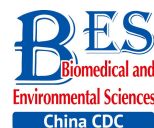


Original Article



Prevalence and Years of Life Lost due to Disability from Dental Caries among Children and Adolescents in Western China, 1990-2015

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Abstract

Objective To analyze the prevalence and years lived with disability (YLD) from dental caries among children and adolescents and the time trends over the past two decades in Sichuan province, the largest province in west China.

Methods Based on the Global Burden of Disease Study 2015 (GBD2015), which systematically assessed the epidemiological characteristics of major diseases and their transitions by country and region from 1990 to 2015, we extracted the estimated results for China. We then used the Bayesian meta-regression method to estimate the sex- and age-specific prevalences and YLDs from dental caries among children and adolescents under 15 years old in Sichuan province and compared them with global and national indicators for the same period.

Results In 2015, there were almost 6 million cases of dental caries in children and adolescents (aged < 15 years) in Sichuan province, accounting for 6% of the total cases in China. For children under 5 years, the prevalence of deciduous caries was 55.9%, and the YLDs value was 10.8 per 100,000, while it was 24.3% and 5.1 per 100,000 respectively among 5- to 14-year-olds; for those aged 5 to 14 years, the prevalence of permanent caries was 21.5%, and the YLDs value was 11.5 per 100,000. From 1990 to 2015, the prevalence of dental caries for children under 5 years increased substantially, by 16.2%, and the YLDs increased by 8.7%. Among those aged 5 to 14 years, the prevalence increased and the YLDs decreased.

Conclusion Dental caries remains a huge health burden in Western China. In contrast to the global and national data, the trend has increased rapidly over the past 25 years in this region. This work provides suggestions for the prevention and control for oral health in China with the policy of two-child.

Key words: Children and adolescents; Dental caries; YLD; Disease burden

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INTRODUCTION

As one of the most prevalent diseases among children and adolescents, dental caries is characterized by lifelong progressive and cumulative outcomes and affects approximately 80% of the world's population^[1-3]. Dental caries is preventable and treatable; however, it has been ignored by the public or perceived as low priority in policy discussions^[4], especially in low-income communities. Although the prevalence of dental caries is decreasing in developed countries^[5], it continues to increase in most developing countries^[6]. It is important to understand the levels and trends of dental caries in children and adolescents, who are in the early stages of life, and to introduce effective measures to assess and reduce the burden of disease^[7].

China has experienced rapid socio-economic growth in the past decades; however, the dental caries situation in China remains similar to that in developing countries, with a high prevalence and low treatment rate^[8]. Sichuan has the largest population in west China, and children and adolescents account for 16% of the province's population^[9]. The prevalence of caries and health loss due to dental caries for children and adolescents in Sichuan is an important factor not only in governmental investment and planning for dental services but in public health practitioners' and dentists' delivery and practice of dental services.

The Global Burden of Disease Study 2015 (GBD 2015) is a comprehensive effort to assess summary measurements of population health worldwide. It provides systematic and comparable estimates of the burden from diseases and injuries and their disabling consequences at the national and sub-national levels from 1990-2015^[1].

In this study, we report the prevalence of and years of life lost due to disability (YLD) from both deciduous and permanent caries in children and adolescents under 15 years old in Sichuan from 1990 to 2015. Additionally, we compare those figures with the estimates for China as a whole and with global indicators during the same period.

MATERIALS AND METHODS

Overview

The detailed methods of the GBD 2015 study have been published previously^[1,3,10-11]. Briefly, the GBD 2015 study comprehensively assessed the

burden of all major diseases and injuries for 195 countries by age, sex, cause, year and geography from 1990 to 2015 using a wide range of updated and standardized analytical procedures. Based on the GBD 2015 study, the present work extracted the Chinese estimates by province and analyzed the prevalence of dental caries in Sichuan, in western China. Additionally, the present study determined the corresponding YLDs since dental caries mainly affects quality of life and rarely has fatal outcomes.

Data Sources

The data sources used in the GBD 2015 for the Chinese estimates mainly included the China World Health Survey 2002^[12], the second national survey of the oral health status of children and adults in China^[13], studies regarding the prevalence of dental caries and its factors among Chinese provinces^[14-18], studies of the effectiveness of certain caries prevention programs^[19-20], and other published scientific literature^[21]. The incidence, prevalence, risk rate, risk factors, covariates and other useful data regarding dental caries were extracted for further analyses. The data analysis was strictly controlled to ensure reliability and quality, which were examined with 3 independent systematic reviews^[22].

Disability Weights

The disability weights used in the GBD 2015 for all nations and sub-nations were based on the results of household and open internet surveys in 9 countries (Bangladesh, Indonesia, Peru, USA, Tanzania, Hungary, Italy, the Netherlands, and Sweden). All the participants were aged 18 years or older^[23].

Prevalence and YLD Estimate

Prevalence and YLD were estimated by age, sex, cause, and year. The Bayesian meta-regression method was applied to estimate the outcomes of oral disease, including prevalence estimates and uncertainty distribution, between 1990 and 2015. DisMod-MR, a Bayesian meta-regression tool developed for the GBD 2010, was used to analyze the prevalence. YLDs were calculated as the prevalence (frequency) times the disability weight of the associated sequelae (severity) times the duration of symptoms. National estimates should be calculated first, and provincial estimates should be based on the national estimates. This technological process has been described in detail elsewhere^[1].

RESULTS

In 2015, over 2 million children under 5 years of age suffered from deciduous caries, and the prevalence was 55.9% in Sichuan. Moreover, almost 4 million children aged 5 to 14 years had dental caries, and the prevalences of deciduous and permanent caries were 24.3% and 21.5%, respectively (Table 1 and Table 2).

We compared the sex-specific trends of cases and prevalence from 1990 to 2015 in Sichuan (Table 3) and found that male indexes were consistently higher than the female indexes in the deciduous caries group, but the situation was reversed for permanent caries. The number of dental caries cases decreased gradually in both males and females over the 25-year period. The prevalence of deciduous caries in children under 5 increased over the 25-year period, but the rate of caries in 5- to 14-year-olds fluctuated. For permanent caries, the rate remained stable for both males and females.

Regarding YLDs, the value was higher for permanent caries than for deciduous caries (Table 3). The rates of deciduous caries were nearly the same for males and females; however, for permanent caries, the female indexes were higher than male indexes.

From 1990 to 2015, the overall prevalence of and YLDs for dental caries among children under 15 years changed in different ways for the world, China and Sichuan (Tables 1 and 2). Among children under 5 years of age, the prevalence of deciduous caries in Sichuan increased by 16.2%; globally and in China, however, the prevalence changes were 0% and 9.4%, respectively. In addition, the YLDs in Sichuan increased by 8.7%, whereas YLDs decreased by 2.3% globally and increased by 0.8% in China. Among 5- to 14-year-olds, YLDs due to permanent caries increased by 3.2% in Sichuan, while globally, it increased by 0.9%, and in China, it decreased by 1.9%. The YLDs worldwide, in China and in Sichuan decreased by 3.1%, 8.1%, 2.9%, respectively, and the total prevalence and YLDs decreased.

DISCUSSION

The burden of oral diseases in populations worldwide has previously been reported^[22], but in this study, we focused on children and adolescents under 15 years of age and the major oral health problem in this age group. Dental caries is the most important cause of tooth loss in children^[7] and the

greatest risk factor for developing further tooth decay^[24]; furthermore, it is closely related to periodontal disease and other oral disorders in later life^[25-27]. Although dental caries rarely results in serious consequences, it may still cause severe harm in the forms of pain, injury, infection, malnutrition, psychological problems, and impaired social interactions^[28]. Thus, it is important to provide prevention and timely treatment. Although many chronic diseases cannot be easily detected and cured, dental caries is preventable and curable in the early stages^[29-31].

This study revealed that there the number of caries cases is large and rapidly increasing in Sichuan. Therefore, more effective determinations of different age- and sex-related differences should be performed to reduce the burden of oral disease in children and adolescents in the future^[32-35]. Since water fluoridation is not conducted in Sichuan, the use of fluoridated toothpaste seems to be an effective and feasible method for addressing the challenges of caries in children. The data shows male indexes were consistently higher than female indexes for deciduous caries, while the results were reversed for permanent caries. These findings are similar to those of the third national epidemiological survey of oral health status in China^[36]. The reason could be more frequent tooth brushing and reduced sugar intake among females under 5 years of age and increased sugar intake and lower awareness of oral hygiene among females aged 5 to 14 years. With increased age, oral health awareness also strengthened, and the total prevalence of dental caries decreased. Given the poor dexterity of children, parents/teachers should pay more attention to children' oral hygiene. The increasing prevalence and low treatment rate of caries also reflected the ignorance of parents/teachers and the public^[37].

The GBD 2015 data for Sichuan in west China shows that the prevalence of dental caries increased rapidly over the past 25 years in this province compared with the worldwide rates and the those of China as a whole. Furthermore, Sichuan had the highest increase in YLDs among children under 5 years of age and the lowest decrease in YLDs among children aged 5 to 14 years. The differences in these rates could be due to social, economic and lifestyle transformations^[38], increases overweight and obesity among children^[39-40], poor oral health services^[41] and public ignorance regarding dental health, which can lead to more untreated dental caries.

Table 1. Deciduous Caries Prevalence and YLDs in Children under 5 Years, 1990 to 2015, with Percentage Change

Region	No. of Cases (millions)			Prevalence (%)			YLDs			YLDs Rate (100 K)		
	1990	2015	% change	1990	2015	% Change	1990	2015	% change	1990	2015	% change
Global	253.9 (200.3 to 305.3)	262.3 (205.0 to 319.3)	3.3 (1.2 to 4.9)	45.5 (35.9 to 54.7)	45.5 (35.5 to 55.4)	0.0 (-2.1 to 1.6)	643.8 (277.6 to 1257.1)	661.8 (283.7 to 1300.5)	2.8 (0.3 to 4.8)	10.1 (4.3 to 19.7)	9.9 (4.2 to 19.4)	-2.3 (-4.6 to -0.4)
China	58.2 (48.4 to 67.1)	38.5 (32.2 to 44.2)	-33.9 (-36.1 to -31.3)	51.8 (43.0 to 59.5)	56.7 (47.8 to 65.2)	9.4 (5.6 to 14.0)	137.0 (59.4 to 267.1)	90.6 (39.1 to 176.1)	-33.9 (-36.4 to -31.0)	10.8 (4.7 to 21.1)	10.9 (4.7 to 21.2)	0.8 (-3.0 to 5.2)
Sichuan	4.5 (3.5 to 5.4)	2.0 (1.7 to 2.3)	-55.2 (-59.4 to -49.2)	48.1 (38.0 to 57.7)	55.9 (46.2 to 64.0)	16.2 (5.5 to 32.0)	10.6 (4.5 to 21.2)	4.7 (2.0 to 9.1)	-55.3 (-60.7 to -48.3)	10.0 (4.2 to 19.9)	10.8 (4.6 to 20.9)	8.7 (-4.5 to 25.6)

Table 2. Dental Caries Prevalence and YLDs of Children Aged 5-14 Years, 1990 to 2015, with Percentage Change

Region	Type	No. of Cases (millions)			Prevalence (%)			YLDs			YLDs Rate (100 K)		
		1990	2015	% change	1990	2015	% change	1990	2015	% change	1990	2015	% change
Global	DC	300.6 (234.7 to 376.2)	310.4 (234.0 to 399.0)	3.2 (-1.1 to 6.4)	28.9 (22.6 to 36.2)	27.0 (20.4 to 34.7)	-6.6 (-10.6 to -3.8)	796.9 (338.7 to 1588.7)	810.0 (341.2 to 1639.2)	1.6 (-2.7 to 5.1)	7.2 (3.1 to 14.4)	6.5 (2.8 to 13.2)	-9.6 (-13.5 to -6.6)
	PC	293.1 (238.4 to 355.7)	326.9 (262.4 to 399.5)	11.5 (9.1 to 13.5)	28.2 (23.0 to 34.2)	28.5 (22.9 to 34.8)	0.9 (-1.3 to 2.7)	2018.3 (881.2 to 3845.2)	2199.4 (963.5 to 4275.0)	9.0 (6.1 to 11.4)	18.3 (8.0 to 34.9)	17.7 (7.8 to 34.5)	-3.1 (-5.6 to -0.9)
China	DC	62.1 (50.6 to 77.0)	38.9 (30.8 to 49.2)	-37.4 (-42.0 to -31.9)	32.2 (26.2 to 39.8)	28.1 (22.3 to 35.6)	-12.5 (-18.8 to -5.0)	145.5 (63.8 to 298.2)	91.3 (39.5 to 190.5)	-37.3 (-42.2 to -31.7)	7.2 (3.2 to 14.8)	5.9 (2.6 to 12.3)	-18.3 (-24.7 to -10.9)
	PC	41.5 (32.6 to 52.9)	29.1 (22.5 to 37.5)	-29.8 (-34.0 to -25.2)	21.5 (16.9 to 27.4)	21.1 (16.2 to 27.2)	-1.9 (-7.7 to 4.7)	247.2 (103.6 to 490.0)	174.2 (72.7 to 344.4)	-29.5 (-33.7 to -24.7)	12.3 (5.1 to 24.3)	11.3 (4.7 to 22.3)	-8.1 (-13.5 to -1.9)
Sichuan	DC	3.5 (2.6 to 4.6)	2.1 (1.6 to 2.7)	-41.2 (-47.6 to -35.2)	24.4 (18.2 to 31.7)	24.3 (18.4 to 31.3)	-0.5 (-11.8 to 9.6)	8.3 (3.4 to 17.7)	4.9 (2.1 to 10.3)	-41.1 (-49.1 to -32.3)	5.5 (2.3 to 11.7)	5.1 (2.1 to 10.8)	-6.8 (-7.0 to 25.7)
	PC	3.0 (2.3 to 3.9)	1.8 (1.4 to 2.4)	-39.0 (-42.9 to -34.8)	20.9 (15.9 to 27.3)	21.5 (16.3 to 28.0)	3.2 (-3.5 to 10.5)	18.0 (7.4 to 36.4)	11.0 (4.5 to 22.1)	-38.6 (-44.5 to -32.7)	11.9 (4.9 to 24.0)	11.5 (4.7 to 23.0)	-2.9 (-12.2 to 6.4)

Note. Abbreviations: DC, Deciduous caries; PC, Permanent caries.

Table 3. Prevalence and YLDs Attributed to Dental Caries by Sex among Children under 15 Years of Age, 1990 to 2015, in Sichuan

Type	Age	Sex	No. of Cases (millions)			Prevalence (%)			YLDs			YLDs Rate (100 k)		
			1990	2015	% change	1990	2015	% change	1990	2015	% change	1990	2015	% change
DC	Under 5 years	Male	2.4 (1.9 to 2.9)	1.1 (0.9 to 1.2)	-56.3 (-60.0 to -51.0)	50.2 (40.1 to 59.4)	57.1 (47.2 to 65.6)	5.9 (-3.0 to 18.7)	5.8 (2.5 to 11.3)	2.5 (1.1 to 4.9)	-56.3 (-62.3 to -48.8)	10.4 (4.5 to 20.3)	11.0 (4.8 to 21.4)	5.9 (-8.7 to 24.1)
			2.1	0.9	-54.0	45.9	54.7	12.4	4.9	2.2	-54.1	9.6	10.7	12.1
		Female	1.6 to 2.6	0.8 to 1.1	(-59.6 to -45.7)	(35.4 to 57.0)	(44.2 to 62.7)	(-1.4 to 32.6)	(2.0 to 9.8)	(1.0 to 4.3)	(-61.8 to -43.2)	(4.0 to 19.3)	(4.6 to 20.6)	(-6.7 to 38.7)
	5-14 years	Male	1.9 (1.4 to 2.4)	1.1 (0.8 to 1.4)	-42.7 (-50.1 to -35.7)	25.1 (18.5 to 32.6)	24.1 (17.9 to 31.2)	-10.1 (-21.7 to 0.9)	4.4 (1.8 to 9.4)	2.5 (1.0 to 5.2)	-42.5 (-52.2 to -31.8)	5.6 (2.3 to 12.0)	5.1 (2.1 to 10.5)	-9.9 (-25.0 to 7.0)
			1.7	1.0	-39.5	23.7	24.4	-3.3	3.9	2.4	-39.6	5.3	5.1	-3.4
		Female	1.2 to 2.2	0.8 to 1.3	(-45.9 to -32.7)	(17.7 to 31.4)	(18.6 to 31.6)	(-13.5 to 7.5)	(1.6 to 8.3)	(1.0 to 4.9)	(-49.4 to -28.5)	(1.2 to 11.3)	(2.2 to 10.7)	(-19.1 to 14.2)
PC	5-14 years	Male	1.4 (1.0 to 1.8)	0.9 (0.6 to 1.2)	-38.7 (-44.5 to -32.6)	18.7 (14.0 to 24.7)	19.3 (14.5 to 25.9)	-3.8 (-13.0 to 5.7)	8.3 (3.4 to 16.8)	5.1 (2.1 to 10.6)	-38.3 (-46.5 to -30.2)	10.6 (4.3 to 21.4)	10.3 (4.3 to 21.2)	-3.2 (-16.1 to 9.6)
		Female	1.6 (1.2 to 2.1)	1.0 (0.8 to 1.3)	-39.3 (-44.6 to -33.3)	23.2 (17.7 to 30.0)	24.0 (18.2 to 31.2)	-3.0 (-11.5 to 6.6)	9.7 (4.1 to 19.6)	5.9 (2.4 to 11.8)	-39.0 (-46.3 to -31.2)	13.2 (5.6 to 26.6)	12.9 (5.2 to 25.7)	-2.5 (-14.2 to 9.9)

Note. Abbreviations: DC, Deciduous caries; PC, Permanent caries.

The decline in YLDs due to permanent caries in China could partly be related to the children’s dental caries prevention project^[42] that began in some cities in central and western China in 2009. Free pit and fissure sealants were provided for permanent teeth for children aged 7 to 9 years, fluoride was provided for deciduous teeth for children aged 3 to 6 years, and oral hygiene education was offered in the implementation areas and gradually expanded to the entire nation. As of 2015, the project has been implemented in nearly 50 counties, accounting for 27% of the area of Sichuan province; still, the number of children served and the scope of the project are inadequate, especially in ethnic minority areas. Additionally, the declines in both prevalence and YLDs in relation birth-rate decreases could be changed by the Chinese two-child policy implemented in 2016.

According to the ‘Health China 2030’ plan, the prevalence of dental caries in children under 12 years should be kept below 25%, and every person has the right to have a healthy mouth^[43].

However, our findings indicate that this goal is difficult to achieve. This conclusion is further supported by a recent study showing that the burden of disease attributed to dietary risk factors, tobacco smoking, alcohol use and physical inactivity continued to increase from 1990 to 2010^[44].

The study took advantage of the data from the GBD 2015, which used an integrated modeling method that made the findings comparable. However, this study shares many limitations with the GBD study^[6,22], such as the relatively high 95% uncertainty interval for quantities, the less-than-comprehensive data sources used to estimate oral diseases, and the failure to consider some national sources of oral health data. For China, the GBD 2015 does not include data from the Chinese children's dental project or internal data from the education system, which may impact the accuracy of the data and underestimate the burden of oral disease^[45]. These oversights remind us that it is necessary to establish an oral health surveillance system throughout the whole nation. In addition, whether the GBD’s disability weighting based on 9 countries and a network survey is applicable for China remains questionable.

CONCLUSION

Overall, the results for western China show that the prevalence of dental caries increased

significantly over the past 25 years compared to global and national data. The YLDs for children under 5 years of age increased, while they decreased for children aged 5 to 14 years old. Given the recent introduction of the two-child policy in China, the number of dental caries cases could increase. These factors point to the need for greater efforts to relieve the burden of oral disease in children and adolescents. It will be helpful to establish a national oral health surveillance system to track trends and service needs.

AUTHOR CONTRIBUTIONS

Prof. ZHOU MG, WANG Z, DENG Y conceived the study and provided overall guidance. WANG Z and DENG Y prepared the first draft. Prof. ZHANG JX, WANG Z, DENG Y, and YANG SJ finished the draft based on comments from the other authors. ZENG XY and LIU SW acquired the data. All other authors contributed to the analysis and reviewed the manuscript.

CONFLICT OF INTEREST

No conflict of interest to declare.

ETHICAL APPROVAL AND INFORMED CONSENT

This article does not contain any studies with human participants or animals performed by any of the authors.

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