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Original Article

# The dental use by pediatric patients in the National Health Insurance of Taiwan in 2020

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Dental use;  
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**Abstract** *Background/Purpose:* Although the penetration rate of National Health Insurance (NHI) of Taiwan is as high as 99%, our children still face the impact of oral diseases. This study investigated the profile of dental use by pediatric patients in the NHI of Taiwan in 2020.

*Materials and methods:* Data on the population and medical records of NHI were obtained from the websites of Ministry of the Interior and the NHI Administration. The pediatric dental patient data were divided into 3 age groups (0–4, 5–9, and 10–14 years) to investigate and analyze dental treatment records claimed in 2020.

*Results:* In Taiwan, the two most common oral diseases in children were dental caries and gingivitis & periodontal diseases. The dental use rate for treatment of dental caries in children was 16.84% for the 0-4-year, 55.69% for the 5-9-year, and 34.29% for the 10-14-year age groups. Moreover, in all 3 age groups of children, dental caries needed the highest NHI expenses, followed in a descending order by gingivitis & periodontal diseases and diseases of pulp & periapical tissues. Among them, dental caries needed more than half (51.15%) of all dental NHI expenses in the 5-9-year age group.

*Conclusion:* Due to the long-term lack of awareness and behavior for oral health care among Taiwanese people, the dental caries rate of the children remains high. From a cost-effectiveness viewpoint, Taiwan government should develop a better oral health care policy to prevent dental caries and gingivitis & periodontal diseases in children.

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## Introduction

The 2017 Global Burden of Disease Study estimated that 531 million children have caries in their deciduous teeth. In addition to dental caries, young children also experience oral problems such as gingivitis & periodontal diseases, impacted teeth, trauma, oral clefts, and malocclusion. Poor oral health can lead to malnutrition, low self-esteem, or missing school.<sup>1–4</sup> Oral health is critical to an individual's overall health and quality of life. The World Health Organization (WHO) established the goal for creating nationwide oral health care in 1979 with the theme of "Health for All". The plan was to set a year 2000 oral health goal that 50% of children aged 5–6 years were free of dental caries. In 2010, this goal was raised to 90%.<sup>5</sup> A survey of oral cavity status of children under the age of 6 years in Taiwan found that the prevalence of dental caries is 60% for 3-year-old children, 75% for 4-year-old children, and 89% for 5-year-old children. These data indicate that the prevalence of dental caries in preschool children is higher than the standards of WHO.<sup>6</sup> Although the prevalence of dental caries in the general population has been declined over the past few decades, dental caries in deciduous teeth remains a prevalent public health problem in many countries, including Taiwan.<sup>5</sup>

In fact, children's oral health affects not only their quality of life, but also their quality of learning, which in turn affects their overall physical and mental health during their subsequent growth and development. The poor oral health of children may also adversely affect their future oral health, thus creating a vicious circle, which is more likely to lead to an increase in future oral medical expenses and even an increase in overall medical expenses. Therefore, the national health care policy needs to pay more attention to the improvement of children's oral health. In addition, some effective methods should be used to understand the types of oral problems of our children in order to propose an effective children's oral health policy.

To understand the oral cavity status of our children, oral examination is the most direct method, but there are still problems such as inspection methods, sampling methods, sampling ratios, and additional budgets. Fortunately, the National Health Insurance (NHI) was implemented in Taiwan in 1995, and the penetration rate has reached 99% of the entire population.<sup>7</sup> Since the implementation of NHI, the patients' medical records, including the types of diseases, have been stored in the NHI database. Therefore, we have the opportunity to extract the medical records of children from the NHI database and to analyze the types of children's oral diseases and their expenses for dental care. We hope that the results of this study can be used as a reference for the formulation of the children's oral health care policy.

## Materials and methods

This study adopted the methods of the secondary data analysis. The population data in mid-2020 of Taiwan were obtained from the Ministry of the Interior. The dental treatment records, including the numbers of patients, outpatient visits and their medical expenses, and disease classifications, were obtained from the website of the NHI Administration. This study only investigated and analyzed dental treatment records claimed in 2020. In this study, the pediatric dental patient data were divided into 3 age groups (0–4, 5–9 and 10–14 years) in order to match the 3 age groups published by the Ministry of the Interior, and all pediatric patients of the overall population were used as a group for comparison. According to the dental patients who received NHI services in 2020, the dental use rate, the mean numbers of outpatient visits per patient, and the mean medical expense NHI points per patient were analyzed in the 3 age groups and all patients of the same age group based on various oral-related diseases by the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10). The dental use rate of children in each age group was calculated by dividing the number of patients in each age group to the total population of the same age group. This study further compared the dental use rates of children in each age group and in the overall population, the mean numbers of visits per patient, and the mean medical expense NHI points per patient in each age group of patients in Taiwan in 2020.

## Results

The numbers of patients, the numbers of outpatient visits, and the medical expense NHI points for various types of oral diseases in different age groups of pediatric patients in Taiwan in 2020 are shown in [Table 1](#). According to ICD-10, dentistry-related diseases of the children are classified into: 1) disorders of tooth development and eruption, 2) embedded and impacted teeth, 3) dental caries, 4) other diseases of hard tissues of teeth, 5) diseases of pulp and periapical tissues, 6) gingivitis and periodontal diseases, 7) other disorders of gingiva and edentulous alveolar ridge, 8) other disorders of teeth and supporting structures, 9) cysts of oral region, not elsewhere classified, 10) diseases of salivary glands, 11) stomatitis and related lesions, 12) other diseases of lip and oral mucosa, 13) diseases of tongue, and 14) others. In 2020, the overall population of Taiwan was 23,582,179; of them, 950,552 (4.03%) were of the 0-4-year age group, 1,041,754 (4.42%) were of the 5-9-year age group, and 994,568 (4.22%) were of the 10-14-year age group ([Table 1](#)). In the overall population, there were 11,079,061 patients, 41,516,897 outpatient visits, and

**Table 1** The numbers of patients, the numbers of outpatient visits, and the medical expense National Health Insurance (NHI) points for various types of oral diseases in different age groups of pediatric patients in Taiwan in 2020.

| Population   | 0–4 years (950,552; 4.03%) |                 |                 | 5–9 years (1,041,754; 4.42%) |                   |                   | 10–14 years (994,568; 4.22%) |                 |                 | Overall (23,582,179; 100%) |                    |                    |
|--|----------------------------|-----------------|-----------------|------------------------------|-------------------|-------------------|------------------------------|-----------------|-----------------|----------------------------|--------------------|--------------------|
|  | Patients (%)               | Visits (%)      | Expenses (%)    | Patients (%)                 | Visits (%)        | Expenses (%)      | Patients (%)                 | Visits (%)      | Expenses (%)    | Patients (%)               | Visits (%)         | Expenses (%)       |
| Disorders of tooth development and eruption              | 21,536 (5.95)              | 27,912 (3.03)   | 14,523 (1.90)   | 144,475 (17.27)              | 239,437 (6.94)    | 138,721 (4.65)    | 57,848 (10.17)               | 85,576 (5.15)   | 48,903 (3.26)   | 357,617 (3.23)             | 536,435 (1.29)     | 587,213 (1.28)     |
| Embedded and impacted teeth                              | 48 (0.01)                  | 58 (0.01)       | 29 (0.00)       | 1552 (0.19)                  | 2292 (0.07)       | 2613 (0.09)       | 1893 (0.33)                  | 3258 (0.20)     | 4644 (0.31)     | 177,407 (1.60)             | 269,470 (0.65)     | 626,500 (1.37)     |
| Dental caries  | 160,043 (44.22)            | 321,253 (34.89) | 360,492 (47.34) | 580,149 (69.35)              | 1,353,812 (39.24) | 1,524,743 (51.15) | 341,026 (59.95)              | 596,434 (35.88) | 730,860 (48.70) | 6,304,315 (56.90)          | 12,608,387 (30.37) | 15,948,109 (34.86) |
| Other diseases of hard tissues of teeth                  | 18,374 (5.08)              | 24,062 (2.61)   | 11,201 (1.47)   | 46,281 (5.53)                | 67,963 (1.97)     | 32,178 (1.08)     | 20,015 (3.52)                | 26,206 (1.58)   | 14,167 (0.94)   | 541,597 (4.89)             | 711,096 (1.71)     | 620,585 (1.36)     |
| Diseases of pulp and periapical tissues                  | 18,589 (5.14)              | 32,647 (3.55)   | 79,143 (10.39)  | 132,958 (15.89)              | 230,304 (6.68)    | 415,666 (13.94)   | 26,942 (4.74)                | 43,373 (2.61)   | 72,599 (4.84)   | 1,803,645 (16.28)          | 3,397,432 (8.18)   | 6,569,977 (14.36)  |
| Gingivitis and periodontal diseases                      | 243,311 (67.22)            | 400,438 (43.49) | 242,303 (31.82) | 552,767 (66.08)              | 1,042,566 (30.22) | 611,166 (20.50)   | 420,613 (73.94)              | 700,384 (42.13) | 520,698 (34.70) | 9,409,902 (84.93)          | 19,182,625 (46.20) | 18,083,020 (39.53) |
| Other disorders of gingiva and edentulous alveolar ridge | 681 (0.19)                 | 804 (0.09)      | 510 (0.07)      | 1885 (0.23)                  | 2317 (0.07)       | 1401 (0.05)       | 988 (0.17)                   | 1221 (0.07)     | 707 (0.05)      | 55,800 (0.50)              | 74,584 (0.18)      | 44,815 (0.10)      |
| Other disorders of teeth and supporting structures       | 3231 (0.89)                | 3830 (0.42)     | 2111 (0.28)     | 164,175 (19.63)              | 253,206 (7.34)    | 145,242 (4.87)    | 77,037 (13.54)               | 111,459 (6.70)  | 61,481 (4.10)   | 804,281 (7.26)             | 1,142,247 (2.75)   | 1,018,256 (2.23)   |
| Cysts of oral region, not elsewhere classified           | 135 (0.04)                 | 150 (0.02)      | 85 (0.01)       | 1320 (0.16)                  | 1660 (0.05)       | 1031 (0.03)       | 482 (0.08)                   | 766 (0.05)      | 639 (0.04)      | 29,840 (0.27)              | 39,954 (0.10)      | 25,345 (0.06)      |
| Diseases of salivary glands                              | 236 (0.07)                 | 315 (0.03)      | 248 (0.03)      | 1061 (0.13)                  | 1518 (0.04)       | 1080 (0.04)       | 559 (0.10)                   | 804 (0.05)      | 756 (0.05)      | 24,975 (0.23)              | 40,404 (0.10)      | 25,501 (0.06)      |
| Stomatitis and related lesions                           | 33,526 (9.26)              | 40,461 (4.39)   | 15,956 (2.10)   | 107,315 (12.83)              | 139,673 (4.05)    | 53,128 (1.78)     | 45,870 (8.06)                | 58,442 (3.52)   | 21,668 (1.44)   | 1,349,421 (12.18)          | 2,032,155 (4.89)   | 785,071 (1.72)     |
| Other diseases of lip and oral mucosa                    | 1891 (0.52)                | 2189 (0.24)     | 882 (0.12)      | 6443 (0.77)                  | 8228 (0.24)       | 3190 (0.11)       | 2636 (0.46)                  | 3185 (0.19)     | 1287 (0.09)     | 103,144 (0.93)             | 193,264 (0.47)     | 104,437 (0.23)     |
| Diseases of tongue                                       | 187 (0.05)                 | 211 (0.02)      | 101 (0.01)      | 421 (0.05)                   | 499 (0.01)        | 227 (0.01)        | 204 (0.04)                   | 225 (0.01)      | 93 (0.01)       | 5634 (0.05)                | 8953 (0.02)        | 5302 (0.01)        |
| Others   | 46,665 (12.89)             | 66,326 (7.20)   | 33,890 (4.45)   | 60,776 (7.27)                | 106,275 (3.08)    | 50,551 (1.70)     | 19,496 (3.43)                | 31,183 (1.88)   | 22,176 (1.48)   | 645,586 (5.83)             | 1,279,891 (3.08)   | 1,302,475 (2.85)   |
| Overall  | 361,939 (100)              | 920,656 (100)   | 761,476 (100)   | 836,509 (100)                | 3,449,750 (100)   | 2,980,937 (100)   | 568,834 (100)                | 1,662,516 (100) | 1,500,678 (100) | 11,079,061 (100)           | 41,516,897 (100)   | 45,746,606 (100)   |

Patients: Number of patients.

Visits: Number of visits.

Expenses: The unit of medical expenses is 1000 NHI points. The value of one NHI point is settled quarterly, and one NHI point fluctuates around NT\$0.8–1.2.

45,746,606 thousand NHI points for the medical expenses. Among the 3 age groups of children, children in the 5-9-year age group had the highest values of the above parameters (836,509, 3,449,750, and 2,980,937, respectively), followed in a descending order by children in the 10-14-year age group (568,834, 1,662,516, and 1,500,678, respectively) and children in the 0-4-year age group (361,939, 920,656, and 761,476, respectively) (Table 1).

In the overall population and the 3 age groups of children, the two most common oral diseases were dental caries and gingivitis & periodontal diseases. Among various oral diseases, they were the top two diseases that had the highest number of patients, number of outpatient visits, and medical expense NHI points. In the overall population, dental caries had the highest number of patients, number of outpatient visits, and medical expense NHI points. In the 0-4-year and 10-14-year age groups, gingivitis & periodontal diseases had the highest numbers of patients and numbers of outpatient visits, while dental caries had the highest medical expense NHI points. On the contrary, in the 5-9-year age group, dental caries had the highest number of patients, number of outpatient visits, and medical expense NHI points (Table 1). However, in the overall population, gingivitis & periodontal diseases had the highest number of patients, number of outpatient visits, and medical expense NHI points.

In the overall population, diseases of the pulp & periapical tissues had the third highest number of patients, number of outpatient visits, and medical expense NHI points. In the 0-4-year age group, stomatitis & related lesions had the third highest number of patients and number of outpatient visits. In the 5-9-year and 10-14-year age groups, other disorders of teeth & supporting structures had the third highest number of patients and number of outpatient visits. However, in all 3 age groups of children, diseases of pulp & periapical tissues had the third highest medical expense NHI points (Table 1).

It should be noted that the sum of the number of patients of various oral diseases was greater than the total number of patients because a patient might have medical records of more than 2 oral diseases. Among various oral diseases, dental caries accounted for 30.37% and 34.86% of the number of outpatient visits and the medical expense NHI points in the overall population (Table 1). Moreover, the dental caries accounted for 34.89% and 47.34% of the number of outpatient visits and the medical expense NHI points, respectively, in the 0-4-year age group, 39.24% and 51.15%, respectively, in the 5-9-year age group, and 35.88% and 48.70%, respectively, in the 10-14-year age group (Table 1). The ratios of the number of outpatient visits and the medical expense NHI points of dental caries to those of all oral diseases in the 3 age groups of children were higher than those of the overall population. These ratios were highest in children of the 5-9-year age group. In addition, gingivitis & periodontal diseases accounted for 46.20% and 39.53% of the number of outpatient visits and the medical expense NHI points, respectively, in the overall population. Moreover, gingivitis & periodontal diseases accounted for 43.49% and 31.82% of the number of outpatient visits and the medical expense NHI points, respectively, in the 0-4-year age group, 30.22% and 20.50%, respectively, in the 5-9-year age group, and

42.13% and 34.70%, respectively, in the 10-14-year age group (Table 1). The ratio of the number of outpatient visits of gingivitis & periodontal diseases to those of all oral diseases and the ratio of the medical expense NHI points of gingivitis & periodontal diseases to those of all oral diseases in all 3 age groups of children were lower than those of the overall population. These ratios were lowest in children of the 5-9-year age group (Table 1).

The dental use rates, the mean numbers of outpatient visits per patient, and the mean medical expense NHI points per patient for various types of oral diseases in different age groups of pediatric patients in Taiwan in 2020 are shown in Table 2. We found that the dental use rate, the mean number of outpatient visits per patient, and the mean medical expense NHI points per patient for the overall population were 46.98%, 3.75, 4129, respectively. Among all 3 age groups of children, children in the 5-9-year age group had the highest values of the above parameters (80.30%, 4.12, and 3564, respectively), followed in a descending order by children in the 10-14-year age group (57.19%, 2.92 and 2638, respectively) and children in the 0-4-year age group (38.08%, 2.54 and 2104, respectively) (Table 2).

In the overall population, gingivitis & periodontal diseases and dental caries were the top two disease that had the highest dental use rates (39.90% and 26.73%, respectively) and the highest mean number of outpatient visits per patient (2.04 and 2.00, respectively), while diseases of pulp & periapical tissues and embedded & impacted teeth were the top two diseases that had the highest mean medical expense NHI points per patient (3643 and 3531, respectively) (Table 2).

In the 0-4-year age group, gingivitis & periodontal diseases and dental caries were the top two diseases that had the highest dental use rates (25.60% and 16.84%, respectively), while dental caries and diseases of pulp & periapical tissues were the top two diseases that had the highest mean number of outpatient visits per patient (2.01 and 1.76, respectively) and the highest mean medical expense NHI points per patient (2252 and 4258, respectively) (Table 2).

In the 5-9-year age group, dental caries and gingivitis & periodontal diseases were the top two disease that had the highest dental use rates (55.69% and 53.06%, respectively) and the highest mean number of outpatient visits per patient (2.33 and 1.89, respectively), while diseases of pulp & periapical tissues and dental caries were the top two diseases that had the highest mean medical expense points per patient (3126 and 2628, respectively) (Table 2).

In the 10-14-year age group, gingivitis & periodontal diseases and dental caries were the top two disease that had the highest dental use rates (42.29% and 34.29%, respectively), while diseases of pulp & periapical tissues and embedded & impacted teeth were the top two diseases that had the highest mean medical expense NHI points per patient (2695 and 2453, respectively) (Table 2). In other words, although in the overall population and in all 3 age groups of children, dental caries and gingivitis & periodontal diseases had relatively high values in the dental use rate and the mean number of outpatient visits per patient, diseases of pulp & periapical tissues had the highest mean medical expense NHI points per patient (Table 2).

**Table 2** The dental use rates, the numbers of outpatient visits per patient, and the medical expense National Health Insurance (NHI) points per patient for various types of oral diseases in different age groups of pediatric patients in Taiwan in 2020.

| Population   | 0–4 years (950,552; 4.03%) |                |                 | 5–9 years (1,041,754; 4.42%) |                |                 | 10–14 years (994,568; 4.22%) |                |                 | Overall (23,582,179; 100%) |                |                 |
|--|----------------------------|----------------|-----------------|------------------------------|----------------|-----------------|------------------------------|----------------|-----------------|----------------------------|----------------|-----------------|
|  | Use rate (%)               | Visits/Patient | Expense/Patient | Use rate (%)                 | Visits/Patient | Expense/Patient | Use rate (%)                 | Visits/Patient | Expense/Patient | Use rate (%)               | Visits/Patient | Expense/Patient |
| Disorders of tooth development and eruption              | 2.27                       | 1.30           | 674             | 13.87                        | 1.66           | 960             | 5.82                         | 1.48           | 845             | 1.52                       | 1.50           | 1642            |
| Embedded and impacted teeth                              | 0.01                       | 1.21           | 604             | 0.15                         | 1.48           | 1684            | 0.19                         | 1.72           | 2453            | 0.75                       | 1.52           | 3531            |
| Dental caries  | 16.84                      | 2.01           | 2252            | 55.69                        | 2.33           | 2628            | 34.29                        | 1.75           | 2143            | 26.73                      | 2.00           | 2530            |
| Other diseases of hard tissues of teeth                  | 1.93                       | 1.31           | 610             | 4.44                         | 1.47           | 695             | 2.01                         | 1.31           | 708             | 2.30                       | 1.31           | 1146            |
| Diseases of pulp and periapical tissues                  | 1.96                       | 1.76           | 4258            | 12.76                        | 1.73           | 3126            | 2.71                         | 1.61           | 2695            | 7.65                       | 1.88           | 3643            |
| Gingivitis and periodontal diseases                      | 25.60                      | 1.65           | 996             | 53.06                        | 1.89           | 1106            | 42.29                        | 1.67           | 1238            | 39.90                      | 2.04           | 1922            |
| Other disorders of gingiva and edentulous alveolar ridge | 0.07                       | 1.18           | 749             | 0.18                         | 1.23           | 743             | 0.10                         | 1.24           | 716             | 0.24                       | 1.34           | 803             |
| Other disorders of teeth and supporting structures       | 0.34                       | 1.19           | 653             | 15.76                        | 1.54           | 885             | 7.75                         | 1.45           | 798             | 3.41                       | 1.42           | 1266            |
| Cysts of oral region, not elsewhere classified           | 0.01                       | 1.11           | 630             | 0.13                         | 1.26           | 781             | 0.05                         | 1.59           | 1326            | 0.13                       | 1.34           | 849             |
| Diseases of salivary glands                              | 0.02                       | 1.33           | 1051            | 0.10                         | 1.43           | 1018            | 0.06                         | 1.44           | 1352            | 0.11                       | 1.62           | 1021            |
| Stomatitis and related lesions                           | 3.53                       | 1.21           | 476             | 10.30                        | 1.30           | 495             | 4.61                         | 1.27           | 472             | 5.72                       | 1.51           | 582             |
| Other diseases of lip and oral mucosa                    | 0.20                       | 1.16           | 466             | 0.62                         | 1.28           | 495             | 0.27                         | 1.21           | 488             | 0.44                       | 1.87           | 1013            |
| Diseases of tongue                                       | 0.02                       | 1.13           | 540             | 0.04                         | 1.19           | 539             | 0.02                         | 1.10           | 456             | 0.02                       | 1.59           | 941             |
| Others   | 4.91                       | 1.42           | 726             | 5.83                         | 1.75           | 832             | 1.96                         | 1.60           | 1137            | 2.74                       | 1.98           | 2018            |
| Overall  | 38.08                      | 2.54           | 2104            | 80.30                        | 4.12           | 3564            | 57.19                        | 2.92           | 2638            | 46.98                      | 3.75           | 4129            |

Use rate (%): Number of patients/total population of the same age group.

Visits/Patient: Dental visits per patient.

Expenses/Patient: Medical expense NHI points per patient. The unit of medical expenses per patient is one NHI point. The value of one NHI point is settled quarterly, and one NHI point fluctuates around NT\$0.8–1.2.

## Discussion

Taiwan's NHI began in March 1995. By 2020, more than 99% of the overall population was covered by NHI.<sup>7</sup> By searching the database of the NHI Administration website, we can study the epidemiology of oral diseases in patients of different age groups in Taiwan. In this study, we found that the overall dental use rate for the overall Taiwanese population in 2020 was 46.98% (Table 2). This dental use rate is higher than that of 40.7% in 2006.<sup>8</sup> The increase in dental use by the overall population may be due to the increase in the penetration rate of Taiwan's NNI and the increased public's emphasis on oral health. The 5-9-year age group of children had the highest dental use rate (80.30%), followed by the 10-14-year age group of children (57.19%). Moreover, these two dental use rates (80.30% and 57.19%) were even higher than that (46.98%) of the overall population (Table 2). Such a high dental use rate may be due to the Taiwan's oral health policy that conducts a comprehensive oral examination for every elementary or high school student. The students with detected dental or oral defects are advised and referred to see their dentists for further dental treatments.

This study found that from the perspective of numbers of patients and outpatient visits, the two most common oral diseases were dental caries and gingivitis & periodontal diseases. In the overall population and the 0-4-year and 10-14-year age groups, gingivitis & periodontal diseases were the most common disease claimed. However, in the 5-9-year age group, dental caries was the most common disease claimed. In the overall population, gingivitis & periodontal diseases needed the highest medical expense NHI points, followed in a descending order by dental caries and diseases of pulp & periapical tissues. Moreover, in all 3 age groups of children, dental caries needed the highest medical expense NHI points, followed in a descending order by gingivitis & periodontal diseases and diseases of pulp & periapical tissues. Among them, in the 5-9-year age group, dental caries needed more than half (51.15%) of all dental expense NHI points. In addition, the mean number of outpatient visits per patient in all 3 age groups of children were consistently highest for dental caries. Therefore, the more common and serious oral problem of children in Taiwan should be dental caries. However, oral problems of children such as gingivitis & periodontal diseases and diseases of pulp & periapical tissues cannot be ignored. In fact, the Taiwan Dental Association also pointed out that dental caries (tooth decay), periodontal disease, dental trauma, and teeth malalignment are more common oral diseases in children.

The impact of oral health on overall health cannot be ignored. Although oral diseases do not immediately harm the body, they can seriously affect people's quality of life. Oral health of preschool children is even more noteworthy. Oral problems in childhood may affect their overall health and quality of life in the future.<sup>9</sup> Through the prevention and treatment of oral diseases, it helps to improve the quality of a healthy life. Dental caries is one of the most influential chronic diseases in the world, affecting at least three billion people.<sup>10</sup> The impact of dental caries on preschool children includes absenteeism, inability to

concentrate, decreased self-esteem, poor social relationships, impaired language skills, poor sleep quality, stunted growth caused by the insufficient diet, etc.<sup>11</sup> If dental caries is not treated and the symptoms worsen, young children may lose their anterior teeth, resulting in delayed speech development and psychological trauma.<sup>12</sup> Toothache caused by the dental caries may lead to eating difficulties, incomplete nutrient absorption, and adverse effects on children's growth and development.

In 2011, the prevalence of dental caries among children in Taiwan was 31.40% for 2-3-year-old children, 61.55% for 3-4-year-old children, 78.05% for 4-5-year-old children, and 79.32% for 5-6-year-old children.<sup>13</sup> In 2018, the overall dental caries rate of the preschool children was 46.93%, of which the dental caries rate of 5-year-old children was as high as 65.43%, and the dental caries-free rate was 34.57%.<sup>14</sup> Compared with the goal set by the WHO that more than 90% of 5-year-old children will be free of dental caries by 2010, the dental caries rate of 5-year-old children in Taiwan is still much higher.<sup>9</sup> The international comparison of dental caries status of the preschool children is usually based on the age group of 5-year-old children. The prevalence of dental caries among 5-year-old children in neighboring countries are 62.2% in South Korea, 39.0% in Japan, 55.4% in Hong Kong, 48.9% in Singapore, and 71.3% in Malaysia.<sup>14</sup> Those in Europe and the United States are 23.3% in the United Kingdom, 48.2% in Australia, 63.4% in Italy, 13.7% in Germany, 4% in Sweden, 36.3% in Norway, and 21.4% in the United States.<sup>14</sup> Compared with other neighboring countries or advanced countries, the oral health status of the preschool children in Taiwan is still serious.

In addition, this study found that the dental use rate for treatment of dental caries in all 3 age groups of children was 16.84% for 0-4-year, 55.69% for 5-9-year, and 34.29% for 10-14-year age groups, indicating that there may be many children with dental caries in Taiwan who do not use dental resources of NHI to treat dental caries. The American Dental Association identifies the lack of usage of dental resources as a risk factor for the childhood dental caries. A 2009 national survey in the United States found that 25% of children in the families of low socioeconomic status have untreated dental caries, and only 10.5% of children in the families of middle and high socioeconomic status have untreated dental caries.<sup>15</sup> In other words, the rate of dental caries treatment in children is proportional to the socioeconomic status of their family. The parents with the higher income and education levels have significantly higher rate of dental caries treatment for their preschool children than those with the lower income or education level.

In terms of the accessibility of dental resources and services, Taiwan is not inferior to other developed countries. However, due to the long-term lack of awareness and behavior for oral health care among Taiwanese people, the dental caries rate remains high. Advanced education and regular supervision of dental care are effective in reducing the risk of dental caries and periodontal disease.<sup>16</sup> From a cost-effectiveness viewpoint, Taiwan's oral hygiene policy should continue to promote the development of oral health care for children. Therefore, it is urgent to establish a professional team for oral hygiene care

and cultivate professional manpower with special ability of oral hygiene care.

### Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

### References

1. Sheen MH, Hsiao SY, Huang ST. Translation and validation of Taiwanese version of the early childhood oral health impact scale (ECOHIS). *J Dent Sci* 2020;15:513–8.
2. Tsang C, Sokal-Gutierrez K, Patel P, et al. Early childhood oral health and nutrition in urban and rural Nepal. *Int J Environ Res Publ Health* 2019;16:2456.
3. Losso EM, Tavares MC, Silva JY, Urban A. Severe early childhood caries: an integral approach. *J Pediatr* 2009;85:295–300.
4. Gift HC, Reisine ST, Larach DC. The social impact of dental problems and visits. *Am J Publ Health* 1992;82:1663–8.
5. Hsu CL, Lin WS, Lin CH, Liu JF. The effect of professional fluoride application program for preschool children in Taiwan: an analysis using the National Health Insurance Research Database (NHIRD). *J Dent Sci* 2018;13:248–55.
6. Tsai YL, Hsiang CL, Lee LA, et al. *Oral health status under 6 years old children in Taiwan*. Executive Yuan: Health Care Research Report of Department of Health, 1997:28–9 [In Chinese].
7. Ministry of Health and Welfare. *The 2020 national health insurance medical statistics*. Taipei, Taiwan: Ministry of Health and Welfare, 2021 [In Chinese].
8. Lai WH, Ho SC, Weng TY, Huang ST. Profile of nonsurgical root canal treatment under the national health insurance in Taiwan in 2006. *J Dent Sci* 2009;4:187–90.
9. Douglass JM, Douglass AB, Silk HJ. A practical guide to infant oral health. *Am Fam Physician* 2004;70:2113–20.
10. Kassebaum NJ, Bernabé E, Dahiya M, Bhandari B, Murray CJL, Marcenes W. Global burden of untreated caries: a systematic review and metaregression. *J Dent Res* 2015;94:650–8.
11. Low W, Tan S, Schwartz S. The effect of severe caries on the quality of life in young children. *Pediatr Dent* 1999;21:325–6.
12. Von Burg MM, Sanders BJ, Weddell JA. Baby bottle tooth decay: a concern for all mothers. *Pediatr Nurs* 1995;21:515–9.
13. Health Promotion Administration. *Oral health status survey of children under 6 years old in Taiwan, 2011*. Taipei, Taiwan: Health Promotion Administration, 2013 [In Chinese].
14. Ministry of Health and Welfare. *Oral health status survey of children under 6 years old in Taiwan, 2018*. Taipei, Taiwan: Ministry of Health and Welfare, 2019 [In Chinese].
15. Dye BA, Li X, Thornton-Evans G. Oral health disparities as determined by selected healthy people 2020 oral health objectives for the United States, 2009-2010. *NCHS Data Brief* 2012;104:1–8.
16. Thompson CL, McCann AL, Schneiderman ED. Does the Texas First Dental Home Program improve parental oral care knowledge and practices? *Pediatr Dent* 2017;39:124–9.