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DENTAL SURVEY OF SCHOOL CHILDREN IN CHANDIGARH, PUNJAB, INDIA

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Dedication

This thesis is dedicated to my parents,
Dr Manmohan Singh Badwal & Usha Badwal,
my Brother Sandeep Singh Badwal & Sister in law Rajvinder Kaur, and my nephew Rohandeep Singh Badwal for encouraging me in my pursuit of higher education and giving me all their support.

****

Foreword

This survey was carried out in Chandigarh, India, and surrounding rural areas. Chandigarh is one of seven Union Territories located between Punjab and Haryana, and although Chandigarh is totally independent of these two states, the seats of government of these separate political entities are all located within Chandigarh.

The thesis is in two parts. Part one is a review of the literature on caries experience in children and adolescents in Chandigarh, Punjab, and surrounding northern Indian states. Only published data regarding dental caries epidemiology conducted between 1952 and 2006 were reviewed.

Part Two is a report of a dental survey of school children aged 6 and 12 years in Chandigarh and surrounding rural areas that was conducted during the months of April to June, 2007.

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Abbreviations

dmft	The number of decayed, missing, and filled primary teeth
DMFT	The number of Decayed, Missing, and Filled permanent teeth
WHO	World Health Organisation

PART ONE

LITERATURE SURVEY OF SCHOOLCHILDREN IN CHANDIGARH, PUNJAB, INDIA

CHAPTER 1
INTRODUCTION

Background

Dental caries is the most common oral disease in the world showing striking geographic variations in socio-economic distribution and severity (Beal and James, 1980, Burt & Eklund, 1992, Cyril and Enwonwo, 1974, Cyril and Enwonwo, 1981, Peterson, 1990). Though many studies have been conducted in different parts of the world, Rai et al (2007) claimed that there is a great deficiency in baseline data concerning the oral health of Indian school children.

Oral health policy in India

WHO focused its attention on oral health in 1994 and chose the theme 'Oral Health for Healthy Life' for World Health Day (Lal et al., 2004). A National Oral Health Policy was formulated by the Dental Council of India, through inputs from two national workshops organized in 1991 and 1994 at Delhi and Mysore, respectively (Lal et al., 2004).

These two workshops considered the recommendations of two earlier national workshops. The first was in Bombay in 1984 and dealt with oral health goals for India, and the second in 1986, related to a draft Oral Health Policy prepared by the Indian Dental Association.

In 1995, the Ministry of Health and Family Welfare (2005) accepted, in principle, the National Oral Health Policy formulated by the Dental Council of India and incorporated it within the National Health Policy. In implementing the Oral Health Policy, a National Oral Health Care Programme was established by the Ministry of Health and Family Welfare (Undated). The main goals of this programme are:

- Oral health for all by 2010.
- To bring down the incidence of oral and dental diseases to less than 40% from the existing prevalence of 90%.
- To bring down the DMFT in school children between 6-12 years of age to less than 2 - it is approximately 4 at present.
- To reduce the high prevalence of periodontal diseases.
- At the age of 18 years, 85% should retain their teeth.
- To achieve a 50% reduction in edentulousness between the age of 35-44 years.
- To achieve a 25% reduction in edentulousness at the age of 65 and above.
- To achieve a 50% reduction in present level of malocclusion.
- To reduce the number of new cases of oral cancer and precancerous lesions from the existing level.

Purpose of literature review

The main purpose of this review is to compile an oral health database relating to oral hygiene status, dental caries experience, and fluorosis prevalence in Chandigarh and surrounding northern Indian states. Included in this review are reference data from elsewhere in India.

The focus of this review is on children aged 6 and 12 years. While data for other child and adolescent groups are included in the tables for completeness, the analysis and discussion is limited mainly to the 6- and 12-year-olds.

CHAPTER 2

CARIES EXPERIENCE IN INDIAN CHILDREN

Chandigarh

The dental caries experience of children in Chandigarh is shown in Table 2.1. Results relate to studies conducted over a 23 year period from 1977 to 2000. Caries experience in the primary dentition appears to have increased very slightly over this period (Chawla et al., 2000; Tewari & Chawla., 1977). In the permanent dentition, the DMFT scores of 12-year-olds decreased by more than 50% from 1977 to 2000, whereas they appear to have increased in 6 - 16-year-olds. However since caries experience is age-related, this apparent increase cannot be confirmed in the absence of evidence relating to age balance in 1977 and 1986. Across the age groups, the DMFT scores are generally not greater than four and mostly less than two. Caries experience in the primary dentition is similar in urban and rural children, higher in rural 15-year-olds compared with those in urban areas. On the other hand, caries experience in rural 6-16 year-olds appears to be lower in rural areas but, as noted above, the age balance is not given and this result may not be reliable.

Punjab

In Punjab, results relate to studies conducted over a 41 year period from 1952 to 1993 (Table 2.2). Across the studies and age groups, the DMFT scores are generally not greater than five and mostly less than four.

Age-specific caries experience has changed over this period, for example, from 1986 to 1993 the dmft scores in the deciduous dentition have increased four fold. In the permanent dentition, caries prevalence appears to have increased since 1952. In Ludhiana, the age-specific DMFT scores in 1986 indicate an annual caries incidence of 0.6. Rural

children had much higher DMFT scores in both the primary and permanent dentitions.

Haryana

Data from studies conducted in Haryana relate to a period of more than 27 years from 1980 to 2007 (Table 2.3). Caries prevalence (primary dentition) rates at age 6 years have increased from 24.7 in 1980 to 38.2 in 2001. Age specific DMFT scores appear to have increased over this period. For example, in 1985 the DMFT score of 15-year-olds was 1.4 whereas in 2007, 12-year-olds had a DMFT score of 3.15. Across the age groups, the DMFT scores are generally not greater than three and mostly less than two. Rural children had lower caries experience scores in both primary and permanent dentitions.

New Delhi

In New Delhi, results refer to studies that were conducted over a 7 year period from 1986 to 1993 (Table 2.4). Overall, both mean dmft and DMFT scores, except for two studies, are less than one. In rural regions, the DMFT scores increase only gradually with increasing age. However, in the urban regions, the age-specific scores of children examined in 1993, aged 10 to 15 years, apparently decrease from 1.53 to 0.27 (Parkash, 1993). It is noted the numbers in each age group are not reported, so that the observed trend, contrary to what is expected, cannot be considered reliable.

Uttar Pradesh

Studies have been conducted in Uttar Pradesh over a 36 year period from 1957 to 1993 (Table 2.5). Age-specific caries prevalence rates have increased over this period from 45% to 53% (Chaudhary et al., 1957; Mitra et al., 1993). The DMFT scores are reported in only few of the studies shown in table 2.5. These DMFT scores do not appear to increase with age and, across the age groups, they are generally not greater than four

and mostly less than two. Generally, caries prevalence is lower among children from the lower socio-demographic groups compared with children at higher levels (Chandra & Chawla, 1979; Gangwar et al., 1990). Compared with urban children, rural children had a lower caries experience in both the primary and permanent dentitions.

North India

Other data on caries experience in north India relate to children in Jammu and Kashmir, Himachal Pradesh, and Bihar. The data shown in Table 2.6 refer to studies conducted between 1979 and 1991. In the deciduous dentition, the highest dmft score of 2.9 was recorded in Jammu and Kashmir in 1985 which was almost twice the dmft score of Bihar. Across the age groups, the DMFT scores are generally not greater than six and mostly less than two. Caries experience in the deciduous dentition is slightly lower in rural children compared with urban children. In Jammu and Kashmir, on the other hand, permanent dentition caries experience in children aged 15 years appears to be higher in rural children compared with urban children. In other states, rural and urban DMFT scores are similar. Generally, DMFT scores are lower among children from lower socio-demographic groups compared with children at higher social levels (Singh & Singh, 1991; Duggal et al., 1991).

Rest of India

There are reports of studies conducted elsewhere in India over a 23 year period from 1979 to 2002 (Table 2.7). The DMFT scores do not appear to be age-related in the various studies. Across the age groups, DMFT scores are not greater than four and mostly less than three. Two studies show that DMFT scores are highest in children from lower socio-demographic groups (Rahmatulla et al, 1993; Sogi & Bhaskar, 2002), whereas so-called elite children in Udaipur had the highest caries prevalence rate. In comparing rural and urban children, caries experience in the primary and permanent dentitions is almost the same.

Table 2.1: Dental caries experience of Indian children - Chandigarh

Region	Year	Age	Dentition	n	Groups[a]	dmft/ DMFT	dmfs/ DMFS	Caries prevalence	Reference
Urban									
	1985	5	Deciduous			2.30		59	WHO (Undated)
	1977	6	Deciduous	68		2.59			Tewari & Chawla (1977)
	1985	6	Deciduous			2.80			Chawla et al. (2000)
	2000	5 - 6	Deciduous	131		2.70	6.10		Chawla et al. (2000)
	1999	4 - 12	Not stated	24	Group A	1.90			Lehl et al. (1999)
				26	Group B	6.00			Lehl et al. (1999)
	1977	6 - 16	Permanent	1511		3.93			Tewari & Chawla (1977)
	1986	6 - 16	Permanent			5.22	8.26		Narinder et al. (1986)
	1977	12	Permanent	216		3.88			Tewari & Chawla (1977)
	2000	12	Permanent	223		1.25	2.00		Chawla et al. (2000)
	1985	15	Permanent			1.40		51	WHO (Undated)
	1985	15	Permanent			1.38			Chawla et al. (2000)
	2000	15	Permanent	155		1.10	1.50		Chawla et al. (2000)
Rural									
	1985	5	Deciduous			2.20		60	WHO (Undated)
	1986	6 - 16	Permanent			2.91	3.78		Narinder et al. (1986)
	1985	15	Permanent			2.20		63	WHO (Undated)

a Group A = deft + DMFT 1-3; Group B = deft + DMFT > 3

Table 2.2: Dental caries experience of Indian children - Punjab

Region	Year	Age	Socio-demographic	Dentition	n	dmft/ DMFT	dmfs/ DMFS	Caries prevalence	Reference
Urban									
Ludhiana	1986	7		Deciduous	101	1.02	1.61	62	Gauba et al. (1986)
	1986	8		Permanent	153	1.48	1.98	71	Gauba et al. (1986)
	1986	9		Permanent	171	2.06	2.73	82	Gauba et al. (1986)
	1986	10		Permanent	157	2.38	3.13	84	Gauba et al. (1986)
	1986	11		Permanent	134	2.67	3.94	85	Gauba et al. (1986)
	1986	12		Permanent	173	3.89	4.57	86	Gauba et al. (1986)
Moga	1953	6 - 20		Permanent	727			59	Thaper (1953)
Amritsar	1952	8 - 13		Permanent	400			52	Talim (1983)
Ludhiana	1986	7 - 17		Permanent	1516	3.87	5.79	82	Gauba et al. (1986)
Patiala	1977	N.S[a]		Permanent	11813			9	Singh et al. (1977)
		N.S	Slums	Permanent	763			7	Singh et al. (1977)
		N.S	Modern[b]	Permanent	949			12	Singh et al. (1977)
Faridkot	1985	N.S		Permanent	2915			31	Singh et al. (1985)
Punjab State	1993	N.S						52	Mitra & Verma (1993)
Rural									
Talwandi	1993	N.S		Deciduous		3.66	5.37	80	Gauba et al. (1993)
Dhanansu	1993	N.S		Deciduous		4.75	8.36	94	Gauba et al. (1993)
Bhatian	1993	N.S		Deciduous		4.80	7.29	94	Gauba et al. (1993)
Talwandi	1993	N.S		Permanent	144	4.16	5.18	79	Gauba et al. (1993)
Dhanansu	1993	N.S		Permanent	185	5.63	7.93	91	Gauba et al. (1993)
Bhatian	1993	N.S		Permanent	154	6.11	8.58	96	Gauba et al. (1993)

a Not Stated
b New primary schools

Table 2.3: Dental caries experience of Indian children - Haryana

Region	Year	Age	Dentition	n	dmft/ DMFT	dmfs/ DMFS	Caries prevalence	Reference
Urban								
Amballa Cantt	1980	5	Deciduous	12			32	Singh & Chib (1980)
	1985	5	Deciduous		1.40		45	Tewari et al.(1985)
Amballa Cantt	1980	6	Deciduous	20			25	Singh & Chib (1980)
Rohtak	2001	6	Deciduous	157	0.91		38	Tewari & Tewari (2001)
	2001	3 - 7	Permanent	509	0.73		34	Tewari & Tewari (2001)
Rohtak	2007	9	Permanent	500	2.82	3.82		Rai et al. (2007)
	2007	10	Permanent	567	2.87	3.87		Rai et al. (2007)
	2007	11	Permanent	624	3.40	3.76		Rai et al. (2007)
Amballa Cantt	1980	12	Permanent	7			13	Singh & Chib (1980)
Rohtak	2007	12	Permanent	613	3.15	4.26		Rai et al. (2007)
	1985	15	Permanent		1.40		50	Tewari et al. (1985)
Amballa Cantt	1980	5 - 18	Permanent	586			22	Singh & Chib (1980)
Rural								
	1985	5	Deciduous		1.30		56	Tewari et al. (1985)
	1999	12	Permanent	233	0.79		33	Singh et al. (1999)
	1985	15	Permanent		1.30		48	Tewari et al. (1985)
	1999	12 - 16	Permanent	1000	1.03		39	Singh et al. (1999)

Table 2.4: Dental caries experience of Indian children - Delhi

Region	Year	Age	Dentition	n	dmft/ DMFT	Caries prevalence	Reference
Urban							
	1991	11	Permanent	31	0.30		Visavadia & Kumar (1991)
	1993	10	Permanent		1.53	57	Parkash (1993)
	1993	11	Permanent		1.44	52	Parkash (1993)
	1993	12	Permanent		0.86	36	Parkash (1993)
	1993	13	Permanent		0.12		Parkash (1993)
	1993	14	Permanent		0.13		Parkash (1993)
	1993	15	Permanent		0.27		Parkash (1993)
Rural							
	1986	5 - 7	Deciduous	132	0.42	26	Pandit et al. (1986)
	1986	8 - 10	Permanent	128	0.53	34	Pandit et al. (1986)
	1986	11 - 13	Permanent	165	0.56	39	Pandit et al. (1986)
	1986	14+	Permanent	33	0.61	27	Pandit et al. (1986)
	1986	5 - 14+	Permanent	458	0.52	33	Pandit et al. (1986)

Table 2.5: Dental caries experience of Indian children - Uttar Pradesh

Region	Year	Age	Gender	Socio-demographic	Dentition	n	dmft/ DMFT	Caries prevalence	Reference
Urban									
Lucknow	1985	5			Deciduous		4.40	89	WHO (Undated)
	1985	15			Permanent		1.00	43	WHO (Undated)
Uttar Pradesh State	1979	4 - 15			Permanent	15000			Chandra & Chawla (1979)
				High		5203		58	Chandra & Chawla (1979)
				Medium		9066		46	Chandra & Chawla (1979)
				Poor		731		45	Chandra & Chawla (1979)
Lucknow	1957	5 - 16	M		Permanent	2281		45	Chaudhary et al. (1957)
		5 - 16	F		Permanent	709		44	Chaudhary et al. (1957)
Uttar Pradesh State	1993	6 - 17			Permanent	980		53	Mitra et al. (1993)
Uttar Pradesh State	1978	9 - 17			Permanent	513		3	Taneja et al (1978)
Rural									
Lucknow	1985	5			Deciduous		1.80	64	WHO (Undated)
	1990	5 - 6			Deciduous	133		36	Gangwar et al. (1990)
	1985	15			Permanent		0.50	21	WHO (Undated)
	1990	7 - 8			Permanent	122		55	Gangwar et al. (1990)
	1990	9 - 10			Permanent	223		46	Gangwar et al. (1990)
	1990	11 - 12			Permanent	263		38	Gangwar et al. (1990)
	1990	13 - 14			Permanent	171		19	Gangwar et al. (1990)

Continued over

Table 2.5 (continued): Dental caries experience of Indian children - Uttar Pradesh

Region	Year	Age	Gender	Socio-demographic [a]	Dentition	n	dmft/ DMFT	Caries prevalence	Reference
Rural									
Lucknow	1990	5 - 14		2	Permanent	227		45	Gangwar et al. (1990)
	1990	5 - 14		3	Permanent	276		35	Gangwar et al. (1990)
	1990	5 - 14		4	Permanent	364		37	Gangwar et al. (1990)
	1990	5 - 14		5	Permanent	45		38	Gangwar et al. (1990)
	1990	5 - 14			Permanent	912		38	Gangwar et al. (1990)

a 2 = children from higher socio-demographic level , 5 children from lowest socio-demographic level (Data for level 1 not given)

Table 2.6: Dental caries experience of Indian children - North India

Region	Year	Age	Gender	Socio-demographic	Dentition	n	dmft/ DMFT	Caries prevalence	Reference
Urban									
Himachal Pradesh	1985	5			Deciduous		2.00	53	WHO (Undated)
Jammu & Kashmir	1985	5			Deciduous		2.90	75	WHO (Undated)
Bihar	1985	5			Deciduous		1.50	54	WHO (Undated)
Patna	1981	5 - 13			Deciduous			61	Singh & Singh (1981)
	1981	5 - 13			Permanent	1167		53	Singh & Singh (1981)
	1981	5 - 13		High	Permanent	707		52	Singh & Singh (1981)
	1981	5 - 13		Low/Medium	Permanent			50	Singh & Singh (1981)
	1981	5 - 13	M		Permanent	550		50	Singh & Singh (1981)
	1981	5 - 13	F		Permanent	617		54	Singh & Singh (1981)
	1981	5 - 13			Permanent			39	Singh & Singh (1981)
Himachal Pradesh	1985	15			Permanent		1.20	50	WHO (Undated)
Jammu & Kashmir	1985	15			Permanent		1.50		WHO (Undated)
Bihar	1985	15					1.10	43	WHO (Undated)
Jammu & Kashmir	1985	30 - 35			Permanent		4.90		WHO (Undated)
Bihar	1985	30 - 35			Permanent		1.80	69	WHO (Undated)
Kashmir	1979				Permanent	845		27	Dhar et al. (1979)
Rural									
Himachal Pradesh	1985	5			Deciduous		2.40	55	WHO (Undated)
Jammu & Kashmir	1985	5			Deciduous		2.80		WHO (Undated)

Continued over

Table 2.6 (continued): Dental caries experience of Indian children - North India

Region	Year	Age	Gender	Socio-demographic	Dentition	n	dmft/ DMFT	Caries prevalence	Reference
Rural									
Bihar	1985	5			Deciduous		1.10	35	WHO (Undated)
North India	1991	4 - 7							Duggal et al. (1991)
	1991	4 - 7		Low		45	0.72		Duggal et al. (1991)
	1991	4 - 7		Medium		44	3.70		Duggal et al. (1991)
	1991	4 - 7		High		45	6.91		Duggal et al. (1991)
Himachal Pradesh	1985	15					1.30	49	WHO (Undated)
Jammu & Kashmir	1985	15					4.40		WHO (Undated)
Bihar	1985	15					1.30	50	WHO (Undated)
North India	1991	12 - 16							Duggal et al. (1991)
	1991	12 - 16		Low		46	1.14		Duggal et al. (1991)
	1991	12 - 16		Medium		46	3.46		Duggal et al. (1991)
	1991	12 - 16		High		46	6.72		Duggal et al. (1991)
Jammu & Kashmir	1985	30 - 35					5.80		WHO (Undated)
Bihar	1985	30 - 35					1.90	63	WHO (Undated)

Table 2.7: Dental caries experience of Indian children - India

Region	Year	Age	Socio-demographic	Dentition	n	dmft/ DMFT	dmfs/ DMFS	Caries prevalence	Reference
Urban									
Orissa	1992	5		Decidious	167	2.47	3.88		Sahoo et al . (1992)
	1992	8		Permanent	138	2.46	4.28		Sahoo et al . (1992)
	1992	11		Permanent	171	2.09	3.27		Sahoo et al . (1992)
Belgaum	2002	11		Permanent	265	0.94		37	Kulkarni & Deshpande (2002)
	2002	12		Permanent	301	1.11		46	Kulkarni & Deshpande (2002)
	2002	13		Permanent	505	1.09		43	Kulkarni & Deshpande (2002)
	2002	14		Permanent	473	1.21		45	Kulkarni & Deshpande (2002)
Devangree	2002	13 -14		Permanent	2007				Sogi & Bhaskar (2002)
	2002	13 -14	1[a]	Permanent	350	3.15	3.93		Sogi & Bhaskar (2002)
	2002	13 -14	2	Permanent	477	2.83	3.72		Sogi & Bhaskar (2002)
	2002	13 -14	3	Permanent	341	2.85	3.84		Sogi & Bhaskar (2002)
	2002	13 -14	4	Permanent	366	2.83	3.91		Sogi & Bhaskar (2002)
	2002	13 -14	5[b]	Permanent	473	3.49	4.80		Sogi & Bhaskar (2002)
Belgaum	2002	15		Permanent	461	1.45		52	Kulkarni & Deshpande (2002)
Orissa	1992	15		Permanent	173	1.98	2.87		Sahoo et al. (1992)
Madras	1993	15	Low	Permanent	169	1.28			Rahmatulla et al. (1993)
	1993	15	Medium	Permanent	169	1.21			Rahmatulla et al. (1993)
	1993	15	High	Permanent	58	0.60			Rahmatulla et al. (1993)
Wardha	1993	5 - 14		Permanent	778			17	Rao & Bharambe (1993)
	1993	5 - 14		Permanent	123			23	Rao & Bharambe (1993)
Jaipur	1989	6 - 14		Permanent	512			10	Jain (1989)

a Children from highest socio-demographic level
b Children from lowest socio-demograpghic level

Continued over

Table 2.7 (continued): Dental caries experience of Indian children - India

Region	Year	Age	Socio-demographic	Dentition	n	dmft/ DMFT	dmfs/ DMFS	Caries prevalence	Reference
Urban									
Belgaum	2002	11 - 15		Permanent	2005	1.18		45	Kulkarni & Deshpande (2002)
Jaipur	1989	6 - 45+		Permanent	1384			15	Jain (1989)
Udaipur	1979			Permanent	1011			9	Mathur et al. (1979)
	1979		Elite	Permanent	379			16	Mathur et al. (1979)
	1979		Middle/lower	Permanent	492			5	Mathur et al. (1979)
Rural									
Orissa	1992	5		Decidious	160	2.66	4.94		Sahoo et al. (1992)
	1992	8		Permanent	102	3.46	5.68		Sahoo et al. (1992)
	1992	11		Permanent	152	1.99	2.87		Sahoo et al. (1992)
Wardha	1993	5 - 14		Permanent	375			16	Rao & Bharambe (1993)
	1993	5 - 14		Permanent	250			15	Rao & Bharambe (1993)
Orissa	1992	15		Permanent	175	2.14	3.11		Sahoo et al . (1992)
Udaipur	1979		Middle/lower	Permanent	140			6	Mathur et al. (1979)

CHAPTER 3

DENTAL CARIES IN INDIAN CHILDREN AND FLUORIDE EXPOSURE

Dental caries and fluoride concentration in drinking water

Data is available over a 23 year period from 1977 to 2000 regarding the association between dental caries experience and fluoride concentration in drinking water in India, although most studies were conducted recently (since 1999) (Table 3.1). In each of the age-specific groups, these data show an indirect relationship between the concentration of fluoride in drinking water and caries experience. In Chandigarh, the fluoride levels in 1977 and 1986 were reported as 0.28 and 0.38 ppm, respectively. This small difference does not account for the decreased DMFT values of 3.88 and 1.25, respectively. According to Chawla et al, the decrease in caries experience during this period is due to the commencement of marketing fluoride toothpaste.

Dental caries and fluorosis

Data relating to fluorosis prevalence and associated caries prevalence in Indian states are available over a period of 22 years from 1977 to 1999 (Table 3.2), although in most studies, which surveyed large numbers of individuals, the actual fluoride concentration in drinking water was not reported. Fluorosis prevalence was low. However, in one study, a comparison was drawn between two regions where the concentration of fluoride in drinking water was 0.5 ppm and 1.2 ppm; the respective fluorosis prevalence rates were 1% and 57%. The DMFT score associated with 1.2 ppm was almost half that observed in the other region (0.39 vs 0.65) (Menon & Indushekar, 1999).

Table 3.1: Dental caries experience by fluoride concentration in drinking water in India.

Region	Year	Age	n	F in ppm	dmft/DMFT		DMFS		Caries prevalence	Reference
					Urban	Rural	Urban	Rural		
Chandigarh	1977	5 - 6		0.28	2.60[a]					Tewari & Chawla (1977)
Chandigarh	1985	5 - 6		0.38	2.80[a]					Chawla et al. (2000)
Chandigarh	2000	5 - 6		0.38	2.73[a]		6.10			Chawla et al. (2000)
Dharwad	1999	6	624	0.5	0.03				3	Menon & Indushekar (1999)
Dharwad	1999	6	256	1.2	0.01				1	Menon & Indushekar (1999)
Punjab	1986	7	101	0.3 - 0.5	1.02		1.61			Gauba et al. (1986)
Dharwad	1999	7	413	0.5	0.19				13	Menon & Indushekar (1999)
Dharwad	1999	7	461	1.2	0.12				6	Menon & Indushekar (1999)
Punjab	1986	8	153	0.3 - 0.5	1.48		1.98			Gauba et al. (1986)
Dharwad	1999	8	489	0.5	0.27				16	Menon & Indushekar (1999)
Dharwad	1999	8	477	1.2	0.15				8	Menon & Indushekar (1999)
Punjab	1986	9	171	0.3 - 0.5	2.06		2.73			Gauba et al. (1986)
Dharwad	1999	9	386	0.5	0.27				14	Menon & Indushekar (1999)
Dharwad	1999	9	394	1.2	0.30				13	Menon & Indushekar (1999)
Punjab	1986	10	157	0.3 - 0.5	2.38		3.13			Gauba et al. (1986)
Dharwad	1999	10	485	0.5	0.56				27	Menon & Indushekar (1999)
Dharwad	1999	10	422	1.2	0.29				15	Menon & Indushekar (1999)
Punjab	1986	11	134	0.3 - 0.5	2.67		3.94			Gauba et al. (1986)
Dharwad	1999	11	337	0.5	0.68				33	Menon & Indushekar (1999)
Dharwad	1999	11	454	1.2	0.42				19	Menon & Indushekar (1999)

a Primary dentition

Continued over

Table 3.1 (continued): Dental caries experience by fluoride concentration in drinking water in India.

Region	Year	Age	n	F in ppm	DMFT		DMFS		Caries prevalence	Reference
					Urban	Rural	Urban	Rural		
Chandigarh	1977	12		0.28	3.88					Tewari & Chawla (1977)
Chandigarh	2000	12		0.38	1.25		2.00			Chawla et al. (2000)
Punjab	1986	12	173	0.3 - 0.5	3.89		4.57			Gauba et al. (1986)
Dharwad	1999	12	300	0.5	0.78				31	Menon & Indushekar (1999)
Dharwad	1999	12	488	1.2	0.60				25	Menon & Indushekar (1999)
Dharwad	1999	13	264	0.5	0.81				38	Menon & Indushekar (1999)
Dharwad	1999	13	263	1.2	0.22				28	Menon & Indushekar (1999)
Dharwad	1999	14	141	0.5	1.06				56	Menon & Indushekar (1999)
Dharwad	1999	14	188	1.2	0.78				35	Menon & Indushekar (1999)
Chandigarh	1977	15		0.38	4.70					Chawla et al. (2000)
Chandigarh	1985	15		0.38	1.38					Chawla et al. (2000)
Chandigarh	2000	15		0.38	1.10		1.50			Chawla et al. (2000)
Dharwad	1999	15	106	0.5	1.09				56	Menon & Indushekar (1999)
Madras	1993	15	396	0.8	1.15					Rahmatulla et al.(1993)
Dharwad	1999	15	127	1.2	0.75				30	Menon & Indushekar (1999)
Madras	1993	15	216	2 - 3.6		1.30				Rahmatulla et al.(1993)
Dharwad	1999	16	160	0.5	1.46				48	Menon & Indushekar (1999)
Dharwad	1999	16	88	1.2	0.71				31	Menon & Indushekar (1999)
Dharwad	1999	6 - 16	3605	0.5	0.65				23	Menon & Indushekar (1999)
Dharwad	1999	6 - 16	3618	1.2	0.39				16	Menon & Indushekar (1999)
Chandigarh	1986	6 - 16	823	0.28 - 0.30	5.22	2.91	8.26	3.78		Narinder et al. (1986)

Continued over

Table 3.1 (continued): Dental caries experience by fluoride concentration in drinking water in India.

Region	Year	Age	n	F in ppm	DMFT		DMFS		Caries prevalence	Reference
					Urban	Rural	Urban	Rural		
Punjab	1986	7 - 17	1516	0.3 - 0.5	3.87		5.79			Gauba et al. (1986)
Talwandi Kalan		NS[b]	73	0.27		3.66[a]		5.37	80	Gauba et al. (1993)
Dhanansu		NS	105	0.033		4.75[a]		8.36	94	Gauba et al. (1993)
Bhatian		NS	95	0.28		4.80[a]		7.29	94	Gauba et al. (1993)
Talwandi Kalan		NS	144			4.16		5.18	79	Gauba et al. (1993)
Dhanansu		NS	185			5.63		7.93	91	Gauba et al. (1993)
Bhatian		NS	154			6.11		8.58	96	
Haryana	1998	NS	266	0.34	1.41				52	Sharma et al.(1998)
Haryana	1998	NS	341	0.66	0.80				43	Sharma et al.(1998)
Haryana	1998	NS	541	1.01	0.44				28	Sharma et al.(1998)
Haryana	1998	NS	310	1.19	0.47				29	Sharma et al.(1998)
Haryana	1998	NS	340	1.59	0.56				31	Sharma et al.(1998)
Haryana	1998	NS	608	2.36	0.61				37	Sharma et al.(1998)
Haryana	1998	NS	162	3.13	0.50				36	Sharma et al.(1998)
Haryana	1998	NS	102	4.05	0.58				39	Sharma et al.(1998)
Haryana	1998	NS	325	6.48	0.65				43	Sharma et al.(1998)
Haryana	1998	NS	36	8.5	0.75				44	Sharma et al.(1998)

b Not stated

Table 3.2: Fluorosis prevalence and associated caries prevalence in selected Indian States

State	Year	Age	n	Gender	Fluorosis prevalence[a]	Fluoride (ppm)	DMFT	Caries Prevalence	Reference
Patiala, Punjab	1977	NS[b]	11813		0.19				Singh et al. (1977)
Kashmir	1979	NS	845		0.00			27	Dhar et al. (1979)
				Males	0.00			31	Dhar et al. (1979)
				Females	0.00			20	Dhar et al. (1979)
Punjab	1985	NS	2915		15.16			31	Singh et al. (1985)
Jaipur	1989	6 - 45+	1384		1.66			15	Jain (1989)
	1989	6 - 14	512		1.56			10	Jain (1989)
	1989	15 -24	225		1.78			12	Jain (1989)
	1989	25 - 34	202		2.97			17	Jain (1989)
	1989	35 - 44	172		2.33			25	Jain (1989)
	1989	45+	273		0.37			19	Jain (1989)
Dharwad	1999	7 - 16	3605		1.00	0.50	0.65	23	Menon & Indushekar (1999)
	1999	8 - 16	3618		57.00	1.20	0.39	16	Menon & Indushekar (1999)
	1999	6	624			0.50	0.03	3	Menon & Indushekar (1999)
	1999	12	300			0.50	0.78	31	Menon & Indushekar (1999)
	1999	6	256			1.20	0.01	1	Menon & Indushekar (1999)
	1999	12	488			1.20	0.60	25	Menon & Indushekar (1999)

a Dean Index (WHO, 1977)
b Not stated

CHAPTER 4

CARIES EXPERIENCE IN INDIAN CHILDREN AND OTHER RISK FACTORS

Diet and caries

Diet risk factors and caries experience has been studied in India over a period of 22 years from 1979 to 2001 (Table 4.1). The DMFT scores and caries prevalence rates appear to be slightly less among non-vegetarians compared with vegetarians. There is said to be anecdotal evidence that vegetarians add more sugar to their diets compared with non-vegetarians.

All the studies showed increases in DMFT score and caries prevalence rates with increasing levels of sugar consumption and increasing frequency of sugar consumption. Regarding the daily frequency of exposure to sugar, exposures ranging from zero to five were associated with DMFT scores that ranged from 0.63 to 4.52 (Sahoo et al., 1992). Slightly higher DMFT scores were associated with increasing frequency (0 - 4) of between-meal sugar exposures compared with an increasing frequency (low, medium, and high) of at-meal sugar exposures. The respective DMFT scores ranged from 1.38 to 4.55 and from 1.53 to 3.67 (Sahoo et al., 1992).

Oral hygiene and caries

Studies have reported on caries and the oral hygiene relationship in India for over a 48 year period from 1957 to 2005 (Table 4.2). All the studies showed that almost all children practiced some method of oral hygiene, and most used some form of dentifrice to clean their teeth; only few children were reported to not engaging in some form of oral hygiene. An early study showed that a majority of children used to clean their teeth with a finger (Chaudhary et al., 1957). It was reported that 52.4% of the

children used a home made dentifrice (not specified) and that 14.1% used the traditional method of cleaning their teeth with datun (a wooden stick from the neem tree). More recently, Visavadia & Kumar (1991) reported that 97% of children in Delhi brushed their teeth using a toothbrush and toothpaste or toothpowder.

A striking observation regarding the data shown in Table 11 is that children in India use a wide variety of tooth cleaning methods.

Frequency of tooth brushing was associated in one study with caries prevalence; those who brushed more regularly had a lower prevalence rate compared with children who brushed irregularly or who never brushed at all (Pandit et al., 1986).

A recently published study reported data that showed a direct relationship between socio-demographics and oral hygiene status (Sogi & Bhaskar, 2002). The children of parents in the highest income group had an Oral Hygiene Index score of 1.13 compared with a score of 1.79 for children of parents in the lowest income group.

Table 4.1: Dental caries in Indian children by diet risk factor

Region	Year	Age	n	Group[a]	Diet risk factor	DMFT Urban	DMFT Rural	DMFS Urban	DMFS Rural	Caries prevalence	Reference
					Vegetarian						
Uttar Pradesh	1979	4 - 7			Yes	6.06[b]					Chandra & Chawla (1979)
		4 - 7			No	5.68					Chandra & Chawla (1979)
		8 - 11			Yes	6.75					Chandra & Chawla (1979)
		8 - 11			No	6.51					Chandra & Chawla (1979)
		12 - 15			Yes	7.50					Chandra & Chawla (1979)
					No	7.47					Chandra & Chawla (1979)
Amballa	1980	5 - 18			Yes					20.05	Singh & Chib (1980)
					No					21.9	Singh & Chib (1980)
Lucknow	1990	5 - 14	664		Yes					38.2	Gangwar et al. (1990)
			268		No					38.4	Gangwar et al. (1990)
Delhi	2001	5 - 12	804		Yes					65.5	Yadav (2001)
					No					59.46	Yadav (2001)
					Sweet consumption						
Delhi		5 - 12			Chocolates					63	Yadav (2001)
		5 - 12			Sweets					60	Yadav (2001)
Chandigarh		4 - 12		Group A	25.5 + 8.4[c]	1.90					Lehl et al. (1999)
		4 - 12		Group B	38.8 + 13.8[c]	6.00					Lehl et al. (1999)

a Mean per 100 erupted teeth

b Group A = deft + DMFT 1-3 ; Group B = deft + DMFT > 3

c Mean sweet score: At meal score + Between meal score (After Nizel, 1966)

Continued over

Table 4.1 (continued): Dental caries in Indian children by diet risk factor

Region	Year	Age	n	Group[a]	Diet risk factor	DMFT Urban	DMFT Rural	DMFS Urban	DMFS Rural	Caries prevalence	Reference
					Daily frequency of sugar exposure						
Orissa	1992		27		0	0.63	2.08	1.04	3.17		Sahoo et al. (1992)
			58		1	1.03	0.59	1.67	0.74		Sahoo et al. (1992)
			155		2	1.50	1.48	2.33	2.23		Sahoo et al. (1992)
			194		3	1.84	2.12	2.99	3.22		Sahoo et al. (1992)
			140		4	3.02	2.95	4.78	5.27		Sahoo et al. (1992)
			64		5	4.52	4.88	6.92	7.61		Sahoo et al. (1992)
					Total sugar exposure[c]						
Orissa	1992		434		Low	1.53		2.46			Sahoo et al. (1992)
			204		Medium	3.49		5.45			Sahoo et al. (1992)
			11		High	6.73		11.00			Sahoo et al. (1992)
Orissa	1992		365		Low		1.70		2.56		Sahoo et al. (1992)
			213		Medium		3.56		6.01		Sahoo et al. (1992)
			11		High		6.91		12.55		Sahoo et al. (1992)
Chandigarh	1999	4 - 12	50								Lehl et al. (1999)
			24	Group A	1.05+0.4	1.90					Lehl et al. (1999)
			26	Group B	1.47+0.42	6.00					Lehl et al. (1999)

a Group A = deft + DMFT 1-3 ; Group B = deft + DMFT > 3

c Low = 0-3 daily exposures, Medium = 4-5, High = 6+

Continued over

Table 4.1 (continued): Dental caries in Indian children by diet risk factor

Region	Year	Age	n	Group[a]	Diet risk factor	DMFT		DMFS		Caries prevalence	Reference
						Urban	Rural	Urban	Rural		
					Frequency of between meal sugar exposures						
Orissa	1992		117		0	1.38		2.08			Sahoo et al. (1992)
			258		1	1.63		2.67			Sahoo et al. (1992)
			171		2	2.74		4.41			Sahoo et al. (1992)
			89		3	3.87		5.96			Sahoo et al. (1992)
			11		4	4.55		7.09			Sahoo et al. (1992)
			54		0		1.44		2.63		Sahoo et al. (1992)
			228		1		1.85		2.63		Sahoo et al. (1992)
			188		2		2.37		3.95		Sahoo et al. (1992)
			105		3		4.13		6.95		Sahoo et al. (1992)
			10		4		5.80		9.90		Sahoo et al. (1992)
Chandigarh	1999			Group A	0.75 + 0.38	1.90					Lehl G et al. (1999)
				Group B	1.12 + 0.4	6.00					Lehl G et al. (1999)

a Group A = deft + DMFT 1-3 ; Group B = deft + DMFT > 3

Continued over

Table 4.1 (continued): Dental caries in Indian children by diet risk factor

Region	Year	Age	n	Group[a]	Diet risk factor	DMFT		DMFS		Caries prevalence	Reference
						Urban	Rural	Urban	Rural		
					Frequency of at meal[c] sugar exposures						
Orissa	1992		305		Low	1.53		2.36			Sahoo et al. (1992)
			271		Medium	2.65		4.27			Sahoo et al. (1992)
			73		High	3.67		5.18			Sahoo et al. (1992)
			311		Low		1.99		3.20		Sahoo et al. (1992)
			225		Medium		2.71		4.33		Sahoo et al. (1992)
			53		High		4.30		7.17		Sahoo et al. (1992)
Chandigarh	1999			Group A	0.30+0.30	1.90					Lehl et al. (1999)
				Group B	0.31+0.27	6.00					Lehl et al. (1999)

a Group A = deft + DMFT 1-3 ; Group B = deft + DMFT > 3
c Low = 0-3 daily exposures; Medium = 4-5, High = 6+

Table 4.2: Caries prevalence in Indian children by oral hygiene method

Region	Age	n	Social class	Oral hygiene method	Percentage using method	Frequency of tooth cleaning	Percentage frequency	Oral hygiene status	Caries prevalence	Reference
Lucknow	5 - 16	1561		Finger & Home made dentrifice	52.4					Chaudhary et al. (1957)
										Chaudhary et al. (1957)
		875		Brush & Propietry dentrifice	29.4					Chaudhary et al. (1957)
										Chaudhary et al. (1957)
		418		Datun[a]	14.1					Chaudhary et al. (1957)
		122		None	4.1					Chaudhary et al. (1957)
Udaipur	NS	1011							9	Mathur et al. (1979)
		448						Good	8	Mathur et al. (1979)
		527						Fair	9	Mathur et al. (1979)
		36						Poor	22	Mathur et al. (1979)
Delhi	5 - 14	458							33	Pandit et al. (1986)
		234		Not stated		Regular			21	Pandit et al. (1986)
		172		Not stated		Not Regular			48	Pandit et al. (1986)
		52		Not stated		Never			42	Pandit et al. (1986)
Delhi	11	31		Brush	97					Visavadia & Kumar (1991)
				Datun	7					Visavadia & Kumar (1991)
				Finger	7					Visavadia & Kumar (1991)
				Toothpaste	87					Visavadia & Kumar (1991)
				Toothpowder	16					Visavadia & Kumar (1991)
				Salt	0					Visavadia & Kumar (1991)

a Neem stick (Traditional use of branch of the neem tree for tooth cleaning)

Continued over

Table 4.2 (continued): Caries prevalence in Indian children by oral hygiene method

Region	Age	n	Social class	Oral hygiene method	Percentage using method	Frequency of tooth cleaning	Percentage frequency	Oral hygiene status	Caries prevalence	Reference
Ranikhet	6-17	980				Daily	84			Mitra & Verma (1993)
						Occasionally	15.6			Mitra & Verma (1993)
						Never	0.4			Mitra & Verma (1993)
				Brush & Paste	50.6					Mitra & Verma (1993)
				Used Powder	26.3					Mitra & Verma (1993)
				Used Twigs	6.5					Mitra & Verma (1993)
				Rinsing with water	7.5					Mitra & Verma (1993)
Wardha	NS	778							17	Rao & Bharambe (1993)
		62		Coal					20	Rao & Bharambe (1993)
		102		Ash					16	Rao & Bharambe (1993)
		473		Manjan					15	Rao & Bharambe (1993)
		81		Paste					15	Rao & Bharambe (1993)
		5		Nus[b]					40	Rao & Bharambe (1993)
		31		Dantum					39	Rao & Bharambe (1993)
		24		None					16	Rao & Bharambe (1993)
Haryana	3 - 7	305		Datoon	59.92					Tewari & Tewari (2001)
		112		Finger & tooth powder	22					Tewari & Tewari (2001)
		26		Finger & tooth paste	5.1					Tewari & Tewari (2001)
		51		Toothbrush & toothpaste	10	Twice weekly	10			Tewari & Tewari (2001)
		15		Toothbrush & toothpaste	2.94	Once daily	2.94			Tewari & Tewari (2001)
		0		Toothbrush & toothpaste	0	After every meal	0			Tewari & Tewari (2001)

b tobacco extract used for cleaning teeth

Continued over

Table 4.2 (continued): Caries prevalence in Indian children by oral hygiene method

Region	Age	n	Social class[c]	Oral hygiene method	Percentage using method	Frequency of tooth cleaning	Percentage frequency	Oral hygiene status	Caries prevalence	Reference
Devangree	13 -14	2007	1					1.13[d]		Sogi & Bhaskar (2002)
			2					1.30		Sogi & Bhaskar (2002)
			3					1.46		Sogi & Bhaskar (2002)
			4					1.56		Sogi & Bhaskar (2002)
			5					1.79		Sogi & Bhaskar (2002)
Tamil Nadu	6 - 12	113		Brush & paste	75					Joshi et al. (2005)
		11		Finger & powder	7					Joshi et al. (2005)
		26		Paddy husk powder	17					Joshi et al. (2005)
	6 - 12	62		Brush & paste	83					Joshi et al. (2005)
		6		Finger & powder	8					Joshi et al. (2005)
		7		Paddy husk powder	9					Joshi et al. (2005)
	6 - 12	51		Brush & paste	68					Joshi et al. (2005)
		5		Finger & powder	7					Joshi et al. (2005)
		19		Paddy husk powder	25					Joshi et al. (2005)

c 1-5: children of parents whose earnings (Rupees per month); >1900, 950-1899, 570-949, 285-569, and <284, respectively.
d Oral Hygiene Index score

CHAPTER 5

DISCUSSION OF CARIES EXPERIENCE IN INDIA

Although epidemiological studies on dental caries experience have been conducted in India, very few studies have been carried out in the northern states, for example, in Chandigarh, Punjab, Haryana, Himachal Pradesh or Jammu and Kashmir. Most studies conducted in north India are quite old and recent data that might be suitable for the evaluation of caries trends is not available.

A difficulty encountered during the preparation of this review was that dmft/DMFT data were presented in some reports in relation to varying combinations of age-groups, for example, for the combined ages of 6-15 years. Since caries experience is age-dependent, the interpretation of a DMFT score that relates to broad age group is limited. When caries experience is reported in this fashion, the data are not able to be compared meaningfully with data from other studies.

The few epidemiological studies which have been conducted in north India tend to show a reduction in caries experience over the past 50 years.

There is little information available on caries experience in deciduous dentition. Much of the information available is confusing because of varying combinations of age groups.

There are only a few studies that have been conducted to identify the relationship between dental caries experience and diet risk factors in Chandigarh and surrounding northern states. Information on the beneficial

effects of fluoride toothpastes is also not available, yet there has been an increase in the use of fluoride toothpaste in India and, probably, a large proportion of the population clean their teeth regularly. It is possible that there has been a reduction in caries prevalence because the Indian market has been flooded with fluoridated toothpaste, both international and local brands, over the past 15 years (Chawla et al., 2000).

It appears that fluorosis prevalence is low in Chandigarh and surrounding rural areas because, unlike other regions of India, the concentration of fluoride in drinking water is relatively low (less than 0.4 ppm).

Conclusion

In conclusion, caries experience in Chandigarh and surrounding northern states may have reduced over the past 50 years. There remains a scarcity of information on caries experience in the primary dentition. In future, studies need to be conducted on a systematic basis in order to monitor expected detrimental changes in dental caries experience due to increasing urbanization and to identify and quantify associated risk factors in Chandigarh and elsewhere in India, in order that rational planning may commence for appropriate dental services nationwide.

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PART TWO

DENTAL SURVEY
OF SCHOOL CHILDREN IN
CHANDIGARH, PUNJAB, INDIA

DENTAL SURVEY OF SCHOOL CHILDREN IN CHANDIGARH, PUNJAB, INDIA

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Abstract

Introduction - In order to inform policy on caries prevention and the provision of other dental services in Chandigarh, a survey of school children was undertaken. The aims were: to determine (1) dental caries experience, (2) fluorosis prevalence, (3) and dental caries risk factors.

Material and Methods - School children aged 6 and 12 years living in Chandigarh, and surrounding rural areas were surveyed. The population was stratified into four socio-demographic groups: one rural, and three urban - the upper-middle, lower-middle, and lower classes. The schools were randomly selected from lists provided by the Chandigarh and Punjab Education Office. The children were examined to establish caries and fluorosis status. In addition, the 12-year-olds were interviewed to assess their exposure to caries risk factors.

Results - A total of 882 children aged 6 years were examined. Their overall dmft score was 1.43. Of the 849 12-year-olds examined, their overall DMFT score was 0.57.The DMFT score of urban poor class children was 0.97, more than twice that of rural children which was 0.35 ($p<0.001$). Fluorosis prevalence was 10%. Compared with those who consumed hot sugary drinks but did not use fluoridated toothpaste, those who were exposed to the combination of daily hot sugary drinks and fluoridated toothpaste, or fluoridated toothpaste alone, or neither, had decreased odds, 0.63, 0.38, and 0.10, respectively, of experiencing caries.

Discussion - Since the main caries risk factor identified in this study was frequent daily exposure to hot sugary drinks, health education regarding the dangers of high dietary sucrose and access to affordable fluoridated toothpaste is needed to reduce the caries burden. Consideration should be given to fluoridating the Chandigarh water supply. Priority should be given to establishing a preventive orientated program for urban children.

Introduction

Dental caries is one of the most prevalent diseases in children worldwide. and has a multi-factorial etiology involving, plaque microorganisms, saliva, fluoride, and diet factors (Van Loveren and Duggal, 2004). Although the prevalence of caries in developed countries has declined(Bratthall et al., 1996), mainly because world-wide use of fluorides, it is an increasing problem in developing countries (Hobdell, 2001).

The situation in India is somewhat unclear because oral health surveillance has not been routinely conducted. Available data from north India is of an *ad hoc* nature and indicates that caries experience is increasing in the primary and permanent dentitions in Punjab, Haryana, and Uttar Pradesh (Gauba et al., 1986; Gauba et al., 1993; Talim,. 1983; WHO (Undated); Rai et al., 2007; Chaudhary et al., 1957; Mitra et al., 1993). The indications are that this increase is more marked in the primary dentition. (Gauba et al., 1986; Gauba et al., 1993; Singh & Chib., 1980; WHO (Undated). In capital Delhi, and the northern states of Jammu and Kashmir, Bihar, and Himachal Pradesh, available data is insufficient to demonstrate any trends (Pandit et al.,1986; WHO (Undated).

In Chandigarh, caries experience in the primary dentition appears to have increased very slightly over a 23 year period (Tewari & Chawla (1977); Chawla et al., 2000), whereas in the permanent dentition, DMFT scores of 12-year-olds, for example, have decreased by more than 50% from 1977 to 2000 (Tewari & Chawla, 1977; Chawla et al., 2000). In 1985, caries experience in the primary dentition was similar in urban and rural areas (WHO (Undated). On the other hand, data relating to possible urban rural differences in the permanent dentition are not comparable and the situation remains unclear. Hence, the risk of increasing caries experience with increasing urbanization that may occur in India is of concern but at this stage, is not quantifiable.

Dental care in India is delivered mainly by the private sector. There is no central databank of information on dental health and in these circumstances it is not possible to plan effectively for the development of dental services, both in public and private. Although around 7000 new dental graduates per annum enter the workforce (currently, the dentist to population ratio is 1:30,000) the population distribution of dentists is grossly uneven. Only 10% of Indian doctors serve the rural sector where 70% of the Indian population reside and this most likely reflects the situation regarding the distribution of dentists (Ministry of Health and Family Welfare., 1995).

In 1995, a National Oral Health Policy was determined (Ministry of Health and Family Welfare, 1995). Soon afterwards, a National Oral Health Care Programme was established by the Ministry of Health and Family Welfare (Undated) to implement the National Oral Health Policy. One of the goals of this programme was "to bring down the DMFT in school children between 6-12 years of age to less than 2 which is approximately 4 at present.

In order to inform policy on caries prevention and the provision of other dental services in Chandigarh that impact on the goals of the National Oral Health Care Programme, a survey of school children was undertaken. The aims of this survey were: to determine (1) dental caries experience, (2) fluorosis prevalence, (3) and dental caries risk factors.

Material and Methods

Study population

The present study was conducted among school children aged 6 and 12 years living in Chandigarh, Punjab, and surrounding rural areas. The population was stratified into four socio-demographic groups: one rural, and three urban - the upper-middle, lower-middle, and lower classes. Urban schools which levied fees of Rupees 500 and above, 100 to 500,

and less than 100 were identified as having children from the upper-middle, lower-middle, poor class backgrounds, respectively. Schools located at least 8 km from the urban boundary were classed a rural.

Sampling

It was planned to survey 200 6-year-olds and 200 12-year-olds in each of the four socio-demographic strata, giving a total of 1,600. The participants were selected using a two-stage stratified cluster sampling method. Within each stratum, schools were randomly selected from lists provided by the Chandigarh and Punjab Education Office.

Recruitment

Permission to conduct the survey was obtained from the District Education Officer. The principals of the selected schools were approached and all agreed to participate. In private schools informed consent was obtained from parents whereas in government funded schools, school principals gave consent on behalf of parents. Within schools, all clusters of Class 1 (age 6) and Class 7 (age 12) children were selected and all children in each cluster were included. In order to reach the required sample size, 11 schools were eventually selected for inclusion in the survey.

Caries assessment

Dental caries experience (dmft/DMFT) was scored following the criteria established by World Health Organisation (WHO, 1997). The d/D component was differentiated as (1) a cavity of at least 1mm or (2) that of 4mm or more. The dental examinations were performed outside in shaded natural daylight by a single calibrated dentist. Dental mirrors and probes were not used, but wooden spatulas were used to retract cheeks and lips for visual inspection. The clinical findings were recorded by an assistant. Radiographs were not taken.

Fluorosis assessment

The Dean scoring system was used assess dental fluorosis status (WHO, 1997). As for the caries assessment, the 12-year-olds were assessed for fluorosis while standing outside and positioned so that their teeth were shaded from direct sunlight.

Caries risk assessment

The 12-year-olds completed a questionnaire to obtain information on their exposure to cariogenic foods (daily frequency of consumption of chocolates, sweets, biscuits, soft drinks, and hot sugary drinks such as tea and milk), oral hygiene behaviour, and dental visiting behaviour. With regard to the type of dentifrice used, the children were asked to identify the product they used from among a basket containing all of the dentifrices available in the local shops. The questionnaire was administered separately to each 12-year-old during an interview. To ensure that the answers to the questions were unbiased, the school teachers separated the already interviewed children from those who were waiting their turn.

Water fluoride concentration assessment

Ground water and tap water samples were collected from Chandigarh and surrounded rural areas. They were analysed for fluoride concentration at the Trace Inorganics Laboratory in Sydney.

Data quality control

Data quality was monitored through duplicate examinations of around 10% of the children one month after their first examinations.

Statistical analysis

Clinical data were entered electronically for computer analysis. Caries experience and fluorosis prevalence distributions were generated and related statistics were calculated. Regarding the determination of caries risk, distributions of DMFT scores by a range of potential explanatory variables were analysed. Variables that were significantly associated with

caries experience were examined further using logistic regression methods. Multivariable regression models were developed to check for confounding and to identify significant independent predictors of caries experience. Examination reliability was assessed using the kappa statistic. These analyses were conducted using EpiInfo™ Version 3.2.2 and SAS 9.1 software.

Results

Parental consent was 100% in relation to children attending private schools. At government schools, due to problems with English literacy, consent was given by the school principals on behalf of children and their parents. The kappa statistics indicating measurement reliability for examinations of the primary and permanent dentitions were 0.99 and 0.96, respectively.

Caries experience at age 6 years

A total of 882 children aged 6 years were examined, there being more males than females in the sample (Table 1). Nearly 60% of these children were caries free. The overall dmft score was 1.43 which was comprised mainly of the decayed component (1.29). More than half of this value was contributed by cavities that were 4mm in diameter or greater. There were very few filled or missing teeth. Males had significantly more dmft than females (p=0.006). Finally, very few erupted first permanent molars in the 6-year-olds had carious lesions.

The distribution of the caries experience findings in the 6-year-olds, by socio-demographic group, is shown in Table 2. There was approximately 25% of the sample in each of the four groups. Caries freedom was significantly different across the groups, being lowest among the urban upper-middle class children and highest among rural children. This difference was also reflected across the dmft scores; that for upper middle-class children being 2.31, more than twice that of 0.95 for rural children (p<0.001). DMFT scores in the erupted first permanent molars,

Table 1: dmft statistics for 6-year-olds in Chandigarh

	n	%	%cf[a]	d_{1mm}[b]	d_{4mm}[b]	d[c]	m	f	dmft	sd	p value	DMFT 6[d]	SD	p value
Males	517	58.6	53.6	0.60	0.83	1.44	0.09	0.07	1.60	2.50		0.04	0.264	
Females	365	41.4	62.2	0.44	0.63	1.07	0.06	0.06	1.19	2.15	0.006	0.06	0.287	0.394
Total	882	100	57.1	0.53	0.74	1.29	0.08	0.06	1.43	2.37		0.05		

a percentage caries free children
b Cavities of at least 1mm or 4mm or more.
c d = d1mm + d4mm + filled teeth with recurrent caries.
d erupted first permanent molars

Table 2: dmft by socio-demographic status Chandigarh 6-year-olds

Socio-demographic		n	%	% cf	d	m	f	dmft	sd	p value	DMFT6[a]	SD	p value
Urban	**Upper middle**	211	24	44.5	1.99	0.10	0.22	2.31	3.02		0.03	0.226	
	Lower middle	206	24	62.6	1.15	0.06	0.05	1.26	2.19		0.06	0.329	
	Poor	239	27	52.7	1.18	0.10	0.00	1.27	1.92		0.09	0.343	
Rural		212	25	68.6	0.89	0.05	0.00	0.95	2.04	0.000	0.01	0.133	0.001
Total		882	100	57.1	1.29	0.08	0.06	1.43	2.37		0.05	0.273	

a First permanent molars

though negligible, were highest in children from the urban poor socio-demographic group (0.09) and lowest in children from the rural area (0.01) ($p<0.001$).

Caries experience at age 12 years

There were 849 12-year-olds of whom 67% were male (Table 3). More than 70% of these children were caries free and the overall DMFT score was 0.57 which was comprised mainly of the decayed component (0.53). This value was contributed to equally by cavities of at least 1mm and those of 4mm in diameter or more. Males and females had similar DMFT scores of around 0.6. The mean decayed components of the DMFT index were almost identical in those who had visited and dentist and those who had not (not shown in Table 4).There was approximately 25% of the sample in each of the socio-demographic groups (Table 4). The main difference across the groups was that caries freedom differed significantly, being lowest among the urban poor children and highest among rural children. These differences were reflected across the DMFT scores; that for urban poor children being 0.97, more than twice that of 0.35 for rural children ($p<0.001$).

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The fluoride concentrations in drinking water from three river sources were 0.16, 0.20, and 0.24 ppm. The ground source well water had a concentration of 0.29. Fluorosis prevalence was 10% (Figure 1). According to the Dean Index codes normal and questionable are treated as non-cases; and more severe grades count as prevalent cases. Nearly three quarters of the sample were classified as having normal tooth enamel and 17% were rated as having questionable signs of fluorosis.

Associations between caries experience (mean DMFT) in the 12-year-olds and the potential explanatory variables investigated in the questionnaire survey are shown in Table 5. Six associations were significant: socio-demographic (already noted), use of toothbrush, type of toothpaste used, frequency of consumption of hot sugary drinks, dental

Table 3: DMFT statistics for 12-year-olds in Chandigarh

	n	%	%CF[a]	D_{1mm}[b]	D_{4mm}[b]	D[c]	M	F	DMFT	SD	P value
Males	575	67	71.5	0.29	0.23	0.53	0.01	0.03	0.57	1.15	
Females	274	33	71.5	0.24	0.26	0.53	0.01	0.04	0.58	1.10	0.909
Total	849	100	71.5	0.28	0.24	0.53	0.01	0.03	0.57	1.13	

a Percentage caries free chil;dren.
b Cavities of at least 1mm or 4mm or more.
c D = D1mm + D4mm + filled teeth with recurrent caries.

Table 4: DMFT by social-demographic status Chandigarh 12-year-olds

Socio-demographic		n	%	% CF	D	M	F	DMFT	SD	P value
Urban	**Upper middle**	214	25	76.2	0.38	0.00	0.11	0.50	1.04	
	Lower middle	205	24	73.2	0.42	0.00	0.01	0.44	0.90	
	Poor	218	26	56.0	0.94	0.04	0.00	0.97	1.50	
Rural		212	25	81.1	0.34	0.00	0.00	0.35	0.86	0.00
Total		849	100	71.5	0.53	0.01	0.03	0.57	1.13	

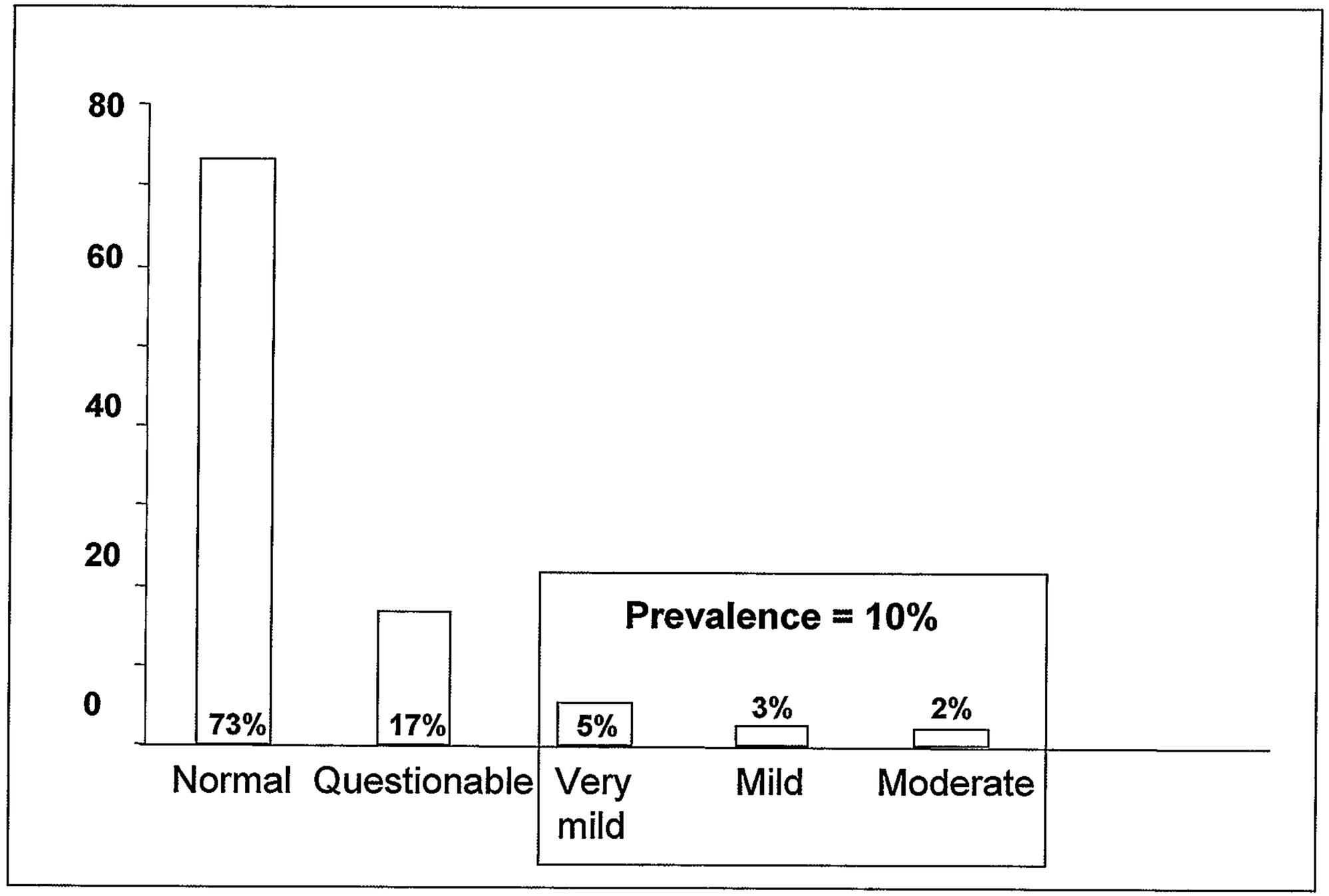

Figure 1. Distribution of Dean fluorosis scores in 12-year-old children.

Table 5: Caries experience of 12-year-olds by potential explanatory variables

	n	%	% CF	Mean DMFT	SD	P- value
Socio-demographic factors						
Gender						
Male	575	68	72.00	0.57	1.15	
Female	274	32	72.00	0.58	1.10	0.909
School						
Rural	212	25	81.00	0.35	0.86	
Urban Upper Middle	214	25	76.00	0.50	1.04	
Urban Lower Middle	205	25	73.00	0.44	0.90	
Urban poor	218	25	56.00	0.97	1.50	0.000
Oral Hygiene factors						
Do you use a toothbrush ?						
Yes	815	96	72.40	0.54	1.09	
No	34	4	50.00	1.24	1.79	0.003
How often do you brush your teeth?						
Never	10	1	50.00	1.70	2.45	
Once daily and more	797	94	71.90	0.54	1.08	
Sometimes	42	5	69.00	0.76	1.45	0.170
Toothpaste type used						
Fluoridated	684	80	73.20	0.52	1.08	
Non-fluoridated	165	20	64.20	0.76	1.32	0.015

Continued over

Table 5 (continued): Caries experience of 12 -year-olds by potential explanatory variables

	n	%	% CF	Mean DMFT	SD	P- value
Risk of Dental Caries						
Sugar exposures in a day						
6 - 9	119	14	68.90	0.59	1.13	
3 - 5	481	57	71.10	0.57	1.11	
0 - 2	249	29	73.50	0.56	1.18	0.755
How many chocolates you have daily						
Zero	670	79	72.70	0.53	1.08	
One	141	17	68.10	0.60	1.13	
Two and more	38	4	63.20	1.11	1.78	0.150
How often you have sweets						
Zero	773	91	72.00	0.56	1.12	
Once daily	76	9	67.00	0.68	1.22	0.356
How often you have biscuits in a day						
Never	483	57	71.00	0.56	1.07	
Once	354	41	73.00	0.58	1.23	
Twice	12	2	58.00	0.67	0.98	0.617
How often do you take soft drinks						
Never	664	78	71.00	0.59	1.16	
Once daily	169	20	73.00	0.47	0.96	
Twice daily	16	2	63.00	0.75	1.53	0.598
How often you take hot sugary drinks Two groups						
Never	53	6	83.00	0.23	0.54	
Once or or more daily	796	94	70.70	0.59	1.16	0.035

Continued over

Table 5 (continued): Caries experience of 12-year-olds by potential explanatory variables

	n	%	% CF	Mean DMFT	SD	P- value
How often you take cold sugary drinks						
Never	416	49	70.00	0.69	1.33	
Once daily	314	37	75.00	0.42	0.85	
Twice daily	87	10	69.00	0.48	0.89	
Thrice daily	32	4	69.00	0.63	1.18	0.273
Oral Health Attitude						
Visits to dentist						
Never	627	74	74.00	0.53	1.11	
Yes	222	26	65.00	0.68	1.18	0.024
Reason of visit						
Needed a filling	68	8	53.00	0.91	1.23	
Needed a checkup	65	7	75.00	0.54	1.13	
Never	626	74	74.00	0.53	1.11	
Orthodontics	15	2	80.00	0.20	0.41	
Others	28	3	82.00	0.32	0.86	
Toothache	47	6	55.00	0.89	1.40	0.001
Beetel nut						
Zero	845	99	71.60	0.57	1.13	
Once daily	4	1	50.00	1.00	1.41	0.334
Fluorosis						
Fluorosis = 1	85	10	79.00	0.39	0.91	
Fluorosis = 0	755	89	71.00	0.59	1.16	
NOT RECORDED	9	1	77.80	0.44	0.88	0.240

Continued over

Table 5 (continued): Caries experience of 12-year-olds by potential explanatory variables

	n	%	% CF	Mean DMFT	SD	P- value
Fluorosis						
Severe	3	1	79.00	2.00	2.00	
Moderate	17	2	71.00	0.35	1.46	
Mild	21	2	77.80	0.29	0.56	
Very mild	44	5	77.00	0.64	1.43	
Questionable	140	16	74.00	0.41	0.81	
Normal	615	73	70.00	0.61	1.16	
Not recorded	9	1	78.00	0.67	1.66	0.130

visits, and reason for visits. Daily chocolate consumption showed a non-significant trend of higher DMFT by increased consumption frequency. Variables that were significantly associated with caries experience were investigated further in logistic regression analysis, except that the dental visit variables were not included because they are related to consequences of caries experience, not predictors of caries. Since toothbrush use is equivalent to use of toothpaste, toothbrush use was not considered further. The results of the logistic regression analyses are shown in Table 6. Caries experience was dichotomized as 0 or one or more.

Regarding social class, the urban poor is shown as reference group. Compared with this group, the odds of caries experience was significantly less in all the other socio-demographic groups (adjusted Odds Ratios ranged from 0.29 to 0.48). In the univariate analyses, use of fluoridated toothpaste was associated with significantly decreased odds of experiencing one or more DMFT, whereas consumption of hot sugary drinks was associated with twice the odds of experiencing caries but this result did not reach statistical significance. However, following adjustment by means of the multiple regression, the effects were reversed. The odds of caries associated with the daily consumption of hot sugary drinks increased and became significant (OR=2.44), whereas compared with users of non-fluoridated toothpaste, the adjusted odds associated with the observed reduction in caries experience in relation to users of fluoridated toothpaste were clearly non-significant. As a result, the possibility of interaction between toothpaste use and the consumption of sugary drinks was tested but the effect was not significant. Never-the-less, the situation was explored further in an analysis of a new exposure variable that combined fluoridated toothpaste use with the consumption of hot sugary drinks. The results of this analysis are shown in Table 7. A very clear trend is evident showing that in comparison with those children who consumed hot sugary drinks but did not use

fluoridated toothpaste, those who were exposed to the combination of daily hot sugary drinks and fluoridated toothpaste, or fluoridated toothpaste alone, or neither, had decreased odds of experiencing caries. In this multi-variable analysis, the socio-demographic factor remained as a highly significant predictor ($p<0.001$).

DISCUSSION

The overall dmft score for 6-year-olds (1.43) was lower than reported in previous studies. Since 80% of the 12-year-olds reported that they used fluoridated toothpaste, it is reasonable to suppose that most 6-year-olds also used fluoridated toothpaste and that the low caries experience is due to fluoride toothpaste use that has flooded the market in recent times.

More than 70% children aged 12 year were caries free, despite the reported high frequency of daily exposures to dietary sugar. The mean DMFT score for 12-year-olds of 0.57 is already less than the 2010 goal of <2 set by the National Oral Health Care Programme (Lal et al., 2004). However, there were marked caries experience differences between urban and rural children. Caries experience in the deciduous dentition was about 2.5 times greater in urban upper-middle class children compared with rural children, whereas in the permanent dentition, the DMFT score of the urban poor class children was nearly three times greater than the value for rural children. Despite the protective effect of fluoridated toothpaste, the caries challenge due to urbanization and consequent exposure to highly processed carbohydrate diets is likely to become more intense in future (David et al., 2005). Differences in caries experience between socio-demographic groups in India have been reported previously by Singh et al. (1985) and Sudha et al. (2005) and are attributed to differences in exposure to dietary sugars between the groups.

The gender ratio in the sample was not equal. One large school, selected randomly, had a much higher proportion of boys, and this distorted the overall distribution.

Table 6: Logistic regression analysis of potential predictors of caries experience in Chandigarh 12-year-olds

Predictor	n	%	Unadjusted Odds ratio			Adjusted Odds ratio		
			OR	95% CI	P value	OR	95% CI	P value
Socio-demographic								
Urban poor	218	26	1.00			1.00		
Rural	212	25	0.30	0.19 0.46	0.000	0.29	0.18 0.45	0.000
Urban upper middle	214	25	0.40	0.26 0.60	0.000	0.42	0.27 0.65	0.000
Urban lower middle	205	24	0.47	0.30 0.70	0.001	0.48	0.32 0.74	0.001
Frequency of hot sugary drinks								
Never	53	6	1.00			1.00		
Once or more daily	796	94	2.02	0.97 4.21	0.060	2.44	1.15 5.16	0.020
Toothpaste type used								
Non-fluoridated	165	20	1.00			1.00		
Fluoridated	684	80	0.66	0.46 0.94	0.022	0.80	0.54 1.18	0.261

DMFT dichomised as 0 or 1+

Table 7: Logistic regression analysis of potential predictors of caries experience[a] in Chandigarh 12-year-olds

Predictor	n	%	Unadjusted Odds ratio			Adjusted Odds ratio		
			OR	95% CI	P value	OR	95% CI	P value
Socio-demographic								
Urban poor	218	26	1.00			1.00		
Rural	212	25	0.30	0.19 0.46	0.000	0.28	0.18 0.44	0.000
Urban upper middle	214	25	0.40	0.26 0.60	0.000	0.42	0.27 0.64	0.000
Urban lower middle	205	24	0.47	0.30 0.70	0.001	0.48	0.32 0.73	0.001
Caries risk factor[b]								
Hot sugary drinks (HSD) only	155	18	1.00			1.00		
HSD and fluoridated toothpaste	641	76	0.63	0.43 0.91	0.013	0.76	0.51 1.13	0.171
Fluoridated toothpaste only	43	5	0.38	0.17 0.88	0.024	0.40	0.17 0.95	0.037
Neither	10	1	0.19	0.02 1.50	0.115	0.13	0.02 1.08	0.059

a DMFT dichomised as 0 or 1+

b Daily exposure to (1) hot sugary drinks and (2) fluoridated toothpaste.

Since the fluoride concentration in the Chandigarh water supply is less than 0.3 parts per million, the fluorosis prevalence of 10% was unexpected. It is possible that most of the children with fluorosis were migrants who had come to Chandigarh because their parents had migrated from other states in search of employment or had swallowed toothpaste when they were younger.

Since almost all dmf and DMF teeth were decayed and that half of the cavities observed at 12 years were 4mm or more in diameter, these teeth will likely need to be extracted before the children reach the age of 20. These findings indicate that there is an urgent need to plan for child dental services in which a priority should be given to a preventive focus.

CONCLUSION

The distribution of caries suggests that a population approach to prevention should be implemented. Since the main caries risk factor identified in this study was frequent daily exposure to hot sugary drinks, health promotion regarding the dangers of high dietary sucrose consumption may also prove helpful in reducing the dental caries burden in some children and other health problems in later life.

Access to good quality and affordable fluoridated toothpaste is needed to reduce the caries burden. Consideration should be given to fluoridating the Chandigarh water supply. Priority should be given to establishing a preventive orientated program for the urban lower socio-economic children.

Surveys need to be conducted on a systematic basis in order to monitor expected detrimental changes in dental caries experience associated with urbanization and to identify and quantify associated risk

factors in Chandigarh, and elsewhere in India, in order that rational planning may commence for appropriate dental services nationwide.

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APPENDIX

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The University of Sydney

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19 December 2006

Associate Professor W Evans
Community Oral Health and Epidemiology
Faculty of Dentistry
Westmead Centre for Oral Health
Westmead Hospital
C24

Dear Professor Evans

I am pleased to inform you that the Human Research Ethics Committee (HREC) at its meeting on 12 December 2006 approved your protocol entitled **"Dental Survey of 6 year olds and 12 year olds in India"**

Details of the approval are as follows:

Ref No.:	***12-2006/9740***
Approval Period:	***December 2006 – December 2007***
Authorised Personnel:	***Associate Professor W Evans***
	Dr M G Varkey
	Dr B Christian
	Dr A S Badwal
	Dr P Grover
	Dr P Mehta
	Dr V Chabbra

The HREC is a fully constituted Ethics Committee in accordance with the *National Statement on Ethical Conduct in Research Involving Humans-June 1999* under *Section 2.6.*

The approval of this project is **conditional** upon your continuing compliance with the *National Statement on Ethical Conduct in Research Involving Humans.* We draw to your attention the requirement that a report on this research must be submitted every 12 months from the date of the approval or on completion of the project, whichever occurs first. Failure to submit reports will result in withdrawal of consent for the project to proceed.

Special Condition of Approval

- Notify the name of schools in India when they become available.

Chief Investigator / Supervisor's responsibilities to ensure that:

(1) All serious and unexpected adverse events are to be reported to the HREC as soon as possible.

(2) All unforeseen events that might affect continued ethical acceptability of the project are to be reported to the HREC as soon as possible.

(3) The HREC must be notified as soon as possible of any changes to the protocol. All changes must be approved by the HREC before continuation of the research project. These include:-

- If any of the investigators change or leave the University.
- Any changes to the Participant Information Statement and/or Consent Form.

(4) All research participants are to be provided with a Participant Information Statement and Consent Form, unless otherwise agreed by the Committee. The Participant Information Statement and Consent Form are to be on University of Sydney letterhead and include the full title of the research project and telephone contacts for the researchers, unless otherwise agreed by the Committee and the following statement must appear on the bottom of the Participant Information Statement. *Any person with concerns or complaints about the conduct of a research study can contact the Senior Ethics Officer, University of Sydney, on (02) 9351 4811 (Telephone); (02) 9351 6706 (Facsimile) or gbriody@usyd.edu.au (Email).*

(5) The HREC approval is valid for four (4) years from the Approval Period stated in this letter. Investigators are requested to submit a progress report annually.

(6) A report and a copy of any published material should be provided at the completion of the Project.

Yours sincerely

John Watson

Associate Professor J D Watson
Chairman
Human Research Ethics Committee

The University of Sydney

Faculty of Dentistry
Faculties of Health

Wendell Evans, *MDS, DDSc*
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21 February 2007

The Education Officer
Chandigarh
Punjab
INDIA

Dear Sir,

Dental survey of 6 year olds and 12 year olds in India

I am the director of the Master of Dental Science (MDSc) program in the discipline of Community Oral Health and Epidemiology, Faculty of Dentistry, University of Sydney. Most candidates enrolled in this program are international students preparing to become specialists in Public Health Dentistry. During year 2 of the MDSc program, international students conduct a research project in their country of origin, relevant to a Public Health Dentistry theme of importance in that country.

My MDSc student, Dr Amandeep Singh Badwal from India, graduated in dentistry from Baba Farid University of Health Sciences (Faridkot) and he is registered to practice dentistry with the Punjab Dental Council, India. He wishes to conduct his research project in Chandigarh in 2007. This will entail a dental survey of children attending schools in Chandigarh. The survey will comprise (1) a brief dental examination of the children that will be conducted according to World Health Organisation protocols, and (2) a short set of questions on oral habits and sugar intake to be answered by the children.

Altogether we plan to survey 1600 children; 400 in rural areas (200 6-year olds and 200 12-year olds) and 1200 in urban areas 3 x (6-year olds and 200 12-year olds) that is 400 in poor urban areas, 400 in lower middle-class areas and 400 in upper middle-class areas.

It is anticipated that this survey will take place during the months of April to August 2007.

I would be grateful if you advice on two matters. Firstly, what is the process for obtaining permission from your office for Dr Badwal to conduct this proposed survey? Secondly, what are the requirements in relation to obtaining consent from the school principals and the parents of the children?

Thank you for your help and I look forward to hearing from you shortly.

Yours faithfully,

Wendell Evans

The University of Sydney

Faculty of Dentistry
Faculties of Health

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21 February 2007

The District Education Officer
Mohali
Punjab
INDIA

Dear Sir,

Dental survey of 6 year olds and 12 year olds in India

I am the director of the Master of Dental Science (MDSc) program in the discipline of Community Oral Health and Epidemiology, Faculty of Dentistry, University of Sydney. Most candidates enrolled in this program are international students preparing to become specialists in Public Health Dentistry. During year 2 of the MDSc program, international students conduct a research project in their country of origin, relevant to a Public Health Dentistry theme of importance in that country.

My MDSc student, Dr Amandeep Singh Badwal from India, graduated in dentistry from Baba Farid University of Health Sciences (Faridkot) and he is registered to practice dentistry with the Punjab Dental Council, India. He wishes to conduct his research project in Mohali in 2007. This will entail a dental survey of children attending schools in Mohali. The survey will comprise (1) a brief dental examination of the children that will be conducted according to World Health Organisation protocols, and (2) a short set of questions on oral habits and sugar intake to be answered by the children.

Altogether we plan to survey 1600 children; 400 in rural areas (200 6-year olds and 200 12-year olds) and 1200 in urban areas 3 x (6-year olds and 200 12-year olds) that is 400 in poor urban areas, 400 in lower middle-class areas and 400 in upper middle-class areas.

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Thank you for your help and I look forward to hearing from you shortly.

Yours faithfully,

Wendell Evans

The University of Sydney

Faculty of Dentistry
Faculties of Health

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Email: w.evans@dentistry.usyd.edu.au

Date:

The School Principal
.....
.....
.....
.....

Dear School Principal,

Dental survey of 6 year olds and 12 year olds in India

I am planning to conduct a dental survey of children aged 6 and 12 years in Chandigarh. The survey has been approved by the Education Officer, Chandigarh. This survey will be conducted during the months of April to August in 2007. Your School has been selected to be included in this survey.

I am writing to request your permission to conduct the dental survey in your school.

The survey will involve the completion of a questionnaire by the 12-year-olds only and a dental examination of the children aged 6 and 12 years to determine their tooth decay status. The dental examination will pose no risk to the children and precautions against cross infection will be strictly adhered to.

School children examined will be given a report of their dental treatment needs to notify their parents of any need to seek dental care. A report will also be sent to your school to let you know the results of the survey.

The results of the survey may be used by the Ministry of Health as the basis for planning and evaluating future oral health programs, and as a reference in relation to monitoring changes in levels and patterns of oral diseases.

If you agree to allow your school children and your school to participate in this dental survey, please complete the attached consent form. Should you need further information, please contact Dr Amandeep Singh Badwal on 98 1506 8624.

You will be informed in good time the date and time of our visit to your school as soon as we get permission from you.

Yours sincerely

Dr Amandeep Singh Badwal
MDSc Student,
University of Sydney

Cc: The Education Officer - Chandigarh

The University of Sydney

Dental survey of 6 year olds and 12 year olds in India

CONSENT FORM

Consent to allow for the Dental Survey

I agree for the Dental Survey of children aged 6 and 12 years to be conducted in my school.

On behalf of the children and their parents who are not English literate, I give consent for the children to be examined.

I acknowledge that the purpose of the survey and how it will be conducted has been explained to me.

I understand that the examination is not compulsory and that any child who is not willing to be examined may refuse without prejudice.

Name of School _____

Name of School Principal_____

Signature_____

Date _____

The University of Sydney

PARTICIPANT INFORMATION STATEMENT

1. **What is this study about?**
   Oral health is an essential part of general health. This study will show the amount of tooth decay in children aged 6 and 12 years.

2. **Who is carrying out the study?**
   This study is being conducted by an Indian dentist, who is training to be a dental specialist. Associate Professor Wendell Evans at the University of Sydney – Australia supervises his training.

3. **What does the study involve?**
   This study is part of a big study carried out in four states of India. The study involves a dental examination of your child conducted according to World Health Organization standards. Dr Amandeep Singh Badwal will also ask questions about your child's oral habits.

4. **How much time will the study take?**
   It will take only few minutes to complete everything.

5. **Can I withdraw from the study?**
   Yes, you can withdraw anytime without penalty.

6. **What if I require further information?**
   Please contact Dr Amandeep Singh Badwal by telephone 98 1506 8624 for any further information.

Any person with concerns or complaints about the conduct of the research study can contact Manager for Ethics Administration, University of Sydney on (612) 9351 4811.

The University of Sydney

PARENT/GUARDIAN CONSENT FORM

Title of research project: "Dental survey of 6 year olds and 12 year olds in India"
Name of Investigator: Dr Amandeep Singh Badwal
Chief Investigator: Associate Professor Wendell Evans

I permit ....., who is aged ..... years, to participate in the survey.

In giving consent I acknowledge that:

1. I have received the Patient Information Statement and that I have read and understood the information given.
2. Dr Amandeep Singh Badwal has given me the opportunity to discuss this information and to ask questions about the project, and they have been answered to my satisfaction.
3. I understand that I can withdraw my child from the study at any time without penalty now or in the future.
4. I understand that if I have any further questions relating to my child's participation in this survey I may contact Dr Badwal who will be happy to answer them.

Signature of Parent/Guardian

..... Date .....

CLINICAL EXAMINATION FORM FOR 6-YEAR-OLDS

Clinical criteria - primary teeth (including first permanent molars)

0 = sound

1 = cavity at least 1mm diameter as seen using sharp eyes.

2 = cavity of this size ○ (4mm or greater)

3 = filled and decayed

M = missing due to caries (do not use for natural exfoliation)

F = filled and sound

T = fractured, discoloured, or missing due to trauma

X = unerupted (when the primary incisor has exfoliated but the permanent tooth has not erupted) and erupted permanent incisors.

The University of Sydney

All India Dental Survey

Clinical examination for children aged 12

Name _____

School _____ ☐

ID ☐ **SEX** ☐ **CLASS** ☐ **AGE** ☐

17	16	15	14	13	12	11	21	22	23	24	25	26	27

47	46	45	44	43	42	41	31	32	33	34	35	36	37

0 = Sound
1 = Cavity at least 1mm diameter as seen using sharp eyes.
2 = Cavity of this size O (4mm) or greater (indicating need for urgent care)
3 = Filled and decayed
M = Missing due to caries
F = Filled and sound
T = Tooth that is fractured, discoloured, or missing due to trauma
8 = Unerupted permanent tooth and any remaining primary tooth
9 = Tooth extracted for orthodontic reasons

☐

Fluorosis score (Based on upper central incisors)

0 Normal
1 Questionable
2 Very mild
3 Mild
4 Moderate
5 Severe
X Not recorded for any reason

Questionnaire

1 How do you clean your teeth?

1 Use a toothbrush.
2 Use finger.
3 Use neem sticks.
0 Do not clean.

2 Some children clean their teeth...

1 Once a week
2 Twice a week
3 Once daily
4 More than once daily
0 Never

.....how often do you clean your teeth?

3 Which of the following toothpastes do you use?

(To be selected from a basket containing commonly used toothpastes, and other tooth cleaning items used in India)

4 Indicate how many times you have the following sugar containing food items in a day in between meals

Chocolates Sweets Biscuits

Soft Drink Hot Drink Other

5 Some children chew or use betel nut/pan?

1 Once a week 2 Twice a week
3 Once daily 4 More than once daily
0 Never

.....how often do you chew or use betel nut/pan?

6 Have you been to a dentist ?

0 No
1 Yes

7 Why did you visit a dentist ?

1 Had toothache
2 Needed a filling
3 Need a checkup
4 To have my teeth straightened
5 Other _____

The University of Sydney

Dental survey of 6 year olds and 12 year olds in India

NEED FOR DENTAL CARE

Dear Parent,

I have examined your child..... today and wish to inform you that he/she needs to attend the dental clinic at..... for dental treatment.

Sincerely,

Dr Amandeep Singh Badwal
Dentist

The FREQ Procedure

Table of first by second

Table: Within-examiner reliability - analysis of duplicate examinations for caries in age 6.

first second

Frequency, Percent , Row Pct , Col Pct	0	1	2	4	5	6	9	Total
0	924	0	0	0	0	0	1	925
	87.50	0.00	0.00	0.00	0.00	0.00	0.09	87.59
	99.89	0.00	0.00	0.00	0.00	0.00	0.11	
	100.00	0.00	0.00	0.00	0.00	0.00	1.35	
1	0	20	1	0	0	0	0	21
	0.00	1.89	0.09	0.00	0.00	0.00	0.00	1.99
	0.00	95.24	4.76	0.00	0.00	0.00	0.00	
	0.00	100.00	3.85	0.00	0.00	0.00	0.00	
2	0	0	25	0	0	0	0	25
	0.00	0.00	2.37	0.00	0.00	0.00	0.00	2.37
	0.00	0.00	100.00	0.00	0.00	0.00	0.00	
	0.00	0.00	96.15	0.00	0.00	0.00	0.00	
4	0	0	0	1	0	0	0	1
	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.09
	0.00	0.00	0.00	100.00	0.00	0.00	0.00	
	0.00	0.00	0.00	100.00	0.00	0.00	0.00	
5	0	0	0	0	10	0	0	10
	0.00	0.00	0.00	0.00	0.95	0.00	0.00	0.95
	0.00	0.00	0.00	0.00	100.00	0.00	0.00	
	0.00	0.00	0.00	0.00	100.00	0.00	0.00	
6	0	0	0	0	0	1	0	1
	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.09
	0.00	0.00	0.00	0.00	0.00	100.00	0.00	
	0.00	0.00	0.00	0.00	0.00	100.00	0.00	
9	0	0	0	0	0	0	73	73
	0.00	0.00	0.00	0.00	0.00	0.00	6.91	6.91
	0.00	0.00	0.00	0.00	0.00	0.00	100.00	
	0.00	0.00	0.00	0.00	0.00	0.00	98.65	
Total	924	20	26	1	10	1	74	1056
	87.50	1.89	2.46	0.09	0.95	0.09	7.01	100.00

The FREQ Procedure

Statistics for Table of first by second

Test of Symmetry

Statistic (S)	2.0000
DF	21
Pr > S	1.0000

Kappa Statistics

Statistic	Value	ASE	95% Confidence Limits	
Simple Kappa	0.9917	0.0059	0.9802	1.0000
Weighted Kappa	0.9931	0.0063	0.9808	1.0000

Sample Size = 1056

Table: Within-examiner reliability - analysis of duplicate examinations for caries in age 12.

First Second

Frequency, Percent, Row Pct, Col Pct	0	1	2	4	5	8	Total
0	1092	1	0	0	0	0	1093
	92.86	0.09	0.00	0.00	0.00	0.00	92.94
	99.91	0.09	0.00	0.00	0.00	0.00	
	100.00	14.29	0.00	0.00	0.00	0.00	
1	0	4	2	0	0	0	6
	0.00	0.34	0.17	0.00	0.00	0.00	0.51
	0.00	66.67	33.33	0.00	0.00	0.00	
	0.00	57.14	33.33	0.00	0.00	0.00	
2	0	2	4	0	0	0	6
	0.00	0.17	0.34	0.00	0.00	0.00	0.51
	0.00	33.33	66.67	0.00	0.00	0.00	
	0.00	28.57	66.67	0.00	0.00	0.00	
4	0	0	0	6	0	0	6
	0.00	0.00	0.00	0.51	0.00	0.00	0.51
	0.00	0.00	0.00	100.00	0.00	0.00	
	0.00	0.00	0.00	100.00	0.00	0.00	
5	0	0	0	0	3	0	3
	0.00	0.00	0.00	0.00	0.26	0.00	0.26
	0.00	0.00	0.00	0.00	100.00	0.00	
	0.00	0.00	0.00	0.00	100.00	0.00	
8	0	0	0	0	0	62	62
	0.00	0.00	0.00	0.00	0.00	5.27	5.27
	0.00	0.00	0.00	0.00	0.00	100.00	
	0.00	0.00	0.00	0.00	0.00	100.00	
Total	1092	7	6	6	3	62	1176
	92.86	0.60	0.51	0.51	0.26	5.27	100.00

Statistics for Table of first by second

Test of Symmetry

Statistic (S)	1.0000
DF	15
Pr > S	1.0000

Kappa Statistics

Statistic	Value	ASE	95% Confidence Limits	
Simple Kappa	0.9683	0.0138	0.9412	0.9953
Weighted Kappa	0.9952	0.0022	0.9909	0.9995

Sample Size = 1176

Key to examination codes:

0 Sound
1 1mm cavity
2 4mm cavity
4 Trauma
5 Filled
8 Not erupted