

Oral Health among Children and Adolescents with Disabilities in one Welfare  
School in Chengdu from 2018 to 2019

by

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A thesis submitted in partial  
fulfillment of the requirements for the degree of  
Master of Science in the Global Health Program  
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2023

ABSTRACT

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## Abstract

**Background:** To identify the oral health status of children and adolescent with disabilities in one welfare school in Chengdu. With several disabilities, physical and intellectual deficiency will affect disabled children's daily life. They pay little attention to their own health status especially oral health. Therefore, this vulnerable group require some concerns. Examining their oral health status is necessary to change their situations of low access to oral health resources and failure of describing their feelings for various reasons, which could help them reduce the rate of having oral diseases. We aim to explore the severity of caries and periodontal status among child with disabilities.

**Methods:** We included 173 disabled children, 92 participants in 2018 and 81 participants in 2019, who were at least three years old and less than 24. They obtained the treatment from West China Stomatological Hospital and participated in an examination of their oral health status. There were four outcomes: caries, gingivitis, dental calculus, and oral health. Although there were three indexes [decayed (dt/DT), missed (mt/MT), and filled (ft/FT) teeth] indicating decayed tooth, we combined three indexes into one ("caries") to check whether one tooth is healthy or unhealthy. For gingivitis and dental calculus, "yes or no" is the statistical method. Oral health is a new index that represents whether one's oral health status is healthy. If one person obtains caries or gingivitis or both, it means unhealthy. We used the logistic regression to examine how demographic characteristics (age, sex, household registration, and nationality) were jointly associated with each of the four outcomes

(caries, gingivitis, dental calculus, and oral health) separately.

**Results:** Four indexes (caries, gingivitis, dental calculus, and oral health) were created to determine disabled children's oral health status. Disabled children's mean of caries was 2.77, and they shared a caries prevalence rate of 63%. 31 (17.9%) had one caries and 78 (45.1%) had two or more caries. More than 75% of had obtained fewer than five caries. For caries prevalence, we found a significantly higher prevalence of dental caries among participants aged less than 12 years (87.7%) than those aged at least 12 years (50.9%). After mutually adjustment of socio-demographic characteristics, participants aged at least 12 years had a 86% (95% CI: 65%, 94%) lower odds of having dental caries than those aged less than 12 years. For gingivitis, we found a significantly higher gingivitis detection rate among Han (87.7%) than Qiang (18.8%) and Zang (7.9%). After mutually adjustment of socio-demographic characteristics, Zang had a 81% (95% CI: 17%, 96%) lower odds of having gingivitis than Han. For dental calculus, we found a significantly higher detection rate of dental calculus among males (14.6%) than females (3.9%). After mutually adjustment of socio-demographic characteristics, females had a 376% (95% CI: 22%, 1754%) higher odds of having dental calculus than males. For oral health rate, we found a significantly higher oral health rate among participants aged at least 12 years (38.8%) than those aged less than 12 years (10.5%). After mutually adjustment of socio-demographic characteristics, participants aged at least 12 years had an 82% (95% CI: 65%, 94%) lower odds of having good oral health than those aged less than 12 years.

**Conclusions:** We presented disabled children's oral health status in three oral health criteria: caries status, periodontal health status (gingivitis and dental calculus), and general oral health status. The comprehensive oral health status of disabled children shared a high mean of caries and a high prevalence rate. Their periodontal health status was better than the Fourth National oral Health Epidemiological Survey criteria. The comprehensive oral health rate was poor. Therefore, additional studies are necessary to make improvements to it.

# Contents

Abstract .....	iv
List of Tables .....	viii
List of Figures .....	ix
Acknowledgements .....	x
1. Introduction .....	1
1.1 Caries.....	3
1.2 Periodontal Disease .....	5
1.2.1 Gingivitis.....	6
1.2.2 Dental Calculus .....	7
1.3 Oral cancer.....	7
1.4 Disabled population in the world and in China .....	8
1.4.1 Disabled population in the world .....	8
1.4.2 Disabled population in China .....	9
1.4.3 Disabled children and adolescents.....	10
1.5 Oral health criteria.....	10
1.6 Research Gap.....	14
1.7 Research Aim .....	14
2. Methods.....	15
Data sources and study participants .....	15
Measurements.....	15
Outcome variable: caries, gingivitis, dental calculus, and oral health .....	15
Covariates .....	16
Statistical Analysis.....	16
3. Results.....	18
3.1 Sample Characteristics .....	18
3.2 Number of caries .....	19
3.3 Caries Prevalence .....	20
3.4 Gingivitis .....	21
3.5 Dental Calculus .....	22
3.6 Oral health .....	23
4. Discussion .....	25
4.1 Summary of Study aims and main Findings .....	25
4.2 Similarities and Differences with Previous and Current Studies.....	26
4.3 Strengths and Limitations .....	27
4.4 Future Direction.....	29
5. Conclusion .....	30
References .....	31

## List of Tables

Table 1: Sociodemographic Characteristics of oral Health Conditions of the deaf, hard of Hearing, and Mentally Disabled Children/Teenagers.....	18
Table 2: The Distribution of Number of Caries.....	19
Table 3: Prevalence rate of Caries in the deaf, hard of Hearing, and Mentally Disabled Children/Teenagers.....	20
Table 4: Prevalence rate of Caries in the deaf, hard of Hearing, and Mentally Disabled Children/Teenagers.....	22
Table 5: The detection rate of dental calculus in the deaf, hard of Hearing, and Mentally Disabled Children/Teenagers .....	23
Table 6: The Oral Health Rate in the deaf, hard of Hearing, and Mentally Disabled Children/Teenagers .....	24



## List of Figures

Figure 1: Prevalence rate of Deciduous Teeth Caries Among Chinese 3-5 Years old..	11
Figure 2: Mean of Deciduous Teeth Caries (dmft) Among Chinese 3-5 Years old.....	12
Figure 3: The Distribution of Number of Caries.....	19

## **Acknowledgements**

I want to thank my primary supervisor, Dr. Chenkai Wu, and my committee members Dr. Qian Long and Dr. Yunguo Liu, for what they all have done to help me with my master's thesis. I completed my final manuscript with their continuous support and guidance in my academic writing. Furthermore, I am also very grateful that all the research assistants and administrative staff at Global Health Research Center offered sustained support during my graduate study, which was essential for me to overcome all the challenges. At last, I would like to thank my parents for their unconditional support and love.

# 1. Introduction

Oral health is an invaluable asset and an integrated component of one's quality of life and health conditions (6). However, oral health is often affected by various oral diseases every day: the most common diseases are dental caries and periodontal diseases, but other oral diseases such as oral cancers, mucosal and salivary gland diseases, and edentulism also threaten people's life. Although dental diseases are significant public health concerns for populations worldwide, they are frequently overlooked and not given the recognition they deserve by the general public.

Nearly 3.5 billion people worldwide are affected by oral diseases, and three-quarters of those affected reside in middle-income countries.(7). The most common oral disease is untreated, permanent tooth caries, with approximately 2 billion cases worldwide, followed by severe periodontal disease, with around 1 billion cases. Untreated deciduous tooth caries and edentulism have approximately 510 million and 350 million cases, respectively. (7). In addition, oral diseases are estimated to have a higher global incidence than the combined total of the five major non-communicable diseases (mental diseases, cardiovascular diseases, diabetes, chronic respiratory diseases, and cancer) by approximately 1 billion cases. This places a significant disease burden on affected populations. (7).

These diseases have the potential to pose significant public health issues at global, regional, and national levels, thereby endangering the health and wellbeing of both individuals and populations. Those oral diseases are a health problem and have wider social and economic implications. For instance, oral diseases can lead to pain,

discomfort, and disfigurement, affecting a person's quality of life. They can also result in increased healthcare costs, loss of productivity, and reduced economic growth due to missed workdays or limited job opportunities. According to various studies, the prevalence of tooth pain in children ranges from 5% to 33%, and this likelihood increases with age, severity of tooth decay, and lower socioeconomic status (30). Lifelong dental pain has been observed in numerous children from low- and middle-income countries as well as certain populations in high-income countries (31-34). Oral issues such as caries will also affect school performance because of reducing time in school, probably exacerbating social inequalities (35-39). Furthermore, according to many studies, untreated oral caries and related oral issues decreased children's and their caregivers' quality of life (40-43).

Oral health issues are not limited to children and adolescents, as adults and older individuals also experience a range of dental problems. Population-based studies have reported that orofacial pain has a 4-week prevalence rate of 26% in the United Kingdom and 53% in Canada (44, 45), while another report in 2012 indicated that nearly a quarter of adults had suffered from toothache in the preceding six months (46). These oral diseases are widespread and have a significant impact on people's daily activities, such as work and food intake, which ultimately lowers their quality of life.

Finally, oral diseases can have a significant impact on an individual's quality of life, with economic burden being a key factor. This burden includes direct costs associated with treatment, indirect costs such as loss of productivity due to work or

school absence, and intangible costs like pain, difficulty eating, tasting food, speaking, and even expressing emotions through smiling (47). In 2015, the global direct cost of oral diseases was estimated at \$356.80 billion, with an additional \$187.61 billion in indirect costs (48), leading to a substantial economic burden on society. There is a need to establish criteria for analyzing and identifying ways to reduce the disease burden and minimize negative impacts on individuals' quality of life.

## **1.1 Caries**

Professionals defined caries as the gradual loss and destruction (corrosion) of the hard tissue of the teeth (enamel and dentin). It happens because free sugars in drinks or food are converted into acids by bacteria in the mouth that damage the teeth over time. Free sugars, which include sugars added to foods by manufacturers, cooks, or consumers, as well as those found naturally in honey, syrups, and fruit juices, can lead to the development of cavities and permanently damaged areas on the teeth over time.

The leading cause of caries is sugar consumption. Sugar has become an indispensable part of people's life: obtaining sugar is never a problem. High and middle-income countries have been found to significantly exceed the WHO's recommendations for sugar consumption, and the trend is gradually rising in several low-income countries (49). The substantial levels of free sugars found in children's food have raised concerns, leading to several guidelines aimed at reducing the risk of

caries that may be caused by sugar consumption (49, 50, 51).

The severity of dental caries is typically measured using the DMFT index. It is a tool used by dentists and public health professionals to estimate the prevalence and severity of dental caries (tooth decay) in populations. The acronym DMFT stands for Decayed, Missing, and Filled Teeth. It is a numerical score that represents the total number of teeth in an individual's mouth that are decayed, missing due to decay or other causes, or have been filled due to decay or other reasons.

To calculate an individual's DMFT score, a dentist will examine each tooth in the mouth and assess its condition. Teeth with visible cavities or decay belong to "decayed," while we categorized teeth missing due to decay or other causes as "missing." Teeth treated with fillings or other restorations for decay or other reasons will be called "filled." The total number of decayed, missing, and filled teeth is then added up to calculate the DMFT score (2). The DMFT index is a useful tool for assessing the oral health of both individuals and populations, and can be used to evaluate the effectiveness of various oral health interventions and treatment strategies over time (2). A higher DMFT score indicates a higher prevalence and severity of dental caries, thereby highlighting the need for increased preventive and treatment measures to be taken.

According to the data of the 4th national oral flow survey, the permanent caries prevalence rate in Chinese is 38.5%, and this rate in the primary teeth of 5 years old children is up to 71.9%(2). The average number of dental decay in the primary teeth is more than 4, and caries in Chinese children is severe. At the same time, caries in

permanent teeth prevalence among 12-year-olds was 34.5 percent, which increased by 7.8 percent compared with ten years ago(2). The prevalence of caries in primary teeth among 5-year-olds was 70.9 percent, up 5.8 percentage points from 10 years ago. Caries in children have been on the rise.

The DMFT index can be used to evaluate the oral health of individuals and populations over time and to assess the effectiveness of oral health interventions and treatment strategies. A higher DMFT score indicates a higher prevalence and severity of dental caries and may suggest a need for increased prevention and treatment measures.

In addition, it is worth noting that the DMFT index is not a perfect measure of oral health, as it does not capture other essential factors such as gum disease or oral cancer. Nonetheless, it remains a widely used and valuable tool for assessing the burden of dental caries and guiding oral health policy and practice.

## **1.2 Periodontal Disease**

Periodontal disease, or gum disease, is a chronic inflammatory condition affecting the tissues surrounding and supporting the teeth. It is caused by the accumulation of plaque, a sticky film of bacteria that forms on the teeth and gums, and can lead to a range of symptoms, from mild gum inflammation to tooth loss.

Periodontal disease typically progresses in stages, starting with gingivitis, a reversible form of gum inflammation. If left untreated, gingivitis can progress to periodontitis, which involves damage to the tissues that support the teeth, including

the gums, periodontal ligaments, and bone. Advanced periodontitis can cause significant damage to the teeth and supporting structures, leading to tooth loss and other complications.

### **1.2.1 Gingivitis**

Periodontal diseases include gingivitis (gum disease), a reversible inflammation of the gums that cause swelling and bleeding. Clinically, the characteristics of gingivitis are edema, erythema, and bleeding after a periodontal examination.

Gingivitis is usually painless, and many people may not realize they have it.

However, if left untreated, it can progress to a more severe form of periodontal disease called periodontitis with the influence of factors such as tobacco, systemic disorders, or compromised immune response. It will damage the deeper gum tissues and bones.

The prevalence rate of severe periodontal disease is estimated to be around 19%, translating to over 1 million cases worldwide (2). The onset of the severe periodontal disease epidemic is observed in late adolescence, with the peak incidence occurring at around 60 years of age (11, 12). A similar distribution trend was noted in China, where the periodontal health rate among different age groups was observed: teenagers aged 12-15 years showed a rate of around 30%-40%, adults aged 35-44 years had a rate of 9.1%, and elders aged 55-64 years had the lowest rate of 5% (2).



## **1.2.2 Dental Calculus**

Dental calculus is one of the causes of gingivitis. Known as tartar, it is a complex, mineralized deposit that forms on the teeth and below the gum line. It is caused by plaque buildup, a sticky film of bacteria that forms on the teeth, and can lead to a range of oral health problems if left untreated.

Dental calculus forms when plaque is not removed from the teeth and gums through regular brushing and flossing. Over time, minerals such as calcium and phosphate in saliva can build up and harden, forming a hard, rough deposit that is difficult to remove with regular brushing and flossing.

## **1.3 Oral cancer**

Oral cancer is also an oral disease affecting the mouth and throat. It develops when cells in the mouth or throat grow and divide uncontrollably, forming a mass or tumor. Oral cancer can occur in various mouth parts, including the tongue, gums, cheeks, lips, roof, and floor.

Oral cancer is the eighth most common cancer worldwide. According to the latest report in 2020, there were about 4.29 million new cancer cases and 2.81 million cancer deaths in China in 2015, compared with about 4.29 million cancer deaths in 2015. There were 48,100 new cases of oral cancer and 22,100 deaths from oropharyngeal cancer, accounting for 1.12% and 0.79% of all new cancer cases and deaths, respectively (8,9). While the lowest incidence rate of oral cancer was in Central America and West Africa, with less than 3 per 100000 population, the

incidence rate in China was slightly higher than 3 per 100000 population (10). Furthermore, although the absolute number of oral cancers is not high, the burden gradually rose in recent years. The oral health status determines the risks of getting oral cancers.

## **1.4 Disabled population in the world and in China**

### **1.4.1 Disabled population in the world**

Disability in hearing and intelligence is common in both developing and developed countries (19). It means an abnormality or abnormalities in an anatomical structure or loss of a particular organ or function that affects one's ability to participate in daily work and activity. According to the World Health Organization, it is estimated that approximately 15% of the world's population, or one billion people, have some form of disability (20). More than 50 million people in the United States have various disabilities, including hearing loss, cognitive impairment, limited mobility, and so on (21).

The WHO recognizes that people with disabilities are a diverse and heterogeneous group and that disability can be temporary or permanent, visible or invisible, and can affect people of all ages, genders, and socio-economic backgrounds. Therefore, the WHO emphasizes the importance of promoting the rights and inclusion of people with disabilities and providing accessible and inclusive services and environments to support the full participation of people with disabilities in all aspects of society (20).

However, although the WHO offered guidance in paying attention to the disabled population's disadvantages, disability still had a significant impact on people's lives, affecting their physical, emotional, and social well-being: Limitations on physical functioning can impact their ability to perform daily tasks, participate in activities, and access services (20). The disabled population might have negative attitudes and feel shame as some may experience discrimination, prejudice, and social exclusion based on their disability, impacting their self-esteem, relationships, and opportunities (20). The disabled population could meet many problems because of their disability, so paying attention to their health status is essential: They are vulnerable. Oral health is one of the health concerns here. It can affect one's quality of life.

#### **1.4.2 Disabled population in China**

In China, more than 85 million people have obtained various forms of disability that influence their daily life (22), representing approximately 6% of the total population of China. Moreover, the disabled population could face significant challenges, including barriers to education, employment, and healthcare (23). Therefore, these vulnerable groups could experience much inconvenience and inequality in maintaining their health status.

Efforts have been made to improve the quality of life for people with disabilities in China, such as the introduction of laws and policies to protect their rights and ensure equal access to services and opportunities: The Chinese government has

launched several initiatives to address these challenges, including the "Healthy China 2030" plan, which aims to improve healthcare and health services for people with disabilities, and the "National Rehabilitation Plan 2016-2020", which aims to provide better rehabilitation services and support for people with disabilities.

### **1.4.3 Disabled children and adolescents**

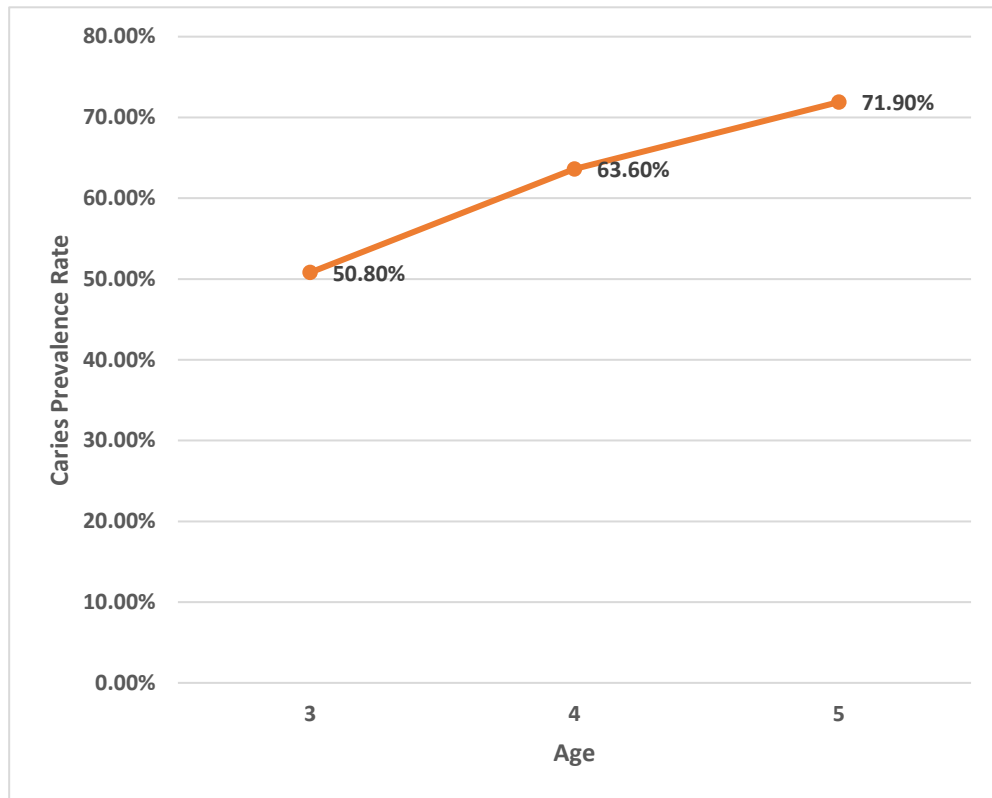
Children and teenagers with disabilities pay less attention to oral health, and the prevalence of oral diseases is higher than average (24,25). Because physical and intellectual deficiency would affect their everyday life, children and teenagers with disabilities require more care and supervision, including those related to their oral health (26,27). Improvements in social and health conditions, quality of life and life expectancy, and greater access to medical resources and treatment could allow us to pay more attention to these vulnerable groups (28,29). Therefore, there is a potential to explore more about the exact knowledge and situation of the dental condition of different disabled children and teenagers (29).

## **1.5 Oral health criteria**

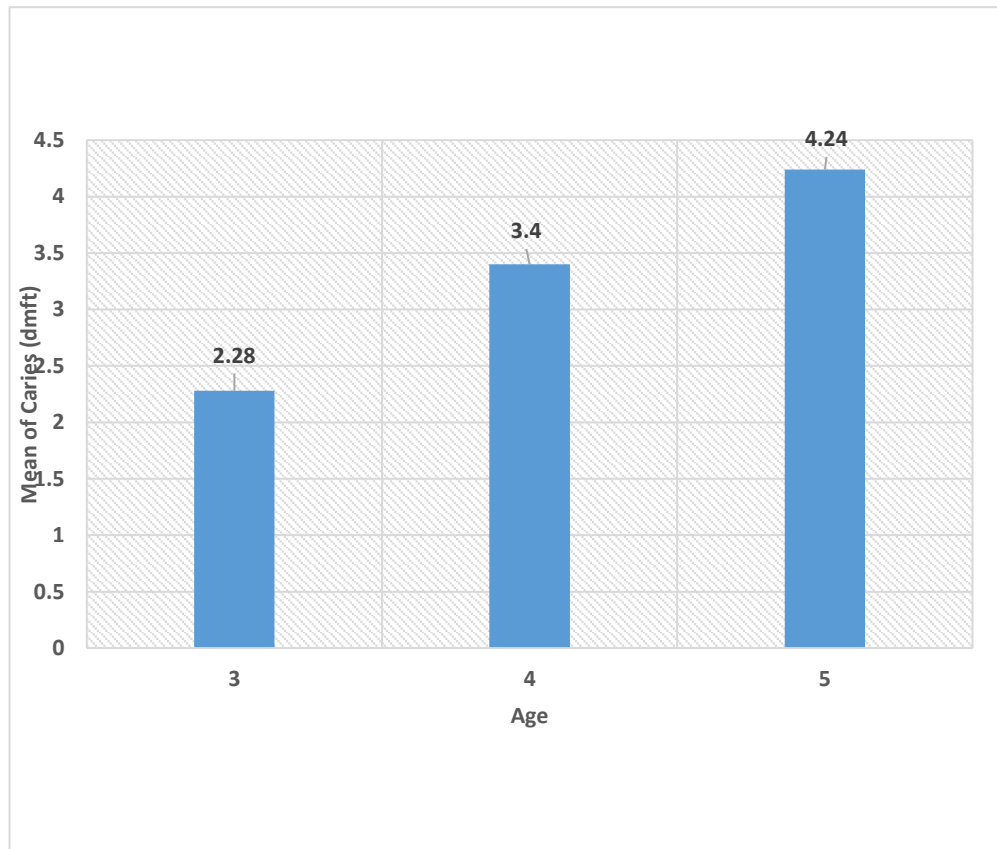
According to the Fourth National oral Health Epidemiological Survey, there are two groups of children's and adolescents' dental status: ages 3-5 and 12-15.

For the group of children who are 3-5 years old, the total caries prevalence rate was 62.5%, and the mean of deciduous tooth caries was 3.35. The caries prevalence rates of deciduous teeth at 3, 4, and 5 years old in China were 50.8%, 63.6%, and 71.9%; the

mean of deciduous tooth caries were 2.28, 3.40, and 4.24, respectively (2). The severe status of deciduous teeth caries increased with age (figure 1, figure 2).



**Figure 1: Prevalence rate of Deciduous Teeth Caries Among Chinese 3-5 Years old**



**Figure 2: Mean of Deciduous Teeth Caries (dmft) Among Chinese 3-5 Years old**

For the adolescent group who are 12-15 years old, their prevalence rate of permanent tooth caries was 41.9%, while the mean of permanent tooth caries was 1.04. The caries prevalence rates of deciduous teeth at 12 and 15 years old were 38.5% and 44.4%; the mean of permanent tooth caries were 0.86 and 1.20, respectively (2). Furthermore, 12 years adolescents had a periodontal health rate of 41.6%. In contrast, the detection rate of gingivitis and dental calculus were 58.4% and 61.3%. For 15 years old adolescents, the former health rate was 34.8%, and the detection rate of gingivitis and dental calculus were 64.7% and 73.6% (2).

Oral diseases are one of the most common disease burdens among children with disabilities worldwide, and the need for dental care should be a concern. One study

in India showed the severity of disabled children's oral health status: In special schools, 89.8% of children had dental caries compared with 58.6% from the control group. The mean of caries [DMFT (decayed, missing, filled teeth)] for special school children were  $2.52 \pm 2.61$  and  $0.61 \pm 1.12$ , respectively. Moreover, a higher prevalence of malocclusion was also found in disabled children with special healthcare needs: 66.4% obtained definite malocclusion, while 17.4% of controls had malocclusion ( $p < 0.001$ ) (13).

Therefore, disabled children indeed had poor oral health status. They might pay less attention to or have no idea about oral health issues(13). Additionally, they had problems getting to regular oral health services because of physical limitations (13). Most people agreed that disabled children have higher rates of caries prevalence rate, gingivitis, and dental calculus than the average population (14,15). At the same time, several studies reported a higher rate of untreated oral diseases in disabled children than in normal adolescents (16,17,18). One study from India also indicated that disabled children with mental retardation and cerebral palsy had an extremely high dft(no missing teeth counted) score of 3.95. Children with Down's syndrome also obtained an average of 2.44 caries under the DMFT index (16). For periodontal status, this study used Community Periodontal Index as a reference: only 3.7% of the disabled children had a score of 0 (meaning healthy periodontium). There are approximately 36% getting a score of 1 (meaning gingivitis), and 48% had a score of 2 (meaning calculus) (16).

## **1.6 Research Gap**

Although dentists have explored much about detailed oral health conditions of teenagers, the knowledge about the oral health status of the unique population, such as disabled children (referring to the deaf, hard of hearing, and mentally disabled children/teenagers in this research), is still not enough. Disabled children usually have low access to oral health resources and cannot describe their feelings for several reasons, which makes them vulnerable to oral diseases. Therefore, paying attention to their oral health conditions is essential.

## **1.7 Research Aim**

The overarching goal of this work is to examine the oral health conditions of children/teenagers with disabilities from one welfare school in Chengdu from 2018 to 2019. There were three specific aims. Firstly, to identify the caries status of children/teenagers with disabilities. Secondly, to examine the periodontal health status (gingivitis and dental calculus) of children/teenagers with disabilities. Thirdly, to identify the general oral health status of children/teenagers with disabilities.



## **2. Methods**

### **Data sources and study participants**

West China Stomatological Hospital is the first stomatological hospital in China. It is one of China's first-class 3A stomatological hospitals with the National Stomatology Center of China. Every year West China Stomatological Hospital has one "volunteer project" to offer oral health examination and essential oral treatment for some welfare schools in Sichuan. This survey was conducted in 2018 in Wenchuan with annual follow-ups. The deaf, hard of hearing, and mentally disabled children/teenagers aged 6-22 years from the welfare school were enrolled at baseline, and additional cohorts were added.

### **Measurements**

#### **Outcome variable: caries, gingivitis, dental calculus, and oral health**

Guided by the Fourth National Oral Health Epidemiological Survey (2), four oral health condition measures were used: caries, dental calculus, gingivitis, and oral health.

The examination report for every participant includes the status of every tooth: There are 20 codes for teeth indicating health conditions, with 10 for primary teeth and 10 for the permanent tooth. The number of caries will be recorded in this part. Furthermore, gum health is another record in the examination report. Gingivitis and dental calculus status are registered in this part.

There were five indicators of oral health: clean teeth, no caries, no pain, standard gum color, and no bleeding. Therefore, we determine one's oral health condition with careful consideration of caries and Gingivitis. Every person should have no caries or gingivitis to be in "oral health."

## **Covariates**

Sociodemographic factors included age in years, sex, household registration (urban and rural), and nationality (Han, Zang, Qiang, and Hui). We classified age into two groups: less than 12 years and greater than or equal to 12 years.

## **Statistical Analysis**

We described the demographic characteristics of the study participants using means and standard deviations for continuous variables and counts and percentages for categorical variables. We compared these characteristics between 2018 and 2019 using the two-sample t-test for continuous variables and the chi-squared test for categorical variables. We examined the distribution of number of caries using a histogram; we calculated its key descriptive statistics, including relative frequency, minimum, maximum, mean, standard deviation, and quartiles. Subsequently, we estimated the prevalence of caries, the detection rate of gingivitis and dental calculus, and oral health rate, respectively, among the entire sample and by demographics (age, sex, household registration, and nationality). The chi-squared test was used to examine whether the prevalence was different by each demographic feature. We then

used the logistic regression to examine how demographic characteristics were jointly associated with each of four outcomes (caries, gingivitis, dental calculus, and oral health), separately.

All tests were two-sided with a significance level of  $p < 0.05$ . We conducted the analyses using Stata 17.

### 3. Results

#### 3.1 Sample Characteristics

A total of 173 participants aged 3-23 years were included; 81 did the oral examination in 2018 and 92 participated in 2019. The sociodemographic characteristics of the study participants were similar between 2018 and 2019 (Table 1). The mean age of the entire sample was 13.66 (SD=0.28) years. 57 (32.9%) were below 12 (also percentage); 57 (32.9%), 96 (55.5%) were males; 165 (95%) were rural residents; 14 (8.1%) belonged to Han nationality, 89 (51.5%) were belong to Zang nationality, 69 (39.9%) belonged to Qiang nationality, and there was only one participant belonging to Hui nationality in 2018.

**Table 1.** Sociodemographic Characteristics of oral Health Conditions of the deaf, hard of Hearing, and Mentally Disabled Children/Teenagers from one welfare school in Wenchuan from 2018 to 2019

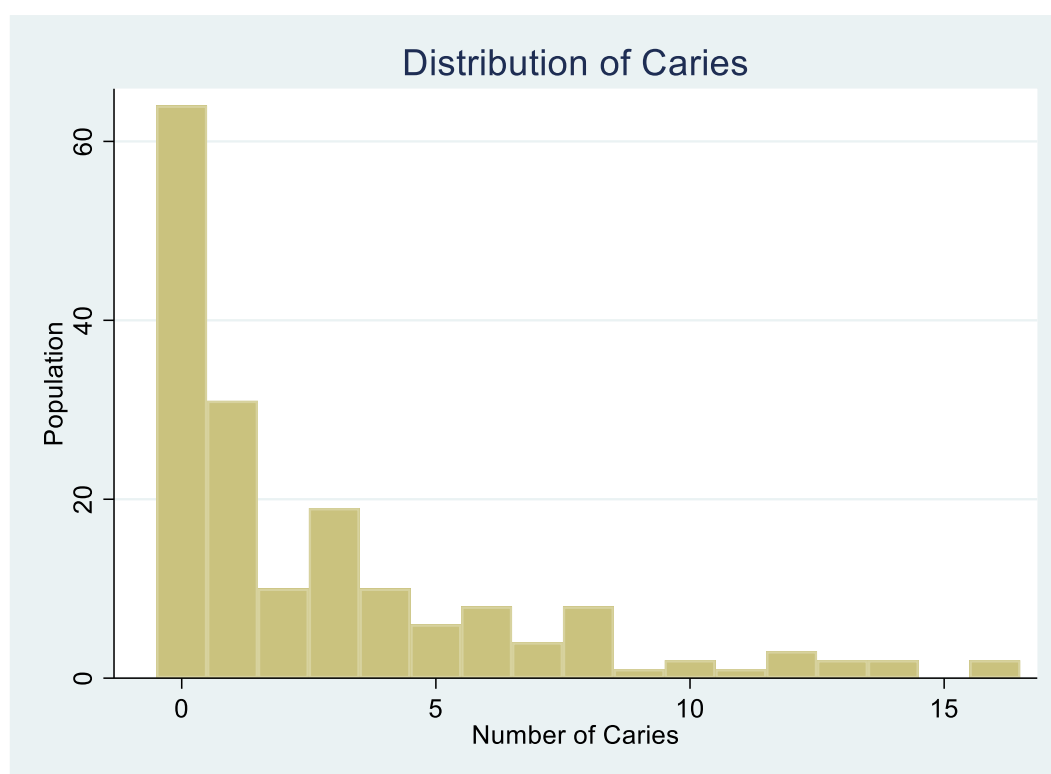
Characteristics	2018-2019	2018	2019	P value
Total	173	92	81	
Age, years, Mean±SD	13.66±0.28	13.58±0.39	13.74±0.43	0.803
<12 years	57 (32.9%)	29 (31.5%)	28 (34.6%)	
≥12 years	116 (67.1%)	63 (68.5%)	53 (65.4%)	
Sex				<0.05
Male, N (%)	96 (55.5%)	51 (55.4%)	44 (55%)	
Female, N (%)	77 (44.5%)	41 (44.6%)	36 (45%)	
Household Registration				<0.05
Urban	8 (5%)	6 (7%)	2 (1%)	
Rural	165 (95%)	86 (93%)	79 (99%)	
Nationality				0.553
Han	14 (8.1%)	9 (9.8%)	5 (6.2%)	
Zang	89 (51.5%)	44 (47.8%)	45 (55.5%)	
Qiang	69 (39.9%)	38 (41.3%)	31 (38.3%)	
Hui	1 (0.6%)	1 (1.1%)	0 (0%)	

\*P values were obtained using t-test for continuous variables and chi-squared test for

categorical variables.

### 3.2 Number of caries

Figure 3 shows the distribution of the number of caries for the entire sample. A total of 64 (37.0%) participants had no caries, while 31 (17.9%) had one caries and 78 (45.1%) had two or more caries. On average, participants had 2.77 (SD=3.65) caries (Table 2). More than 75% of had obtained fewer than five caries.



**Figure 3:** Distribution of Number of Caries of the deaf, hard of Hearing, and Mentally Disabled Children

**Table 2.** The Distribution of Number of Caries

	Number of Caries
Largest	16
Smallest	0
Mean (SD)	2.77 (3.65)
25th percentile	0
Median	1
75th percentile	4

Number of Caries	Population
0	64 (37.0%)
1	31 (17.9%)
2	10 (5.8%)
3	19 (11.0%)
4	10 (5.8%)
5	6 (3.5%)
6	8 (4.6%)
7	4 (2.3%)
≥8	21 (12.1%)

### 3.3 Caries Prevalence

We found a significantly higher prevalence of dental caries among participants aged less than 12 years (87.7%) than those aged at least 12 years (50.9%; Table 3). Males had a higher prevalence of dental caries than females (67.7% vs. 57.1%); however, the difference was not statistically significant. Han (78.6%) had a higher detection rate of dental calculus than those Zang (61.7%) and Qiang (60.9%), but the difference was not statistically significant either. Participants who lived in urban and rural areas had a similar prevalence of dental caries. After mutually adjustment of socio-demographic characteristics, participants aged at least 12 years had a 86% (95% CI: 65%, 94%) lower odds of having dental caries than those aged less than 12 years.

**Table 3.** Prevalence rate of Caries in the deaf, hard of Hearing, and Mentally Disabled Children/Teenagers

Characteristics	Sample size	Prevalence of Caries	P value	Odds Ratio
Total	173	109 (63.0%)		
Age, years			<0.05	
<12 years	57	50 (87.7%)		Ref.
≥12 years	116	59 (50.9%)		0.14 (0.06, 0.35)
Sex			0.153	
Male, N (%)	96 (55.5%)	65 (67.7%)		Ref.
Female, N (%)	77 (44.5%)	44 (57.1%)		1.19 (0.60, 2.37)

Household Registration			0.976	
Urban	8	5 (62.5%)		Ref.
Rural	165	104 (63.0%)		1.48 (0.28, 7.91)
Nationality			0.591	
Han	14	11 (78.6%)		Ref.
Zang	89	55 (61.7%)		0.31 (0.07, 1.35)
Qiang	69	42 (60.9%)		0.33 (0.77, 1.46)
Hui	1	1 (100%)		

\* P values were obtained using t-test for continuous variables and chi-squared test for categorical variables.

### 3.4 Gingivitis

We found a significantly higher gingivitis detection rate among Han (87.7%) than Qiang (18.8%) and Zang (7.9%; Table 4). Participants aged less than 12 years had a lower detection rate of gingivitis than those aged at least 12 years (7.0% vs. 18.1%), but the difference was not statistically significant. Males had a higher prevalence of dental caries than females (17.7% vs. 10.4%); however, the difference was not statistically significant either. Participants who lived in urban had a higher detection rate of gingivitis than those who lived in rural areas (25.0% vs. 13.9%). After mutually adjustment of socio-demographic characteristics, Zang had a 81% (95% CI: 17%, 96%) lower odds of having gingivitis than Han. Additionally, participants at least 12 years had a 196% (95% CI: 8%, 853%) higher odds of having gingivitis than those less than 12 years, which is not significant but close to it.

**Table 4.** The detection rate of Gingivitis in the deaf, hard of Hearing, and Mentally Disabled Children/Teenagers

Characteristics	Sample Size	Gingivitis Detection Rate	P value	Odds Ratio
Total	173	25 (14.5%)		
Age, years			0.051	
<12 years	57	4 (7.0%)		Ref.
≥12 years	116	21 (18.1%)		2.96 (0.92, 9.53)
Sex			0.174	
Male, N (%)	96 (55.5%)	17 (17.7%)		Ref.
Female, N (%)	77 (44.5%)	8 (10.4%)		2.08 (0.78, 5.49)
Household Registration			0.385	
Urban	8	2 (25%)		Ref.
Rural	165	23 (13.9%)		1.59 (0.24, 10.40)
Nationality			<0.05	
Han	14	5 (35.7%)		Ref.
Zang	89	7 (7.9%)		0.19 (0.04, 0.83)
Qiang	69	13 (18.8%)		0.54 (0.14, 2.11)
Hui	1	1 (100%)		

\* P values were obtained using t-test for continuous variables and chi-squared test for categorical variables.

### 3.5 Dental Calculus

We found a significantly higher detection rate of dental calculus among males (14.6%) than females (3.9%; Table 5). Han (21.4%) had a higher detection rate of dental calculus than those Qiang (13.0%) and Zang (5.6%), but the difference was not statistically significant. Participants aged less than 12 years had a higher detection rate of gingivitis than those aged at least 12 years (10.5% vs 9.5%), however, the difference was not statistically significant either. Participants who lived in urban and rural areas also had a similar detection rate of dental calculus (12.5% vs. 9.7%). After mutually adjustment of socio-demographic characteristics, females had a 376% (95%



CI: 22%, 1754%) higher odds of having dental calculus than males.

**Table 5.** The detection rate of dental calculus in the deaf, hard of Hearing, and Mentally Disabled Children/Teenagers

Characteristics	Sample Size	Dental Calculus Detection rate	P value	Odds Ratio
Total	173	17 (9.8%)		
Age, years			0.828	
<12 years	57	6 (10.5%)		Ref.
≥12 years	116	11 (9.5%)		0.91 (0.28, 2.94)
Sex			<0.05	
Male, N (%)	96 (55.5%)	14 (14.6%)		Ref.
Female, N (%)	77 (44.5%)	3 (3.9%)		4.76 (1.22, 18.54)
Household Registration			0.795	
Urban	8	1 (12.5%)		Ref.
Rural	165	16 (9.7%)		2.67 (0.25, 28.62)
Nationality			0.149	
Han	14	3 (21.4%)		Ref.
Zang	89	5 (5.6%)		0.27 (0.05, 1.56)
Qiang	69	9 (13.0%)		0.75 (0.14, 3.97)
Hui	1	1 (100%)		

\* P values were obtained using t-test for continuous variables and chi-squared test for categorical variables

### 3.6 Oral Health

We found a significantly higher oral health rate among participants aged at least 12 years (38.8%) than those aged less than 12 years (10.5%; Table 6). Additionally, we also found a significantly higher oral health rate among Zang (32.6%) than those Qiang (29.0%) and Han (14.3%: Table 6). Males had a lower oral health rate than females (26.0% vs. 33.8%); however, the difference was not statistically significant.

Participants who lived in urban and rural areas had a similar oral health rate (25% vs. 29.7%). After mutually adjustment of socio-demographic characteristics, participants aged at least 12 years had an 82% (95% CI: 65%, 94%) lower odds of having good oral health than those aged less than 12 years.

**Table 6.** The Oral Health Rate in the deaf, hard of Hearing, and Mentally Disabled Children/Teenagers

Characteristics	Sample size	Oral Health rate	P value	Odds Ratio
Total	173	51 (29.5%)		
Age, years			<0.05	
<12 years	57	6 (10.5%)		Ref.
≥12 years	116	45 (38.8%)		0.18 (0.07, 0.46)
Sex			0.149	
Male, N (%)	96 (55.5%)	25 (26.0%)		Ref.
Female, N (%)	77 (44.5%)	26 (33.8%)		1.11 (0.54, 2.26)
Household Registration			0.811	
Urban	8	2 (25%)		Ref.
Rural	165	49 (29.7%)		1.23 (0.20, 7.63)
Nationality			<0.05	
Han	14	2 (14.3%)		Ref.
Zang	89	29 (32.6%)		0.26 (0.05, 1.41)
Qiang	69	20 (29.0%)		0.35 (0.07, 1.86)
Hui	1	0 (0%)		

\*P values were obtained using t-test for continuous variables and chi-squared test for categorical variables.

## **4. Discussion**

### **4.1 Summary of Study aims and main Findings**

Obtaining the "volunteer project" data from West China Stomatological Hospital, we built and validated some comprehensive tables about associations between several oral health criteria and socio-demographic characteristics to identify the oral health status of children with disability. Oral health criteria included three primary measurements: caries status, periodontal health status (gingivitis and dental calculus), and general oral health status.

For caries status, this group of disabled children had a higher prevalence rate and caries average numbers than the standard from the Fourth National oral Health Epidemiological Survey and WHO. 1.2 was the lowest standard of the severity of caries, while this group of disabled children's mean of caries was 2.77. It means they had a medium-level severity of caries. Furthermore, 30% was the standard caries prevalence rate, while they shared a rate of 63%, a severe oral health issue. At the same time, disabled children under 12 years old had a significantly higher prevalence rate of caries than those aged at least 12 years.

Han participants had a significantly higher gingivitis detection rate for periodontal health status than Zang and Qiang participants. Males had a higher dental calculus detection rate than females. Additionally, both general gingivitis and dental calculus detection rate were lower than the detection rate from the Fourth National oral Health Epidemiological Survey.

For general oral health status, disabled children aged at least 12 had a

significantly higher oral health rate than those aged more than 12 years.

## **4.2 Similarities and Differences with Previous and Current Studies**

Previous studies have consistently shown that children with disabilities are at a higher risk of oral health problems. In India, two studies have reported extremely high DMFT scores and caries prevalence rates among disabled children (13,16). Although disabled children generally had a "medium" caries status, with a DMFT mean score of around 2.7, different disabilities were associated with varying levels of DMFT scores and caries prevalence rates. For example, children with Down's syndrome had a lower DMFT mean score of 2.44, while children with cerebral palsy and mental retardation had a higher score of 3.95 (16). These findings suggest that different disabilities may impact children's oral health behaviors and understanding differently, making it challenging to implement a one-size-fits-all approach to improve their oral health conditions.

Several recent studies have confirmed that caries and periodontal diseases are the main oral health issues affecting disabled children (52, 53, 54). These studies have revealed that disabled children often have a high prevalence rate of caries and a high mean caries score (52, 54), while the prevalence of periodontal disease varies. Some studies have reported a relatively low prevalence rate of 22.8% (compared to 60%-70% in the Fourth National Oral Health Epidemiological Survey) (54), whereas others have reported a relatively high rate of 36% (16). In the present study, the prevalence

rate was 14.5%, which is close to the "good" criteria for periodontal health. Although the DMFT score and caries prevalence rate were consistent with the severe caries prevalence group (around 2.7), the periodontal status was not consistent with previous studies that suggested disabled children have poor periodontal health. The difference in periodontal status warrants further investigation.

Finally, the Fourth National oral Health Epidemiological Survey suggested that children at least 12 years old have better oral health status than those under 12 (2), the same as this study's result. Older children have essential knowledge, so they have more opportunities to access health information, such as the importance of oral health.

### **4.3 Strengths and Limitations**

This study has several strengths. Firstly, it is the first to investigate the oral health status of children with disabilities, particularly from ethnic minorities. Children with disabilities are a vulnerable group who may not have access to regular schools and require special services from teachers. However, teachers may not pay enough attention to their oral health, making it crucial to focus on their oral health issues. Secondly, this study introduced a comprehensive index, the oral health rate, which considers most of the major oral diseases to determine the oral health status of the target population. This index provides a direct reflection of whether disabled children have oral health problems without having to check multiple oral indexes. Finally, the study's findings can serve as a reference for policymakers to pay more

attention to the oral health conditions of vulnerable groups.

This study also had limitations. First, the data we used for calculating the mean of caries and caries prevalence were DMFT index[decayed (dt/DT), missed (mt/MT), and filled (ft/FT) teeth]. However, we included decayed, missed, and filled teeth in only one category: caries lesion. When one tooth belongs to any of the three index groups, it will add to the caries lesion. At the same time, we did not categorize their teeth status into primary and permanent teeth because the participants' ages ranged from 3-23. Some children have both primary and permanent teeth, so to analyze caries' status, I chose to combine them.

Moreover, although the DMFT index is a valuable tool to reflect one's oral health conditions, it does not account for the severity of decay within individual teeth or the location of decay in the mouth. Additionally, the DMFT index may not capture the impact of dental caries on quality of life, such as pain or difficulty eating. Those limitations would be made us lose some information diversity. However, from another perspective, calculating the result could be more straightforward. All three DMFT indexes have one thing in common: they represent one tooth influenced by oral diseases. The approach used in this study could be a direct way to show the result and determine the oral health status. Second, participants in 2018 and 2019 were different. Therefore, analyzing the improvement and weaknesses of the target population was hard. Third, the data we obtained were only about examinations of disabled children's teeth—no questionnaire about their parents' and teachers' knowledge and attitudes about oral health issues. There is no survey about disabled

children's habits and behaviors in their daily life. Without those data, it was easier to do further analysis, like the causes of oral diseases and even the improvements to change the terrible oral health status.

#### **4.4 Future Direction**

After analyzing the data from disabled children, we could find out that it is necessary to pay attention to their oral health status. Now we made the first step: identify where the health issue is. Therefore, the next step is to do further work: collecting more categorized data about oral health status, having questionnaires and surveys about children's, parents', and teachers' knowledge and attitudes about oral issues, and obtaining data about children's daily habits and behaviors. Examining the oral health issue and offering treatment is never enough. Different disabilities have other effects on one's behaviors. Categorizing variously disabled children is necessary, even if this is hard because of the lack of medical and educational resources.

Furthermore, preventing oral health issues should also be considered. For instance, providing professionals to teach children basic oral health knowledge can help them change their terrible oral health status. At that time, we require further pilot study to check its progress.

## **5. Conclusion**

In conclusion, we present disabled children's oral health status in three oral health criteria: caries status, periodontal health status (gingivitis and dental calculus), and general oral health status. We also calculate the odds ratio about associations between each oral health criterion and socio-demographic characteristics. The comprehensive oral health status of disabled children was consistent with previous studies that shared a high mean of caries and a high prevalence rate. Nevertheless, their periodontal health status was better than the Fourth National oral Health Epidemiological Survey criteria. The comprehensive oral health rate showed that their oral health status was poor. Additional studies are necessary to check whether their oral health status is changed and how to improve it.



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