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The disparity in caries and sealants between migrant and native children in Shanghai: A cross-sectional study

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Abstract

Objective: To investigate the disparity in dental caries between native and migrant children in Shanghai, China.

Methods: Between 2013 and 2015, a random cluster sample of native and migrant children aged 5, 9, 12 and 15 years was collected from each district in Shanghai. Oral examination was performed following the World Health Organization (WHO) method, and findings were reported as decayed-missing-filled teeth of primary dentition (dmft) and permanent dentition (DMFT).

Results: A total of 10 150 children were examined, and 33.6% of them were migrants. Migrant children had a higher prevalence of deciduous caries than native children (the 5-year-old age group, 67.8% vs 63.0%, $P = 0.024$; the 9-year-old age group, 75.9% vs 66.1%, $P < 0.001$), and higher dmft values were found in migrant children. But with respect to permanent teeth, no statistical differences were found between the two groups in caries prevalence or DMFT. After controlling for potential confounders by logistic regression, migrant children showed a higher risk of deciduous caries (odds ratio 1.42, 95% confidence interval 1.25-1.61, $P < 0.001$) but not of permanent caries. Migrant children exhibited relatively lower deciduous Restorative Care Index (RCI). However, 9- and 15-year-old migrant children had a higher permanent RCI than their native counterparts.

Conclusions: Dental caries prevalence in migrant children was higher in the deciduous teeth but not in the permanent teeth compared to that in their native counterparts. School-based dental public health services may contribute to reducing the disparity in dental health status between migrant and native children.

KEYWORDS

dental caries, dental sealant, migrant children, Restorative Care Index (RCI), school-based preventive programs, Treatment Needs Index (TNI)

1 | INTRODUCTION

The health of internal migrants is the central element of social cohesion in contemporary societies and a priority for reducing health disparity. China, one of the fastest growing entities in the world, launched a reform and opening-up policy in 1978, which drove a large number of people from the rural areas to the cities.[1,2] The migrant population increased from 30 million in the 1980s to 236 million in 2012, nearly one-sixth of the total population of China.[3] It is expected that by 2020, the internal migrant population of China will be 291 million, and 76% of these people will be rural-urban migrants.[4] In 2013 in Shanghai, one of the largest cities in China, 41% of the total 24.15 million residents were migrants.[5]

Oral health is a vital part of children's health, and dental caries remains the most common, yet preventable, childhood disease worldwide.[6,7] The oral health of migrant children has attracted considerable research attention.[8,9] Migrant children often have low socioeconomic status, which generally leads to health disparities between migrant and native children.[10-12] However, preventive dental services may be underused by children from low-income families.[13] Oral health education and services provided to both native and migrant children in schools and kindergartens play an important role in reducing health disparities and improving health equity.[14,15] In addition, Shanghai is the only province in China where school-based oral health education and services have been included by the local government in basic public health services since 2011.[16]

The scale of migration and the local oral health policy in Shanghai provide a unique opportunity to investigate the status and disparity of oral health in internal migrant children. This study presents data on the disparities in caries experience, sealant prevalence, Treatment Needs Index (TNI) and Restorative Care Index (RCI) between migrant and native children of different ages in Shanghai from 2013 to 2015.

2 | STUDY POPULATION AND METHODOLOGY

2.1 | Study population

The present study was designed as a cross-sectional study, and it was based on the data collected through the Annual Dental Health Survey of School and Pre-school Children of Shanghai. A multistage random cluster sampling was performed every year. In brief, one kindergarten, one primary school and one junior high school were selected randomly from each of the 17 districts of Shanghai. Then, 50 children aged 4-5 years were randomly recruited from one kindergarten (they were referred to as the 5-year-old group), 50 children aged 8-9 years were randomly recruited from one primary school (the 9-year-old group), and 50 children aged 11-12 years and 50 children aged 14-15 years were randomly recruited from one junior high school (the 12-year-old group and the 15-year-old group, respectively). Random number tables were applied for randomization. A total of 1700 children were examined for deciduous caries, and 2250 children were examined for permanent caries each year. Basic information on age, sex, living region (urban or suburban) and residence type was recorded. Residence type, also known as *Hukou*, is an official record of household registration in China. In our study, the children with *Shanghai Hukou* status were referred to as "native children," or they were defined as "migrant children."

This study was reviewed and approved by the Independent Ethics Committee of Shanghai Stomatological Hospital (No. 2013013). Written informed consent was obtained from the parents or guardians of all children before participation in the study.

2.2 | Dental examinations

Clinical dental examinations were performed in schools and kindergartens using a 0.5-mm ball-ended Community Periodontal Index probe and a disposable plain dental mirror. We used the basic criteria of the World Health Organization (WHO) oral health survey to diagnose caries.[17] A positive caries diagnosis was made only when both visual and tactile criteria were met simultaneously. Bite-wing X-ray or other X-ray examinations were not performed. WHO coding was used to characterize the caries, and 20 and 28 teeth were used as the basis for calculating decayed-missing-filled teeth of primary dentition (dmft) and permanent dentition (DMFT), respectively. Only deciduous teeth were recorded in the 5-year-old children, whereas permanent teeth were examined in the 12- and 15-year-old age groups. Both deciduous and permanent teeth were recorded in the 9-year-old age group. The indices of oral health, including caries prevalence, sealant prevalence, TNI and RCI, were calculated using the following formulas:

a $\text{Deciduous caries prevalence} = \frac{\text{Number of persons with dmft}>0}{\text{Population size aged 5 or 9}}$,

b $\text{Permanent caries prevalence} = \frac{\text{Number of persons with DMFT}>0}{\text{Population size aged 9, 12 or 15}}$,

c $\text{Sealant prevalence} = \frac{\text{Number of persons with teeth fissure sealants}}{\text{Population size}}$,

d $\text{Deciduous TNI} = \frac{\sum_1^n \text{dt}}{\sum_1^n \text{dmft}}$,

e $\text{Permanent TNI} = \frac{\sum_1^n \text{DT}}{\sum_1^n \text{DMFT}}$,

f $\text{Deciduous RCI} = \frac{\sum_1^n \text{ft}}{\sum_1^n \text{dmft}}$,

g $\text{Permanent RCI} = \frac{\sum_1^n \text{FT}}{\sum_1^n \text{DMFT}}$.

The dental examinations were performed by four calibrated examiners from the Department of Preventive Dentistry at Shanghai Stomatological Hospital. Five per cent of children were re-examined to evaluate the intra-examiner reliability during the annual examinations, and the Kappa was between 0.92 and 0.97.

2.3 | Statistical analyses

The expectation-maximization algorithm was applied to insert missing values of teeth status before analysis. There were no missing data for the dental variables like migrant status, sex, age and year. The caries prevalence, sealant prevalence, TNI and RCI were estimated as described above. A Mann-Whitney *U* test was used to compare the differences in dmft and DMFT values between the different groups. A chi-squared test was used to investigate the differences in the prevalence of caries and sealants, RCI, and TNI between native and migrant children. To control the potential confounding effects, logistic regression was

performed. The deciduous or permanent caries variable was included as a dependent variable in the multivariable logistic regression models, and variables like migrant status, age, sex and examination year were included simultaneously as independent variables. Data imputation and statistical analyses were performed using IBM Statistical Packages for Social Sciences (SPSS) Statistics Version 21 (IBM Corp.). The level of statistical significance was set at 0.05 for all two-sided statistical tests.

3 | RESULTS

3.1 | Demographic characteristics of the study sample

Between 2013 and 2015, 3400 children were recruited and examined annually, with an exception of fifty 12-year-old children who were not recruited in 2013. Among the total 10 150 children, 5072 (50.0%) were males, 6738 (66.4%) were natives and 3412 (33.6%) were migrants. The proportion of migrant children in rural regions was significantly higher than the proportion of migrant children in urban regions. When stratified according to age, there was a significant difference in the proportion of migrant children among the four age groups, and the proportion of migrant children in the 9-year-old age group was the highest. There was no significant difference in the proportion of migrant children between boys and girls (Table 1).

3.2 | Caries status

Between 2013 and 2015, migrant children had a significantly higher prevalence of deciduous caries than native children (67.8% vs 63.0% in the 5-year-old age group; 75.9% vs 66.1% in the 9-year-old age group; Table 2). After controlling for the potential confounding factors, such as age, sex, examination years and living regions by multivariate logistic regression, a higher risk of deciduous caries was still found in migrant children and the odds ratio (OR) was 1.42 (95% confidence interval [CI] 1.25-1.61; Table 3). There was no significant difference in caries prevalence or DMFT in permanent teeth between native and migrant children in the 9-, 12- and 15-year-old age groups during any of these years (Table 2). It seemed that they had a similar risk of permanent caries, and the OR was 1.05 (95% CI 0.95-1.17; Table 3).

TABLE 1 Demographic characteristics of the native and migrant subjects

	Native		Migrant			
	N	%	n	%	*P*	Total
Age (y)					<0.001	
5	1833	71.9	717	28.1		2550
9	1353	53.1	1197	46.9		2550
12	1580	63.2	920	36.8		2500
15	1972	77.3	578	22.7		2550
Sex					0.334	
Boys	3344	65.9	1728	34.1		5072
Girls	3394	66.8	1684	33.2		5078
Year					<0.001	
2013	2312	69.0	1038	31.0		3350
2014	2414	71.0	986	29.0		3400
2015	2012	59.2	1388	40.8		3400
Living region					<0.001	
Urban	3649	76.8	1101	23.2		4750
Rural	3089	57.2	2311	42.8		5400
Total	6738	66.4	3412	33.6		10 150

3.3 | Sealant prevalence

Only the prevalence of sealants on permanent teeth was compared between native and migrant children because there were very few sealants in the 5-year-old children. Between 2013 and 2015, the 9- and 12-year-old migrant children (7.2% and 3.5%, respectively) had significantly lower sealant prevalence than the native children (12.4% and 7.7%, respectively). However, migrants who were 15 years old in 2014 had a slightly higher prevalence of sealants than native children (4.7% vs 3.3%, respectively; Figure 1).

3.4 | TNI and RCI for dental caries

In these three years, the 5- and 9-year-old migrant children had greater TNI of their deciduous teeth (88.2% and 75.3%, respectively) than their native counterparts (84.9% and 73.2%, respectively), but among the 9- and 15-year-old children, the migrants were found to have less restoration needs for permanent teeth. In contrast to TNI, migrant children seemed to have lower deciduous RCI (in the 5-year-old age group, 11.5% vs 14.9%, $P < 0.001$; in the 9-year-old age group, 23.1% vs 25.7%, $P = 0.016$) and higher permanent RCI than native children (Table 4).

4 | DISCUSSION

To our knowledge, this is the first study to compare the status of dental caries between migrant and native children in Shanghai. We found that migrant children had a higher risk of deciduous caries and lower deciduous RCI than native children, but this disparity was reduced in the older age groups, which indicated that the dental health of migrants might have improved.

According to our results, migrant children tended to have more caries in deciduous but not in permanent teeth than their native counterparts. The higher prevalence of deciduous caries and the dmft scores have been verified in several studies and reports from China and other countries.[8,18,19] It is possible that migrant children who moved to Shanghai may have access to more refined food that they would normally not consume, which could result in more chances of consuming sugary snacks and a higher risk of developing dental caries.[20,21] Older children might have spent more

TABLE 2 Caries in native and migrant children among different age groups, 2013-2015

	2013			2014			2015			Total		
Age group	Native	Migrant	*P*	Native	Migrant	*P*	Native	Migrant	*P*	Native	Migrant	*P*
5-y-old												
n	538	312		641	209		654	196		1833	717	
Deciduous caries (%)	61.2%	68.6%	0.030	61.6%	71.3%	0.011	65.9%	62.8%	0.417	63.0%	67.8%	0.024
dmft (SD)	3.25 (3.87)	3.82 (4.36)	0.067	2.83 (3.51)	3.82 (3.75)	<0.001	3.19 (3.72)	2.97 (3.40)	0.601	3.08 (3.07)	3.59 (3.95)	0.002
9-y-old												
n	440	410		526	324		387	463		1353	1197	
Deciduous caries (%)	68.0%	78.1%	0.001	65.6%	75.0%	0.004	64.9%	74.7%	0.002	66.1%	75.9%	<0.001
dmft (SD)	2.47 (2.52)	3.03 (2.62)	0.001	2.11 (2.27)	2.84 (2.53)	<0.001	1.79 (1.92)	2.50 (2.21)	<0.001	2.14 (2.28)	2.77 (2.45)	<0.001
Permanent caries (%)	31.4%	28.8%	0.412	20.5%	22.5%	0.489	22.5%	24.2%	0.558	24.6%	25.3%	0.683
DMFT (SD)	0.58 (1.06)	0.59 (0.90)	0.381	0.32 (0.71)	0.36 (0.78)	0.445	0.32 (0.67)	0.32 (0.64)	0.614	0.40 (0.84)	0.39 (0.78)	0.749
12-y-old												
n	561	239		573	277		446	404		1580	920	
Permanent caries (%)	39.2%	42.7%	0.361	37.3%	36.8%	0.882	37.9%	37.6%	0.936	38.2%	38.7%	0.792
DMFT (SD)	0.95 (1.50)	1.04 (1.69)	0.433	0.72 (1.17)	0.72 (1.21)	0.885	0.65 (0.99)	0.73 (1.20)	0.843	0.78 (1.26)	0.81 (1.35)	0.816
15-y-old												
n	773	77		674	176		525	325		1972	578	
Permanent caries (%)	51.6%	58.4%	0.253	43.5%	47.2%	0.380	45.5%	43.1%	0.486	47.2%	46.4%	0.721
DMFT (SD)	1.48 (2.02)	2.00 (2.58)	0.103	1.07 (1.62)	1.31 (1.85)	0.185	1.04 (1.48)	1.14 (1.68)	0.947	1.22 (1.77)	1.30 (1.89)	0.701

Abbreviation: SD, standard deviation.

TABLE 3 The association of migrant status and dental caries using multivariable logistic regression

Outcome	Factors	OR	Lower 95% CI	Upper 95% CI	*P*
Deciduous caries	Migrant status				
	Native	Reference			
	Migrant	1.42	1.25	1.61	<0.001
	Age groups				
	5-y-old	Reference			
	9-y-old	1.26	1.12	1.42	<0.001
	Sex				
	Boys	Reference			
	Girls	0.96	0.86	10.9	0.542
	Year				
	2013	Reference			
	2014	0.96	0.83	1.11	0.564
	2015	0.98	0.85	1.14	0.832
Permanent caries	Migrant status				
	Native	Reference			
	Migrant	1.05	0.95	1.17	0.368
	Age groups				
	9-y-old	Reference			
	12-y-old	1.91	1.69	2.16	<0.001
	15-y-old	2.75	2.44	3.11	<0.001
	Sex				
	Boys	Reference			
	Girls	1.66	1.51	1.83	<0.001
	Year				
	2013	Reference			
	2014	0.74	0.66	0.83	<0.001
	2015	0.77	0.68	0.87	<0.001

time in school where they could have received more education on dental health. In such a case, their dental health habits might be more like dental health habits of their native classmates than those of their parents. Previous studies have shown that differences in the prevalence of caries between native German and immigrant children decreased with increasing age.[22] One study reported that older immigrant children had better dental status than native children.[23]

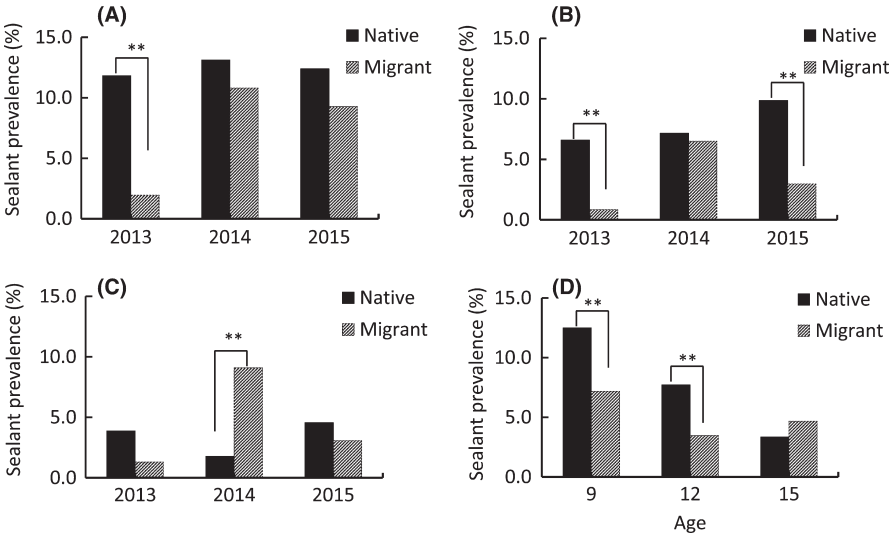

FIGURE 1 Prevalence of sealants in native and migrant children of different age groups, 2013-2015. A, 9-y-old; B, 12-y-old; C, 15-y-old; D, combined. $^{**}P < 0.01$

Pit and fissure sealants are considered to be an effective and safe method to prevent occlusal caries on primary and permanent teeth.[24,25] This method was also proved to be effective in both clinics and schools.[26] The prevalence of sealants can be considered an important indicator of access to preventive dental services. Sealant prevalence in permanent teeth of 12-year-old children in Shanghai was only 0.6% in 2005,[27] and increased sealant prevalence was noted in this study. Moreover, our study indicated that there was a decreasing trend in the difference in sealant prevalence between native and migrant children. Since the 1950s, Shanghai has established the Tertiary Prevention and Control Network of Dental Disease, which provides dental health surveillance, dental health education and promotion, some caries prevention and restoration services for both native and migrant residents of this city.[28] Since 2011, the use of a sealant in permanent teeth has been incorporated in the Shanghai Basic Public Health Service Project.[16] Public health personnel provide cost-free sealants for permanent teeth to both native and migrant children in primary schools. However, because of budget limitations, especially shortage of dental public health personnel, in 2015, only approximately 39 548 children received cost-free sealants (91 091 teeth) including 16 695 migrant children (39 445 teeth) (unpublished data). This number was far less than that needed for school children in Shanghai and much less than that in developed countries.[29-31]

Since 2011, dental filling has also been included in Shanghai school and kindergarten basic public health service.[32] Community dentists have provided cost-free fillings in schools and kindergartens every year, and subsequently, RCI has increased and TNI has decreased among children. In 2005, TNI values in 5-year-old children and 12-year-old children in Shanghai were 92.1% and 63.7%, respectively, which were higher than those in children in 2015. However, deciduous TNI was still unsatisfactory, which indicated that parents may play a key role in improving dental fillings in preschool children. A relatively higher deciduous TNI among migrant children in Shanghai and poorer oral health knowledge and behaviour of migrant parents might contribute to this disparity. Pan et al[33] reported poor dental practices among parents of migrant children in Guangzhou, a large area in the South of China. This situation may also exist in Shanghai.

Our findings indicated a notable reduction in dental service utilization, including sealants and fillings offered for all children in Shanghai over the past 10 years, although inequality still exists. A previous study indicated that migrant children might have less access to dental services because of socioeconomic factors and lack of medical insurance.[34] School-based dental public health services may play an important role in ensuring accessibility of the service and reducing disparity in dental utilization as well as dental status between migrant and native children.

There are several advantages of this study. First, it was one of the few studies focusing on the disparities in dental health status and dental service utilization between migrant and native children from the same school or kindergarten, which might strengthen the comparability between the two groups. Second, this study investigated four age groups, which included deciduous, mixed and permanent dentition stages. Finally, our study was conducted over three consecutive years and this enabled us to reveal the changes in the disparity of dental health between native and migrant children.

TABLE 4 Restorative Care Index (RCI) and Treatment Needs Index (TNI) for dental caries among native and migrant children in different age groups, 2013-2015

Age group	Index	2013			2014			2015			Total		
		Native	Migrant	*P*	Native	Migrant	*P*	Native	Migrant	*P*	Native	Migrant	*P*
5-y-old	Deciduous TNI	82.6%	86.5%	0.004	85.4%	90.5%	<0.001	86.4%	88.3%	0.221	84.9%	88.2%	<0.001
	Deciduous RCI	16.9%	13.1%	0.005	14.5%	9.3%	<0.001	13.5%	11.3%	0.166	14.9%	11.5%	<0.001
9-y-old	Deciduous TNI	73.9%	76.4%	0.161	73.0%	71.5%	0.438	72.5%	77.1%	0.024	73.2%	75.3%	0.062
	Deciduous RCI	24.6%	22.0%	0.144	26.0%	26.4%	0.810	27.2%	21.7%	0.006	25.7%	23.1%	0.016
	Permanent TNI	82.7%	78.7%	0.276	65.1%	51.7%	0.024	61.5%	61.7%	0.964	72.6%	66.5%	0.037
	Permanent RCI	17.3%	20.3%	0.407	33.1%	45.8%	0.031	36.9%	38.3%	0.817	26.5%	32.4%	0.040
12-y-old	Permanent TNI	73.4%	76.3%	0.394	52.7%	55.0%	0.585	46.4%	60.5%	0.001	60.1%	64.3%	0.061
	Permanent RCI	26.2%	23.3%	0.387	47.1%	45.0%	0.625	53.3%	39.5%	0.001	39.6%	35.5%	0.074
15-y-old	Permanent TNI	67.6%	61.7%	0.145	44.3%	46.5%	0.548	45.8%	46.5%	0.832	55.7%	49.6%	0.004
	Permanent RCI	31.7%	38.3%	0.102	55.2%	53.0%	0.570	53.9%	53.0%	0.792	43.8%	50.0%	0.003

Despite the above-mentioned contributions to existing knowledge, the present study had some limitations. First, we defined the migrant status of a child based on the family household registration information, that is, *Hukou*. The *Hukou* status of a migrant family probably changed to *native* after the family members had lived in that city for several years or had fulfilled some other criteria. Thus, there may be some migrants in the native group. However, the proportion of people with changed status was limited as there were about 25 thousand people with changed status on an annual basis, that is, 0.2% of the total native population. Second, as we did not collect information on parents' education, socioeconomic status or time of migration of parents to the city, the role of socioeconomic factors in the disparity of oral health among children could not be explored. Finally, there may be a small number of migrant children in Shanghai who did not attend any school or kindergarten and were excluded from this study.

5 | CONCLUSIONS

This cross-sectional study showed that the deciduous teeth status of migrant children in Shanghai is less favourable than the deciduous teeth status of natives, but their permanent teeth statuses were similar. In the future, effective dental care and preventive programs should be tailored for deciduous teeth of younger migrant children and prospective longitudinal studies should be planned to follow up the changes in oral health status of migrant children.

6 | CLINICAL RELEVANCE

6.1 | Scientific rationale for the study

There are many internal migrant populations in China, and nearly one-third of children in Shanghai are from migrant families. The disparity in dental health between migrant and native children has not been previously studied.

6.2 | Principal findings

Compared to native children, migrants had a higher risk of deciduous caries and lower deciduous RCI. But the prevalence of permanent caries was similar in the two groups of children; even migrant children were found to have higher permanent RCI.

6.3 | Practical implications

School-based dental public health services may contribute to reducing the disparity in dental health between migrant and native children.

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CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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