

# Caries experience in nursery school children in Sendai, Japan: Time trends from 1972–2002

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**Abstract** Since 1972, we have been conducting an annual clinical dental examination for young children at 13 nursery schools in the north district in Sendai, Japan. In the present study, we have included the results of examinations conducted in 1997 and 2002, and analyzed the time trends in caries experience of the primary dentition over a 30-year period from 1972 to 2002. The caries experience in the primary dentition markedly decreased in 1977 and remained stable for about 15 years, but in 1997, it markedly decreased again and continued to decrease in a linear fashion until 2002. The time trends in caries experience in the primary dentition in each age group were further analyzed by ascertaining caries experience in each tooth type. The results showed that, in 2 to 4-year-old, the decrease of caries experience for the primary maxillary incisors, canines and first molars seemed to stop decreasing in 2002, but for the 5-year-old, the caries experience for the maxillary incisors and canines and the maxillary and mandibular first and second molars markedly decreased from 1997 to 2002.

## Key words

Caries experience,  
Epidemiology,  
Nursery school children,  
Primary teeth,  
Time trends

## Introduction

Caries prevalence in the primary dentition of young children in Western industrialized countries declined during the late 1970's and early 1980's<sup>1–14</sup>. A number of reports, however, have shown that caries experience in the primary dentition remained stable or even increased slightly in the 1980's and 1990's, following a decrease in several countries<sup>7,8,10–21</sup>. In Japan, several studies performed from the 1970's to the early 2000's showed that the caries experience in the primary dentition decreased markedly up to the early 1980's, remained fairly stable thereafter, and then began to decrease again in the 1990's<sup>22–26</sup>.

Since 1972, we have been conducted clinical dental examinations annually at 13 nursery schools

in the north district in Sendai. In order to avoid enrolling the same child twice, the results of annual examinations were analyzed every 5 years.

We reported marked reduction of caries prevalence in nursery school children during the 1970's which did not continue through the 1980's or the beginning of the 1990's<sup>27,28</sup>. The aim of the present study was to analyze the results of the surveys on caries experience of nursery school children in Sendai in 1997 and 2002, and to clarify the time trends in caries prevalence in the primary dentition of them over a 30-year period from 1972 to 2002.

## Materials and Methods

The ages of 1 year and 6 year were excluded from this study, because the number was not sufficient as subjects. All children aged 2–5 have been selected as subjects (Table 1). Calibrated dentists registered

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caries clinically but clinical dental examination was carried out by one dentist in each annual year. The same examination methods and diagnostic criteria for dental caries, and the same record form have been used in each studies from 1972 to 2002. Visual

dental examinations were carried out under natural daylight with young children for a supine position and older children for standing position. Dental caries were examined for all surfaces of each primary tooth by using a plane dental mirror and

Table 1 Number of subjects, caries prevalence and caries treatment rates for carious teeth by age in 1997 and 2002

	1997				2002			
	Age 2	3	4	5	Age 2	3	4	5
Number of subjects	108	159	198	189	142	165	198	195
Caries prevalence								
Percentage with caries (%)	34.3	62.3	76.8	84.7	24.6	44.8	59.6	62.1
Mean deft	1.34	2.75	4.48	6.41	0.77	2.25	3.38	3.73
Mean defs	2.02	4.55	7.20	11.62	0.92	3.25	5.56	5.99
Mean f-teeth	0.01	0.31	1.09	1.98	0.01	0.27	0.84	1.38
Caries treatment rates (%)	0.7	11.2	24.4	31.0	0.9	11.9	24.8	37.0

$$\left( \text{Caries treatment rates} = \frac{\text{number of f-teeth}}{\text{number of def-teeth}} \times 100 \right)$$

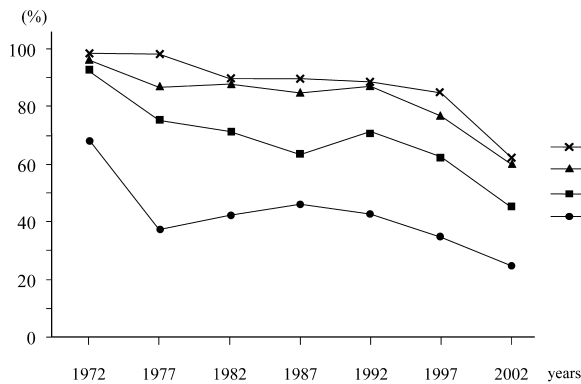


Fig. 1 Percentage of nursery school children with caries in Sendai

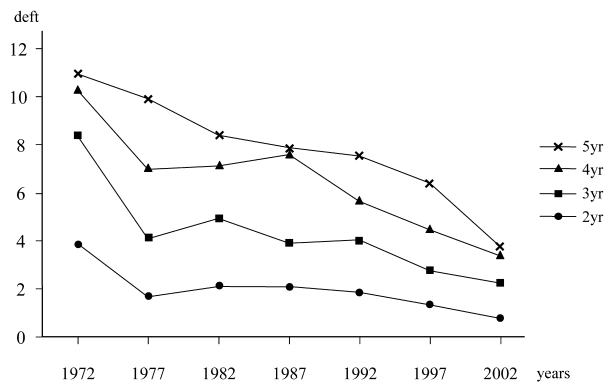


Fig. 2 Mean deft values per child in Sendai

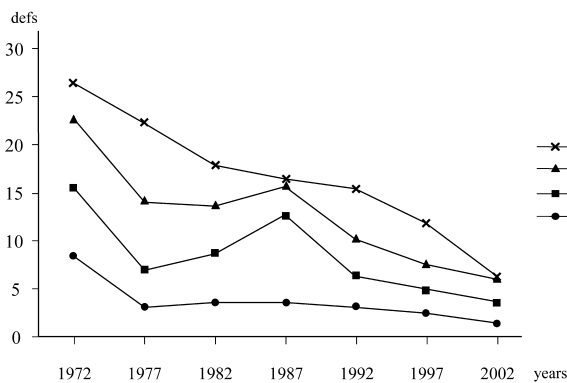


Fig. 3 Mean defs values per child in Sendai

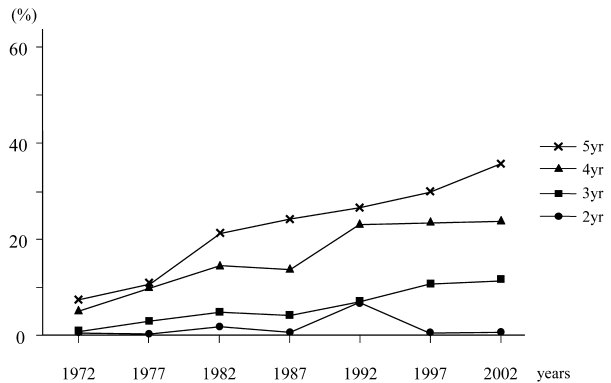


Fig. 4 Caries treatment rates for carious teeth

an explorer. The severity of caries was assessed based on cavitation levels, disregarding white or discolored spots and fissures. Furthermore, the state of caries treatment was evaluated.

For each group in age from 2 to 5-year-old, the following parameters were calculated to ascertain time trends in caries experience, the percentage of subjects with caries, the mean deft and defs values per subject, the mean filled-tooth value per subject, the rate of caries treated teeth, and the percentage of def teeth for each tooth type. Data obtained from all seven surveys were compared in each group.

**Results**

Figure 1 showed the time trends in caries experience in the primary dentition in terms of the percentage of subjects with caries. From 1972 to 1977, the percentage decreased in the 2, 3 and 4-year-old, and the degree of decrease was greater for younger subjects: approximately 30% for the 2-year-old, approximately 17% for the 3-year-old, and approximately 10% for the 4-year-old<sup>28)</sup>. During the 1980's,

the percentage of subjects with caries remained fairly stable, but it decreased again in 1997 for all groups<sup>28)</sup>. This trend continued to 2002 most in a linear fashion. However, in the 5-year-old, the percentage of subjects with caries remained high at 98% during the 1970's, and although there was a decrease of approximately 8% in 1982<sup>28)</sup>, it kept high level and reached a plateau at 84% up to 1997. However, in 2002, there was a decrease of about 35% lowering the percentage of subjects with caries to 62.1% (Table 1).

Table 1, Figures 2 and 3 showed the time trends in caries experience in the primary dentition in terms of the mean deft and defs values per subject. In all groups, the mean deft and defs values per subject decreased markedly during the 1970's<sup>27)</sup>. The mean deft value per subject and the mean defs value per subject then remained stable for about 15 and 10 years, respectively, and both values markedly decreased during the 1990's and in 2002. Over the 30-year period, the mean deft value for the 4-year-old decreased from 10.3 to 3.4 and those for the 5-year-old from 10.9 to 3.7, indicating that the

Table 2 Percentage of deft of each tooth type in primary teeth in 1997 and 2002

Age (yr)	Teeth type	1997		2002		Teeth type	1997		2002	
		%	S.E.	%	S.E.		%	S.E.	%	S.E.
2	51 & 61	19.9 ± 2.7	19.0 ± 2.3	71 & 81	0 ± 0	0 ± 0				
3		26.4 ± 2.5	27.3 ± 2.5		0.3 ± 0.3	1.2 ± 0.6				
4		35.0 ± 2.4	34.1 ± 2.4		0.5 ± 0.4	2.8 ± 0.8				
5		47.7 ± 2.6	33.4 ± 2.4		8.0 ± 1.5	3.2 ± 1.0				
2	52 & 62	7.4 ± 1.8	7.0 ± 1.5	72 & 82	1.4 ± 0.8	0 ± 0				
3		12.9 ± 1.9	12.4 ± 1.8		0.6 ± 0.4	0.6 ± 0.4				
4		14.5 ± 1.8	14.9 ± 1.8		1.5 ± 0.6	2.8 ± 0.8				
5		24.6 ± 2.2	14.0 ± 1.8		5.1 ± 1.2	2.7 ± 0.8				
2	53 & 63	5.6 ± 1.6	1.8 ± 0.8	73 & 83	0.5 ± 0.5	0 ± 0				
3		6.9 ± 1.4	8.2 ± 1.5		2.6 ± 0.9	1.9 ± 0.8				
4		11.4 ± 1.6	8.8 ± 1.4		3.1 ± 0.9	4.4 ± 1.0				
5		15.6 ± 1.9	8.5 ± 1.4		11.6 ± 1.7	6.5 ± 1.3				
2	54 & 64	3.2 ± 1.2	1.8 ± 0.8	74 & 84	11.2 ± 2.2	5.3 ± 1.3				
3		6.0 ± 1.3	7.9 ± 1.5		19.5 ± 2.2	13.9 ± 1.9				
4		15.4 ± 1.8	12.9 ± 1.6		37.1 ± 2.4	26.5 ± 2.2				
5		31.5 ± 2.4	17.7 ± 1.9		48.8 ± 2.6	32.3 ± 2.4				
2	55 & 65	7.6 ± 2.4	1.4 ± 1.0	75 & 85	20.8 ± 3.3	5.1 ± 2.6				
3		25.7 ± 2.5	15.9 ± 2.0		38.7 ± 2.8	23.6 ± 2.3				
4		47.8 ± 2.5	26.0 ± 2.2		57.1 ± 2.5	35.9 ± 2.4				
5		62.6 ± 2.5	30.3 ± 2.3		68.2 ± 2.4	39.7 ± 2.5				

S.E.: Sampling error

number of carious teeth decreased by approximately seven teeth. Also, the mean defs value for the 4-year-old decreased remarkably from 22.7 to 5.6 and those for the 5-year-old from 26.4 to 6.0, and resulting that, the number of carious tooth surfaces

decreased by about 20. For the 3-year-old, the average decrease in carious teeth and tooth surfaces was 6 and 12, respectively, and in the 2-year-old, the respective values were 3 and 7.

Table 1 and Figure 4 showed the time trends in the state of caries treatment. The mean f-teeth value per subject began to decrease after 1992 in most age groups, and in 2002, an average of one tooth was treated in the 4 and 5-year-old. Over the 30-year period, the rate of caries treatment in 3 to 5-year-old increased slightly, and over the 10-year period since 1992, there was a slight increase of about 4% in the 3-year-old and about 9% in the 5-year-old. In 2002, only about one fourth of all carious teeth were treated in the 3-year-old and only about one third of all carious teeth were treated in the 5-year-old.

Table 2 and Figures 5 to 9 showed the time trends in the percentage of def teeth of each tooth type. The time trends were unique for the maxillary central incisors and maxillary and mandibular first

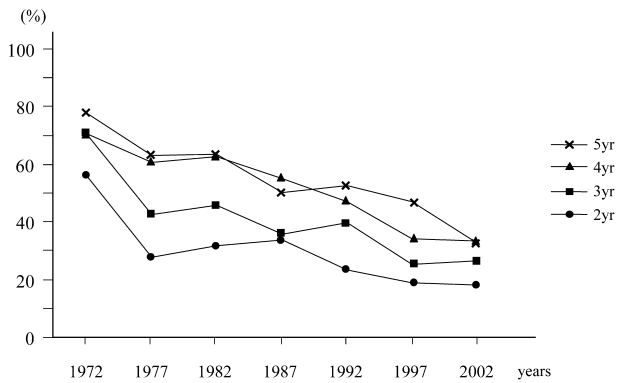


Fig. 5 Percentage of deft on primary maxillary central incisors (51 & 61)

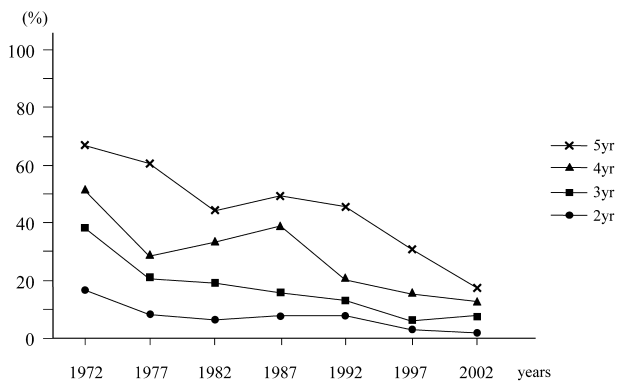


Fig. 6 Percentage of deft on primary maxillary first molars (54 & 64)

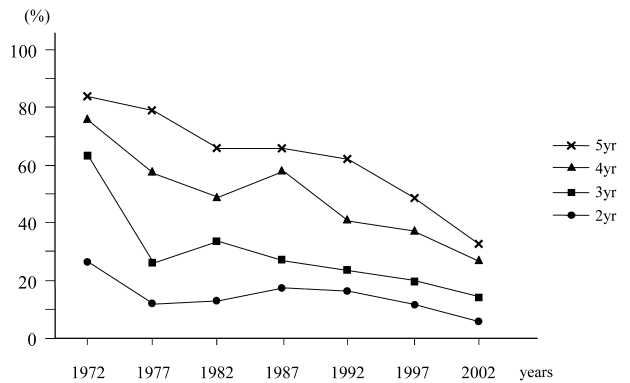


Fig. 7 Percentage of deft on primary mandibular first molars (74 & 84)

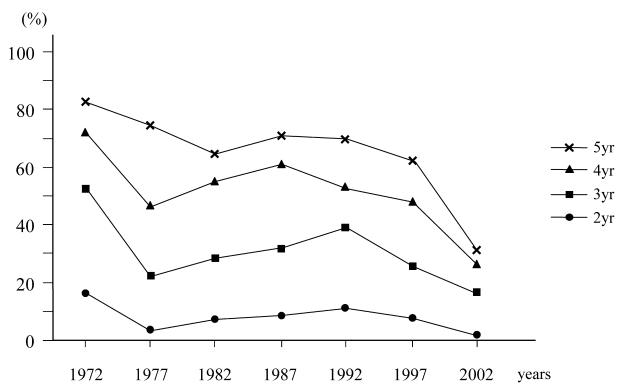


Fig. 8 Percentage of deft on primary maxillary second molars (55 & 65)

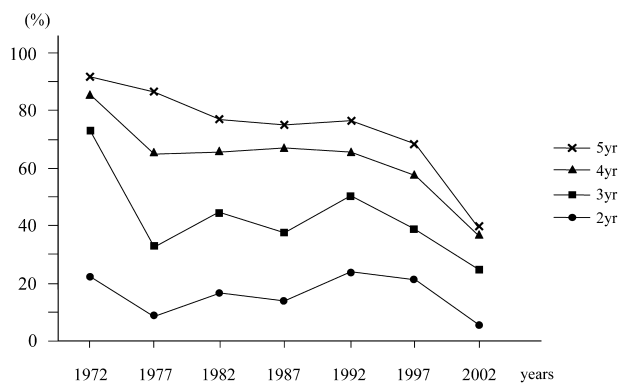


Fig. 9 Percentage of deft on primary mandibular second molars (75 & 85)

and second molars.

The percentage of deft in the primary maxillary central incisors markedly decreased from 1972 to 1977 in all groups, and after 1977, there were differences among the groups. For the 2 and 3-year-old, the percentage of deft did not markedly decrease before 1992, and although it decreased in 1997, there was no further decrease in 2002. In the 4-year-old, the percentage of deft did not decrease before 1982, but it continued to decrease in a linear fashion up to 1997. However this decline was ceased to 2002, as observed in the case with the 2 and 3-year-old. In the 5-year-old, the percentage of deft decreased up to 2002, except in 1982 and 1992 (Fig. 5).

As to the percentage of deft in the primary maxillary lateral incisors, the time trends for the 2 and 3-year-old were similar to those in the primary central incisors, but the time trends for the 4 and 5-year-old were different. For the 4-year-old, the percentage decreased except in 1987, but there was no further decrease in 2002.

As to the percentage of deft in the primary maxillary canines, the time trends for the 2 and 3-year-old were similar to those for the maxillary incisors. However, the percentage in the 2-year-old decreased in 2002, but this tendency was not observed in the 3-year-old. In the 4-year-old, the percentage decreased in all years except in 1987, and the decrease was not marked in 2002. In the 5-year-old, the percentage decreased every year except in 1977 and 1992, and it continued to decline in 2002.

As to the percentage of deft in the primary mandibular anterior teeth including canines, the time trends were mostly comparable. For the 2 to 4-year-old, the percentage markedly decreased in 1977 and it slightly fluctuated but gradually decreased in 2002. In the 5-year-old, the percentage gradually decreased over the 30-year period.

As to the percentage of deft in the primary first molars, the time trend for the maxillary and mandibular teeth of the 2 to 4-year-old were very similar up to 1997. After a marked decrease in 1977, there was either a slight decrease or increase in some groups in age, but there was no change in other groups. As to the primary maxillary first molars, the percentage gradually decreased for the 2 and 3-year-old, but there appeared to be no further decrease in 2002. As to the primary mandibular first molars, the percentage had continued to decrease up to 2002 in 2 to 4-year-old. Furthermore, in the

5-year-old, the percentage of deft for the primary maxillary and mandibular first molars continued to decrease after 1972, except in 1987 and 1992, and there was a marked decrease from 1997 to 2002 (Figs. 6 and 7).

As to the percentage of deft in the primary maxillary and mandibular second molars, for the 2 to 4-year-old, there was a marked decrease in 1977, and there was a slight increase or a stable condition up to 1992, but there was a marked decrease in 1997 and 2002. In the 5-year-old, there was a gradual decrease except in 1987 and 1992, and there was a marked decrease in 2002 (Figs. 8 and 9).

## Discussion

According to previous reports from industrialized countries, there is some evidence that the continuous decline in caries experience among young children has leveled off or even slightly increased<sup>7,8,10-21</sup>.

In our country, caries experience in the primary dentition markedly decreased from 1975 to 1981, but it showed no significant change in 1987 by the national dental disease survey reports published by the Ministry of Health and Welfare of Japan. However, there were further decreases in 1993 and 1999, and there has been a linear decrease after 1987<sup>22</sup>. Despite these two marked decreases, the caries experience among young children remains high in Japan and in the beginning of the 2000's, the average number of carious teeth in 3 to 5-year-old in Japan was 2.0 to 2.5 times higher when compared to developed Western countries<sup>20,21</sup>. According to the most of surveys on caries experience in the primary dentition conducted from the 1970's to early 2000's in Japan, the caries experience had markedly decreased by the end of the 1980's, remained stable thereafter, and then decreased again during the 1990's<sup>23,26</sup>.

In the present study, the caries experience in the primary dentition markedly decreased in 1977 and remained stable for about 15 years<sup>27</sup>, but in 1997, it markedly decreased again and continued to decrease in a linear fashion until 2002. Over this last 10-year period, the caries experience in the primary dentition markedly decreased (Figs. 1-3). Hence, the time trends in caries experience in the primary dentition among nursery school children were very similar to the results of the above-mentioned surveys conducted by the Ministry of Health and Welfare in Japan. While it is not clear why the caries experience

in the primary dentition remained stable during the 1980's and then decreased again in the latter half of the 1990's, the reason for the decrease in the 1990's was probably different from that in the 1970's<sup>26</sup>. We believe that the marked decrease of caries experience in the primary dentition during the 1970's would be explained by improvement of parents' awareness and knowledge about children's oral health because of periodic dental examinations provided nursery schools and oral health examinations provided by local governments<sup>27</sup>. Furthermore, an increase in the percentage of children who received topical fluoride application and a decrease in the total annual consumption of sugar per person in Japan might have indirectly lowered the caries experience. Another marked decrease in caries experience in the primary dentition that was observed during the latter half of the 1990's may be due to other new factors such as a rapid increase in the market share of fluoridated toothpastes. Also, children stay in nursery schools for longer periods, and preventive procedures such as fissure sealing, are being carried out more often from 1990's.

Although the time trends in caries experience observed in the present study were similar to those reported by the Ministry of Health and Welfare, there was a slight time lag. In other words, the caries experience in nursery school children in Sendai was 3 to 4 years behind the national trends. For example, the mean number of carious teeth for 5-year-old was 3.7 in 1999, but this figure was reached in 2002 in the present study. This time lag in the caries experience indicated that the percentage of children with carious teeth in Sendai is higher than the average of national studies. The increase of caries experience in the primary dentition continued after World War II, and it decreased during the 1970's and 1990's mostly in large cities. Although similar trends have been seen in provincial cities with some delay, there are still differences between large and small cities.

Also, some recent studies<sup>22,23,25,26</sup> on caries experience in the primary dentition have suggested age-related differences. According to the study conducted from 1975 to 1995, there was a marked decrease in caries experience in children older than 4-year-old, which was not observed in 3-year-old. According to a study conducted from 1996 to 2002, a significant decrease was observed in 4 and 6-year-old, but not in 2, 3 and 5-year-old<sup>29</sup>. In the present study, the caries experience in the primary

dentition remained stable from the 1980's to the early part of the 1990's, but all age groups showed decrease in 1997 and 2002. This result agreed with the above-mentioned studies<sup>22,23,25,26</sup>. In other words, the rate of decrease was the greatest for 5-year-old, followed by 4-year-old, but it became gradual for 2 and 3-year-old (Figs. 2 and 3).

In recent years, the caries experience in the primary dentition has not increased from the age of 3 to 5 years. If the occurrence of caries can be suppressed up to the age of 3 years, this may contribute to reduced caries experience in the primary dentition of 4 and 5-year-old<sup>26</sup>.

The time trends in caries experience in the primary dentition in each age group were further analyzed by ascertaining caries experience in each tooth type. The results showed that, in 2 to 4-year-old, the caries experience for the primary maxillary incisors, canines and first molars appeared to stop decreasing in 2002, but for the 5-year-old the caries experience for the maxillary incisors and canines, and the maxillary and mandibular first and second molars markedly decreased from 1997 to 2002 (Figs. 5–9). However, the percentage of deft in the primary maxillary central incisors of 2 to 4-year-old remained at 20–30%, and although the percentage of deft in the primary mandibular first molars, mandibular and maxillary second molars of 4 and 5-year-old has continued to decrease, it remains fairly high rate of 26–40% (Table 2). In this manner, the caries experience still remains high rate in the primary maxillary incisors and the primary maxillary and mandibular molars. The caries experiences in the primary maxillary incisors and maxillary and mandibular molars in 2002 in the present study were higher than that of the data in 1999 by the Ministry of Health and Welfare in Japan. In some groups, the difference was about 10%. Hence, the results of caries experience for the children in Sendai are high level.

In the future, it will be more necessary to continue to emphasize the importance of oral hygiene as was done during the 1970's namely introduction of superior ways such as mouthwash with fluoride solution and tooth brushing using fluoride tooth paste and preventive treatment such as fissure sealing by dental professionals.

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