per cent for 4 year olds to 34.7 per cent for 10 year olds. However, approximal carious lesions as a percentage of all decayed surfaces increased considerably, from 31.4 per cent for 3 year olds to 59.7 per cent for 10 year olds. Decayed smooth surfaces decreased as a percentage of all decayed surfaces, from 31.8 per cent for 3 year olds to only 5.6 per cent for 10 year olds.

In the permanent dentition, decayed surfaces are largely confined to pit and fissure surfaces (Fig 2). At 7 years of age, 93 per cent of decayed surfaces presented as decayed pit and fissure surfaces although this decreased somewhat across older ages, so that 15 year olds only had 72.5 per cent of decayed surfaces as pit and fissure surfaces. Decayed surfaces as mesial and distal tooth surfaces increased across older age groups from 4.8 per cent of all decayed surfaces for 7 year olds to just over one-fifth of all decayed surfaces experienced for 15 year olds. Finally, the percentage of decayed surfaces as smooth surfaces was low across all age groups, accounting for less than 7 per cent of total decayed surfaces.

The results shown in Figs 1 and 2 do not take into account differences in the numbers of pit and fissure, approximal and smooth surfaces present in the mouth at any given age. At age 6, for example, there are 12.0 pit and fissure surfaces, 34.7 approximal surfaces and 30.8 smooth surfaces present in the deciduous dentition on average. At age 12, there are 19.2 pit and fissure surfaces present, 48.4 approximal surfaces present and 53.3 smooth surfaces present in the permanent dentition on average.

Figures 3 and 4 present information on the percentage of all pit and fissure surfaces, the percentage of all approximal surfaces and the percentage of all smooth surfaces which are either decayed, missing due to decay or filled due to decay (dmf or DMF), for both the deciduous and permanent dentitions, respectively. The percentage of pit and fissure surfaces with caries experience in the deciduous dentition

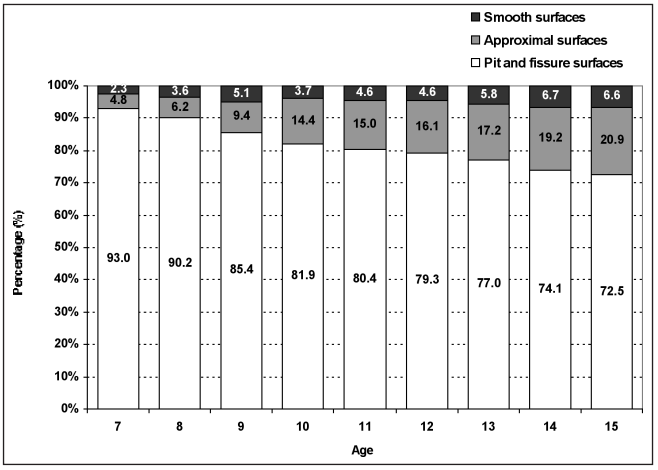

Fig 2. Distribution of permanent decayed surfaces by tooth surface types in South Australia, 2003.

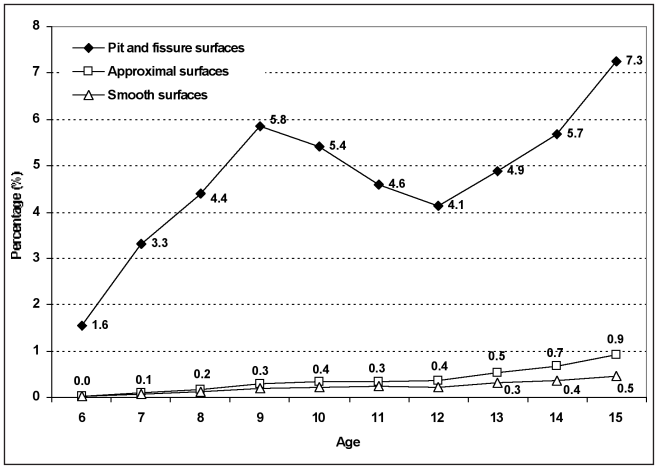

Fig 4. Percentage of permanent pit and fissure, approximal and smooth surfaces with caries experience (DMF) in South Australia, 2003.

Table 1. Mean number of decayed, missing and filled (dmf/DMF) surfaces and percentage of surfaces affected on teeth with dmfs/DMFS >0

Teeth types	Decayed, missing and filled surfaces		No. of surfaces affected (teeth with caries experience)				
			1	2	3	4	5
	mean	SD	%	%	%	%	%
Deciduous teeth – 6 year olds							
Central incisors	0.32	1.37	56.5	17.7	2.9	0.9	22.1
Lateral incisors	0.23	1.22	60.1	10.9	2.7	1.3	25.1
Canines	0.12	0.67	83.6	11.5	1.2	0.1	3.6
1st molars	1.41	2.78	43.7	41.9	5.6	0.8	8.0
2nd molars	1.40	2.66	61.8	25.5	6.0	1.0	5.7
Permanent teeth – 12 year olds							
Central incisors	0.09	0.59	40.9	31.2	15.6	6.2	5.8
Lateral incisors	0.04	0.33	74.0	14.8	6.0	0.6	3.8
Canines	0.00	0.03	80.0	20.0	0.0	0.0	0.0
1st premolars	0.03	0.50	55.7	18.2	3.4	0.0	22.7
2nd premolars	0.02	0.25	70.1	18.6	7.2	0.0	4.1
1st molars	0.78	1.56	79.2	17.0	2.0	0.3	1.5
2nd molars	0.11	0.53	93.3	5.6	0.1	0.4	0.6

(dmfs) is considerably higher than for approximal and smooth surfaces (Fig 3). At any age, pit and fissure surfaces are between 3.9 (4 year olds) and 1.9 (10 year olds) times more likely to be affected by caries experience than approximal surfaces and between 3.5 (3 year olds) and 9.1 (10 year olds) times more likely to be affected by caries experience than smooth surfaces. At age 6, approximately one in eight pit and fissure surfaces will have current or past caries experience compared to only one in 25 approximal surfaces and one in 55 smooth surfaces.

In the permanent dentition, the intra-oral distribution of caries is even more skewed towards pit and fissure surfaces (Fig 4). For both approximal and smooth surfaces, there is evidence of caries experience in no more than 1 per cent of all surfaces of these types. In contrast, between 3.3 per cent and 7.3 per cent of all pit and fissure surfaces for children aged between 7 and 15 years of age are decayed, missing or filled.

Table 1 shows the mean dmfs and DMFS by tooth type for both the 6-year-old deciduous dentition and the 12-year-old permanent dentition, as well as the number of affected surfaces on teeth with one or more surfaces which are decayed, missing or filled due to caries. For 6 year olds, 1st and 2nd molars had the majority of deciduous caries experience (dmfs = 1.41 and 1.40, respectively). While disease experience on canines predominantly only occured on one surface (83.6 per cent), 56.3 per cent of 1st molars with dmfs >0 had more than one surface affected. Caries experience on central incisors (dmf = 0.32) and lateral incisors (dmfs = 0.23) was uncommon, but in approximately one-quarter of occasions involved all surfaces, most likely reflecting an extraction.

In the permanent dentition of 12 year olds, caries experience was predominantly confined to 1st molars (DMFS = 0.78), accounting for 72.9 per cent of all caries experience in that age group. Permanent central incisors with DMFS >0 were most likely to have more than one surface affected, with 31.2 per cent of affected central incisors having two surfaces affected and 15.6 per cent having three surfaces affected. About 80 per cent of 1st permanent molars with caries experience had only one surface affected with only 1.5 per cent having all surfaces affected. In contrast, 22.7 per cent of 1st premolars with caries experience had all surfaces affected.

Discussion

These findings show quite distinct patterns of caries experience in the deciduous and permanent dentitions of a large sample of South Australian children. Although decayed pit and fissure surfaces were more prevalent than decayed approximal and smooth surfaces for children aged 3 and 4 years old, by the time children turned 10 almost 60 per cent of deciduous decayed surfaces occurred in approximal surfaces. This can be contrasted to the permanent dentition, where decay in pit and fissure surfaces was most prevalent across all age groups and ranged from over 90 per cent of 7–8 year olds to just under three-quarters of all decayed surfaces for 15 year olds. After controlling for the number of each type of tooth surface present, pit and fissure surfaces were most likely to be affected by caries experience in both the deciduous and permanent dentitions. For 6 year olds, most deciduous caries experience (dmfs) occurred on 1st and 2nd molars and almost 50 per cent of decayed surfaces occurred on approximal surfaces while for 12 year olds the majority of caries experience (DMFS) occurred on permanent 1st molars and almost 80 per cent of decayed surfaces were pit and fissure surfaces. This is comparable to the results of a smaller sample of South Australian children by Slade *et al*. in the early 1990s where just over 80 per cent of decayed, missing or filled surfaces were pit and fissure surfaces.[7]

The benefit of understanding the intra-oral distribution of children's caries is that the distribution of caries has an appreciable influence on both preventive efforts and on the interventions adopted to address dental caries. It is also possible that the intra-oral distribution of caries may vary by fluoride exposure. Singh and Spencer, for example, found that patterns of exposure to water fluoridation had an effect on the caries experience of permanent first molars.[11] However, compared to smooth and approximal surfaces, pit and fissure surfaces are thought to have less favourable physical conditions for the uptake of fluoride ions through, for example, water fluoridation.[12]

These results support the continued use of fissure sealants to prevent caries in the permanent dentition. However, the distribution of caries in the deciduous dentition indicates the need for other caries preventive approaches, such as fluoride varnish, for deciduous teeth.

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Address for correspondence:
Mr Jason Armfield
Australian Research Centre for Population Oral Health
School of Dentistry
The University of Adelaide
South Australia 5005
Phone: +61 8 8303 5438
Fax: +61 8 8303 3070
Email: jason.armfield@adelaide.edu.au