Effects of Parental Migration and the Caregiver's Response to Health Advice on Oral Health of 6-to-8 Years Old Rural Children: A Cross-Sectional with Short Follow-up Study

Sichen Liu

A Thesis Submitted in Fulfilment of the Requirements for the Degree of

Doctor of Philosophy in Oral Health Science

Prince of Songkla University

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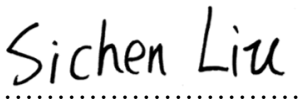
Major Advisor



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ABSTRACT

Background

International and internal parental migration have been steadily increased with urbanization and globalization. Children with parental migration are called "left-behind children (LBC)". Parental migration has been shown to have a negative effect on the children's health and oral health. No studies have explored the complex association between parental migration and dental caries in children and examined the responses to professional advice on oral health care between caregivers of left-behind children (LBC) and non-left-behind children (NLBC). Understanding those will help policymakers develop a specific and effective policy and improve the healthcare services for left-behind children.

Objectives

The objectives of this study were 1) to compare the oral health behaviours between the 6-8-year-old children with different parental migration duration; 2) to investigate whether parental migration is associated with dental caries among 6-8-year-old children, and 3) to compare the responses to the dental professional advice of the caregivers of LBC and NLBC.

Methods

There were 2 parts to the study. Part I aims to answer objectives 1 and 2 and was the cross-sectional study. Moreover, Part II was a prospective cohort study for objective 3. This study population was children aged 6-8 years old. The sample size was calculated with a 5% replacement for the non-response total getting at least 466 children. It was conducted in 7 primary schools in three rural counties in Yunnan, China. The multi-level stratified cluster sampling was used to select the samples. The

questionnaires were modified from the 4th National Oral Epidemiological Survey in China. Part I, the caregivers of all children were interviewed using structural questionnaire on demo-socioeconomic characteristics, children's oral health behaviours, and oral health care utilization. An oral health examination based on the criteria of the WHO oral health survey was conducted on children. The advice was given to caregivers after an oral health examination. After 2-3 months, the questionnaire regarding response to advice for self-care and professional care and the reasons were collected from the caregivers.

The weighted descriptive statistics were used to estimate a representative oral health situation among the targeted population accounting for the cluster of the studied samples. A Chi-square test for survey data was used to compare the difference in outcome variables among parental migration durations. A Chi-squared test for trend in proportions for weighted proportions was performed to test a linear trend between dental caries and parental migration durations. The effect of parental migration on dental caries in children was analysed by Structural Equation Modelling (SEM) to investigate the complex relationships between the exposures and outcomes as well as their mediators and confounders.

Results

Data were collected from 500 Chinese children aged 6-8-year-old with their caregivers. There were 191 children without parental migration (38.2%), 50 children with parental migration of less than 6 months (10%), 87 children with parental migration of 6 to 12 months (17.4%), and 172 children with parental migration of more than 12 months (34.4%). Primary caregivers of children with parental migration were more likely to be mothers or non-parents, had older ages, had lower than elementary school, and had no jobs. This study found a high prevalence and number of total caries (91.6% and 7.53 ± 4.27, respectively). The univariable analysis showed no significant differences in frequency of toothbrushing, fluoride toothpaste, dental attendance, and the number of dental caries ($p > 0.05$) but significant difference in the frequency of snacking consumption between different parental migration durations ($p < 0.02$). In addition, there was a statistically significant linear increase in caries prevalence in the primary teeth (dft) and total caries (DMFT + dft) with increased parental migration

durations ($p < 0.05$).

The SEM showed that after controlling for the socioeconomic status of the caregiver, there was an association between parental migration and dental caries in number of permanent teeth in the children through snack consumption. Longer parental migration duration and non-parental or single parent caregivers increased the snack frequency of the children, and consequently increased the risk of dental caries in number of permanent teeth.

In part II, 389 children with their caregivers participated. It consisted of 183 NLBC (47%) with No or < 6 months of parental migration and 206 LBC (53.0%) with ≥ 6 months of parental migration. Significantly, more NLBC's than LBC's caregivers supervised their children for daily oral health behaviours or self-care ($p < 0.04$). About one-third of the caregivers took their children to visit the dentist after getting professional advice. There was no significant difference in response to the advice for professional care between LBC and NLBC's caregivers. The main reason for not bringing children to visit dentists was that caregivers thought that dental disease was not severe and the child had no pain. These reflected no concern about their children's oral health among most caregivers.

Conclusions

This study demonstrated that after controlling for SES, parental migration increases dental caries in number of permanent teeth in children through snacking frequency. Caregivers had good compliance with self-care or supervising children's daily oral health behaviours, but not professional care or bringing children to the dental clinic. There is a need to develop the policy and oral health promotion programs specific to the children and caregivers in parental migration families. More oral health education should provide to all caregivers in the rural families to raise oral health knowledge and awareness. Interdisciplinary cooperation research should conduct in this group to understand the impact of parental migration on children's health, oral health, and well-being.

Keywords: Parental migration, left-behind children, dental caries, oral health behaviours, response to advice.

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Thank you for these days that pursued a Ph.D. It makes me stronger. It is the most meaningful thing to me.

Toast to the time, toast to the experiences, toast to the life.

Sichen Liu

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Chapter 1 Introduction

Globally, there were an estimated 258 million international migrants, and 763 million internal migrants in 2019 accounted for one in seven of the world's population[1]. The majority of them were labour migrants who originated from low-income or middle- income countries and relocated to search for employment opportunities either internationally or internally within a country e.g., from rural to urban settings[2]. As the result of parental migration, children were often left behind in the care of other family members or caregivers. These children are often called "left-behind children (LBC)"[3] .

Statistics of China's census indicated a fast growth in the number of LBC, which was increased from 8.05% (30.09 million) in 2000 to 25% (68.87 million) in 2015[4]. In the Philippines, about 27% of children (approximately 9 million) have at least one parent living abroad[5], while in Kyrgyzstan this percentage is at least 10% (259,000 children)[6]. This rapid increase in LBC has been an important public health concern.

Many problems among these LBCs have been raised, for example, depression[7], malnutrition[8], high dropout rates[9], and weak social relationships[10]. However, health, as well as oral health of LBC, has been largely overlooked in research and public policy.

Oral health ultimately supports and reflects the health of the entire body[11]. The systematic review in 2018 on the impacts of parental migration on the health of LBC found that there are increased risks of depression, anxiety, suicidal ideation, conduct disorder, substance use, wasting and stunting among LBC when compared to non-left-behind children (NLBC)[3]. Even though there are several studies on the impact of parental migration on children's oral health, some aspects such as the factors associated with oral health problems among LBC are still unclear[12, 13]. For example, in China, although there were consistent evidences showing that oral health problems of LBC were more than NLBC[14-16], there are still controversy on whether the left behind condition is the direct risk factor of those oral health problems. For example, the study by Qiu suggested that parental migration is the risk factor of caries

among 12-year-old LBC[12], but other studies suggested that the risk factor were poor eating habits[17], or low access to dental service[18].

To date, it is still unclear on whether parental migration especially the duration of parental migration is associated oral health problems of the child. Furthermore, there is no study examining the difference in the responses to the professional advice on oral health care between caregivers of LBC and NLBC. Understanding those will help the policymakers to make a specific and effective policy for LBC and to improve the primacy healthcare service.

Therefore, this study compared the oral health status of children with different durations of parental migration in the rural areas of China, and explored more on the effect of parental migration duration, as well as other related factors on the oral health problems of the children ages 7 years. Furthermore, we examined how the caregivers of both NLBC and LBC respond to the dental professional advice on the oral health of their children.

Chapter 2 Literature review

The literature review of the related topics are as follows.

1. Overview and definition of LBC
2. Situation of LBC
   2.1 Situation of LBC in international immigrant families
   2.2 Situation of LBC in domestic immigrant families
3. The problems of LBC
   3.1 Mental health and family relationship
   3.2 Physical health and well-being
   3.3 Education and school
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   3.5 Oral health
4. Factors affecting oral health
   4.1 Intra-oral level
   4.2 Child level
   4.3 Family level
   4.4 Community level

1. Overview and definition of left-behind children

With the progress of industrialization, urbanization, and the development of market economy, some people have to leave their hometowns to work in other areas to improve the economic situations of their families[19]. Most of these people have to leave their children in the countryside and entrust them to the care of others. These children eventually are called “left-behind children (LBC)”. LBC are children who do not live with their migration parents. There are 2 types of parental migration, international and internal or domestic migration.

In the international immigrant families, LBC are children who do not live with their transnational migration parents. While for domestic immigrant families, LBC refer to children who live in their original domicile but do not live together with their parents, as either one parent or both parents have migrated[9].

Several definitions are given for LBC. Some definitions indicate the age of the child. For example, the common used definition of LBC in China by the National Statistics Bureau of China (NSBC) states that “children under the age of 18 whose parents have been working outside the home”[20]. The second definition is "both parents are migrant workers, or one parent is a migrant worker and the other parent lacks child supervision ability, and the child is under the age of 16”[21]. Moreover, there is a more specific definition of LBC by previous studies which is “children under the age of 18 whose parents have been working outside the home for more than six consecutive months[22, 23]”. This study applied this definition.

2. Situation of left-behind children

Over the past few decades, both international and domestic migrations have increased dramatically. The examples for international migrant countries were Mexican, Sri Lanka, and the Philippines. Domestic migration is highly prevalence in Asia including China. Both international and domestic migration result in children who are left behind.

2.1 Situation of LBC from international immigrant families

In 2017, Asia and Europe were the regions for the largest numbers of international migrants - 106 million and 61 million, respectively, followed by Latin America 38 million migrants[24]. Since most of LBC come from low-/middle income countries, we will elaborate on the situation of LBC in Asia and Mexico in this part.

Mexico is one of the countries where largest numbers of persons born in the country live outside its borders. The number of Mexican-born persons residing abroad was 13 million in 2017[24]. The 2005 survey of Mexican immigrants throughout the United States showed that 18% of Mexican immigrants left at least one child ages 0 to 18 years old in their home country[25]. Another study in 2016, found that of all Mexican immigrants in the United States, 38% of men and 15% of women had a son or daughter living in Mexico[26]. Furthermore, about 11.3 million of these Mexican immigrants in the United States were undocumented[27], this possibly increased the number of LBC in Mexico. In sum, in Mexico, the number of LBC is gradual growth and mostly are international migration to the United State of America.

Sri Lanka and the Philippines are the most prominent countries of international labour migration in Asia, due to the long history of migrant workers[28]. Total estimated international labour migrations from Sri Lanka in 2008 was 1.8 million, of which 65% were women[29]. Nearly 80% of female migrants are married, of which 85% had children, thereby resulting in high prevalence of LBC in Sri Lanka. These LBC in Sri Lanka had either father or grandmother as the main substitute care[30].

In 2005, more than 8 million (10%) out of the 85 million Filipinos were working or living abroad in the Philippines[31], while over 72% of total migrants from the Philippines were women workers[32]. Since of that, a more pressing concern is with regards to LBC. Though there is no systematic data on the number of children left behind, it was estimated in 2005 to be 9 million or 27% of the total youth[5]. Undoubtedly, the number of LBC has increased in recent years

2.2 Situation of LBC from domestic immigrant families

In 2016, United Nations Department of Economic and Social Affairs (UNDESA) reported that globally the number of domestic migrants was more than three times of the number of international migrants (763 million vs. 244 million)[33]. Internal migration is much more prevalent than international migration, especially in Asia.

Based on the changing of social context, there is the trend of fast growth of LBC due to domestic migration, especially in some countries in Asia such as the Philippines[34], Thailand[35] and China[9].

Domestic migrants in the Philippines constitutes a significant number of LBC. Approximately 2.9 million Filipinos changed residence between 2005 and 2010[34]. About 50% were long distance movers (changed province) and 45.4% were short distance movers (changed city). Both the long distance and short distance movers were correspondingly increased the number of LBC.

Rural-to-urban migration is also prevalent in Thailand. It has been influenced mainly by disparities in both economic and social status among urban and rural areas[35]. Most LBC in Thailand lives with their grandparents. When some of the family members have to work in the industrialized or urban areas, they left their children behind with their grandparents in the rural areas[36].

A substantial proportion of Thai children stayed behind when one or both of their parents moved (≥3 million children or 24%)[35]. Most of them were located in the North and North-eastern regions[37, 38]. In 2012, about three-fourths of fathers and about 60% of mothers have experienced being away from the child for at least a two-month period since the child was born[37]. The Multiple Cluster Indicator Survey in 2014 found that 23% and 31% of children respectively lived with neither father or mother[38].

In China, the situation of LBC has got attention of the policymakers, mass media, and researchers. National Bureau of Statistics of China conducted an census population survey[9]. Results indicated that the number of LBC was 68.77 million, accounted for 25% of total children. About 59% of them or 40.5 million lived in rural

areas. Or another way 29.4% of all rural children were LBC which meant 3 out of 10 children in rural areas were LBC. Of all rural LBC, 20.4% lived with father, 30.6% lived with mother, 26.3% lived with their grandparents, and 12.5% lived with other adults[9]. Moreover, 10.3% of rural LBC in China lived alone or with other children[9].

In Yunnan, a low-middle income province located in southwestern China, had 1.1 million LBC in 2018, with an annual increase of 8%[39]. Most LBC is preschool and school-age, such as 32% of the younger than 6-years-old, 53% of them was 7-12-years-old[40].

3. The problems of left-behind children

LBC have many problems which can affect their well-beings. The problems of this group of children are getting attentions from many sectors since the volume of situation is increasing. The example of problems among LBC included mental health and family relationship, physical health and well-being, education, health service utilization and oral health.

3.1 Mental health and family relationship

The most serious problem of LBC was the worsening of mental health, and it is also one of the most concerned issues for policymakers, scholars and the media. Studies on LBC of both international[41-43] and internal immigrants[44, 45] showed that LBC had worse psychology health than NLBC, including suicide attempts[46, 47], self-injury[48], depression[49], personality deviation[50], lacked of a sense of security and too afraid or anxious to interact with other people[51].

Different factors affect the mental health of LBC. Those factors are age, gender, and ethnic of LBC, and the pattern of parental migration.

Wang and others reported that LBC in the middle school had higher personality deviation rates than those in the elementary school[52]. Differently, the meta-analysis by Wu and others' stated that there was no significant difference in the mental health status of LBC between primary and junior high schools[53]. For the gender of LBC, the report by Wu and others' stated that female LBC had significantly poorer mental health status than male LBC[53]. Similarly, the review by Wang and others found

that male LBC had higher neuroticism scores but lower psychoticism score than female LBC[52].

The study by Dong and others conducted in Yunnan found that the LBC of ethnic minorities had significantly lower family support and lower psychological flexibility than the LBC of Han[54]. A systematic literature review (2020) reported that about LBC had higher levels of depression and loneliness than children who do not live in transnational families[55], which is consistent with Wu and others' study[53].

Some studies also focused on the mental health of the main caregivers of LBC. A cross-sectional survey research was conducted among 400 grandmothers, aged 50-79 years, describing the self-perceived burden of LBC[56]. It showed many primary caregivers considered childcare responsibility to be burdened and affected their normal lifestyles. In addition, many studies indicated that the experience of immigration of the family member had an adverse effect on their family relationships[57, 58].

3.2 Physical health and well-being

Nutritional status and growth are the two most problems in preschool-aged LBC under 7 years old. It was shown that non-parent caregivers of poor nutritional status and retarded growth of LBC had relatively poor nutrition knowledge[59, 60], which was consistent with the study in Thailand[61]. To improve the nutritional status of these LBC, providing health allowance assistance to left-behind families were proved to be helpful[62].

Growth retardation is closely related to nutritional status. Xu and others found that parental migration could lead to growth retardation of Chinese LBC[63], which is consistent with the study in Sri Lanka[64]. Lu and others reported gender of the parent, but not left-behind status was associated with stunting[65]. Children who were cared primarily by their fathers had higher stunting compared to those were cared by their mothers. In addition, the study in the Philippines and Vietnam suggested that parental migration was not a risk factor of stunting for left-behind children, whereas having a caregiver with low educational attainment was a major risk factor for stunting

of the children[66].

Physical well-being was also significantly lower among school-aged LBC than NLBC. Those LBC were more likely to have unhealthy diets, low levels of physical activity, and unhealthy habits, e.g., smoking and drinking alcohol[67]. These habits had contributed to the higher risks of stunted growth and unhealthy body weights. Another study in rural Mexico, in 2014 included 239 children aged between 9 to 12 years founds that LBC spent less time on physical activity, especially recreation activities, compared to NLBC[25]. Besides that, Huang and others found that the incidence of accidental injuries among rural primary school-aged LBC was higher than that of peer NLBC[68], which is consistent with the results of Yan[69].

3.3 Education

Many studies report that LBC had poorer education outcome than NLBC[70, 71]. In 2007, a study was conducted among 141 members of Mexican transnational families, found that 41% of LBC ages ≥14 years old dropped out of school[72], which is supported by another study in Mexico in 2001[73] and China in 2017[74]. Generally, these children had poor educational performances and are less likely to complete compulsory education[75, 76].

3.4 Health service utilization

A cross-sectional survey on utilization of health services of 255 LBC was conducted in 3 regions of China which composed of 106 LBC in Yunnan province, 89 LBC in Shanxi province, and 60 LBC in Shanxi province[77]. It was found that the reasons for selecting healthcare service among LBC were medical technology (57.65%), the hospital-to-home distance (21.97%), the cost (14.12%), and the attitude of the staff (6.28%). Regarding the section of the hospital level, the proportions of LBC who chose the hospitals at the village-level, township-level, country-level, and city-level were 50.98%, 29.80%, 12.94%, and 6.27% respectively. One of the reasons why most of LBC chose the village-level hospital was that the reimbursement of medical expenses of the village-level hospitals is higher than other level hospitals. Another reason was

the distance from home to the hospital.

In addition, this study found that 85.49% of LBC had healthcare insurance. Among these LBC who had health insurance, half of them would go to the hospital when they were sick. However, only 35% LBC without health insurance would do so. Most of LBC without health insurance (43.24%) would buy medicine to treat themselves.[77]

3.5 Oral health

Oral health is the essential part of the general health and greatly influences quality of life. It is defined as a state of being free from oral and facial pain, oral diseases and disorders that limit an individual's capacity in biting, chewing, smiling, speaking and psychosocial well-being[78].

3.5.1 Dental caries of LBC

Dental caries is a widely prevalent disease worldwide. According to Global Oral Health Data Bank, prevalence of dental caries varied from 49% to 83% across different countries[79]. It affected an estimated 60-90% of schoolchildren and nearly 100% of adults worldwide[80]. The prevalence of dental caries in India[81] and Thailand[82] of 12 years old children were nearly 50%. In China, the prevalence of dental caries of 12 years old children in 2018 was 40%[83].

There is a small number of studies related to oral health among LBC in China. Table 1 showed that the significantly higher prevalence of dental caries among LBC than NLBC[13, 14, 17, 18]. However, there were controversies on the oral health knowledge and behaviours between LBC and NLBC. Some studies found significant differences between LBC and NLBC on oral health knowledge[13, 84, 85], frequency of snacking[13, 18, 85], and frequency of dental visits[17, 85-87]. Conversely, some studies found no significant differences between the 2 groups concerning oral knowledge[87], frequency of snacking[84, 87], and frequency of dental visits[17]. In addition, there is insufficient evidence to prove that parental immigration are risk factors for caries among the children. (Table 1)

Table 2 shows the results of multiple variable analysis on the association

between parental migration controlling for other factors and dental caries among Chinese children. Only one study found that parental migration is a risk factor among children's dental caries. LBC had a 1.62 times higher risk of dental caries than NLBC[12].

3.5.2 Oral health behaviours of LBC

Toothbrushing frequency is related to plaque removal. A survey of 400 preschool-aged comparing LBC and NLBC in Jiangxi, China[13], found that 45.7% of LBC rarely brushed their teeth or brushed less than once a day, compared to 17.7% of NLBC. This result was consistent with other studies, which reported the significant higher frequency of toothbrushing among NLBC than LBC[13, 88].

In term of snacking frequency, the study of 740 LBC and 783 of NLBC in Henan, China, on the correlation between snacking and dental caries of 12-year-old children[17]. The results showed that 76.63% of LBC ate dessert every day compared to 49.89% of NLBC. Moreover, multivariate logistic regression analysis demonstrated that poor eating habit was the risk factor of dental caries in this group.

Table 1 Studies on LBC's oral health in China

NO	Author	Sample size	Location	Findings						
				Prevalence of caries	Oral health behaviours		Oral health knowledge	Fluoride	Visiting dentists	Notes
					Snacking	Toothbrushing				
1	Ni et al., 2016[85]	720	Anhui	-	$P < 0.05$	$P < 0.05$	$P < 0.05$	$P > 0.05$	$P < 0.05$	-
2	Qiu et al., 2018[12]	1085	Luchuan	$P < 0.05$	$P > 0.05$	$P > 0.05$	-	-	-	Parental migration was a significant risk factor for caries development among 8 to 12-year-old school children in rural China.
3	Ji et al., 2015[17]	1523	Henan	$P < 0.05$	-	-	-	-	-	Multivariate logistic regression analysis showed that eating snacks every day was a risk factor for caries in permanent teeth in 12-year-old LBC.
4	Ji et al., 2015[89]	309	Henan	-	$P > 0.05$	$P < 0.05$	-	$P > 0.05$	$P < 0.05$	-
5	Huang et al., 2011[86]	2880	Henan	-	-	$P < 0.05$	$P > 0.05$	$P < 0.05$	$P < 0.05$	-
6	Gan et al., 2017[14]	1664	Guangxi	$P < 0.05$	-	-	-	-	-	Percentage of LBC with filling and fissure sealants in permanent teeth were 10.7% and 4.6% respectively which were lower than those of NLBC, but no significant difference.

7	Li et al., 2010[15]	984	Hubei	P < 0.05	-	-	-	-	-	-
8	Li et al., 2019[16]	472	Guangxi	P < 0.05	-	-	-	-	-	Multivariate analysis results showed that visiting dentist and duration since last dental visit were risk factors for caries suffering in 12-year-old LBC.
9	Liu et al., 2013[18]	840	Zunyi	P < 0.05	-	-	-	-	-	1.Bad eating habits and the time when a child visits a dentist for the first time were risk factors of caries among LBC 2. LBC's caregivers had low oral health awareness and limited access to oral knowledge.
10	Guo et al., 2012[90]	240	Wenzhou	-	P < 0.05	P < 0.05	-	-	-	-
11	Li et al., 2016[91]	519	Zunyi	P < 0.05	-	-	-	-	-	-
12	Dai et al., 2015[13]	800	Jiangxi	P < 0.05	P < 0.05	P < 0.05	P < 0.05	P < 0.05	-	Significant differences in the caries filling between LBC and NLBC.

Note: - indicates that the article does not include this item.

Table 2 Parental migration factors associated with caries (Multiple variable analysis)

Location	ORs for caries status (95% CI)				
	Parental migration	**Snacking**	**Toothbrushing**	**Visiting dentist**	**Duration since last dental visit**
Luchuan[12]	1.62 (1.26, 2.09)	P > 0.05	P > 0.05	-	-
Guangxi[16]	-	-	P > 0.05	4.89 (1.18, 2.21)	7.18 (1.50, 3.35)
Henan[17]	-	2.09 (1.46, 2.97)	-	0.38 (0.26, 0.56)	-
Zunyi[18]	-	4.74 (2.11, 10.67)	0.16 (0.05, 0.74)	-	-

Note: "- indicates that the article does not include odd ratios in this item.

3.5.3 Oral health knowledge and awareness

Among LBC themselves

Oral health knowledge and awareness are the important factors lead to oral health behaviours both toothbrushing and snacking. The study on 1440 12-year-old LBC in a rural area of Henan, China suggested that LBC had significantly less oral health knowledge and awareness than NLBC[86]. In this study, 43.33% of NLBC knew that dental caries was caused by bacteria, while the percentage of LBC was 29.44%[86].

Among LBC' caregivers

The report of the Ministry of Civil Affairs of China in 2018 stated that 96% of China's LBC were in the care of their grandparents[92]. Most grandparents have limited physical strength or inadequate knowledge to take care of these children. Plus, they may have less knowledge than the parents of LBC on the proper oral health care. Moreover, grandparents were thought to be too busy with their everyday works and did not have enough time and energy to supervise the children to brush and control their snacking behaviour[18].

4. Factors affecting oral health

Generally, most researchers address factors within the individual's oral cavity as the important causes of dental caries[93, 94]. However, these factors are related to the individual's behaviours. Furthermore, the contexts and environments around the individuals can influence their behaviours. Fisher-Owens and others in 2007 introduced the multilevel conceptual model of oral health outcomes which consists of 4 levels of factors including intra-oral, child, family, and community levels[95, 96]. Intra-oral is the core of the model, followed by individuals, families, and communities. Additionally, time affects the dynamic development of the entire model. (Figure 1)

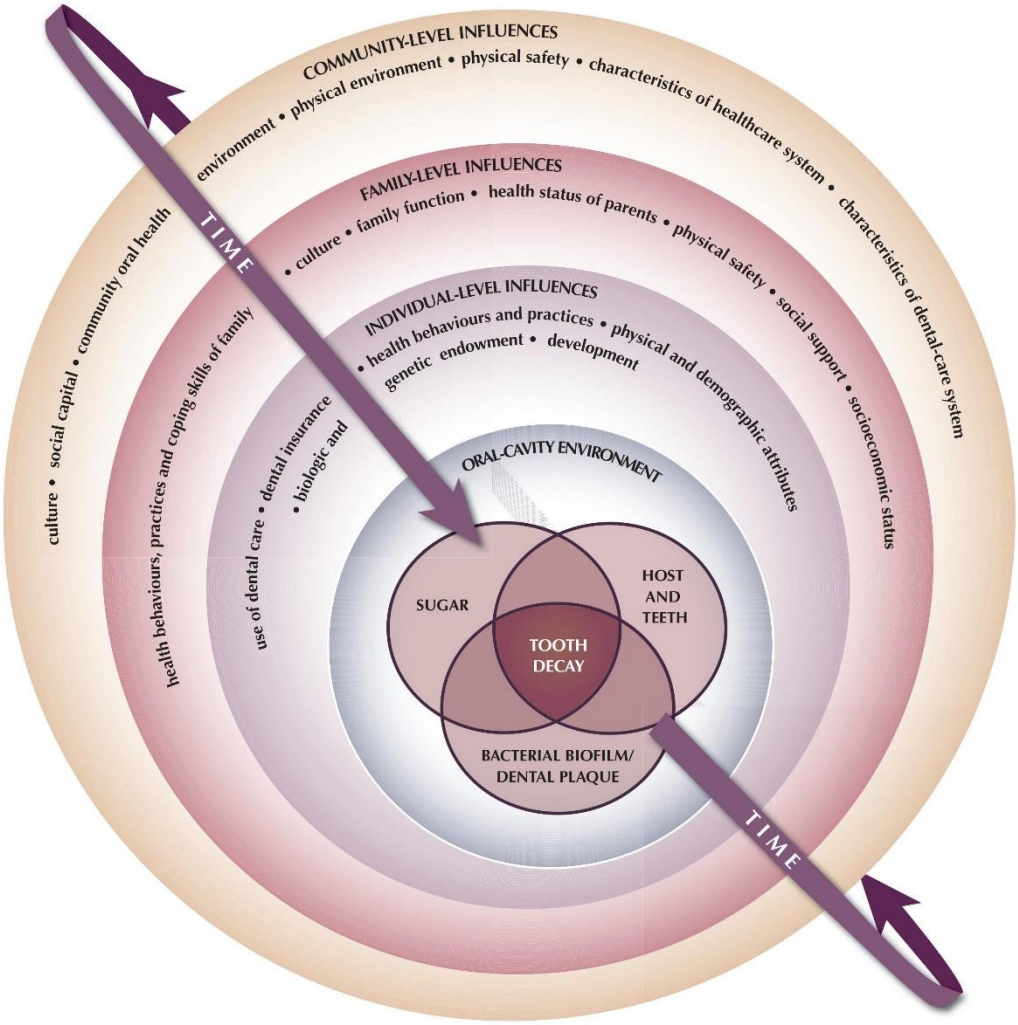

Figure 1 Child, family, and community influences on oral health outcomes of children[96]

4.1 Intra-oral Level

Intra-oral factors are the important causes of dental caries. Four components are required for caries formation: host or teeth, microflora, substrate, and intra-oral environment, and time. Different individuals are susceptible to different degrees of caries development depending on the shape of their teeth (host), plaque level (microflora), exposure to cariogenic foods (substrate), exposure to fluoride, quality, and quantity of saliva (intra-oral environment)[95].

4.2 Child Level

4.2.1 Demographic attributes

Race and ethnicity seem to influence children's oral health both directly and indirectly[97]. Mixed results on the impact of race/ethnicity were found, since it appeared to have socioeconomic and demographic confounding. Age was also associated with oral health. The study found that children's age was strongly positively associated with dental caries, such as in the 1-3-years group (OR = 2.99, 95% CI 1.99-4.50) and the 4-5-years group (OR = 2.08, 95% CI 0.98-4.45)[98].

4.2.2 Utilization of dental service

Obtaining dental health services, particularly those designed to maintain and promote oral health, e.g., fluorides, were associated with good oral health[99].

4.2.3 Oral health behaviours of the child

Healthy sugary foods consumption and twice-daily tooth brushing with fluoridated toothpaste, have shown to be a low-cost clinically effective means of reducing caries for dentate children[100].

4.2.4 Oral health knowledge and awareness of the child

School-aged children's oral health awareness and knowledge would affect their oral health behaviour and influencing dental caries[101]. Oral health education program in school is suggested to be an intervention method to protect children's oral health.

4.3 Family Level

4.3.1 Family composition

A single-parent or reconstituted household increased risk for childhood caries[102]. Parental migration causes family re-composition and may affect children's oral health. The previous study evidenced that parental migration is a risk factor for children's health[3] and children's oral health. Dental caries prevalence was reported to be higher among migrant children[103] and LBC compared with peers[12, 104].

4.3.2 Socioeconomic status (SES)

The family's socioeconomic status, particularly of the parents or caregivers are an important factor affecting the child's health[95]. SES includes household income, caregiver's education, and occupation. Many evidences showed that parents' education and income impact their children's oral health status[83, 95, 105]. Generally, it has been known that low income is an important factor affecting dental caries[83, 95, 105].

4.3.3 Oral health knowledge and awareness of caregivers

Previous studies showed that caregivers' oral health literacy (OHL) was associated with their child's caries experience. The better OHL level of the caregiver was, the lower caries experience of the child[106, 107]. Moreover, the oral health knowledge of the caregiver, who was the grandparent, was also found to influence their grandchildren's oral health significantly[108].

4.3.4 Family environment and coping skills

Family environments enabled and supported healthy choices and lifestyles as well as coping skills of the parents[95]. Effective responses to stress of the parents and the family support seemed to be important, as they could be the buffers against health problems of the individuals in the family[95].

Since the children need care from caregivers. Positive caregiver' responses, such as bringing the child to visit dental care in time and supervising good oral health behaviours of the child can help maintain the good oral health of the child.

4.4 Community level

4.4.1 Oral health service

Having oral health service such as dental clinics in the community would increase the access to the oral care and can bring many benefits for people's oral health[109]. Importantly, participation of the community is essential for oral health promotion because it not only promotes the use of existing local resources but also addresses oral health concerns in the community[110].

4.4.2 Structural Equation Modelling (SEM) study on oral health in China

The four levels of factors in the multilevel conceptual model of oral health outcomes can all interact and affect the oral health. To evaluate these multi-level factors and their inter-relationship, Structural Equation Modelling (SEM) was often used. SEM can illustrate multiple levels of relationships among latent and observed variables[111].

Several studies on oral health in China using SEM had found[112-114]. The studies by Qiu et al.[112] and Qin et al.[113] used SEM to test the association between socioeconomic status (SES), oral health behaviours and number of primary teeth caries (dmft) among children in mainland China.

Qiu and others found that SES directly associated with caregivers' oral health knowledge ($\beta = 0.42$, $p < 0.001$), then affected caregivers' oral health attitudes ($\beta = 0.30$, $p < 0.001$) and children's oral health practices ($\beta = 0.10$, $p < 0.05$). Finally, the better oral health practices of children decreased the number of primary teeth caries ($\beta = -0.18$, $p < 0.001$).[112]

In Qin and others' study, there were 2 pathways for SES and primary teeth caries. First, SES significantly increased the dietary behaviours ($\beta = 0.23$, $p < 0.001$), consequently increased the mean number of primary teeth caries ($\beta = 0.11$, $p < 0.001$). Secondly, SES directly negative associated with mean number of primary teeth caries ($\beta = -0.17$, $p < 0.001$).[113]

Zhang and others study conducted in children aged 5-7-year old in Hongkong and found that mother's SES was associated with children's mean number

of caries in permanent and primary teeth (DMFT + dmft) , through parents' oral health knowledge and attitude and children's oral health behaviours.[114]

Previous studies confirmed the relationship between SES and dental caries through children's oral health behaviours.

5. Health and oral health care systems in China

5.1 Health care system

China's public health system has four tiers: national, provincial, prefecture, and county level. Besides the county hospital, there also are the community health service centres, township hospitals/health centres, and village clinics.[115]

In 2009, the Chinese government implemented a reform. One of the aims is to provide primary care with an unofficial gate-keeping role. Primary health care centres are arranged to be the patient's first contact to the medical care. The primary care physician then may direct the patient to the most appropriate place to seek further care[116]. Therefore, primary health care is the first choice for visiting hospitals among most of rural population.

Between 2008 and 2011, the number of primary healthcare centres increased from 24,260 to 32,860 and the number of village clinics grew from 613,143 to 662,894[117]. However, in the rural areas, the increases of rural primary healthcare centres have been constrained by the limited availability of healthcare staffs. Most patients were more willing to visit primary healthcare centres only when they had trusty and accessible doctors or healthcare staffs[115]. So far, the primary healthcare service in the rural areas of China is still not sufficient.

5.2 Health insurance

The New Cooperative Medical Insurance (NCMS) is one of government insurance programs for rural population. It operates at the county level by the local bureau of health. It covered 98% of the rural population in China in 2012[118]. The program's design and benefit packages are vary geographically[115]. The reimbursement

ratio for rural elderly with NCMS increased by 6.4% across each survey cycle (every three years, from 2005 to 2014). However, it brought an insignificant decrease in the out-of-pocket ratio by 1.4% across each survey cycle[119]. Overall, the benefit of insurance is low and the co-payment is high.

The insurance fund is mainly used for hospitalizations and outpatient expense for the treatment of critical disease. Moreover, given the limited funding, many counties do not cover outpatient services at all[115]. In general, few oral health treatment costs can be reimbursed. Therefore, most of oral health treatment are out-of-pocket costs.

5.3 Oral health policy

In 2017, China stated the goal for 12-year-old children that "The caries rate of 12-year-old children should be controlled within 25%" in the *Healthy China 2030 Plan*[120] and the *China Medium and Long-Term Plan for Prevention and Treatment of Chronic Diseases (2017-2025)*[121]. In 2019, complete oral health service system including structured and developed system of oral health and social support was introduced in order to improve the oral health of the whole people. The *Oral Action Program (2019-2025)*, proposed 4 specific actions which are oral health behaviour popularization action, oral health management optimization, oral health capacity improvement action, and oral health industry development action[122]. It also emphasized, "parents are the first responsible person for the oral health of children". With the reform of oral health policy, the government is advocating the improvement of oral health in China.

5.4 Situation of fluoride in water in China

In China, a nationwide screening of fluoride levels in drinking water in 2008–2009 found that most villages with high fluoride levels (>1.2 mg/l) are located in the Northeast, Northwest and Central China[123]. In southern China, high fluoride water tends to more localize in the areas where had hot spring or coal-firing[124].

A study in 2012 surveyed the fluoride content and distribution pattern in groundwater of eastern Yunnan and western Guizhou, China[125]. The study conducted in Zhaotong city, Yunnan province where is close to our study areas. The results showed that the fluoride content of the fissure water and cold spring water was 0.027 - 0.47 mg/L, and river water was 0.048 - 0.224 mg/L[125]. These fluoride levels were much lower than the safe levels of fluoride in drinking water recommended by the Chinese National Standard of 1.0 mg/L[125].

5.5 Situation of fluoride toothpaste in China

In 2015, the toothpaste market share in China were whitening (28.2%), herb (20.6%), anti-caries (15.2%), fresh breath (10.5%), multifunction (9.6%), anti-sensitivity (8.8%), others (7.1%) [126]. Whereas, in 2020, the top four toothpaste market share were whitening (28.0%), herb (25.0%), anti-sensitivity (10.0%), and others (37.0%)[127]. The China Oral Care Industry Association mentioned that the proportion of herbal toothpaste in the market increased slightly by 2020. The proportions of whitening and anti-sensitivity toothpaste did not change much, and the proportions of others including anti-caries decreased slightly compared with 2015 and 2019[127].

Fluoride is a key element in successful caries prevention[128]. WHO guidance that twice daily toothbrushing with fluoride‑containing toothpaste (1000 to 1500 ppm) should be encouraged[129, 130]. In 2015, the report of the 4th National Oral Health Survey of China, showed that the rate of using fluoride toothpaste among children aged 5 and 12 years olds were 42.2% and 55.0% respectively[131].There were increased trend compared with the 3rd National Oral Health Survey in 2005 (aged 5: 39.0%, aged 12: 46.0%)[132]. However, it still was a low rate of using fluoride toothpaste compared with other countries. For example, the children who using the fluoride toothpaste in US (2019) was 60%[133], and in Sweden (2015) was 80%[134].

6. Gap of knowledge

After the review of literature, the following gap of knowledge can be defined.

A. Few studies on oral health among LBC and effect of parental migration on oral health

Although many studies among LBC were conducted in China, few studies were related to oral health. There is still a substantial research gap with regard to the effect of parental migration and the oral health outcomes. The results of such gaps can contribute to improving the oral health of LBC not only in China, but also in other countries.

B. Unclear the pathway of causation explaining how parental migration affects oral health

Among current studies on LBC's oral health, we cannot get the consistent results of the risk factors of caries in this group. Table 1 (Current studies on LBC's oral health in China) shows few studies have given evidences that parental migration is a risk factor for LBC[12]. Meanwhile, there were controversial results on the significant factors related to oral health behaviours associated with dental caries between LBC and NLBC. In addition, no study used the SEM to investigate the complex relationship between parental migration and oral health of the children. Knowing this relationship can strengthen oral health interventions in this group.

C. No study examining the difference of responses to the professional advice on oral health between caregivers of LBC and NLBC

In this study, we conducted the oral examinations to the children and provide the professional advice one by one to their caregivers, based on an individual's oral health. By comparing the response of caregiver between LBC and NLBC may state the impact of caregivers on children's oral health.

7. Research questions

Question 1: Are there differences in oral health status and behaviours of 6-8-year-old children with different parental migration duration?

Question 2: Is parental migration associated with dental caries among 6-8-year-old children?

Question 3: Do caregivers of LBC and NLBC have different responses to the professional advices on oral health of the children?

8. Objectives

A. To compare the following outcome variables between the 6-8-year-old children with different parental migration duration.

1) Oral health status: dental caries and oral hygiene level.
2) Oral health behaviours: frequency of snacking; frequency of tooth brushing; use of fluoride; dental attendance.

B. To investigate whether parental migration is associated with dental caries among 6-8-year-old children.

C. To compare the responses to the dental professional advices of the caregivers of LBC and NLBC on:

1) Self-care;
2) Professional care.

9. Hypothesis

1. H_a: There are differences in oral health status and behaviours between the 6 to 8 years old children with different parental migration duration.

2. H_a: The association of parental migration and dental caries among 6 to 8 years old children is mediated by oral health knowledge, awareness and behaviours.

3. H_a: Caregivers of LBC and NLBC have different responses to the professional advices on oral health care of the children.

10. Conceptual framework

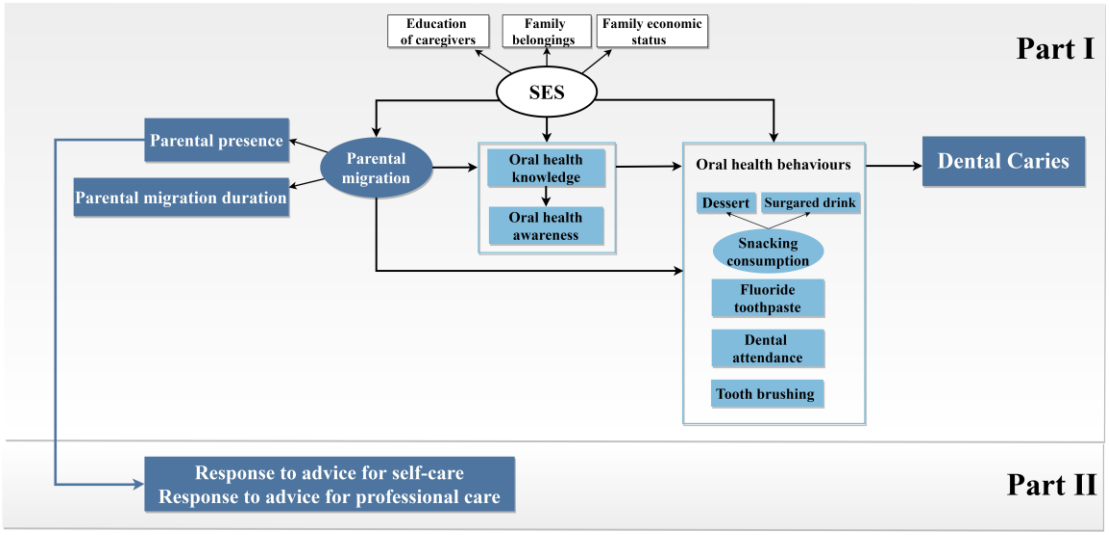

Figure 2 Conceptual framework

11. Study variables

In study 1, the primary outcome was dental caries, and the secondary outcomes were oral health behaviours (snacking and toothbrushing) and oral hygiene status.

In study 2, the primary outcome was the response of caregivers for self-care and professional care of the child.

Table 3 Variables involved in the study

Categories	Sub-categories	Operating definition
Dependent variables		
Main dependent variables		
Dental caries	Number of caries	1) Number of primary teeth caries (dft); 2) Number of permanent teeth caries (DMFT); 3) Number of both in primary and permanent teeth caries (dft + DMFT); (DMFT: Decayed, Missing, and Filled permanent teeth; dft: decay, filled primary teeth;)
	Prevalence of caries	1) Caries prevalence in primary teeth; 2) Caries prevalence in permanent teeth; 3) Caries prevalence both in primary and permanent teeth caries;
Secondary dependent variables		
Oral health behaviours	Sugared drink	4) Few / Never; 5) Once a day; 6) Twice or more a day;
	Dessert	1) Few / Never; 2) Once a day; 3) Twice or more a day;
	Snacking frequency	1) Few / Never; 2) Once a day; 3) Twice or more a day;
	Toothbrushing frequency	1) Never brush; 2) Not brush every day; 3) Once; 4) Twice or more;
	Use of fluoride toothpaste	1) No toothpaste (TP) with fluoride; 2) TP with fluoride not clear; 3) TP without fluoride; 4) TP with fluoride;

	Dental attendance	1) Never; 2) Within 6 months; 3) 6 to 12 months 4) More than 12 months;
Oral hygiene	Oral hygiene index	1) High: mean > 3; 2) Low: mean < 3;
Independent variables		
Main independent variables		
Part 1 Parental migration	Parental migration duration	1) No (ref.); 2) Less than six months (< 6 months); 3) Six months to one year (= 6 months & < 12 months); 4) Equals or more than one year (> = 12 months)
	Parental presence	1) Both parents (Identified by parental migration duration 0 - < 6 months); 2) Mather (Identified by parental migration duration = > 6 months); 3) Father (Identified by parental migration duration = > 6 months); 4) Non-parents (Identified by parental migration duration = > 6 months);
Part 2 Parental migration/Being left behind	LBC= Children under the age of 18 whose parents have been working outside the home for more than six consecutive months [22].	1) Left-behind children (LBC); 2) Non-left-behind children (NLBC)
Other independent variables		
Area of sampling	Location	1) County 1, include school 1, school 2; 2) County 2, include school 3, school 4, school 5, school 6 3) County 3, include school 7;
Child's situation	Age	Age of child (year)
	Gender	1) Female; 2) Male;
Primary caregiver characteristics	Relationship to child	1) Father; 2) Mother; 3) Non-parents;
	Age	Age of caregivers (year)
	Education level	1) No formal schooling to primary education 2) Junior middle school

	Occupations	1) Job (Local merchants; Government officials / doctors / teacher); 2) No job (Farmers; Stay-at-home to take care of children and/or elderly; Stay-at-home elderly);
Family size	Number of children in the family	1) One; 2) More than one;
	Number of family members live together for more than six months in the family	1) 1-4 people; 2) 5-9 people;
Family belongings	Number of family belongings	1) High number (6-9 items); 2) Low number (0-5 items);
Family's economic status	Family income and expense	1) Income more than or equals expense; 2) Income less than expense;
Oral health awareness and knowledge		
Oral health awareness	Four items	1) Not appropriate (Total score:0-2); 2) Appropriate (Total score:3-4);
Oral health knowledge	Seven items	1) Not appropriate (Total score:0-4); 2) Appropriate (Total score:5-7);

Chapter 3 Methodology

1. Research design

The study is a mixed study, including the cross-sectional study for objective A&B and prospective cohort study for objective C.

2. Population and sample

2.1 Study population

The study population in this study were aged 6-8-year-old rural LBC. There are two main reasons for choosing participates for 6-8-year-old. First, between the ages of about 6 to 8 years, the primary teeth start to shed and the permanent teeth begin to come through. It is the golden period for taking care of the children's permanent teeth. Secondly, for most of the 6-8-year-old children, they are grade 1 in China primary school, those children need more physical assistance of caregivers with the daily care of their teeth.

2.2 Sample selection

2.2.1 Select location

Three of the 129 counties from Yunnan province were selected. They were Zhanyi, Huize, and Xuanwei where majority of LBC resided. (Figure 3)

There are similar backgrounds for three counties, as follows:

(1) Similar number of LBC. There was a total of 5,024 LBC in Zhanyi district in 2016. In 2019, a total of 42,819 LBC in Huize[135]. There were 68,960 LBC in Xuanwei in 2013. The enough number of LBC was the main reason of chose those locations. According to the geographical distribution of LBC, Huize has recruited more participants.

(2) Similar number of health care facilities. At the end of 2017, Zhanyi, there were 197 public medical and health institutions, including 14 health service centres and 122 community health service stations/village health centres[136]. At the end of 2017, Huize had a total of 443 public medical and health institutions, including 5

health service centres and 399 community health service stations/village health centres[137]. At the end of 2017, Xuanwei had a total of 467 medical and health units, of that 5 county-level hospitals, 61 community health service centres/township health centres, and 316 village health centres[138].

(3) Similar economic background. In 2017, The total GDP of Zhanyi, Huize, and Xuanwei were 196.89, 180.25, 272.8 billion Yuan, respectively[137].

2.2.2 Sample selection

The multi-level stratified cluster sampling was used to select the samples. First, we selected the districts from 65 districts in 3 counties based on the inclusion criteria which were the health centre. The targeted primary school must be in the suburb areas, and time of travelling to the county hospital less than 1 hour one way. Eighteen districts met the criteria, including 4 districts in Zhanyi, 5 districts in Huize, and 9 districts in Xuanwei.

Second, we selected the primary schools from 53 primary schools in 18 districts according to the school's location and the size of LBC, finished by the located Education Bureau using the unpublished data. A total of 7 primary schools were recruited. Each primary school located in different district in the county. (Figure 4)

Finally, the information of the LBC including name, gender, age and others of each selected primary school were registered by the class teacher. The LBC in each class were recruited from the list until the sample size was satisfied. Finally, the NLBC in each class were randomly selected. (Figure 5)

Figure 3 Location of three studied locations

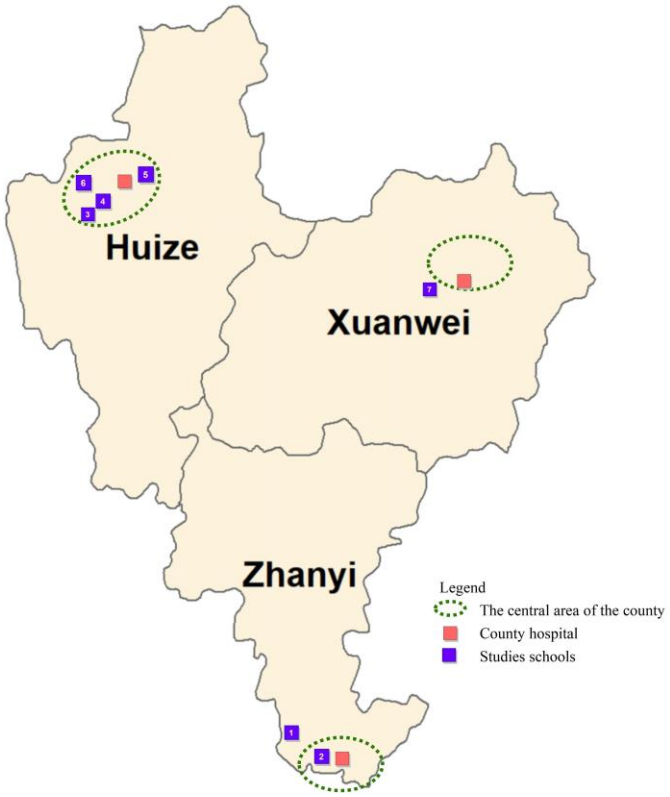

Figure 4 Location of seven studied schools

2.3 Sample size

2.3.1 Sample size for objective A

The sample sizes were calculated using the formula for the comparison of caries prevalence and oral health behaviours between the two groups. The formula for sample size calculation is below.

Testing the hypothesis of a difference between two proportions

$$n_1 = \left[\frac{z_{1-\frac{\alpha}{2}} \sqrt{\bar{p}\bar{q}\left(1+\frac{1}{r}\right)} + z_{1-\beta} \sqrt{p_1 q_1 + \frac{p_2 q_2}{r}}}{\Delta} \right]^2$$

$$r = \frac{n_2}{n_1}, q_1 = 1 - p_1, q_2 = 1 - p_2$$

$$\bar{p} = \frac{p_1 + p_2 r}{1+r}, \bar{q} = 1 - \bar{p}$$

Table 4 Sample size for each objective

Variables	Outcomes		
	Prevalence of caries[14]	Proportion of daily toothbrushing[84]	Proportion of daily snacking[88]
p_1 = Proportion in LBC	48.7%	54.17%	54.16%
P_2 = Proportion in NLBC	35.12%	91.67%	29.17%
n (Each group)	221	26	68

Note: α = 0.05, 1-β = 0.8, n1= n2, estimated non-response rate=5%

The minimum sample size for objective A is 221 for each group or 442 for both groups (Table 4).

2.3.2 Sample size for objective B

In SEM, researchers think about minimum sample sizes regarding the ratio of the number of cases (N) to the number of model parameters (q) that require statistical estimates[139]. A recommended sample-size-to-parameters ratio would be 20:1[139]. In this study, a total of q = 15 parameters require estimates, and then a minimum sample size would be N = 20*15 = 300.

To cover both objectives, at least 442 children are needed. And after substitution for 5% non-response rate, the total sample size is at least 466 children.

2.4 Sample selection criteria

2.4.1 Inclusion criteria for subjects

1). A 6-to-8 years old child who is a day student;
2). A full-time student;
3). The parents and children willing to participate in the study.

2.4.2 Exclusion criteria for subjects

1). The child had been oral surgery in the last week before the data collection day;
2). The child with severe systemic diseases which cannot have oral examination;
3). The child and parent did not cooperate in the data collection process.

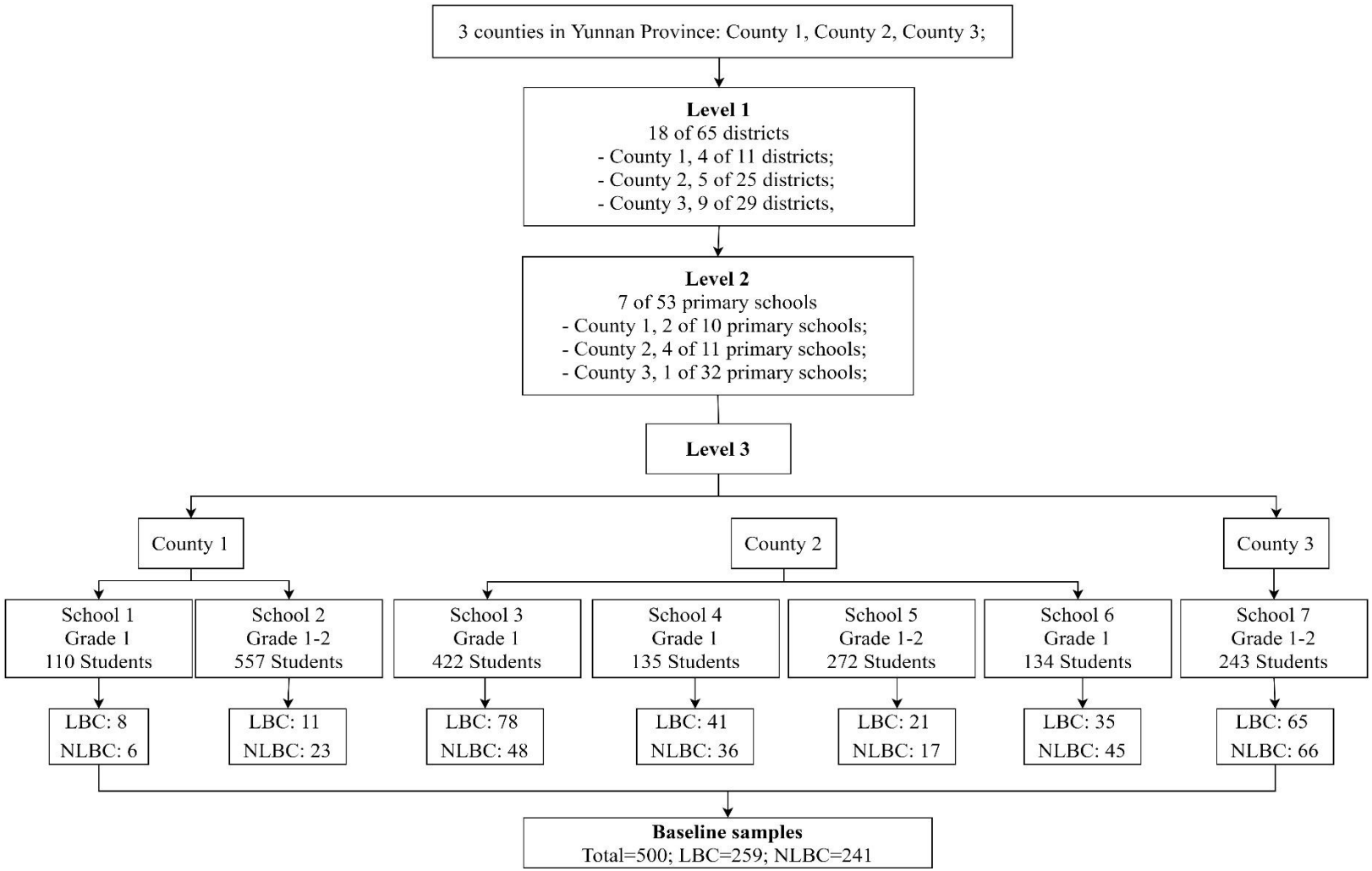

Figure 5 The sampling frame for study subjects

3. Instruments

3.1 Record form for oral health examination

The charting form contains 4 parts, including the individual information, dentition status, the Oral hygiene index (Simplified Oral Hygiene Index (OHI-S) Greene and Vermillion, 1964), and intervention needed and self-care advice. (Appendix 1)

3.2 Questionnaire for caregivers

In this study, the main content of the questionnaire for caregivers (Part C) had used the questionnaire of the Fourth National Oral Epidemiological Survey in China[105], which is the Chinese version of the questionnaire in the Fifth Edition of the Oral Health Survey Basic Methods by the WHO[140].

The questionnaires contain the following contents, Part A Caregiver's information, Part B Family's information, Part C The child's oral health behaviours, caregiver's oral health knowledge and awareness. (Appendix 1)

3.3 Questionnaire for collecting responses to the professional advice of caregivers

The study modified the questionnaire from Fourth National Oral Epidemiological Survey in China, mainly collecting the reasons for use or not oral health utilization[105]. The caregiver's response questionnaire contains six questions, covering four parts: individual information, self-care, professional-care, and obstacle. (Appendix 1)

4. Methodology

4.1 Training and calibrating examiners

4.1.1 Training examiners

The oral hygiene level and tooth status of the participants as well as the advice based on the individual's oral health status and behaviours were be assessed by

two examiners, who was trained and calibrated against an experienced. The training process is based on the Fifth Edition of the Oral Health Survey Basic Methods by the WHO[140].

4.1.2 Calibrating examiners

Two examiners first practice the examination of oral hygiene level and dental caries on a group of 10 subjects to evaluate the intra-examiner reliability. Then, two examiners independently examine the same group of 25 on oral hygiene level and dental caries and compare their findings with each other to evaluate the inter-examiner reliability. This rountin finsihed in three locations respectively before the survey. Three locations calibrating results as follows:

Table 5 Results of calibrating examiners

Locations	An intra-examiner reproducibility		An inter-examiner reproducibility	
	Examiner 1	Examiner 2	Examiner 1	Examiner 2
County 1	0.86	0.87	0.83	0.86
County 2	0.87	0.90	0.85	0.89
County 3	0.86	0.88	0.86	0.88

The intra-examiner reproducibility among three locations was 0.86-0.90. The inter-examiner reproducibility among three locations was 0.83-0.89. In general, the group of examiners had a good consistency level[141]. Assistants were also be trained on recording the results of the oral examination using an oral examination form.

4.2 Validity and reliability of the questionnaires

4.2.1 Validity

Three experts had evaluated the content validity of questionnaires used in this program by the Index of Item - Objective Congruence (IOC), and the score ranged from -1 to +1 (Congruent = + 1, Questionable = 0, Incongruent = -1). The items that had scores lower than 0.5 were revised. On the other hand, the items with scores higher than or equal to 0.5 were reserved. The questionnaire was revised. Then, it was applied in the pilot test.

4.2.2 Reliability

A pilot test of the questionnaire was done in 6-8-year-old children and their caregivers in the similar samples in Lufeng district. Based on this pilot test, the Cronbach's Alpha was 0.86, so the questionnaire was good reliable.

After the pilot study, a few revisions had finished, such as adding answer options for the occupation of caregivers, "stay-at-home taking care of the children and/or elderly", "company staff", and "doctors."

5. Data collection procedure

5.1 Questionnaire and oral examination

The caregivers who can read finished the self-administered questionnaire about the information on children's behaviours (Appendix 1). Caregivers who cannot read were helped by the research assistances to finish the questionnaires.

The children were be examined their oral health status in an activity room with good natural lighting. The subjects were examined on supine position. Both oral health hygiene and tooth status were be evaluated visually and confirmed by tactile examination. The CPI probe or blunt end probe were be used.

The oral hygiene status was be assessed using Simplified Oral Hygiene Index | OHI-S (Simplified)-(Greene and Vermillion, 1964). Four surfaces (distal, buccal, mesial and lingual) of 6 index teeth (tooth 16, 11, 26, 36, 31, and 46) were be examined. Scores 0 to 3 were used to denote different levels of cleanliness. Mean score of all the surfaces was be calculated for each participant. If any index tooth was missing or unerupted, no replacement tooth was be taken and the information for this tooth was be recorded as missing.

The criteria for caries examination was modified from the Fifth Edition of the Oral Health Survey Basic Methods by WHO[140]. This study added one code for the early enamel caries. (Appendix 1)

The caries experiences of deciduous dentition were assessed using the dmft index, which involves decayed teeth (dt), missing teeth (mt), and filled teeth (ft). The “dt” was diagnosed when a lesion was observed beyond doubt in a pit or fissure, or on a smooth surface. The “mt” was recorded when a tooth was missing because of caries. Lastly, “ft”. was diagnosed if a dental filling was found on a tooth with no secondary decay.

5.2 Giving advice to the caregiver

After the oral examination, the caregivers were asked to get together according to their children’s classes. The examiners given the advice to the caregivers based on the results of their children's oral examination one by one. In addition, the caregivers got the written document on the results of their children’s oral health assessment as well as the advice for both professional care and self-care of their children.

5.3 Response check

After three months of baseline, we visited the school and got together with the caregivers who received the advice in the baseline from Zhanyi (September to December 2020) to collect the response questionnaire. Because of the effect of the COVID-19, after two months, we collected the advice response check of the caregivers from Huize and Xuanwei (October 2020 to January 2021). For all illiterate caregivers, the research assistants read the questions to help them finish the questionnaire.

We conducted phone calls for caregivers who did not respond questionnaire to finish the response questionnaire. Those who did not answer the phone were regarded as lost follow up.

6. Data analysis

6.1 Sample weighting

6.1.1 Reasons for sample weighting

All data was entered, checked and cleaned before starting the analysis. In order to reduce potential bias due to the disproportionality of the sample numbers in studies' locations, and get representative results from all study locations due to differences in the probability of selection between cases in a sample samples weighting was used in this study[142]. Using R packages, "pacman" finished all weighting calculations.

The coverage error can be found in Figure 5 (the sampling frame for study subjects) that other primary schools didn't choose in study besides a total of 7 selected schools. In addition, an under-represented sample happened in those 7 schools, such as county 3 only chosen 1 school from 32 primary schools. Since the potential sample bias, the samples cannot represent the wider population being studied.

6.1.2 Method for sample weighting

There were 4 steps to calculate the sample weighting[142]. First, A stratified weight was applied to each age, gender, and location group in the sample using the data of population in three locations regrading age and gender of each location come from the 2020 Yearbook. The weight for the data was divided the number of populations by the number of samples in each age, gender, and location strata.

Secondly, in order to match the sample data to the number of classes in each study schools, there was a cluster weight applied to each class in the school. The cluster weight come from the total number of classes divided by the number of sampled classes of grades 1 to 2 in each school.

Third, an absolutely sample weighting was calculated by multiplying the stratified weights with the cluster weights. Although the absolutely sample weights fit for estimating the total population, it would exaggerate the sample means and 95%CI and other statistical descriptive.

Finally, relative sample weight was used in the study to reduce the

overestimation of descriptive statistics. Relative sample weight was calculated by dividing each absolutely sample weighting by the mean of the all absolute sample weights.

Using R packages, "pacman" finished all weighting calculations

6.2 Univariable analysis

In the results, all frequencies were unweighted frequency marked by N. The percentage has shown in unweighted percentage (unweighted%) and weighted percentage (weighted%). In the results of the descriptive statistics of Part I, we have mainly shown the total frequency and total weighted percentage to describe the general situations in locations of the sampled population.

In the followed part of analysis statistics of Part I, a Chi-square test for complex survey data was used to compare the difference in children's oral health status and behaviours, as well as oral health knowledge and awareness of their caregivers among different between parental migration durations. A Chi-squared test for trend in proportions for weighted proportions was performed to test a linear trend between caries prevalence of caries between and parental migration durations.

Univariable regression analysis was conducted before the structural equation model (SEM), which explored the direct association between independent variables and interest outcomes. The results of univariable regression given the reference and comparison information to the results of SEM.

6.3 Structural equation modelling

After the univariable analysis, a structural equation model (SEM) was used to test the association between parental migration and dental caries in children, mediated by oral health knowledge, awareness, and behaviours, as well as controlled the confounder. Since multivariable analysis well controls the confounder but not mediating variables. Moreover, this study included six intermediate factors, simple multivariable analysis would not be able to handle these complex relationships. So, we

used structural equation model method (SEM) to solve the problems. Using SEM to explore the real path relationship between exposure and outcome variables while considering the effects of mediators and confounders.

There are three main steps on SEM: model specification, model estimation, and model fit.

6.3.1 Model specification

Model specification determines the components of latent variables in the model. Before the model specification, a confirmatory factor analysis (CFA) was used. The goal of CFA is to ensure the reliability and validity of the latent variables and therefore provides support for the suitability of their inclusion in the path model[143]. The goal of EFA was to construct a minimal group to represent the correlations between many original factors.

Four steps in the CFA: 1) indicator reliability, 2) internal consistency reliability, 3) convergent validity, and 4) discriminant validity[143].

Indicator reliability was examining how much of each indicator variance is explained by factor loading of each construct. The internal consistency was measured using Cronbach's Alpha. The factor loading and Cronbach's Alpha coefficients between 0.70 to 1.0 are acceptable[143]. Where convergent validity was measured by average variance extracted (AVE). It reveals the mean percentage of explained variance between the items of a construct. It is acceptable when AVE is higher than 0.50[143]. Discriminant validity tests whether the latent variable is different from others. A heterotrait–monotrait ratio (HTMT) of correlations was used and the HTMT value lower than 0.90 would be recommend[143].

6.3.2 Path analysis

After model specification, the path analysis model can be identified. Using the weighted least square mean and variance adjusted (WLSMV) estimator conducted model estimation to evaluate the path coefficients, due to more binary/dichotomous variables in model. The path coefficients quantify the relationship between two variables. Unstandardized path coefficient estimates and their standard errors were calculated in "lavaan" package in R.

6.3.3 Model fit

The model fit was evaluated by various indices used widely in SEM analysis. There were essential reported fit indexes: chi-squared fit statistic ($\chi 2/df$), root mean square error of approximation (RMSEA), and standardised root mean square residual (SRMR), and goodness-of-fit index (GFI). Four fit indexes should all be close to or better than the recommended levels when the model is acceptable[144].

In Part II, use the unweighted frequency and unweighted percentage was used in all results to describe the situation of the followed sample responses of the caregivers to the dentists' advice on self-care and professional care without aiming to be representative of the original sampled population by dentists.

The threshold of significance was defined at $p < 0.05$. All statistical analyses will be performed using R.

Chapter 4 Results

Part I Oral health outcomes

Part I answered objectives A and B. The descriptive results of the participants and outcomes were also reported (sections 1 & 2). Objective A compared dental caries, children's oral health behaviours, and oral health knowledge and awareness of their caregivers among the children with different parental migration durations (section 3). Objective B investigated whether parental migration is associated with dental caries among 6-8-year-old children (section 4 & 5).

1. Participants' characteristics

1.1 Children characteristics

Table 6 shows the characteristics of areas and samples with unweighted percentages. Of all counties, county 1 had the highest GDP/capita annual net income for the rural population in 2021. Schools' 2nd-6th locate in the central district of the county whereas school 1th and 7th locate in sub-district. All study locations have cement roads between townships. Travelling to the county hospital is less than 1 hour.

The sample consisted of 500 children where county 2 contributed the highest number of subjects (64.2%), followed by county 3 and county 1. The samples in this study aged 6 to 8 years old. However, most children were 6-7 years old and had about the same proportion of males and females. About 38% (191 children) had no parental migration or were non-left-behind children (NLBC). Ten per cent of children were from parental migration of less than months. 17.4% were 6 to 12 months, and 34.4% were more than 12 months, respectively. In the parental migration families, most were father migration (41.6%). Mother (24.2%) and non-parents (24.0%) were the primary caregivers for children with parental migration. All other detailed descriptive results of each county are shown in Appendix 2.

Table 6 Characteristics of areas and samples

Variables	N (Unweighted%)							
	County 1		County 2				County 3	**Total**
	Sch-1	Sch-2	Sch-3	Sch-4	Sch-5	Sch-6	Sch-7	
Area characteristics								
2021 Total population (hundred thousand)	4.05		7.94				11.9	
2021 GDP per capita annual net income for the rural population (RMB)	16,673		7828				15,740	
Distance to local county hospital (KM)	36	1.7	8.9	4	5.9	7.1	14	
Sample characteristics								
N	14	34	126	77	38	80	131	500
Relative weights	14	158	43	11	198	21	55	500
Age of children								
6	2 (14.3)	9 (26.5)	46 (36.5)	48 (62.3)	9 (23.7)	29 (36.2)	31 (23.7)	174 (34.8)
7	8 (57.1)	16 (47.1)	71 (56.3)	29 (37.7)	19 (50.0)	46 (57.5)	57 (43.5)	246 (49.2)
8	4 (28.6)	9 (26.5)	9 (7.1)	0 (0.0)	10 (26.3)	5 (6.2)	43 (32.8)	80 (16.0)
Gender of children								
Female	7 (50.0)	17 (50.0)	61 (48.4)	33 (42.9)	21 (55.3)	41 (51.2)	62 (47.3)	242 (48.4)
Male	7 (50.0)	17 (50.0)	65 (51.6)	44 (57.1)	17 (44.7)	39 (48.8)	69 (52.7)	258 (51.6)
Parental migration durations (month)								
No	6 (42.9)	23 (67.6)	33 (26.2)	35 (45.5)	10 (26.3)	36 (45.0)	48 (36.6)	191 (38.2)
< 6	0 (0.0)	0 (0.0)	15 (11.9)	1 (1.3)	7 (18.4)	9 (11.2)	18 (13.7)	50 (10.0)
6 - < 12	2 (14.3)	2 (5.9)	3 (2.4)	0 (0.0)	20 (52.6)	17 (21.2)	43 (32.8)	87 (17.4)
≥ 12	6 (42.9)	9 (26.5)	75 (59.5)	41 (53.2)	1 (2.6)	18 (22.5)	22 (16.8)	172 (34.4)
Type of parental migration								
No one left	6 (42.9)	23 (67.6)	33 (26.2)	35 (45.5)	10 (26.3)	36 (45.0)	48 (36.6)	191 (38.2)

Father left	2 (14.3)	5 (14.7)	68 (54.0)	36 (46.8)	15 (39.5)	29 (36.2)	53 (40.5)	208 (41.6)
Mother left	0 (0.0)	2 (5.9)	7 (5.6)	4 (5.2)	5 (13.2)	6 (7.5)	1 (0.8)	25 (5.0)
Both parents left	6 (42.9)	4 (11.8)	18 (14.3)	2 (2.6)	8 (21.1)	9 (11.2)	29 (22.1)	76 (15.2)
Parental presence								
Both-parents	6 (42.9)	23 (67.6)	48 (38.1)	36 (46.8)	17 (44.7)	45 (56.2)	66 (50.4)	241 (48.2)
Mother	0 (0.0)	5 (14.7)	31 (24.6)	34 (44.2)	8 (21.1)	18 (22.5)	25 (19.1)	121 (24.2)
Father	0 (0.0)	2 (5.9)	4 (3.2)	4 (5.2)	4 (10.5)	4 (5.0)	0 (0.0)	18 (3.6)
Non-parents	8 (57.1)	4 (11.8)	43 (34.1)	3 (03.9)	9 (23.7)	13 (16.2)	40 (30.5)	120 (24.0)

1.2 Family characteristics

1.2.1 Primary caregiver characteristics

Major of primary caregivers of children were mothers (44.5%). Non-parents of this study mainly were grandparents. More than 60.0% of caregivers were 30-49-years-old. Most of them had a junior high school degree (43.7%) and were farmers and business owners (69.6%). (Table 7)

1.2.2 Family characteristics

More than 70% of the studied samples were in a family with more than one child, and about 60% had more than four people in the family. Most caregivers reported that the household income was higher or equal to the expense (64.6%). Almost all of them had basic health insurance. (Table 8)

Table 7 Characteristics of children's primary caregiver, N (unweighted%)

Variables	County 1		County 2				County 3	**Total**		
	Sch-1	Sch-2	Sch-3	Sch-4	Sch-5	Sch-6	Sch-7	**N**	Unweighted%	**Weighted%**
N	141	34	126	77	38	80	131	500		
Relationship to child										
Father	1 (7.1)	9 (26.5)	18 (14.3)	15 (19.5)	9 (23.7)	13 (16.2)	9 (6.9)	74	14.8	29.7
Mother	5 (35.7)	21 (61.8)	61 (48.4)	57 (74.0)	15 (39.5)	51 (63.7)	66 (50.4)	276	55.2	44.5
Non-parents	8 (57.1)	4 (11.8)	47 (37.3)	5 (6.5)	14 (36.8)	16 (20.0)	56 (42.7)	150	30.0	25.8
Age										
11-29	0 (0.0)	2 (6.5)	29 (25.2)	11 (15.7)	5 (13.5)	14 (20.9)	9 (7.2)	70	15.3	15.7
30-49	6 (42.9)	28 (90.3)	57 (49.6)	55 (78.6)	20 (54.1)	46 (68.7)	68 (54.4)	280	61.0	63.5
50-85	8 (57.1)	1 (3.2)	29 (25.2)	4 (5.7)	12 (32.4)	7 (10.4)	48 (38.4)	109	23.7	20.8
Education level										
University	0 (0.0)	1 (2.9)	2 (1.6)	8 (10.4)	0 (0.0)	1 (1.2)	0 (0.0)	12	2.4	1.4
High school	2 (14.3)	15 (44.1)	11 (8.7)	9 (11.7)	5 (13.2)	6 (7.5)	11 (8.4)	59	11.8	24.5
Junior high school	6 (42.9)	14 (41.2)	45 (35.7)	25 (32.5)	17 (44.7)	29 (36.2)	41 (31.3)	177	35.4	43.7
Primary school	3 (21.4)	4 (11.8)	41 (32.5)	32 (41.6)	11 (28.9)	37 (46.2)	51 (38.9)	179	35.8	22.8
No formal schooling	3 (21.4)	0 (0.0)	27 (21.4)	3 (3.9)	5 (13.2)	7 (8.8)	28 (21.4)	73	14.6	7.5
Occupations										
Officials	1 (7.1)	3 (8.8)	2 (1.6)	0 (0.0)	0 (0.0)	1 (1.2)	2 (1.5)	9	1.8	3.0
Business owners	1 (7.1)	21 (61.8)	17 (13.5)	19 (24.7)	7 (18.4)	14 (17.5)	7 (5.3)	86	17.2	34.5
Farmers	12 (85.7)	3 (8.8)	33 (26.2)	29 (37.7)	17 (44.7)	13 (16.2)	69 (52.7)	176	35.2	35.1
Stay-at-home	0 (0.0)	7 (20.6)	70 (55.6)	27 (35.1)	14 (36.8)	50 (62.5)	50 (38.2)	218	43.6	26.7
Others	0 (0.0)	0 (0.0)	4 (3.2)	2 (2.6)	0 (0.0)	2 (2.5)	3 (2.3)	11	2.2	0.6

Notes: Officials: Government officials/doctors/teachers;
Stay-at-home: Stay-at-home to take care of children and/or elderly;
Each county: N (Unweighted%).

Table 8 Characteristics of children's family situation, N (unweighted%)

Variables	County 1		County 2				County 3	**Total**		
	Sch-1	Sch-2	Sch-3	Sch-4	Sch-5	Sch-6	Sch-7	**N**	Unweighted%	**Weighted%**
N	141	34	126	77	38	80	131	500		
Number of children in the family										
One	4 (28.6)	11 (32.4)	37 (29.4)	29 (37.7)	11 (28.9)	9 (11.8)	42 (32.1)	143	28.8	29.1
More than one	10 (71.4)	23 (67.6)	89 (70.6)	48 (62.3)	27 (71.1)	67 (88.2)	89 (67.9)	353	71.2	70.9
Number of family members										
≤ 4 people	6 (42.9)	16 (47.1)	55 (43.7)	40 (51.9)	12 (31.6)	31 (40.3)	78 (59.5)	238	47.9	42.6
> 4 people	8 (57.1)	18 (52.9)	71 (56.3)	37 (48.1)	26 (68.4)	46 (59.7)	53 (40.5)	259	52.1	57.4
Basic medical insurance for the child										
Yes	13 (92.9)	34 (100.0)	116 (92.1)	72 (93.5)	38 (100.0)	73 (91.2)	128 (97.7)	474	94.8	98.7
No	1 (7.1)	0 (0.0)	10 (7.9)	5 (6.5)	0 (0.0)	7 (8.8)	3 (2.3)	26	5.2	1.3
Family's economic status										
Income ≥ Expense	8 (57.1)	24 (70.6)	79 (62.7)	48 (64.0)	22 (57.9)	29 (39.2)	90 (68.7)	300	61.0	64.6
Income < Expense	6 (42.9)	10 (29.4)	47 (37.3)	27 (36.0)	16 (42.1)	45 (60.8)	41 (31.3)	192	39.0	35.4

Note: Each county: N (Unweighted%).

2. Outcome variables

2.1 Oral health behaviours

Table 9 Children's oral health behaviours

Variables	Total (n=500)	
	N	weighted%
Snacking frequency		
Few / Never	203	32.3
Once a day	108	18.8
Twice or more a day	181	48.6
Brushing frequency		
Twice or more a day	151	30.4
Once a day	256	44.7
Not brush every day	75	21.7
Never brush	11	3.2
Use of toothpaste (TP)		
TP with fluoride	214	56.0
TP without fluoride	94	18.5
TP with fluoride not clear	107	21.6
No TP	17	3.9
Dental attendance		
Within 6 months	102	20.4
6-12 months	78	15.6
More than 12 months	105	21.0
Never	215	43.0
Oral health awareness		
Appropriate	301	67.8
Not appropriate	199	32.2
Oral health awareness		
Appropriate	312	72.7
Not appropriate	188	27.3

About 49% of children ate snacks twice or more a day, but only 30% brushed their teeth twice or more per day. The majority of them used toothpaste (96.1%). However, only 56% reported using fluoride toothpaste. (Table 9)

2.2 Oral health awareness and knowledge of caregiver

Table 10 Appropriateness of oral health awareness and knowledge

Statement	Appropriateness*	
	N	weighted%
Oral health awareness		
1) Oral health is important.	480	97.9
2) Regular oral health examination is necessary.	436	90.9
3) The health of the teeth is decided at birth, and is not significantly associated with your protection.	346	75.0
4) Oral disease prevention mainly depends on yourself.	460	89.3
Oral health knowledge		
1) Bacteria can cause gingival inflammation.	446	94.4
2) Toothbrushing can prevent gingival bleeding.	403	82.0
3) Bacteria can cause dental caries.	394	87.1
4) Sugar intake can lead to dental caries.	414	89.8
5) Deciduous dental caries can be left alone.	340	76.4
6) Pit and fissure sealing can prevent children from dental caries.	142	**31.5**
7) Fluoride can protect teeth.	171	**41.4**

Notes: * Appropriateness in Awareness means: if "Agree" in items 1- 2 and 4, "Disagree" in item 3;
*Appropriateness in Knowledge means: if "Yes" in items 1- 4 and 6 -7; "No" in item 5.

In general, most caregivers had appropriate oral health awareness and knowledge. Nevertheless, 1 out of 4 caregivers did not have an appropriate response to "The health of the teeth is decided at birth and is not significantly associated with your protection". In addition, less than half knew that "Pit and fissure sealing can prevent children from dental caries" (31.5%) and "Fluoride can protect teeth" (41.4%).

2.3 Oral health status

2.3.1 Prevalence of dental caries

Table 11 Prevalence of dental caries in children

Variables	N	Unweighted%	Weighted%
Caries in permeant teeth (DMFT)	128	25.6	40.2
Caries in primary teeth (dft)	468	93.6	91.1
Total caries (DMFT+dft)	469	93.8	91.6

Notes: Caries was detected at both early enamel caries and dentine caries;
DMFT: decayed, missing, and filled permanent teeth;
dft: decayed, filled primary teeth.

Table 11 showed that 91.6% of children had dental caries in primary and permanent teeth. About 40% of them had at least one caries in the permeant teeth.

2.3.2 number of dental caries and level of oral hygiene

Table 12 Average number of dental caries and oral hygiene level in children

Variables*	Unweighted		Weighted	
	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)
Caries in permeant teeth (DMFT)	0.53 (1.06)	0.00 (0.00 - 1.00)	0.92 (1.35)	0.00 (0.00 - 2.00)
Caries in primary teeth (dft)	6.94 (4.01)	7.00 (4.00 - 10.00)	6.61 (3.86)	7.00 (4.00 - 8.00)
Total caries (DMFT+dft)	7.47 (4.28)	7.00 (4.00 - 11.00)	7.53 (4.27)	8.00 (4.33 - 10.00)
Oral hygiene level (OHI-S index)	2.68 (0.47)	2.83 (2.50 - 3.00)	2.58 (0.57)	2.83 (2.33 - 3.00)

Notes: * Caries was detected at both early enamel caries and dentine caries;
DMFT: decayed, missing, and filled permanent teeth;
dft: decayed, filled primary teeth;
Oral hygiene: measured by OHI-S index;
IQR: quantile 25% **-** quantile 75%.

The mean number of total caries experience in both permeant and primary teeth (DMFT+dft) among the children was 7.53 ± 4.27 teeth with mean decayed (D+d) component of 7.13 ± 4.18, missing (M) component of 0.13 ± 0.40, and filled (F+f) component of 0.27 ± 1.10. The median similar to mean value in all measured caries. Whereas, the oral hygiene level measured by the OHI-S index was 2.58 ± 0.57. (Table 12)

3. Differences in related variables by parental migration durations

3.1 Demographic factors

Table 13 Comparison of demographic factors between parental migration durations

Variables	Parental migration durations, N (weighted %)				P
	No (n = 191)	< 6 months (n = 50)	6 -< 12 months (n = 87)	≥ 12 months (n = 172)	
Child level					
Sex					0.40
Female	100 (51.9)	24 (58.1)	37 (44.7)	81 (49.9)	
Male	91 (48.1)	26 (41.9)	50 (55.3)	91 (50.1)	
Caregiver level					
Relation to children					0.02
Father	55 (41.8)	1 (0.7)	7 (31.5)	11 (6.2)	
Mother	123 (55.5)	32 (50.2)	35 (31.4)	86 (42.7)	
Non-parents	13 (2.7)	17 (49.1)	45 (37.1)	75 (51.1)	
Age of caregivers					0.01
11-29	33 (20.6)	6 (5.2)	6 (8.2)	25 (24.1)	
30-49	138 (78.0)	24 (47.4)	35 (55.1)	83 (47.1)	
50-85	10 (1.4)	15 (47.4)	37 (36.7)	47 (28.7)	
Education level					0.01
＞Elementary school	120 (78.9)	15 (17.5)	39 (78.2)	74 (46.4)	
≤ Elementary school	71 (21.1)	35 (82.5)	48 (21.8)	98 (53.6)	
Occupations					0.03
Job	115 (79.1)	23 (49.5)	50 (82.3)	83 (44.9)	
No job	76 (20.9)	27 (50.5)	37 (17.7)	89 (55.1)	
Family level					
Number of children					0.43
One	43 (33.0)	9 (17.6)	30 (26.0)	61 (29.6)	
More than one	147 (67.0)	41 (82.4)	55 (74.0)	110 (70.4)	
Number of family members					0.43
≤ 4 people	79 (36.6)	25 (48.3)	52 (46.3)	82 (47.7)	
＞4 people	111 (63.4)	25 (51.7)	34 (53.7)	89 (52.3)	
Family belongings					0.03
High number	81 (67.6)	12 (25.2)	22 (35.7)	41 (40.8)	
Low number	108 (32.4)	38 (74.8)	63 (64.3)	130 (59.2)	
Economic status					0.33
Income ≥ Expense	112 (68.9)	24 (43.5)	56 (64.6)	108 (61.0)	
Income < Expense	75 (31.1)	26 (56.5)	29 (35.4)	62 (39.0)	

Notes: Unweighted frequency; Survey Chi-squared test for survey complex data.

Table 13 shows that "relation to children", "age, education level and occupations of caregivers" were significant differences among children with different parental migration durations ($p < 0.05$). Compared to children with non-parental migration or NLBC, primary caregivers of children with parental migration (LBC) were more likely to be mothers or non-parents, had older ages, had lower than elementary school, and had no job.

3.2 Oral health related factors

3.2.1 Oral health behaviours, awareness and knowledge

Table 14 Comparison of oral health behaviours, awareness and knowledge between parental migration durations

Variables	Parental migration duration, N (weighted %)				P
	No (n = 191)	< 6 months (n = 50)	6-<12 months (n = 87)	≥ 12 months (n = 172)	
Snacking frequency of children					0.02
Few / never	83 (24.9)	23 (55.9)	34 (41.5)	63 (24.3)	
Once a day	36 (9.7)	7 (11.4)	23 (30.8)	42 (18.6)	
Twice or more	67 (65.4)	20 (32.7)	28 (27.7)	66 (57.1)	
Brushing frequency of children					0.12
Twice or more	58 (33.3)	19 (46.0)	15 (15.1)	59 (50.3)	
Less than twice	127 (66.7)	31 (54.0)	72 (84.9)	112 (49.7)	
Fluoride toothpaste used by children					0.40
Yes	88 (61.4)	17 (38.8)	29 (53.4)	80 (52.9)	
No*	83 (38.6)	27 (61.2)	41 (46.6)	67 (47.1)	
Dental attendance of children					0.78
Yes**	119 (69.8)	25 (55.8)	47 (68.7)	94 (67.8)	
No	72 (30.2)	25 (44.2)	40 (31.3)	78 (32.2)	
Oral health awareness of caregiver					0.08
Appropriate	120 (69.5)	24 (53.9)	51 (73.5)	106 (56.2)	
Not appropriate	71 (30.5)	26 (46.1)	36 (26.5)	66 (43.8)	
Oral health knowledge of caregiver					0.24
Appropriate	119 (80.7)	34 (74.0)	48 (68.6)	111 (61.4)	
Not appropriate	72 (19.3)	16 (26.0)	39 (31.4)	61 (38.6)	

Notes: "No" including toothpaste without fluoride, toothpaste with fluoride not clear, and did not use toothpaste.

"Yes" including dental attendance within 6 months, 6 to 12 months, more than 12 months.

Survey Chi-squared test was used in categorical variables for complex survey samples.

The higher proportion of children from non-parental migration families significantly consumed snacks more frequently than those from parental migration families ($p = 0.02$). Moreover, children from non-parental migration families were more likely to use toothpaste with fluoride and had caregivers with appropriate oral health knowledge than those from parental migration families, but they were not significant different. (Table 14)

3.2.2 Dental caries and oral hygiene

Prevalence of dental caries

Table 15 Comparison of caries prevalence between parental migration durations

Variables	Parental migration durations (months), weighted caries% (SE%)				P1*	P2**
	No (n = 191)	< 6 (n = 50)	6 - < 12 (n = 87)	≥ 12 (n = 172)		
Caries in permeant teeth (DMFT)	43.1 (3.6)	19.7 (5.6)	39.1 (5.2)	41.9 (3.8)	0.50	0.72
Caries in primary teeth (dft)	87.7 (2.4)	90.5 (4.1)	92.5 (2.8)	96.6 (1.4)	0.33	0.01
Total caries (DMFT+dft)	89.0 (2.3)	90.5 (4.1)	92.5 (2.8)	96.6 (1.4)	0.39	0.03

Notes: Caries was detected at both early enamel caries and dentine caries;
DMFT: decayed, missing, and filled permanent teeth;
dft: decay, filled primary teeth;
*P1, p-values by Survey Chi-squared.
**P2, p-values by Survey Chi-squared Test for Trend in Proportions.

No significant differences in all measures of weighted caries prevalence were found among different parental migration durations. However, there was a statistically significant linear increase in prevalence of caries in the primary teeth (dft) and total caries (DMFT + dft) with increased parental migration durations ($p < 0.05$).

Number of dental caries and oral hygiene

Table 16 Comparison of mean caries experience and oral hygiene level between parental migration durations

Variables	Parental migration durations (months), Weighted Mean (SE)				P1*	P2**
	No (n = 191)	< 6 (n = 50)	6 - <12 (n = 87)	≥ 12 (n = 172)		
Caries in permeant teeth (DMFT)	1.04 (0.48)	0.36 (0.04)	0.81 (0.51)	1.06 (0.57)	0.44	0.33
Caries in primary teeth (dft)	5.85 (0.91)	7.06 (0.96)	7.01 (0.19)	7.45 (0.41)	0.21	0.14
Total caries (DMFT+dft)	6.89 (1.33)	7.42 (0.99)	7.82 (0.32)	8.51 (0.75)	0.68	0.39
Oral hygiene (OHI-S index)	2.49 (0.13)	2.74 (0.09)	2.69 (0.01)	2.51 (0.18)	0.01	0.08

Notes: Caries was detected at both early enamel caries and dentine caries;
DMFT: decayed, missing, and filled permanent teeth;
dft: decay, filled primary teeth;
*P1: p-value of Kruskal-Wallis test for complex survey samples;
**P2: p-values of Survey-weighted Linear regression to test a linear trend in the mean caries experience and oral hygiene level parental migration durations, which as a continuous variable (by month).

There was an increasing trend with the parental migration duration in the mean total caries (DMFT + dft), although it was no significant (P = 0.39). The lowest mean total caries (DMFT + dft) value was found in the children with no parental migration (6.89) and the highest (8.51) in children with parental migration of more than twelve months. Moreover, there was a significantly difference in oral hygiene level among different parental migration durations. The children with no parental migration had the best oral hygiene level and those with recent parental migration (< 6 month) had the worst oral hygiene level.

4. Association between oral health behaviors, oral health outcomes and related factors

Table 17 explores the associations between independent variables (parental migration and related factors) and outcome variables (oral health behaviours and oral health) using the univariable regression analysis. These factors would be used in the SEM analysis in the next section.

Children with a low number of family belongings had significantly less snacking consumption than those with high number.

Children from families with parental migration six to twelve months or those living with father significantly brushed their teeth less frequent 2 times and 8 times than those with no parental migration and living with both parents respectively.

Caregivers with less than elementary school education tended to use non-fluoride toothpaste compared with those who graduated more than elementary school level.

Regrading dental attendance, children living with non-parents and caregivers with inappropriate oral health knowledge had significantly less dental attendance than their counterparts.

Children from families with parental migration of more than twelve months had a low risk of having permanent teeth caries prevalence in children.

Next, a structural equation modelling (SEM) by multi-path analysis was used to explore the association between dental caries of the children and parental migration as well as all related variables from this section.

Table 17 Univariable analysis of the association between oral health behaviours, oral health outcomes and related factors

Variables	Outcomes of Interest, OR (95CI%) *				
	Snacking frequency	Brushing frequency	Fluoride toothpaste use	Dental attendance	Dental caries
	< 2 times a day(ref.) vs. ≥ 2 times a day	≥ 2 times a day(ref.) vs. < 2 times a day	Yes (ref.) vs. No	Yes (ref.) vs. No	No (ref.) vs. Yes
Parental migration duration					
No (ref.)					
< 6 months	1.18 (0.62 - 2.26)	0.75 (0.39 - 1.42)	1.68 (0.85 - 3.34)	1.65 (0.88 - 3.09)	0.56 (0.26 - 1.20)
6 - < 12 months	0.87 (0.50 - 1.51)	**2.19 (1.15 - 4.19)**	1.50 (0.85 - 2.65)	1.41 (0.85 - 2.34)	0.90 (0.52 - 1.56)
≥ 12 months	1.12 (0.73 - 1.72)	0.87 (0.55 - 1.36)	0.89 (0.57 - 1.39)	1.37 (0.91 - 2.07)	**0.55 (0.34 - 0.90)**
Parental presence					
Both parents (ref.)					
Mother	0.63 (0.39 - 1.03)	0.87 (0.55 - 1.40)	0.95 (0.60 - 1.53)	0.94 (0.60 - 1.48)	0.68 (0.41 - 1.14)
Father	0.86 (0.31 - 2.37)	**8.28 (1.08 - 63.61)**	0.48 (0.16 - 1.43)	1.48 (0.57 - 3.88)	0.71 (0.23 - 2.22)
Non-parents	1.52 (0.97 - 2.39)	1.46 (0.90 - 2.39)	1.04 (0.64 - 1.70)	**1.59 (1.03 - 2.44)**	0.79 (0.48 - 1.32)
Education level of caregivers					
＞Elementary school (ref.)					
≤ Elementary school	0.89 (0.62 - 1.30)	1.26 (0.85 - 1.86)	**2.04 (1.38 - 3.02)**	1.24 (0.87 - 1.77)	0.90 (0.60 - 1.36)
Oral health awareness of caregivers					
Appropriate (ref.)					
Not appropriate	1.14 (0.79 - 1.66)	1.10 (0.74 - 1.63)	1.26 (0.85 - 1.87)	**1.81 (1.25 - 2.63)**	1.30 (0.86 - 1.96)
Oral health knowledge of caregivers					
Appropriate (ref.)					
Not appropriate	0.78 (0.52 - 1.15)	1.51 (0.99 - 2.27)	1.49 (1.01 - 2.20)	1.08 (0.74 - 1.56)	1.04 (0.69 - 1.57)
Family belongings					
High number (ref.)					
Low number	**0.59 (0.40 - 0.87)**	0.98 (0.65 - 1.47)	1.34 (0.89 - 2.03)	1.13 (0.76 - 1.67)	0.66 (0.43 - 1.02)

Family economic status						
	Income ≥ Expense (ref.)					
	Income < Expense	0.85 (0.59 - 1.23)	1.13 (0.77 - 1.68)	1.22 (0.83 - 1.81)	**0.63 (0.44 - 0.92)**	0.76 (0.51 - 1.15)

Note: Bold black results mean P < 0.05;

*Analysis using Logistic regression (OR and 95%CI).

5. Structural equation modelling (SEM) of the association between dental caries and parental migration

In SEM, three steps we conducted: 1) model specification by confirmatory factor analysis (CFA), 2) path analysis and model estimation using the weighted least square mean and variance adjusted (WLSMV), and 3) model fit by multiple indices.

5.1 Model specification

The outcome of this study was dental caries. The caries in permanent teeth were used in this study because children aged 6 to 8 years old just have permanent teeth erupted. Therefore, it is more appropriate to detect the effect of parental migration on dental caries in permanent teeth than primary teeth in this age group.

The latent variable of dental caries in permanent teeth, which included the DMFT and permanent teeth caries prevalence cannot be constructed, because the factor loading of permanent teeth caries prevalence was more than 1.0 which would cause over represent. Moreover, we chose the DMFT because it is more informative and powerful to represent the dental caries.

We conducted three SEM models based on 3 outcome variables of "dental caries" which were the number of permanent teeth caries (DMFT), the prevalence of permanent teeth caries, and the prevalence of total caries (primary and permanent teeth). Only result of the number of permanent teeth caries (DMFT) was present (Figure 6). However, the other two SEM models were shown in Appendix 3.

Figure 6 present the path analysis in the hypothesis model according to the previous literature. Parental migration duration and presence constructed the exposure variable of "parental migration". There were intermediate factors that oral health knowledge, awareness, and behaviours. In addition, the confounder of "SES" was constructed by family belongings, family economic status, and the education of caregivers. Three latent variables in this path analysis model: parental migration, SES, and snacking consumption. Other were observed variables.

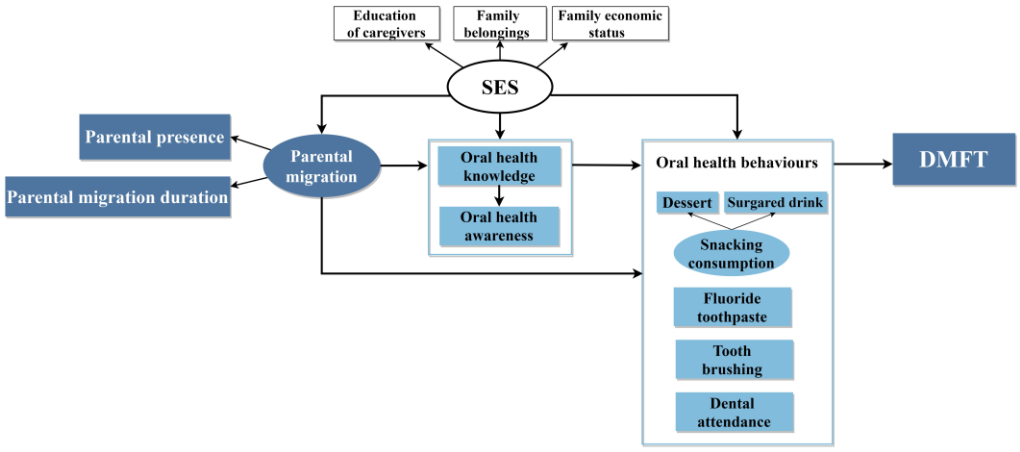

Figure 6 Path analysis model between parental migration and dental caries

Table 18 CFA results

Factors (Specific items)	**Indicator reliability**	**Internal consistency reliability**	**Convergent validity**
	Factor loading	Cronbach's alpha	AVE
Acceptable level	> 0.70-1.00	> 0.70-1.00	> 0.50-1.00
Parental migration		0.86	0.76
Parental presence	0.87		
Parental migration duration	0.87		
SES		0.39	0.56
Family economic status	0.27		
Family belongings	0.81		
Education of caregivers	0.29		
Snacking consumption		0.64	0.56
Sugared drink	0.49		
Dessert	0.96		

Notes: AVE: Average variance extracted.

Table 19 Discriminant validity - HTMT results
(Acceptable level < 0.90)

	Parental migration	SES	Snacking consumption
Parental migration			
SES	0.26		
Snacking consumption	0.13	0.34	

Overall, a good reliability and validity show in the parental migration, and snacking consumption.

Although there was a low internal consistency show in SES, a good convergent validity shown in SES. Three items were still the component of latent variable SES in this study. It makes more sense than keeping only one or two items to represent SES.

There was 0.49 factor loading in “sugared drink”. Normally, factor loading less than 0.40 was recommend to remove it [143]. In addition, it is more sense that both two items to represent the snacking consumption.

5.2 Path analysis and model estimation

Standardised coefficients were computed and added in the structural equation model in Figure 7. Parental migration was directly associated with snacking consumption in children ($\beta = 0.24$, $p < 0.01$), which means longer parental migration duration and children cared by one parent or non-parents were associated with increased their snacking consumption. In addition, snacking consumption was directly associated with dental caries in the number of permanent teeth ($\beta = 0.21$, $p < 0.05$).

SES strong affect snacking consumption in children ($\beta = 0.46$, $p < 0.01$), but weakly affect the parental migration ($\beta = -0.27$, $p < 0.05$). In this study, a higher SES family was associated with increased children's snacking consumption but decreased parental migration.

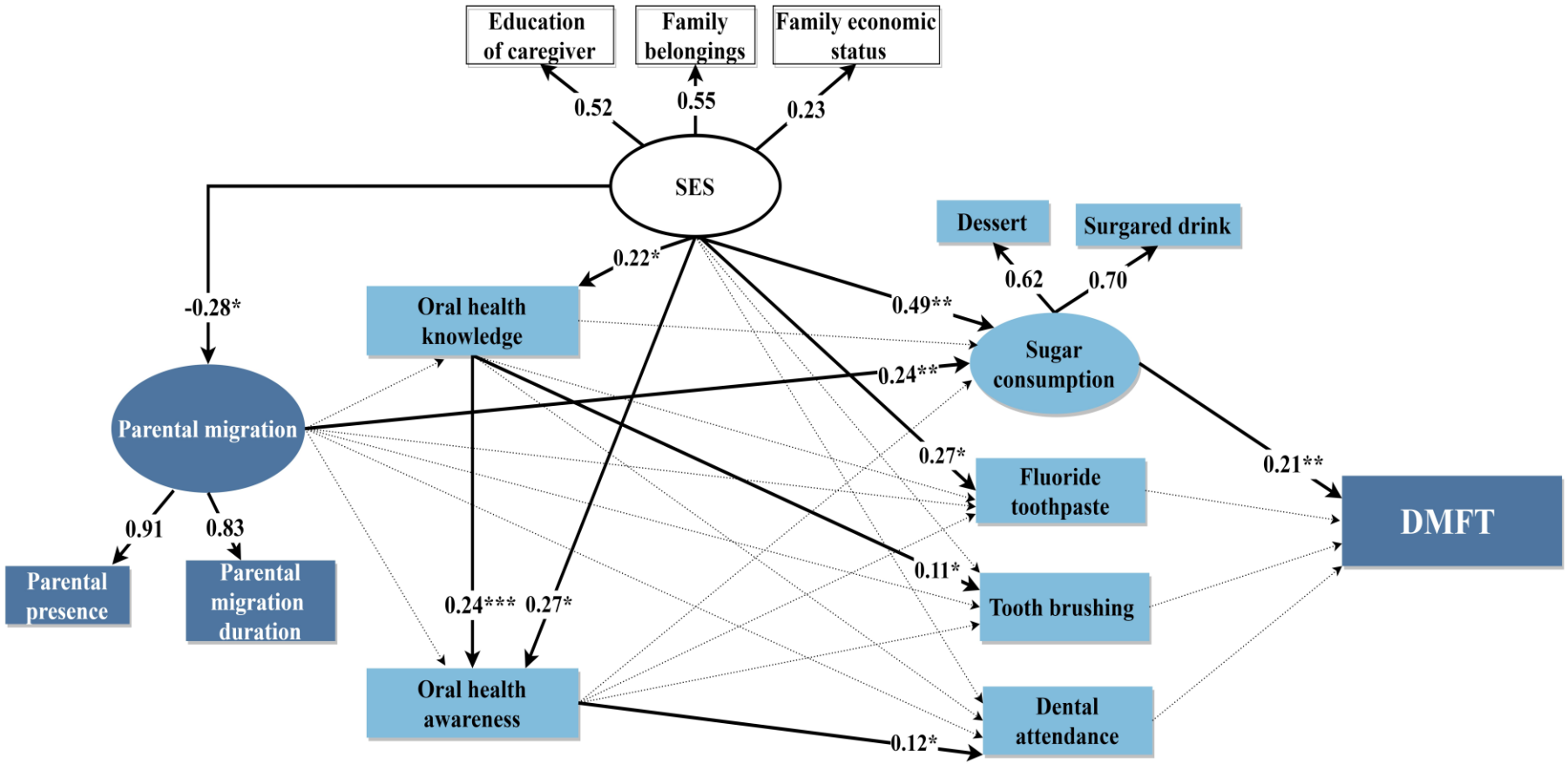

Figure 7 Structural equation model of the relationship between parental migration and dental caries in children

Note - The solid lines indicate significant relationships with the number on each line shows standardized path coefficient.
- The significant level for path coefficients was set at *P < 0.05, ** P < 0.01, and ***P < 0.001.
- The dotted lines indicate insignificant relationships.

5.3 Model fit

Table 20 Goodness of fit measures of the model

Fit index	Recommend levels	This model
$\chi 2$ /df	< 5.00	1.24
RMSEA	< 0.08	0.03
SRMR	< 0.08	0.04
GFI	> 0.90	0.99

$\chi 2$ /df: the chi-squared fit statistic;
RMSEA: root-mean-square error of approximation;
SRMR: standardised root mean square residual;
GFI: goodness-of-fit statistic.

The goodness of fit of the model is summarised in Table 20. The chi-square statistic for the model was 55.79 with 45 degrees of freedom ($p = 0.13$). In terms of goodness of fit indices, RMSEA was 0.03, SRMR was 0.04, GFI was 0.99, all suggesting an acceptable fit. Overall, when considering all indices, the model performed relatively well.

Part II Caregivers' response to advice

This part answered objective C, which compares the caregivers' responses to LBC and NLBC to the dental professional advice between LBC and NLBC. The definition of LBC used in Part II was "children under the age of 18 whose parents have been working outside the home for more than six consecutive months[22]".

Part II included 389 participants from Part I who received professional dental advice. We required the caregiver who received the advice to be the same person as the one who reported the response; thus, some participants were not the same ones. However, the caregivers reported that they transferred the information on their children's dental advice to other caregivers in the family. About 60.4% (235 persons) of caregivers were the same persons.

6. Results of caregivers' response to advice

6.1 Children and caregiver's characteristics

Table 21 Children characteristics of LBC and NLBC in Part II
N (unweighted %)

Variables	Overall	NLBC	LBC
N	389 (100.0)	183(47.0)	206 (53.0)
Age of child			
6	138 (35.5)	65 (35.5)	73 (35.4)
7	184 (47.3)	83 (45.4)	101 (49.0)
8	67 (17.2)	35 (19.1)	32 (15.5)
Sex of child			
Female	180 (46.3)	85 (46.4)	95 (46.1)
Male	209 (53.7)	98 (53.6)	111 (53.9)
Relation to child			
Father	80 (20.6)	48 (26.2)	32 (15.5)
Mother	192 (49.4)	107 (58.5)	85 (41.3)
Grandparents	111 (28.5)	28 (15.3)	83 (40.3)
Others	6 (1.5)	0 (0.0)	6 (2.9)

Table 21 shows the characteristics of 389 participants in Part II, which consisted of 47.0% NLBC and 52.0% LBC. Most children in Part II were aged 6-8-year-old and had about the same proportion of females and males. Most caregivers of LBC were mothers (41.3%) and grandparents (40.3%), while NLBC was the mother (58.5%).

6.2 Utilization of oral health services

Table 22 Utilization of oral health services of the child
N (unweighted %)

Variables	Overall	NLBC	LBC	P*
N	389	183	206	
Time of last dental visit				0.21
Less than 6 months	83 (21.3)	44 (24.0)	39 (18.9)	
6 to < 12 months	62 (15.9)	32 (17.5)	30 (14.6)	
More than 12 months	82 (21.1)	41 (22.4)	41 (19.9)	
Never	162 (41.6)	66 (36.1)	96 (46.6)	
Purpose of last dental visit (Within 1 year, Multiple answers)				0.77
Consulting	49 (21.6)	28 (23.9)	21 (19.1)	
Prevention	18 (7.9)	10 (8.5)	8 (7.3)	
Treatment	79 (34.8)	40 (34.2)	39 (35.5)	
Don't know	81 (35.7)	39 (33.3)	42 (38.2)	
Payment method				0.66
Out of pocket expenses	81 (20.8)	39 (21.3)	42 (20.4)	
Reimbursement	1 (0.3)	1 (0.5)	0 (0.0)	
No fee	18 (4.6)	10 (5.5)	8 (3.9)	
Don't know	289 (74.3)	133 (72.7)	156 (75.7)	
Reasons for did not visit the dentist (Within 1 year, Multiple answers)				
Not concerned about oral health				
No dental diseases	172 (70.2)	77 (72.0)	95 (68.8)	0.70
Not severe	58 (23.7)	26 (24.3)	32 (23.2)	0.96
Wrong beliefs about oral health				
No need to cure primary teeth	62 (25.3)	27 (25.2)	35 (25.4)	1.00
Barriers to the oral health services system				
Economic issue	25 (10.2)	6 (5.6)	19 (13.8)	0.06
Inconvenience	18 (7.3)	5 (4.7)	13 (9.4)	0.24
No dentist nearby	10 (4.1)	5 (4.7)	5 (3.6)	0.75
No reliable dentists	2 (0.8)	1 (0.9)	1 (0.7)	1.00
Difficulty of registration	2 (0.8)	1 (0.9)	1 (0.7)	1.00
No reimbursement	2 (0.8)	1 (0.9)	1 (0.7)	1.00
Others				
No time	13 (5.3)	4 (3.7)	9 (6.5)	0.50
Fear of pain and infectious diseases	14 (5.7)	3 (2.8)	11 (8.0)	0.15

Note: * Analysis using Chi-squared test.

The time of last dental visit was not statistically significant difference between the NLBC and LBC (P = 0.21). Most caregivers who reported that their children visited dentists within 1 year did not know why their children visited dentists and what the payment methods were. About 41.6% of caregivers had never taken their

child to visit the dentist, and this proportion was higher among LBC than NLBC. The majority of caregivers did not visit a dentist because their children did not have any dental diseases. There were no significant differences in the reasons for not visiting a dentist between the caregivers of NLBC and LBC (P > 0.05). (Table 22)

Table 23 Management of oral health oral problems of the child
N (unweighted%)

Variables	Overall	NLBC	LBC	P*
N	389	183	206	
Frequency of toothache during the past 12 months				0.07
Never	162 (41.6)	66 (36.1)	96 (46.6)	
1-2 times or episode	176 (45.2)	87 (47.5)	89 (43.2)	
> 2 times or episode	19 (4.9)	13 (7.1)	6 (2.9)	
Don't know	32 (8.2)	17 (9.3)	15 (7.3)	
Management of toothache				0.17
Go to a public hospital	101 (51.8)	47 (47.0)	54 (56.8)	
Go to a private hospital	31 (15.9)	20 (20.0)	11 (11.6)	
Take pain killing medication	33 (16.9)	14 (14.0)	19 (20.0)	
Go to the traditional dentist	6 (3.1)	3 (3.0)	3 (3.2)	
Do nothing	24 (12.3)	16 (16.0)	8 (8.4)	

Note: * Analysis using Chi-squared test.

Table 23 demonstrates that during the past 12 months, more than half of the children had a toothache, of which 45.2% had 1-2 episodes. And more than half of them visited public hospitals. There was no significant difference in responses to frequency and management of toothache were found between NLCB and LBC.

6.3 Response to advice

Table 24 Comparison of the response to advice between NLBC and LBC, N (unweighted %)

Characteristic	Overall	NLBC	LBC	P*
N	389	183	206	
Supervise daily oral health behaviour of the child				**0.04**
Yes	250 (64.3)	128 (69.9)	122 (59.2)	
No	139 (35.7)	55 (30.1)	84 (40.8)	
Take the child to visit the dentist				0.78
Yes	128 (32.9)	62 (33.9)	66 (32.0)	
No	261 (67.1)	121 (66.1)	140 (68.0)	
Type of oral health setting				0.86
Public	67 (52.0)	34 (54.1)	33 (50.0)	
Private	60 (47.2)	28 (45.9)	32 (48.5)	
Traditional dentistry	1 (0.8)	0 (0.0)	1 (1.5)	

Note: * Analysis using Chi-squared test.

Table 24 showed that 64.3% of caregivers had supervised children's daily oral health behaviours after getting the advice. The proportion of NLBC's caregivers supervising their children was significantly higher than LBC ($p = 0.04$). About one-third of the caregivers took their children to visit the dentist after getting professional advice. There were two purposes for visiting the dentist: consulting and treatment. A higher proportion of NLBC (59.7%) visited the dentist for treatment than LBC (47.0%). This also showed that the mean treatment fee among NLBC was 207.9 RMB compared with that of the LBC, which was 66.5 RMB.

However, there were no significant differences in taking the child to visit the dentist and the type of oral health care setting between LBC and NLBC. Almost equal proportions of public and private settings were reported for taking the children to get dental services.

6.4 Reasons for following and not following the advice

Table 25 Comparison of reasons for **not supervising the children's oral health behaviour** between NLBC and LBC, N (unweighted %)

Characteristic	Overall	NLBC	LBC	P*
N	139	55	84	
It is not serious about the oral problems of the child.				0.23
Yes	20 (14.4)	5 (9.1)	15 (17.9)	
No	119 (85.6)	50 (90.9)	69 (82.1)	
No time since too busy.				0.92
Yes	50 (36.0)	19 (34.5)	31 (36.9)	
No	89 (64.0)	36 (65.5)	53 (63.1)	
The child can take care of himself.				0.53
Yes	106 (76.3)	44 (80.0)	62 (73.8)	
No	33 (23.7)	11 (20.0)	22 (26.2)	

Note: * Analysis using Chi-squared test

The most frequent answer for not supervising the child's oral health behaviours among caregivers was that the child could take care of himself (76.3%), followed by no time or being too busy (36%). (Table 25)

Table 26 Comparison of reasons for **visiting a dentist** after receiving advice between NLBC and LBC, N (unweighted %)

Characteristic	Overall	NLBC	LBC	P*
N	128 (100)	62 (48.4)	66 (51.6)	
Following the advice				1.00
Yes	106 (88.3)	51 (87.9)	55 (88.7)	
No	14 (11.7)	7 (12.1)	7 (11.3)	
Having dentists nearby				0.31
Yes	9 (7.5)	6 (10.3)	3 (4.8)	
No	111 (92.5)	52 (89.7)	59 (95.2)	
Reliable dentists.				1.00
Yes	10 (8.3)	2 (3.4)	8 (12.9)	
No	110 (91.7)	56 (96.6)	54 (87.1)	
Can be reimbursed.				1.00
Yes	2 (1.7)	1 (1.7)	1 (1.6)	
No	118 (98.3)	57 (98.3)	61 (98.4)	
It is important that the child has good oral health.				0.71
Yes	77 (64.7)	39 (67.2)	38 (62.3)	
No	42 (35.3)	19 (32.8)	23 (37.7)	

Note: * Analysis using Chi-squared test

Table 27 Comparison of reasons for **not visiting a dentist** after receiving advice between NLBC and LBC, N (unweighted %) (*Multiple answers*)

Option	Overall	NLBC	LBC	P*
N	261	121	140	
Do not concern				
Having no pain	164 (62.8)	71 (58.7)	93 (66.4)	0.25
No need to cure primary teeth	76 (29.1)	40 (33.1)	36 (25.7)	0.24
Dental disease was not severe	194 (74.3)	90 (74.4)	104 (74.3)	1.00
No time	135 (51.7)	69 (57.0)	66 (47.1)	0.14
Economic issue	14 (5.4)	6 (5.0)	8 (5.7)	1.00
Self-treatment				
Seeking help from relatives	2 (0.8)	2 (1.7)	0 (0.0)	0.21
Seeking help from experiencers	4 (1.5)	2 (1.7)	2 (1.4)	1.00
Self-medication	5 (1.9)	1 (0.8)	4 (2.9)	0.38
Oral health system				
Inconvenience	15 (5.7)	3 (2.5)	12 (8.6)	0.07
Difficulty of registration	4 (1.5)	3 (2.5)	1 (0.7)	0.34
No dentists nearby	9 (3.4)	4 (3.3)	5 (3.6)	1.00
Fear of pain	12 (4.6)	10 (8.3)	2 (1.4)	**0.02**
Responsibility of parent	25 (9.6)	4 (3.3)	21 (15.0)	**<0.01**

Note: * Analysis using Chi-squared test

The most frequent reasons stated by caregivers who took children to visit the dental clinic were ″following the advice″ (88.3%) and ″it is important that the child has good oral health″ (64.7%). (Table 26) While the reason for not bringing their children to see dentists was mainly because they were not concerned about the oral health of the children. There were statistically significant differences in the reasons for not taking the children to see dentists between NLBC and LBC on ″fear for pain″ and ″Responsibility of parent″. More caregivers of NLBC than LBC reported ″fear for pain″ while unsurprisingly, a higher proportion of LBC's caregivers than NLBC's caregivers gave the reason of ″it is the responsibility of the parent″. (Table 27)

Chapter 5 Discussion

Part I Oral health outcomes

Our study examined the relationship between parental migration and dental caries among rural Chinese children aged 6-8 years. This study was conducted in the Yunnan province, located in southwest China, GDP of 2.71 trillion Yuan, ranking 18 in 2021 among 31 provinces of China[145]. The subjects in this study came from three counties that GDP was 30.55 billion Yuan[146], 22.96 billion Yuan[147], and 46.5 billion Yuan[148] in 2021, respectively. This cross-section study included 500 rural Chinese children with a mean age of 7-years-old. More than 60% of them are from parental migration families. It reflects and supports the significant rural-urban parental migration in China.

Most caregivers in this study had junior high school education, which corresponds to the Chinese Census 2020 report, which indicated that the average education level in Yunnan is junior high school[149]. More than 60% of caregivers in this study were farmers or stay-at-home. Therefore, the subjects or caregivers in this study roughly represented a picture of the population in rural areas of China where they had a low economic and low education level, poor jobs, and widespread internal migration.

Among parental migration families in this study, most primary caregivers were mothers or grandparents. These were correspondent with the fact that more than half of children had either their fathers left both parents left (Table 6). A similar phenomenon was reported in China's national report[9].

This study primarily detected effect of parental migration on children's oral health. It specific tested the difference in oral health behaviours, oral hygiene, and dental caries between different parental migration durations. Compared to other studies, this study divided parental migration duration into 4 groups; no, less than 6 months, equal 6 to < 12 months, and ≥ 12 months, whereas other previous studies used 2 categories; non-parental migration or non-left behind (including no or < 6 months left) and left-behind (≥ 6 months left)[12, 150]. Similar results from this study by four parental migration durations are found in other studies which used 2 categories[12].

In this study, more than 98% children had the basic medical insurance (Table 8). However, this basic medical insurance did not cover most oral health diseases[151]. The followings discuss findings on the effect of parental migration on oral health behaviours and dental caries.

Snacking frequency

In this study, 48.6% of children ate snacks more than twice a day (Table 9). This number is higher than the national level, which 38.9% of rural Chinese 5-years-old children drink sweet beverages more than twice a day[131] and higher than the rural Australian children, which 30.0% of children aged 9-years-old ate sugar-sweetened beverages more than twice a day[152].

This result mainly detected the children's snack consumption behaviour at home or outside the school because it is banned to sell snacks in the China primary schools. Usually, the primary schools in China provide students with meals at breakfast and lunch when coming to school[153]. However, most students consume snacks and sweet drinks outside schools depending on the family and the community environment. People living in a low-income family would take the snacks as rewards for children[154]. This attitude together with poor oral health awareness and knowledge of the caregivers increases the chance of eating snacks among Children[155]. In addition, this would be aggravated by many small shops around schools and houses create an easy-buying snacking environment. The concept of snacks consumption and convenience consumption environment increased the frequency of snacks consumption among the children.

This study found that there was a significantly different in snacking frequency among children with different parental migration duration. Interestingly, children with no parental migration ate snack more frequently than those with parental migration (Table 14). This is similar to the Qiu's study[12]. They found that higher proportion of children with no parental migration ate sweet beverages twice a day than children with parental migration. However, there was no statistical difference the Qiu study.

Home access to unhealthy foods was most consistently associated with snacking among young children[155]. In this study, no parental migration families had higher household income than parental migration families (Table 13), so they could afford to buy snack and had more opportunities to access snacks, especially if the caregivers do not have appropriate oral health knowledge and awareness. Our study corresponded with the results of the China's Health and Nutrition Survey from 2004 to 2011 showed that children in the urban areas consumed higher sugar-sweetened beverages than those the rural areas[156]. In addition, children from high income families had more sugar-sweetened beverage consumption than low-income households due to a higher purchasing capability[156].

Brushing frequency

Brushing teeth at least twice a day is the recommendation for appropriate oral health behavior[157]. Only 30.4% of children in this study brushed their teeth twice or more a day (Table 9). This proportion was higher than the proportion of younger children (5 years old) in China which was 24.1%[131]. But it was lower than in other countries, for example, in Mexico where 45.2% of rural children aged 8-12-years-old brushed their teeth more than twice a day[158]. In Australia, 65.0% of 9-year-old rural children brushed twice or more daily[152].

Toothbrushing is an important preventive measure for dental caries and gingivitis. It needs the caregivers to have appropriate oral health awareness and knowledge[159]. However, caregivers of this study showed inappropriate belief in caries protection and oral health knowledge on the benefit of fluoride (Table 10). Therefore, it is needed to raise awareness of oral health and improve oral health education in the general population, especially caregivers.

There was no significant difference in toothbrushing frequency between children with different parental migration duration (Table 14). It is consistent with Qiu's study[12]. It may reflect that insufficient oral health education among caregivers of the children regardless of parental migration or not (Table 14), makes no difference in their children's oral health behaviours. In addition, most children in this study had high plaque levels due to inefficient brushing techniques.

WHO recommended that children less than 8 years old cannot effectively brush their teeth and still need care from their parents[129]. To improve the caregiver's and children's oral health education, especially to develop a correct brushing technique for them, and inspire the motivation of toothbrushing among primary school-aged children to stay healthy oral hygiene style at a young age.

Fluoride toothpaste use

About 96% of children in this study did use toothpaste but only 56.0% used toothpaste containing fluoride (Table 9). These results are similar to the national survey that 97.6% of Chinese children aged 5-year-old use toothpaste and about 42.2% of them used toothpaste with fluoride[131]. It was a low rate of using fluoride toothpaste compared with other countries. For example, the children who using the fluoride toothpaste in US (2019) was 60%[133], and in Sweden (2015) was 80%[134]. A low rate of using fluoride toothpaste may be due to low oral health knowledge. This is supported by the findings that the majority of the caregivers in this study did not know that fluoride can protect teeth (Table 10) and the caregivers with less than elementary school were 2 times more likely to use non-fluoride toothpaste (Table 17). There is no significant difference in fluoride toothpaste use between children with different parental migration durations might be due to the indifferent awareness and knowledge levels between those caregivers (Table 14)

Another common barrier to fluoride toothpaste use among Chinese people is the local brand toothpaste and toothpaste labeling. In this study, 21.6% of toothpaste brands cannot be identified if they contain fluoride or not. Since some toothpaste brands, such as Kuailexiaoshenghuo (快乐小生活) and Qiaoboshi (桥博士), were not found on the common market or several major online shopping platforms. Most of them are native or unpopular brands that usually do not contain fluoride. This is supported by the Chinese national report that 63.6% of 5-years-old children use toothpaste that could not identify the fluoride content[131]. It is difficult to identify the fluoride ingredient on the toothpaste label which is one of the barriers for people to make decisions on buying fluoride toothpaste.

Dental attendance

The study showed that 36.0% of children used the oral health service in the past 12 months (Table 9). It was higher than national report, that 19.2% of 5-year Chinese children had oral health service in the past 12 months[160]. The reasons may be because there were access the oral health resource among population in this study, due to the study locations are close to the county hospital where the dental services were available (Figure 4).

This study found that proportions of dental attendance experience among children with different parental migration were rather low and not significant different (Table 14). It was consistent with other studies that there no significant difference in dental attendance between NLBC and LBC[84, 85].

It may also be explained by the fact that caregivers in all groups of parental migration durations had rather insufficient oral health awareness and knowledge, as well as low SES (Table 13 and 14). This was confirmed by our SEM result which showed that after controlling for the SES, oral health knowledge was associated with dental attendance frequency through the oral health awareness (Figure 7). It was consistent with the Poland study which found that university education of at least one of the parents significantly increased the chance of visiting a dentist[161].

In addition, the results in Table 17 showed that parental presence (non-parents), not parental migration duration was a significant risk factor for dental attendance experience (OR= 1.59, 95% CI = 1.03 - 2.44). Most non-parents tended to be grandparents, therefore, tended to have more barriers for bringing the children to get dental services[162].

In summary, regarding the oral health behaviours of the caregivers in this study, the results showed a significant difference in snack frequency between children with different parental migration durations but not in toothbrushing frequency, fluoride toothpaste use, and dental attendance.

Oral hygiene

The children in this study had poor oral hygiene or high mean OHI-S index (2.58 ± 0.57, Table 12). Compared with other studies using same index: 1.4 (aged 4-5 years)[163]; 1.43 (aged 10-15 years)[164]; 1.33 (aged 7-19 years)[165], the present study showed an extremely high mean OHI-S level. A low family income and caregivers' inappropriate oral health knowledge were a risk for children's oral hygiene. Previous studies proved that low SES in the family and poor oral health knowledge increased the children's oral health problems[166, 167]. Our study confirmed this among rural Chinese children. In addition, this result indicates that rural children had poor oral health behaviours, including eating snacks with high frequency and poor toothbrushing behaviour.

This study showed a statistical difference in oral hygiene levels between children with different parental migration durations (Table 16). The highest OHI-S level was found in the group of those with recent parental migration (< 6 months). This period is the critical period because the whole family members, especially the children need to adjust to the change in the family environment[28, 168]. The caregivers and children themselves had stress and this might influence children's oral health behaviours and oral health[169, 170]. A recent parental absence might have mental health challenges. The longer period of parental migration allows the adjustment of the family members and provides a stable child-caregiver relationship[171, 172].

Evidenced by a cross-sectional study conducted in four Asian countries showed that the more time pass, the more adjustment of the children to their new circumstances and a better relationship with their new caregivers[28, 168]. A Chinese study also supports that the longer duration of parental absence was associated with minor difficulties in children's mental health[173].

Dental caries

Dental caries was the primary outcome of this study. The children in this study had a very high prevalence of total caries (91.6%), and of primary teeth (91.1%) as well as a high mean number of primary carious teeth (6.61 ± 3.86) (Table 11, Table 12). Compared to the Chinese national survey, which reported that 73.4% of 5-years-old rural Chinese children had caries in primary teeth caries with a mean dmft of 4.47 ± 4.60[105]. However, the children in this study were older, therefore had experienced higher dental caries. Secondly, there were different criteria for dental caries examination. This study recorded both early enamel caries and dentine caries, while the national survey detected only dentine caries[131].

Compared with other countries, this study has a higher prevalence of dental caries. For example, in Saudi Arabia (2019), 86.1 % of rural children aged 6-years-old had caries[174]. In Mexico (2020), 72.4% of rural children aged 8-12-years-old had caries in permanent teeth[158]. And in India (2010), 60.4% of rural children aged 3-12-years-old had caries[175]. These data confirmed that dental caries is a global problem, especially among rural children. Improper oral health behaviours were found mainly in the low SES family, and they were associated with dental caries experience[176, 177].

The effect of parental migration on dental caries was investigated using both univariable analysis and multiple variable analysis (SEM). In the univariable analysis, there were no statistical difference in both dental caries prevalence and number of caries experiences between children with different parental migration durations. However, there were a significant linear increase in prevalence of caries in the primary teeth (dft) and total caries (DMFT + dft) with increased parental migration durations (Table 15, Table 16). Moreover, when exploring the factors associated with dental caries, we found no significant associations between dental caries and parental migration duration, parental presence, and other interested factors (Table 17).

This result was consistent with a previous study by Qiu and others in Luchuan where the economic status is lower than this study (12). The Qiu and others study found a significant difference in permanent teeth caries prevalence in children without parental migration (< 6 months) and with parental migration (≥ 6 months).

The explanations for the results of the univariable analysis may be difficult because dental caries is a multifactorial and multilevel disease including Child, family, and community influences[95, 96]. Those children in all groups with and without parental migration shared the same community environment with poor oral health knowledge and awareness. Dental caries is a social-economic disease and has cumulative damage. Even though there were different existing family situations, it was confounded by many factors especially socio-economic status. Therefore, the univariable analysis may be inappropriate.

The main exposure variable in this study is the parental migration which is at the family level. It influences the caregiver's factors that then influence the child's oral health and dental caries. Therefore, the SEM analysis would be more appropriate to investigate this complicate relationship.

Table 17 provides a preliminary direct association between outcome variables (oral health behaviours and dental caries) and independent variables (parental migration duration, parental presence, caregiver and family factors). The results showed that dental caries and brushing frequency was associated with parental migration duration, dental attendance was associated with parental presence and family economic status. Other oral health behaviours were associated with the SES factors. These variables were further used in the SEM analysis.

In the SEM analysis, 428 of all 500 participants were utilized to estimate the model due to missing data. It met the minimum sample sizes and other requirements of the SEM analysis. In the SEM model, parental migration consists of 2 strong variables: parental migration duration and parental presence. This is reasonable because parental migration changes the situation in the family especially the primary caregiver of the child, besides the duration of leaving children. Snacking frequency has 2 component variables which are dessert and sugared drink frequency. This reflected that child usually have dessert and sugared drink as them between meal snack.

The SEM analysis showed that after controlling for SES, parental migration had a significant effect on dental caries in the number of permanent teeth of the children aged 6-8-years-old through the snack frequency. This result was consistent with previous studies that found parental migration is a risk factor for children's dental

caries[12, 178-180]. This study indicates that one parent or non-parent caregivers and longer parental migration duration increased snacking frequency, consequently increasing dental caries in the number of permanent teeth in children.

It may explain by two aspects. First, children's psychological status affects their eating. Previous studies in younger (3-5-years-old)[181] and older (9-14-years-old)[7] children suggested that children with parental migration had more mental health problems than those without parental migration, such as loneliness and depression. Moreover, children with mild emotional stressors might have emotional eating and consumed significantly more calories from snack foods[182].

Secondly, most of the non-parent caregivers in this study were grandparents. Some studies proved that children cared for by grandparents consumed more sugar than those cared for by their parents[104, 183]. Grandparents tend to have indulgent feeding styles to meet their grandchildren's needs[184], therefore, they do not supervise children's daily sugar consumption. In addition, grandparents usually used food as an educational and emotional tool[185]. Furthermore, most grandparents in China had experienced a hungry period in the past decades, so they think that their children must eat full[186]. This perspective would promote the food and snack consumption of the children.

In this study, some children had high snacking consumption but most of them had low brushing frequency and low fluoridated toothpaste use. Since dental caries is the multi-factorial disease, the balancing of risk factors and protective factors are important[187]. To lower the caries risk, high sugar consumption should be balanced with a healthy oral health behaviours, such as brushing with fluoride toothpaste twice daily[187].

Furthermore, SEM model showed a pathway of the relationship between SES and dental attendance through oral health knowledge. This result of SEM confirmed after controlling for SES, the result of the univariable analysis only for the relationship between dental attendance and oral health knowledge, but not for dental attendance and parental presence or oral health awareness. The SEM provides the more reliable relationship since it can adjust for the known confounders.

In summary, this study showed that parental migration was significantly associated with dental caries of the children through the snack frequency. Parental migration composed of parental migration duration and parental presence. Long parental migration duration brings psychological stress and keeps children in an unhealthy dietary lifestyle, while parental presence results in a change in primary caregiver with insufficient parenting styles and skills to care for children that may increase unhealthy dietary behaviours of the children.

Part II Caregivers' response to advice

The definition of LBC in this part was children under 18 whose parents have been working outside the home for more than six consecutive months[22]. We used this definition because it was used in most previous studies[12, 188].

There were 389 caregivers (87.8%) consisting of 183 NLBC and 206 LBC who responded to the questionnaires regarding response to the advice. The reasons for most non-respondents were lost connection which they did not answer the call or invalid phone numbers. Most caregivers of LBC were mothers and grandparents due to the person who migrated away being the father or both father and mother.

Utilization of oral health services

This study found a low oral health services utilization rate among these rural children, especially in the LBC. Treatment was the primary purpose of the last dental visit among people. It is consistent with the Chinese national report in 2018. According to the report[160], a low prevalence of oral health services in the past 12 months among 5-years-old Chinese children (19.2%).

About 41.6% of children did not visit the dentist in the past 12 months (Table 22). The most frequent reason for not visiting the dentist within 12 months reported by the caregivers was that the children did not have dental disease. This reason was the same as the Chinese national survey in which 71.8% of caregivers of 3-5-years Chinese children indicated that their children did not visit a dentist in the past 12 months because "children had no dental diseases". Similar to the Indian study[189], which reported that people did not concern about oral health compared to their other life's needs. However, this result was in contrast to other developed countries. For example, in Australia, 76.7% of rural children aged 9-years-old had their last visit to a dentist less than 12 months[152]. In the US, 84.9 % of rural children aged 6-17-year-old had a preventive dental visit in 2017-2018[190].

There were no significant differences in the utilization of oral health services and their reasons between LBC and NLBC (Table 22). This is due to similar oral health awareness level of both caregivers from families with and without parental

migration (Table 14). In addition, a high frequency of caregivers in both groups reported that the purpose of the child's last dental visit was treatment (Table 22).

This study showed that about half of the children visited the public hospital (51.8%) when they had a toothache (Table 23). Only 15.9% of the children visited the private hospital. It can be explained that most oral health services are out-of-pocket in China.

Response to advice

This study may be the first to compare the responses to pieces of advice and their reasons between LBC and NLBC. The results will help solve the problems of non-compliant and may help set the policy to promote the compliant with the dental advice.

- **Response to advice for self-care**

The primary outcome of part II was the caregiver's response to both self-care and profession-care advice. The results showed that more than 60% of the caregivers followed the advice to self-care or supervised their children's daily oral health behaviours. Moreover, it was a significantly higher proportion of the caregivers of NLBC than those of LBC who followed this advice. This indicates that most caregivers tended to comply with the dentists when they were informed and realized, especially for the specific action that did not require much effort, like self-care[113]. NLBC's caregivers tended to follow the advice for self-care more than LBC's caregivers because they had better oral health knowledge and awareness (Table 14) and thus were more likely to have better care for their children than LBC[191].

There was no significant difference between NLBC and LBC on reasons for not supervising their children. The most frequent reason was the belief that the children could take care of themselves. Most parents think that they should raise their children to have good life skills, especially independence, as soon as possible. They might feel proud of their school-aged children with independent living skills, such as independently brushing their teeth[192]. However, these childrearing values may reflect caregivers' neglect of their school-age children's oral health. It is recommended that

children aged less than 8 years old cannot effectively brush their teeth and still need care from their parents[193].

- **Response to advice for professional care**

Oppositely, only about 30 % of caregivers followed the advice for professional care or taking their children to visit the dentist. A similar and non-significant difference between the proportions of caregivers of NLBC and LBC who took their children to see the dentist after receiving the advice.

This low percentage of compliance in this study was mainly due to less concern about the importance of the child's oral health. For example, the caregiver reported that the child had no pain or they had no time. In addition, the main barrier was that the caregivers thought that the dental disease was not severe.

Although almost all children in this study had the basic medical insurance (Table 8), this basic medical insurance did not cover most oral health diseases[151]. More than 90% of dental expenditure was paid out-of-pocket[151]. This may be one of the barriers for getting dental service. Interestingly, few caregivers mentioned the economic issue. This may be because the governmental oral health service was available, and people could afford it.

Additionally, similar proportions were reported for visiting the public and private oral health care settings. The study locations of this study were close to both private dental clinics and local county hospitals (Figure 4). Both dental service settings had similar distance. Moreover, there were similar fees for the dental service in public and private settings in this study area. These may be explanations for the indifference between the settings where the caregivers brought their children to have dental service in this study.

The caregivers of the NLBC were significantly more likely than LBC to report "fear of pain" for not bringing their children to see the dentist. While a significantly higher proportion of LBC's caregivers than NLBC's caregivers (15.0% vs. 3.3%) reported, "it is the responsibility of the child's parent". These results can be understandable because the parents who were caregivers of NLBC are normally more

concerned about their children's oral health and well-being than non-parents who often were caregivers of LBC.

The most reason given by the caregivers who took their children to see the dentist after getting the advice was, they followed the advice, followed by the concern about the good oral health of their child. These reflect the good attitude and awareness of the caregivers of both NLBC and LBC.

Summarily, the results of Part II suggest that examining the children's oral health and giving advice to the caregivers can help improve the children's oral health, especially for self-care. This activity takes little time but provides a great return on NLBC and LBC. To promote the caregivers' compliance to both self-care and professional care for the children's oral health, the appropriate awareness, knowledge, and belief on oral health should be emphasized. Importantly, the barriers of the LBC's caregivers should be taken into action.

Strengths and limitations

Strengths

Our study was conducted on children who live in rural and under-developed areas with a high prevalence of internal migration and dental diseases. This study may be the first study that studies the effect of parental migration duration and the parental presence on children's oral health. In addition, this is the first study to compare the responses of the NLBC's and LBC's caregivers to advice from the oral health professionals on children's oral health. Furthermore, this study also illustrates the pathway of parental migration and children's dental caries by using Structural equation modelling (SEM).

Limitations

Part I of this study was a cross-section design. This study design cannot provide a causal relationship[194]. It only suggests the association between parental migration and the children's oral health. Secondly, in Part II, some caregivers who answered the questionnaire were not the same person who received the advice. Also, some caregivers who responded to the questionnaire were not primary caregivers due to the problems of travelling to the school. However, the number of both issues was small. In addition, it was informed to the respondent that the information about the child was transferred between the family members. Therefore, the impact of these limitations was expected to be minor.

Chapter 6 Conclusions

Summary

The key results of this study are:

1. There was no significant difference in parental migration duration in toothbrushing frequency, use of fluoride, and dental attendance between parental migration duration, but a significant difference in snacking frequency.

2. Parental migration, including parental migration duration and parental presence, is associated with children's dental caries through snacking consumption after controlling for the SES (family economic status, number of family belongings, and caregiver's education level). A longer time of parental migration and the caregivers who were not both parents increased the frequency of snack consumption in children, consequently increasing dental caries in the number of permanent teeth in children.

3. There is a significant difference in response to advice for self-care between LBC and NLBC's caregivers, but not in response to advice for professional care. Few caregivers took their children to visit the dentist after getting professional advice. The main reason for not bringing children to visit dentists was that caregivers were not concerned about the oral health of the children because they thought that the disease was not severe and the children had no pain.

Suggestions for further application

The results from this study can help to conduct the programs or policies for improving the oral health of the school children in the rural areas, especially those who live in the family with parental migration. The followings are the suggestions.

1. Oral health knowledge and oral health awareness of the parents and caregivers should be provided via various measures to build proper oral health care for the children. For example, comprehensive integration of public and private community-based oral health education and oral health promotion programs should be conducted, especially in the rural areas. As well as, increase the dental coverage in the basic medical insurance and making the local people more acknowledge the local oral health resources to improve the utilization of oral health resources.

2. A public health campaign and education on the effect of appropriate dietary and nutritional behaviour as well as oral hygiene behaviour on health and oral health of the children should be encouraged to promote parenting skills of both parents and non-parents, for example, advocating less sugar consumption and proper tooth brushing with fluoride toothpaste to the caregivers. Furthermore, the policy on regulation and promotion of fluoride toothpaste as well as clear labels on snacking and toothpaste packages to help the consumers to buy healthy products.

3. There is a need for interdisciplinary cooperation such as psychologists, sociologists, educationists, nutritionists, medical doctors, and dentists to care for health, oral health, and well-being of the children with parental migration, especially, the recent LBC (< 6 months), to help them adapt to the family situation. For example, there is a need to build the multi-disciplinary centers with a friendly environment to take care of the children with parental migration, especially for recent parental migration family.

4. The government should give more resources and supports to the rural areas to increase the access to the dental service and support the programs that promote a healthy lifestyle for the children in the schools. Examples are providing three meals and limiting snack shops around the schools to reduce children's snack frequency, enabling healthy environments for a healthy lifestyle, incorporating oral health education into the curriculum for the schoolchildren, and providing more services on

the oral health prevention for children.

Suggestions for further study

Further studies could be conducted on:

1. The effect of parental migration and/or parental presence on oral health in other populations such as different age groups, regions, e.g., urban areas, other countries, etc.

2. The effect of the psychological aspects of the child and the family with parental migration on oral health.

3. The comprehensive exploration of health and oral health problems and their factors among children with and without parental migration or different parental presence.

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Appendix 1 Questionnaires and record form were used in this study

Oral Health Assessment Form for Children, 2020 (OHI-S)

ID _____

Examiner ☐01 ☐02

Dentition status

	16	55	54	53	52 12	51 11	61 21	62 22	63	64	65	26
Tooth												
Occ												
Mes												
Buc												
Dis												
Li												

	46	85	84	83	82 42	81 41	71 31	72 32	73	74	75	36
Tooth												
Occ												
Mes												
Buc												
Dis												
Li												

Primary teeth	Permanent teeth Status
A	0 = Sound
B	1 = Early enamel caries
C	2 = Dental caries
D	3 = Filled w/caries
E	4 = Filled, no caries
——	5 = Missing due to caries
F	6 = Missing for another reason
G	7 = Fissure sealant
H	8 = Fix dental prosthesis/crown,abutment , veneer
——	9 = Not recorded

DI (OHI-S, Greene & Vermillion, 1964)

16 B	11La	26B
46Li	31La	36Li

DI

0 = No debris or stain present

1 = Soft debris covering not more than one third of the tooth surface

2 = Soft debris covering more than one third, but not more than two thirds, of the exposed tooth surface

3 = Soft debris covering more than two thirds of the exposed tooth surface

CI (OHI-S, Greene & Vermillion, 1964)

16 B	11La	26B
46Li	31La	36Li

0 = No calculus present

1 = Supragingival calculus covering not more than third of the exposed tooth surface

2 = Supragingival calculus covering more than one third but not more than two thirds of the exposed tooth surface

3 = Supragingival calculus covering more than two third of the exposed tooth surface

Questionnaire: Caregiver Form

Caregiver ID: Child name:
Survey date: Investigators Number:
Requirements: Please tick "√" in front of the corresponding multiple-choice options "☐ ".

Table A Questionnaire about the basic situation of children's parents or guardians

1. Your child's age is:

2. Your child's gender is:

3. Relationship to child?
1) ☐ Father
2) ☐ Mother
3) ☐ Grandfather
4) ☐ Grandmother
5) ☐ Uncle/aunt
6) ☐ Other, please specify

4. Your date of birth is:

5. Your ethnicity is:

6. What level of education have you completed?
1) ☐ No formal schooling
2) ☐ Primary school completed
3) ☐ Secondary school completed
4) ☐ High school completed
5) ☐ College/university completed
6) ☐ Master and above completed

7. Occupations:
1) ☐ Farmers
2) ☐ Local merchants
3) ☐ Government officials / doctors / teacher
4) ☐ Stay-at-home to take care of children and/or elderly
5) ☐ Stay-at-home elderly

6) ☐ Other, please specify

Table B Family questionnaire

Family size

1. How many people lived together in your family? (People with the same household registration OR living together for more than 6 months.)

2. Besides this child, who else is in the family? (Multiple choice)

1) ☐ Father
2) ☐ Mother
3) ☐ Siblings
4) ☐ Grandpa
5) ☐ Grandma
6) ☐ Uncle
7) ☐ Auntie
8) ☐ Other, please specify

Family environment

3. How far is your home from the nearest health facility?

1) ☐ Community Health Centre
2) ☐ Village Health Centre
3) ☐ Private Clinic

Almost__km, on foot__minutes, by car___minutes.

4. How far is your home from your county hospital?

Almost__km, on foot__minutes, by car___minutes.

Family medical insurance

5. What kind of medical insurance has been buying for this child?

1) ☐ New rural cooperative medical care
2) ☐ Urban residents medical insurance
3) ☐ Commercial medical insurance
4) ☐ Not participated

6. In addition to the above medical insurances, are there any other medical insurances for this child?

1) ☐ Yes 2) ☐ None

Family's economic status

7. What is the level of financial status of your family in the local area?

1) ☐ In > Out 2) ☐ In = Out 3) ☐ In < Out

8. Your family owns (multiple choices):

1) ☐ Air conditioner
2) ☐ Washing machine
3) ☐ TV set
4) ☐ Refrigerator

5) ☐ Computer
6) ☐ Motorcycle
7) ☐ Phone
8) ☐ Water heater
9) ☐ Car

9. Who are the main breadwinner of the family?

1) ☐ The father of the child
2) ☐ The mother of the child
3) ☐ The grandparent of the child
4) ☐ The brother or sister of the child
5) ☐ Other, please specify

If your family has migrant workers, please continue answer Q14. Otherwise, please skip to Table C.

10. Are there the migrant workers for more than one year in your family?

1) ☐ Yes, respectively: (Multiple choice)
   1) ☐ the father of the child 2) ☐ the mother of the child 3) ☐ others
2) ☐ None (skip to Q7)

11. Are there the migrant workers for more than six months in your family?

1) ☐ Yes, respectively: (Multiple choice)
   1) ☐ the father of the child 2) ☐ the mother of the child 3) ☐ others
2) ☐ None (skip to Q7)

12. Why go out for work? (Multiple choice)

1) ☐ Improve the quality of life
2) ☐ Looking for a better job
3) ☐ Other, please specify

13. How old was the child when the parents went out for work?___years old

14. Compared with before don't have migrant workers,

14.1 Has your family's economic situation improved?

1) ☐ Better 2) ☐ Not changed 3) ☐ Worse

14.2 Has your family's health investment increased? (Including: spend more money to see a doctor, or buy more medical insurance, or increase nutrition for children, etc.)

1) ☐ Increased 2) ☐ Not changed 3) ☐ Reduced

14.3 Have a change in the child's emotions?

1) ☐ Happier 2) ☐ No change 3) ☐ Not happy

14.4 Have a change in the child's housework burden?

1) ☐ Aggravated 2) ☐ Not changed 3) ☐ Reduced

14.5 As a child's main caregiver, do you feel the pressure has increased?

1) ☐ Increased 2) ☐ Not changed 3) ☐ Reduced

Table C Oral health status questionnaire

Oral health behaviours

1. How often does your child drink or eat any of the following foods at home? (Tick every line)

	3 Twice or more a day	2 Once a day	1 Few / Never	0 Don't know
1.1 sweets snacks (e.g. cookies, cakes, bread)	☐	☐	☐	☐
1.2 sweet drinks (e.g. cola, fruit juices)	☐	☐	☐	☐
1.3 other, please specify	☐	☐	☐	☐

2. Does your child eat dessert or have a sweet drink before going to bed at night?

1) ☐ Often
2) ☐ Occasionally
3) ☐ Never
4) ☐ Don't know

3. Can the child brush his/her teeth <u>when parents go out for work the nearest time</u>? (If there is no migrant worker, please skip)

1) ☐ Can brush independently
2) ☐ Need caregiver help sometimes
3) ☐ Need caregiver help completely
4) ☐ Did not start brushing teeth

4. How old did your child start brushing his/her teeth?

1) ☐ Half-year-old 2) ☐ One-year-old 3) ☐ Two-year-old 4) ☐ Three-year-old
5) ☐ Four-years-old 6) ☐ Five-years-old 7) ☐ Don't remember

5. How many times does your child brush his/her teeth every day?

1) ☐ Twice times or more
2) ☐ Once
3) ☐ Not brush every day
4) ☐ Never brush

6. Does your child use toothpaste when brushing?
1) ☐ Yes, the brand of toothpaste used by child is:
2) ☐ No
3) ☐ Do not know

7. How do you assess your child's overall oral health?

1) ☐ Excellent	2) ☐ Good	3) ☐ Fair
4) ☐ Poor	5) ☐ Very poor	6) ☐ Do not know

8. How do you assess your child's overall well-being?

1) ☐ Excellent	2) ☐ Good	3) ☐ Fair
4) ☐ Poor	5) ☐ Very poor	6) ☐ Do not know

Utilization of Oral Health Services

9. How often has your child suffered from tooth ache during the past 12 months? (Only one answer)

1) ☐ Never (Go to Q11.1)	2) ☐ A couple of times (1-2 times/episode)
3) ☐ Often (> 2 times/episode)	4) ☐ Don't know (Go to Q11)

10. What did you do when your child suffered from tooth ache during the past 12 months?

1) ☐ Go to a public hospital/stomatology hospital/health clinic
   (If you choose this option, please continue answer **Q10.1**)
   10.1 The hospital level of your treatment:
   1) ☐ Provincial-level 2) ☐ Prefecture-level
   3) ☐ County-level 4) ☐ Primary health centres (Community hospitals/clinics)
2) ☐ Go to a private hospital/dental clinic
3) ☐ Buy/Eat medicines to relieve the pain (Go to Q11.1)
4) ☐ Go to the traditional dentist (Go to Q11.1)
5) ☐ Nothing to do (Go to Q11.1)

11. How long has your child been visiting the dentist from the last time until now?
1) ☐ Within 6 months
2) ☐ From 6 months to 12 months
3) ☐ More than 12 months (If you choose this option, please continue answer Q11.1)
   11.1 What is the reason for not visiting the dentist in public sector in the past 12 months? (Multiple answers)

1) ☐ No dental diseases	2) ☐ Dental disease was not severe
3) ☐ No need to cure primary teeth	4) ☐ Economic issue

5) ☐ Inconvenience
6) ☐ No time
7) ☐ Fear of pain
8) ☐ No dentist nearby
9) ☐ Fear of infectious diseases
10) ☐ No reliable dentists
11) ☐ Difficulty of registration
12) ☐ No reimbursement
13) ☐ Other, please specify

12. Concerning the last dental visit, why your child had to see a dentist? (Only one answer)

1) ☐ Consulting 2) ☐ Prevention 3) ☐ Treatment 4) ☐ Don't know

13. How much is the total cost of your child visiting a dentist in a public hospital/dental clinic in the past year?_____RMB

(Please fill in an integer. If you don't know or refuse to answer, please fill in "N".)

14. In the cost of dentistry, you need to co-pay_____%.

(Please fill in an integer. If you don't know or refuse to answer, please fill in "N".)

Oral health knowledge and awareness

15. What do you think of the statements listed below? (Tick in every line)

	1 Agree	2 Disagree	3 Indifferent	4 Don't know
1) Oral health is important	☐	☐	☐	☐
2) Regular oral health examination is necessary	☐	☐	☐	☐
3) The health of the teeth is decided at birth, and is not significantly associated with your protection	☐	☐	☐	☐
4) Oral disease prevention mainly depends on yourself	☐	☐	☐	☐

16. Do you think the following statements are correct? (Tick in every line)

	1 Yes	2 No	3 Don't know
1) Bacteria can cause gingival inflammation.	☐	☐	☐
2) Toothbrushing can prevent gingival bleeding.	☐	☐	☐
3) Bacteria can cause dental caries.	☐	☐	☐
4) Sugar intake can lead to dental caries.	☐	☐	☐
5) Deciduous dental caries can be left alone.	☐	☐	☐
6) Pit and fissure sealing can prevent children from dental caries.	☐	☐	☐
7) Fluoride can protect teeth.	☐	☐	☐

Advice for the caregivers

1. Bring the child to see dentist for

☐ 1.1 Extraction of teeth #

☐ 1.2 Filling of teeth#

☐ 1.3 Scaling/ tooth cleaning

☐ 1.4 Preventive care; Sealant or professional fluoride application

☐ 1.5 Others

2. Supervise or close care on your child oral health behaviours on

2.1 Toothbrushing

☐ Brush in the morning

☐ Brush before going to bed

☐ Brush with longer time

☐ Others

2.2 Snacking

☐ Less frequent snaking

☐ Limited amount of sweet foods

☐ Others

Dentist feedback (Only done by a dentist)

Patient name___ Age___ Name of public hospital

The person received treatment of_____.

The current situation is ☐ Good

☐ Stable

☐ Need further treatment

Signature

Day, month, Year

Questionnaire for Checking Response
Caregiver Form

Caregiver ID: Child ID: Intervention Urgency: □
Survey date: Investigators Number: □

1. Relationship to child? (Only one answer)
1) □ Father
2) □ Mother
3) □ Grandfather / grandfather
4) □ Grandmother / grandmother
5) □ Uncle/aunt
6) □ Other(specify)

2. According to the last oral examination recommendation, did you supervise your child's oral behaviour, including to increase the frequency of toothbrushing and reduce the frequency of snacking?
1) □ Yes (Go Q3) 2) □ No (Go Q4)

3. What is the reason you supervise your child's oral behaviour? (Multiple answers)
1) □ According to the advice we gave you, you start to supervise your child's oral behaviour.
2) □ According to the results of the last inspection, you think your child's oral health is very important and should be monitored more.
3) □ Others:

4. What is the reason you did not supervise your child's oral behaviour? (Multiple answers)
1) □ It is not serious about oral problems of child.
2) □ No time since too busy.
3) □ The child can supervise himself.
4) □ Others:

5. According to the last oral examination recommendation, did you take your child to visit the dentist?
1) □ Yes (Go Q6, Q7) 2) □ No (Go Q8)

6. What's kind of dentist did you take your child to visit?
1) □ The traditional dentist
2) □ Dentist in the private clinic / hospital, name:___, fee:___RMB
3) □ Dentist in the public clinic / hospital, name:___, fee:___RMB
4) □ Others:_____, name:___, fee:___RMB

7. What is the reason your child has visited the dentist? (Multiple answers)
1) □ Based on our advice last time.
2) □ There is the dentist in the village-hospital.
3) □ I know the trusted dentist nearby.
4) □ The New Cooperative Medical Insurance (NCMS) can reimburse some of the expenses.

5) ☐ It is important that the child has good oral health.
6) ☐ Other reasons:

8. What is the reason your child has not visited the dentist? (Multiple answers)
1) ☐ The child does not need to see a doctor during the dental replacement period.
2) ☐ There is the oral carer in the school.
3) ☐ It is not serious about oral problems of child.
4) ☐ Seeking help from relatives/friends
5) ☐ Seeking help from others who have similar experiences
6) ☐ Self-treatment:
7) ☐ Because of poor household income, we don't visit dentists.
8) ☐ No time since too busy.
9) ☐ It is not convenient to visit a dentist.
10) ☐ It is difficult to register in an outpatient clinic.
11) ☐ No dentist nearby.
12) ☐ Because the child is afraid of the pain of dental.
13) ☐ This is the responsibility of the child's parents.
14) ☐ Other reasons:

Appendix 2 Detailed descriptive results in each county

Table 1 Characteristics of children's oral health behaviour, N (Unweighted%)

Variables	County 1		County 2				County 3	**Total**		
	Sch-1	Sch-2	Sch-3	Sch-4	Sch-5	Sch-6	Sch-7	**N**	Unweighted%	**Weighted%**
N	14	34	126	77	38	80	131	500		
Snacking frequency										
Few / Never	0 (0.0)	1 (2.9)	52 (41.3)	33 (43.4)	19 (50.0)	47 (62.7)	51 (39.5)	203	41.3	32.4
Once a day	5 (35.7)	2 (5.9)	30 (23.8)	19 (25.0)	8 (21.1)	14 (18.7)	30 (23.3)	108	22.0	18.8
Twice or more	9 (64.3)	31 (91.2)	44 (34.9)	24 (31.6)	11 (28.9)	14 (18.7)	48 (37.2)	181	36.8	48.8
Brushing frequency										
Twice or more	1 (7.1)	15 (44.1)	47 (37.3)	25 (33.8)	10 (26.3)	16 (21.1)	37 (28.2)	151	30.6	30.4
Once a day	12 (85.7)	14 (41.2)	68 (54.0)	37 (50.0)	17 (44.7)	44 (57.9)	64 (48.9)	256	51.9	44.7
Not brush every day	1 (7.1)	5 (14.7)	10 (7.9)	12 (16.2)	10 (26.3)	16 (21.1)	21 (16.0)	75	15.2	21.7
Never brush	0 (0.0)	0 (0.0)	1 (0.8)	0 (0.0)	1 (2.6)	0 (0.0)	9 (6.9)	11	2.2	3.2
Use of toothpaste (TP)										
TP with fluoride	8 (61.5)	22 (64.7)	66 (61.7)	35 (47.9)	15 (45.5)	31 (47.0)	37 (34.9)	214	49.5	56.0
TP without fluoride	3 (23.1)	6 (17.6)	26 (24.3)	19 (26.0)	7 (21.2)	16 (24.2)	17 (16.0)	94	21.8	18.5
TP with f not clear	2 (15.4)	6 (17.6)	9 (8.4)	17 (23.3)	10 (30.3)	19 (28.8)	44 (41.5)	107	24.8	21.6
No TP	0 (0.0)	0 (0.0)	6 (5.6)	2 (2.7)	1 (3.0)	0 (0.0)	8 (7.5)	17	3.9	3.9

Note: Each county: N (Unweighted%).

Table 2 Characteristics of utilization of oral health services, N (Unweighted%)

Variables	County 1		County 2				County 3	**Total**		
	Sch-1	Sch-2	Sch-3	Sch-4	Sch-5	Sch-6	Sch-7	**N**	Un weighted%	**Weighted%**
N	14	34	126	77	38	80	131	500		
Time of last dental visit										
Less than 6 months	0 (0.0)	9 (26.5)	30 (23.8)	19 (24.7)	13 (34.2)	16 (20.0)	15 (11.5)	102	20.4	23.3
6 -< 12 months	0 (0.0)	13 (38.2)	16 (12.7)	15 (19.5)	7 (18.4)	10 (12.5)	17 (13.0)	78	15.6	22.7
More than 12 months	5 (35.7)	3 (8.8)	24 (19.0)	14 (18.2)	9 (23.7)	22 (27.5)	28 (21.4)	105	21.0	22.3
Never	9 (64.3)	9 (26.5)	56 (44.4)	29 (37.7)	9 (23.7)	32 (40.0)	71 (54.2)	215	43.0	31.7
Reasons for did not visit the dentist (Without 1 year)										
Not concerned about oral health										
No dental diseases	12 (85.7)	10 (83.3)	51 (63.7)	31 (72.1)	8 (44.4)	38 (70.4)	75 (75.0)	225	70.1	70.2
Not severe	8 (57.1)	0 (0.0)	7 (8.8)	8 (18.6)	7 (38.9)	5 (9.3)	42 (42.0)	77	24.0	24.6
Wrong beliefs of oral health										
No need to cure primary teeth	3 (21.4)	3 (25.0)	19 (23.8)	8 (18.6)	9 (50.0)	10 (18.5)	30 (30.0)	82	25.5	34.5
Barrier to Oral health services system										
Economic issue	1 (7.1)	0 (0.0)	1 (1.2)	6 (14.0)	2 (11.1)	6 (11.1)	16 (16.0)	32	10.0	5.2
Inconvenience	0 (0.0)	0 (0.0)	1 (1.2)	5 (11.6)	0 (0.0)	4 (7.4)	11 (11.0)	21	6.5	2.6
No dentist nearby	1 (7.1)	0 (0.0)	2 (2.5)	3 (7.0)	1 (5.6)	1 (1.9)	4 (4.0)	12	3.7	2.0
No reliable dentists	0 (0.0)	0 (0.0)	1 (1.2)	0 (0.0)	1 (5.6)	0 (0.0)	0 (0.0)	2	0.6	0.7
Difficulty of registration	0 (0.0)	0 (0.0)	1 (1.2)	0 (0.0)	1 (5.6)	1 (1.9)	0 (0.0)	3	0.9	0.8
No reimbursement	1 (7.1)	0 (0.0)	1 (1.2)	1 (2.3)	0 (0.0)	1 (1.9)	0 (0.0)	4	1.2	0.4
Others										
No time	1 (7.1)	0 (0.0)	2 (2.5)	1 (2.3)	4 (22.2)	1 (1.9)	10 (10.0)	19	5.9	11.0

Fear of pain and infectious diseases	0 (0.0)	1 (8.3)	5 (6.2)	2 (4.7)	4 (22.2)	1 (1.9)	4 (4.0)	17	5.3	9.0
Purpose of last dental visit (Within 1 year)										
Consulting	1 (7.1)	12 (35.3)	27 (21.4)	17 (22.1)	10 (26.3)	10 (12.5)	9 (6.9)	86	17.2	22.3
Prevention	0 (0.0)	3 (8.8)	12 (9.5)	5 (6.5)	1 (2.6)	2 (2.5)	3 (2.3)	26	5.2	6.6
Treatment	4 (28.6)	5 (14.7)	25 (19.8)	22 (28.6)	17 (44.7)	13 (16.2)	19 (14.5)	105	21.0	27.3
Don't know	9 (64.3)	14 (41.2)	62 (49.2)	33 (42.9)	10 (26.3)	55 (68.8)	100 (76.3)	283	56.6	43.8
Payment method										
Out of pocket expenses	3 (21.4)	12 (35.3)	20 (15.9)	25 (32.5)	13 (34.2)	7 (8.8)	13 (9.9)	93	18.6	29.6
Reimbursement	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (2.6)	0 (0.0)	0 (0.0)	1	0.2	0.5
No fee	6 (42.9)	0 (0.0)	3 (2.4)	1 (1.3)	2 (5.3)	8 (10.0)	7 (5.3)	27	5.4	5.8
Don't know	5 (35.7)	22 (64.7)	103 (81.7)	51 (66.2)	22 (57.9)	65 (81.2)	111 (84.7)	379	75.8	64.2

Note: Each county: N (Unweighted%).

Table 3 Characteristics of visiting oral health institution, N(Unweighted%)

Variables	County 1		County 2				County 3	**Total**		
	Sch-1	Sch-2	Sch-3	Sch-4	Sch-5	Sch-6	Sch-7	**N**	Un weighted%	**Weighted%**
N	14	34	126	77	38	80	131	500		
Frequency of tooth ache during the past 12 months										
Never	9 (64.3)	9 (26.5)	56 (44.4)	29 (37.7)	9 (23.7)	32 (40.0)	71 (54.2)	215	43.0	31.7
1-2 times or episode	3 (21.4)	17 (50.0)	57 (45.2)	42 (54.5)	20 (52.6)	30 (37.5)	43 (32.8)	212	42.4	43.8
> 2 times or episode	2 (14.3)	1 (2.9)	4 (3.2)	3 (3.9)	7 (18.4)	2 (2.5)	7 (5.3)	26	5.2	7.4
Don't know	0 (0.0)	7 (20.6)	9 (7.1)	3 (3.9)	2 (5.3)	16 (20.0)	10 (7.6)	47	9.4	17.1
Management of toothache										
Go to a public hospital	0 (0.0)	14 (77.8)	42 (68.9)	24 (53.3)	14 (51.9)	9 (28.1)	18 (36.0)	**121**	50.8	**54.9**
Provincial-level	0 (0.0)	0 (0.0)	3 (7.1)	0 (0.0)	0 (0.0)	2 (22.2)	7 (38.9)	12	9.9	2.9
Prefecture-level	0 (0.0)	9 (64.3)	13 (31.0)	15 (62.5)	10 (71.4)	2 (22.2)	5 (27.8)	54	44.6	71.4
County-level	0 (0.0)	5 (35.7)	25 (59.5)	9 (37.5)	4 (28.6)	4 (44.4)	6 (33.3)	53	43.8	25.4
Primary health centres	0 (0.0)	0 (0.0)	1 (2.4)	0 (0.0)	0 (0.0)	1 (11.1)	0 (0.0)	2	1.7	0.2
Go to a private hospital	0 (0.0)	4 (22.2)	2 (3.3)	8 (17.8)	5 (18.5)	14 (43.8)	9 (18.0)	42	17.6	18.3
Take pain killing medication	3 (60.0)	0 (0.0)	12 (19.7)	6 (13.3)	4 (14.8)	4 (12.5)	13 (26.0)	42	17.6	9.8
Go to the traditional dentist	0 (0.0)	0 (0.0)	0 (0.0)	4 (8.9)	0 (0.0)	0 (0.0)	2 (4.0)	6	2.5	0.7
Do nothing	2 (40.0)	0 (0.0)	5 (8.2)	3 (6.7)	4 (14.8)	5 (15.6)	8 (16.0)	27	11.3	16.3

Note: Each county: N (Unweighted%).

Table 4 Characteristics of caregiver's oral health awareness and knowledge, N (Unweighted% of Yes)

Options	County 1		County 2				County 3	**Total**		
	Sch-1	Sch-2	Sch-3	Sch-4	Sch-5	Sch-6	Sch-7	**N**	Un weighted%	**Weighted%**
Oral health awareness										
1) Oral health is important.	14 (100.0)	33 (97.1)	122 (96.8)	76 (98.7)	38 (100.0)	72 (90.0)	125 (95.4)	480	96.0	97.9
2) Regular oral health examination is necessary.	14 (100.0)	29 (85.3)	113 (89.7)	70 (90.9)	35 (92.1)	67 (83.8)	108 (82.4)	436	87.2	90.9
3) The health of the teeth is decided at birth, and is not significantly associated with your protection.	9 (64.3)	29 (85.3)	96 (76.2)	67 (87.0)	31 (81.6)	50 (62.5)	64 (48.9)	346	69.2	75.0
4) Oral disease prevention mainly depends on yourself.	14 (100.0)	30 (88.2)	119 (94.4)	71 (92.2)	36 (94.7)	68 (85.0)	122 (93.1)	460	92.0	89.3
Oral health knowledge										
1) Bacteria can cause gingival inflammation.	13 (92.9)	32 (94.1)	116 (92.1)	75 (97.4)	37 (97.4)	70 (87.5)	103 (78.6)	446	89.2	94.4
2) Toothbrushing can prevent gingival bleeding.	12 (85.7)	30 (88.2)	100 (79.4)	65 (84.4)	34 (89.5)	59 (73.8)	103 (78.6)	403	80.6	82.0
3) Bacteria can cause dental caries.	12 (85.7)	26 (76.5)	104 (82.5)	70 (90.9)	36 (94.7)	61 (76.2)	85 (64.9)	394	78.8	87.1
4) Sugar intake can lead to dental caries.	13 (92.9)	28 (82.4)	100 (79.4)	70 (90.9)	37 (97.4)	64 (80.0)	102 (77.9)	414	82.8	89.8
5) Deciduous dental caries can be left alone.	11 (78.6)	27 (79.4)	84 (66.7)	62 (80.5)	30 (78.9)	50 (62.5)	76 (58.0)	340	68.0	76.4
6) Pit and fissure sealing can prevent children from dental caries.	9 (64.3)	10 (29.4)	41 (32.5)	17 (22.1)	13 (34.2)	27 (33.8)	25 (19.1)	142	28.4	**31.5**
7) Fluoride can protect teeth.	5 (35.7)	16 (47.1)	44 (34.9)	18 (23.4)	17 (44.7)	25 (31.2)	46 (35.1)	171	34.2	**41.4**

Notes: "Yes" in Awareness means appropriate: if "Agree" in items 1- 2 and 4, "Disagree" in item 3;
"Yes" in Knowledge means correct: if "Yes" in items 1- 4 and 6 -7; "No" in item 5;
"No" in both: except for those answers.
Each county: N (Unweighted%).

Table 5 Prevalence of dental caries on children

Variables	County 1		County 2				County 3	**Total**	
(caries% ± SE%)	Sch-1	Sch-2	Sch-3	Sch-4	Sch-5	Sch-6	Sch-7	Unweighted	**Weighted**
N	14	34	126	77	38	80	131	500	
DMFT	57.1 ± 13.2	82.4 ± 6.5	10.3 ± 2.7	15.6 ± 4.1	15.8 ± 5.9	16.2 ± 4.1	36.6 ± 4.2	25.6 ± 2.0	40.2 ± 2.2
DT	57.1 ± 13.2	73.5 ± 7.6	10.3 ± 2.7	13.0 ± 3.8	10.5 ± 5.0	16.2 ± 4.1	35.9 ± 4.2	24.0 ± 1.9	35.0 ± 2.1
MT	0.0 ± 0.0	44.1 ± 8.5	0.0 ± 0.0	0.0 ± 0.0	2.6 ± 2.6	0.0 ± 0.0	0.8 ± 0.8	3.4 ± 0.8	10.4 ± 1.4
FT	7.1 ± 6.9	0.0 ± 0.0	0.0 ± 0.0	2.6 ± 1.8	2.6 ± 2.6	0.0 ± 0.0	0.0 ± 0.0	0.8 ± 0.4	2.4 ± 0.7
dft	100 ± 0.0	100 ± 0.0	90.5 ± 2.6	92.2 ± 3.1	81.6 ± 6.3	91.2 ± 3.2	100 ± 0.0	93.6 ± 1.1	91.1 ± 1.3
dt	100 ± 0.0	100 ± 0.0	90.5 ± 2.6	92.2 ± 3.1	81.6 ± 6.3	91.2 ± 3.2	100 ± 0.0	93.6 ± 1.1	91.1 ± 1.3
ft	7.1 ± 6.9	2.9 ± 2.9	3.2 ± 1.6	6.5 ± 2.8	10.5 ± 5.0	1.2 ± 1.2	5.3 ± 2.0	4.6 ± 0.9	11.0 ± 1.4
DMFT+dft	100 ± 0.0	100 ± 0.0	90.5 ± 2.6	92.2 ± 3.1	84.2 ± 5.9	91.2 ± 3.2	100 ± 0.0	93.8 ± 1.1	**91.6 ± 1.2**
DT+dt	100 ± 0.0	100 ± 0.0	90.5 ± 2.6	92.2 ± 3.1	84.2 ± 5.9	91.2 ± 3.2	100 ± 0.0	93.8 ± 1.1	91.6 ± 1.2
FT+ft	14.3 ± 9.4	2.9 ± 2.9	3.2 ± 1.6	6.5 ± 2.8	10.5 ± 5.0	1.2 ± 1.2	5.3 ± 2.0	4.8 ± 1.0	11.3 ± 1.4

Notes: Caries was detected at both early enamel caries and dentine caries;
DMFT: decayed, missing, and filled permanent teeth;
dft: decay, filled primary teeth;
Each county: N (Unweighted caries% ± SE%).

Table 6 Number of dental teeth caries on children and oral hygiene

Variables (**mean ± sd**)	County 1		County 2				County 3	**Total**	
	Sch-1	Sch-2	Sch-3	Sch-4	Sch-5	Sch-6	Sch-7	Unweighted	**Weighted**
DMFT	1.57 ± 1.65	2.29 ± 1.62	0.12 ± 0.37	0.22 ± 0.60	0.21 ± 0.53	0.26 ± 0.67	0.78 ± 1.19	0.53 ± 1.06	0.92 ± 1.35
DT	1.50 ± 1.56	1.71 ± 1.38	0.12 ± 0.37	0.17 ± 0.50	0.13 ± 0.41	0.26 ± 0.67	0.77 ± 1.19	0.47 ± 0.97	0.75 ± 1.20
MT	0.00 ± 0.00	0.59 ± 0.78	0.00 ± 0.00	0.00 ± 0.00	0.03 ± 0.16	0.00 ± 0.00	0.01 ± 0.09	0.04 ± 0.26	0.13 ± 0.40
FT	0.07 ± 0.27	0.00 ± 0.00	0.00 ± 0.00	0.05 ± 0.36	0.05 ± 0.32	0.00 ± 0.00	0.00 ± 0.00	0.01 ± 0.17	0.05 ± 0.29
dft	7.07 ± 3.47	7.12 ± 3.38	6.60 ± 3.94	6.29 ± 4.00	6.32 ± 4.33	6.50 ± 4.18	8.05 ± 3.92	6.94 ± 4.01	6.61 ± 3.86
dt	6.79 ± 3.56	7.06 ± 3.42	6.53 ± 3.92	6.21 ± 4.00	6.03 ± 4.25	6.49 ± 4.19	7.94 ± 3.92	6.85 ± 4.00	6.38 ± 3.82
ft	0.29 ± 1.07	0.06 ± 0.34	0.06 ± 0.41	0.08 ± 0.31	0.29 ± 1.04	0.01 ± 0.11	0.11 ± 0.68	0.09 ± 0.55	0.23 ± 0.85
DMFT+dft	8.64 ± 3.91	9.41 ± 3.97	6.71 ± 4.06	6.51 ± 4.17	6.53 ± 4.39	6.76 ± 4.31	8.83 ± 4.17	7.47 ± 4.28	**7.53 ± 4.27**
DT+dt	8.29 ± 3.97	8.76 ± 3.99	6.65 ± 4.04	6.38 ± 4.16	6.16 ± 4.28	6.75 ± 4.31	8.71 ± 4.18	7.32 ± 4.26	7.13 ± 4.18
FT+ft	0.36 ± 1.08	0.06 ± 0.34	0.06 ± 0.41	0.13 ± 0.57	0.34 ± 1.30	0.01 ± 0.11	0.11 ± 0.68	0.11 ± 0.62	0.27 ± 1.10
Oral hygiene	2.78 ± 0.25	2.27 ± 0.81	2.59 ± 0.45	2.70 ± 0.36	2.63 ± 0.36	2.73 ± 0.34	2.84 ± 0.46	2.68 ± 0.47	2.58 ± 0.57

Notes: Caries was detected at both early enamel caries and dentine caries;
DMFT: decayed, missing, and filled permanent teeth;
dft: decay, filled primary teeth;
Oral hygiene was sum of Calculus index (CI) and Debris index (DI);
Each county: N (Unweighted mean ± sd).

Table 7 Number of dental teeth caries on children and oral hygiene

Variables	County 1		County 2				County 3	**Total**	
median (IQR)	Sch-1	Sch-2	Sch-3	Sch-4	Sch-5	Sch-6	Sch-7	Unweighted	**Weighted**
DMFT	1.5 (0.0 - 2.8)	2.5 (1.0 - 3.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 2.0)	0.0 (0.0 - 1.0)	0.0 (0.0 - 2.0)
DT	1.5 (0.0 - 2.8)	2.0 (0.2 - 3.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 2.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 1.0)
MT	0.0 (0.0 - 0.0)	0.0 (0.0 - 1.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)
FT	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)
dft	6.5 (6.0 - 8.0)	6.5 (5.0 - 10.0)	7.0 (4.0 - 9.0)	6.0 (3.0 - 9.0)	6.0 (4.0 - 9.0)	6.0 (3.8 - 9.0)	8.0 (5.0 - 11.0)	7.0 (4.0 - 10.0)	7.0 (4.0 - 8.0)
dt	6.0 (4.5 - 7.8)	6.5 (5.0 - 10.0)	7.0 (4.0 - 9.0)	6.0 (3.0 - 8.0)	6.0 (3.2 - 9.0)	6.0 (3.8 - 9.0)	8.0 (5.0 - 11.0)	7.0 (4.0 - 10.0)	6.0 (4.0 - 8.0)
ft	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)
DMFT+dft	8.0 (6.0 - 10.5)	9.5 (7.0 - 12.8)	7.0 (4.0 - 9.0)	6.0 (3.0 - 9.0)	7.0 (4.0 - 9.8)	7.0 (3.8 - 10.0)	9.0 (5.5 - 12.0)	7.0 (4.0 - 11.0)	8.0 (4.3 - 10.0)
DT+dt	8.0 (6.0 - 10.5)	8.5 (6.0 - 11.8)	7.0 (4.0 - 9.0)	6.0 (3.0 - 9.0)	6.0 (3.2 - 9.0)	7.0 (3.8 - 10.0)	9.0 (5.0 - 12.0)	7.0 (4.0 - 11.0)	7.0 (4.0 - 10.0)
FT+ft	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)
Oral hygiene	2.9 (2.5 - 3.0)	2.3 (1.7 - 3.0)	2.7 (2.3 - 3.0)	2.8 (2.5 - 3.0)	2.8 (2.5 - 3.0)	2.8 (2.6 - 3.0)	3.0 (3.0 - 3.0)	2.8 (2.5 - 3.0)	2.8 (2.3 - 3.0)

Notes: Caries was detected at both early enamel caries and dentine caries;

DMFT: decayed, missing, and filled permanent teeth; dft: decay, filled primary teeth;

Oral hygiene was sum of Calculus index (CI) and Debris index (DI);

Each county: N (Unweighted median, IQR).

Table 8 Number of dental surface caries on children

Variables	County 1		County 2				County 3	**Total**	
(**mean ± sd**)	Sch-1	Sch-2	Sch-3	Sch-4	Sch-5	Sch-6	Sch-7	Unweighted	**Weighted**
DMFS	2.21 ± 2.36	4.32 ± 3.66	0.16 ± 0.53	0.43 ± 1.84	0.37 ± 1.30	0.26 ± 0.67	1.17 ± 1.86	0.84 ± 1.96	1.40 ± 2.40
DS	1.93 ± 1.94	1.97 ± 1.85	0.16 ± 0.53	0.17 ± 0.50	0.26 ± 1.16	0.26 ± 0.67	1.14 ± 1.85	0.61 ± 1.36	0.88 ± 1.50
MS	0.00 ± 0.00	2.35 ± 3.13	0.00 ± 0.00	0.00 ± 0.00	0.11 ± 0.65	0.00 ± 0.00	0.03 ± 0.35	0.18 ± 1.03	0.51 ± 1.61
FS	0.29 ± 1.07	0.00 ± 0.00	0.00 ± 0.00	0.26 ± 1.79	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.05 ± 0.73	0.01 ± 0.27
dfs	16.71 ± 12.17	12.94 ± 8.02	11.68 ± 9.88	12.38 ± 11.10	11.45 ± 9.73	12.45 ± 11.54	17.71 ± 11.00	13.70 ± 10.84	12.16 ± 9.17
ds	15.29 ± 12.17	12.65 ± 8.12	11.68 ± 9.88	11.99 ± 11.07	11.45 ± 9.73	12.39 ± 11.57	17.18 ± 10.78	13.43 ± 10.73	12.03 ± 9.11
fs	1.43 ± 5.35	0.29 ± 1.71	0.00 ± 0.00	0.39 ± 1.57	0.00 ± 0.00	0.06 ± 0.56	0.53 ± 3.35	0.27 ± 2.09	0.13 ± 1.40
DMFS+dfs	18.93 ± 13.09	17.26 ± 8.98	11.84 ± 9.97	12.81 ± 11.52	11.82 ± 9.95	12.71 ± 11.64	18.88 ± 11.51	14.54 ± 11.30	**13.56 ± 9.78**
DS+ds	17.21 ± 13.00	14.62 ± 8.95	11.84 ± 9.97	12.16 ± 11.21	11.71 ± 9.93	12.65 ± 11.68	18.31 ± 11.36	14.04 ± 11.13	12.91 ± 9.53
FS+fs	1.71 ± 5.37	0.29 ± 1.71	0.00 ± 0.00	0.65 ± 2.85	0.00 ± 0.00	0.06 ± 0.56	0.53 ± 3.35	0.32 ± 2.30	0.14 ± 1.44

Notes: Caries was detected at both early enamel caries and dentine caries;

DMFS: decayed, missing, and filled permanent surface;

dfs: decay, filled primary surface;

Each county: N (Unweighted mean ± SD).

Table 9 Number of dental surface caries on children

Variables	County 1		County 2				County 3	**Total**	
median (IQR)	Sch-1	Sch-2	Sch-3	Sch-4	Sch-5	Sch-6	Sch-7	Unweighted	**Weighted**
DMFS	2.0 (0.0 - 3.8)	4.0 (2.0 - 6.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 2.0)	0.0 (0.0 - 1.0)	0.0 (0.0 - 3.0)
DS	2.0 (0.0 - 3.0)	2.0 (0.2 - 3.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 2.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 1.0)
MS	0.0 (0.0 - 0.0)	0.0 (0.0 - 4.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)
FS	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)
dfs	15.5 (8.0 - 24.5)	11.5 (7.2 - 19.0)	10.0 (4.0 - 15.0)	10.0 (4.0 - 15.0)	10.0 (6.0 - 13.8)	9.0 (4.0 - 19.2)	16.0 (9.0 - 26.0)	11.0 (5.0 - 20.0)	10.5 (6.0 - 17.0)
ds	11.5 (6.5 - 19.8)	11.0 (6.2 - 19.0)	10.0 (4.0 - 15.0)	9.0 (4.0 - 15.0)	10.0 (6.0 - 13.8)	8.5 (4.0 - 19.2)	16.0 (8.0 - 25.0)	11.0 (5.0 - 20.0)	10.0 (6.0 - 16.7)
fs	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)
DMFS+dfs	16.5 (8.5 - 25.8)	17.0 (10.5 - 24.8)	10.0 (4.0 - 16.0)	10.0 (4.0 - 17.0)	10.5 (6.0 - 15.5)	9.0 (4.0 - 20.0)	18.0 (9.0 - 26.0)	12.0 (6.0 - 21.0)	**12.0 (7.0 - 20.0)**
DS+ds	11.5 (8.0 - 24.2)	12.5 (8.2 - 21.5)	10.0 (4.0 - 16.0)	9.0 (4.0 - 15.0)	10.5 (6.0 - 14.0)	9.0 (4.0 - 20.0)	17.0 (8.5 - 26.0)	11.0 (6.0 - 20.2)	12.0 (6.0 - 17.0)
FS+fs	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)	0.0 (0.0 - 0.0)

Notes: Caries was detected at both early enamel caries and dentine caries;

DMFS: decayed, missing, and filled permanent surface;

dfs: decay, filled primary surface;

Each county: N (Unweighted median, IQR).

Appendix 3 Other results in SEM

1. Outcome variable: Prevalence of permanent teeth caries

Table 28 Goodness of fit measures of the permanent teeth caries prevalence model

Fit index	Recommend levels	This model
$\chi 2$ /df	< 5.00	1.33
RMSEA	< 0.08	0.03
SRMR	< 0.08	0.04
GFI	> 0.90	0.99

$\chi 2$ /df: the chi-squared fit statistic;
RMSEA: root-mean-square error of approximation;
SRMR: standardised root mean square residual;
GFI: goodness-of-fit statistic.

The goodness of fit of the model is summarised in Table 19. The chi-square statistic for the model was 59.71 with 45 degrees of freedom ($p = 0.07$). In terms of goodness of fit indices, RMSEA was 0.03, SRMR was 0.04, GFI was 0.99, all suggesting an acceptable fit. Overall, when considering all indices, the model performed relatively well.

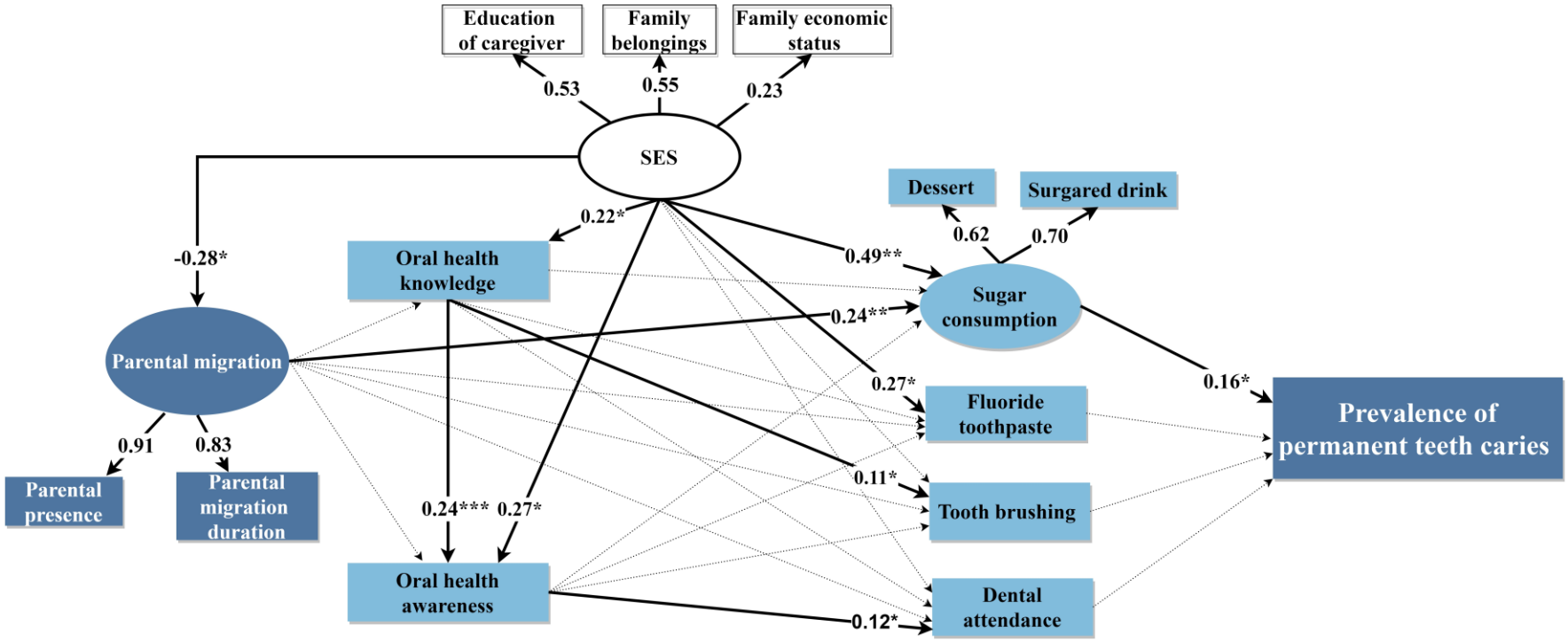

Figure 8 Structural equation model of the relationship between parental migration and dental caries in children

Note - The solid lines indicate significant relationships with the number on each line shows standardized path coefficient.
- The significant level for path coefficients was set at *P < 0.05, ** P < 0.01, and ***P < 0.001.
- The dotted lines indicate insignificant relationships.

2. Outcome variable: Prevalence of total caries

Table 29 Goodness of fit measures of the total caries prevalence model

Fit index	Recommend levels	This model
$\chi 2$ /df	< 5.00	1.23
RMSEA	< 0.08	0.02
SRMR	< 0.08	0.04
GFI	> 0.90	0.99

$\chi 2$ /df: the chi-squared fit statistic;
RMSEA: root-mean-square error of approximation;
SRMR: standardised root mean square residual;
GFI: goodness-of-fit statistic.

The goodness of fit of the model is summarised in Table 19. The chi-square statistic for the model was 55.54 with 45 degrees of freedom ($p = 0.14$). In terms of goodness of fit indices, RMSEA was 0.02, SRMR was 0.04, GFI was 0.99, all suggesting an acceptable fit. Overall, when considering all indices, the model performed relatively well.

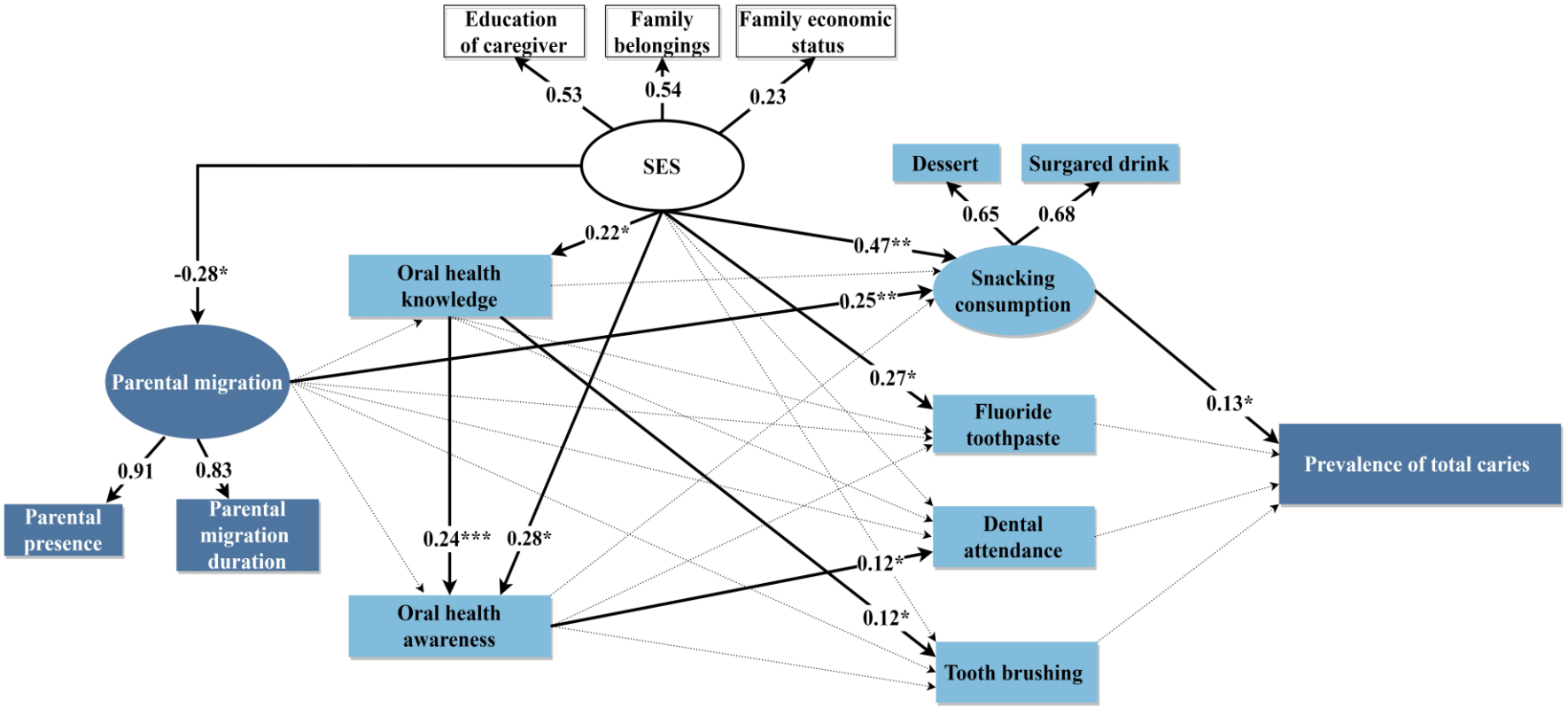

Figure 9 Structural equation model of the relationship between parental migration and dental caries in children

Note - The solid lines indicate significant relationships with the number on each line shows standardized path coefficient.

- The significant level for path coefficients was set at $*P < 0.05$, $**P < 0.01$, and $***P < 0.001$.
- The dotted lines indicate insignificant relationships.

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Scholarship Awards During Enrolment

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List of Publication and Proceedings

1. Dental Caries Status of 3-12-year-old Left-behind Children in China: A Systematic Review and Meta-analysis.

2. Effect of Parental Migration on Oral Health of 6-8-year-old Rural Children: A Cross-sectional Study in Yunnan Province, China

3. Caregiver's Response to Children's Oral Health Advice: A Cohort Study in Yunnan Province, China