A Validation Study of the National Database of Health Insurance Claims and Specific Health Checkups of Japan Regarding the Annual Number of Tooth Extractions Performed Across the Entire Japanese Population

Seitaro Suzuki¹, Naoki Sugihara¹, Hideyuki Kamijo²,³, Manabu Morita³, Takayuki Kawato⁴, Midori Tsuneishi⁵, Keita Kobayashi⁶, Yoshihiro Hasuike⁶,⁷ and Tamotsu Sato⁶,⁷

¹Department of Epidemiology and Public Health, Tokyo Dental College, 2-9-18 Kanda-Misakicho, Chiyoda-ku, Tokyo 101-0061, Japan
²Department of Social Security for Dentistry, Tokyo Dental College, 2-9-18 Kanda-Misakicho, Chiyoda-ku, Tokyo 101-0061, Japan
³Department of Preventive Dentistry, Okayama University Graduate School of Medicine, Dentistry and Pharmaceutical Sciences, 2-5-1 Shikata-cho, Kita-ku, Okayama 700-8525, Japan
⁴Department of Oral Health Sciences, Nihon University School of Dentistry, 1-8-13 Kanda-Surugadai, Chiyoda-ku, Tokyo 101-8310, Japan
⁵Japan Dental Association Research Institute, 4-1-20 kudankita, Chiyoda-ku, Tokyo 102-0073, Japan
⁶8020 Promotion Foundation, 4-1-20 kudankita, Chiyoda-ku, Tokyo 102-0073, Japan
⁷Japan Dental Association, 4-1-20 kudankita, Chiyoda-ku, Tokyo 102-0073, Japan

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Abstract

This report describes a validation study of data in the National Database of Health Insurance Claims and Specific Health Checkups of Japan (NDB) obtained by nationwide surveys on tooth extractions. The following 3 data sources on tooth extractions in Japan were compared: (1) the Nationwide Survey of the Reasons for Permanent Tooth Extractions in Japan (a previous survey conducted by the present authors); (2) the Statistics on Medical Care Activities in Public Health Insurance; and (3) the 4th NDB Open Data Japan. Source 1 was a nationwide survey conducted in 2018; sources 2 and 3 comprised data that are freely available for use by the public. In Source 1, 2,345 of 5,250 dentists approached responded to the questionnaire (recovery rate: 44.8%). The number of extracted teeth among younger age groups (aged 25–50 years) reported in Source 1 was lower than that in the other two sources. In contrast, the number of extracted teeth among older age groups reported in Source 1 was higher than that reported in the other two sources. However, when stratified by age group, all differences across the 3 sources...
regarding the mean annual number of tooth extractions were <0.05 teeth/year. The present results suggest that the NDB is a reliable resource for data on tooth extractions performed across the entire Japanese population.

Keywords: National database — Validation — Tooth loss — Population-based survey

**Introduction**

The number of present teeth has been reported to be associated with quality of life\(^\text{18}\) and the incidence of cardiovascular disease\(^\text{17}\), and a reduced number has been found to be associated with higher mortality\(^\text{15}\). Additionally, the number of present teeth in patients aged 75–80 years has been reported to be inversely associated with medical costs and the number of days of hospitalization\(^\text{20}\). Therefore, understanding the status of tooth loss is important in developing strategies aimed at improving the number of retained teeth.

The National Database of Health Insurance Claims and Specific Health Checkups of Japan (NDB) was developed to conduct surveys and analyses aimed at facilitating the preparation, implementation, and evaluation of a medical expenses optimization plan\(^\text{16}\). This database stores anonymized data regarding medical and dental claims issued since April 2009\(^\text{6}\). Japan has a universal health coverage system, and the NDB contains medical and dental information on almost all procedures performed in the country since 2009.

From 2014 to 2017, Japan’s Ministry of Health, Labour and Welfare published the “NDB Open Data Japan” on its website annually\(^\text{20}\). These data comprise various summary tables and fundamental spreadsheets, access is open\(^\text{9}\). Thus, “NDB Open Data Japan” provides an easily accessible overview of the medical and dental claims made each year.

Similarly, the Ministry of Health, Labour and Welfare publishes the “Statistics on Medical Care Activities in Public Health Insurance” annually\(^\text{10}\). These statistics include all the receipts accumulated in the NDB for the month of May in each survey year.

Recently, several studies in the dental field have used data from the NDB\(^\text{8,24}\). However, the NDB does not include data on dental treatments covered by public funds (i.e., public assistance recipients) or those not covered by public insurance. Therefore, a validation study is necessary to determine and ensure the reliability of the NDB.

However, to our knowledge, no previous study has evaluated the validity of the information stored in the NDB regarding tooth extractions. This report describes a validation study of the tooth-extraction data in the NDB obtained by nationwide surveys on tooth extractions.

**Materials and Methods**

1. **Data sources**

Three different sources were used as references to determine the annual number of tooth extractions performed in Japan. A comparison of the characteristics of these data sources is shown in Table 1.

1) Source 1: Nationwide Survey of the Reasons for Permanent Tooth Extractions in Japan

The data in Source 1 were obtained in an earlier study by this group by conducting the second Nationwide Survey of Reasons for Permanent Tooth Extractions in Japan; the first survey was conducted in 2005\(^\text{2}\). The method of this survey was the same as that of the first: a list of general dental practitioners who were members of the Japan Dental Association (52,449 dentists as of April 1, 2018) was
obtained and used for systematic random selection to shortlist study participants; every 10th dentist on the list was selected. As a result, 5,250 dentists were selected as the sample. The dentists were asked to record the reasons for any permanent tooth extractions they performed between June 4 and 10, 2018. After the survey period, the dentists returned the completed data collection forms. Of the variables included in this survey, the age and sex of each patient and the number of tooth extractions performed during the survey period were used to estimate the annual number of tooth extractions performed across the Japanese population.

2) Source 2: Statistics on Medical Care Activities in Public Health Insurance

The Ministry of Health, Labour and Welfare conducts the “Statistics of Medical Care Activities in Public Health Insurance” survey every year to clarify details regarding medical and dental care activities and obtain the basic data required for the administration of health insurance. These statistics include those on all the receipts accumulated in the NDB during the month of May in each survey year. In the present study, the total number of receipts for tooth extractions (anterior, posterior, and impacted teeth) listed in Statistics on Medical Care Activities in Public Health Insurance for 2018 was determined. On the website, the results are summarized in spreadsheet files. However, the spreadsheet files are only stratified into 5-year age groups and type of dental institution; therefore, it was not possible to stratify the tooth-extraction receipts by sex.

3) Source 3: 4th NDB Open Data Japan

The final source for data on the number of tooth extractions was the fourth version of the NDB Open Data Japan. The collection period for these open-access data was from April 1, 2017 to March 31, 2018. The total number of receipts for tooth extractions (anterior, posterior, and impacted teeth) is presented in a spreadsheet file that is stratified by sex and 5-year age groups. Therefore, the total annual number of receipts for tooth extractions could be obtained from this data source.

2. Statistical analysis

The annual number of tooth extractions according to all sources, except Source 3, was estimated. The method of estimation used in the first Nationwide Survey of Reasons for Permanent Tooth Extractions was employed to determine the total number of annual tooth extractions according to Source 1.
The estimated number of annual tooth extractions was calculated as follows: the number of tooth extractions reported in the survey results \( \times \) the total number of dental clinics in Japan \( \div \) number of valid responses \( \times \) weeks (a year was defined as comprising 52 weeks).

The total number of dental clinics in Japan was obtained from the Survey of Medical Institutions, 2018\(^{11}\). In addition, the interval estimation of the proportion of the population for the number of tooth extractions during the survey period was calculated using the number of valid responses and the number of tooth extractions reported in the survey results. The value was multiplied by 52 weeks to obtain a 95% confidence interval for the number of annual tooth extractions.

For Source 2, the results reported in the 2018 edition of the Statistics of Medical Care Activities in Public Health Insurance was multiplied by 12 (indicating months).

For each source, the mean number of annual tooth extractions per person was calculated by dividing the total number of tooth extractions by the total population of Japan. The total population for each age group was obtained from Population Estimates 2018\(^{22}\).

### Table 2  Characteristics of patients described in Source 1 (nationwide survey)

| Age (years) | Number of patients | Number of extracted teeth |
|-------------|--------------------|---------------------------|
|             | Men | Women | Men | Women | Men | Women |
| <15         | 13  | 0.4  | 24  | 0.7   | 14  | 0.4  |
| 15–19       | 30  | 0.9  | 49  | 1.5   | 36  | 0.9  |
| 20–24       | 128 | 4.0  | 157 | 4.7   | 143 | 3.7  |
| 25–29       | 135 | 4.3  | 173 | 5.2   | 146 | 3.8  |
| 30–34       | 132 | 4.2  | 127 | 3.8   | 153 | 3.9  |
| 35–39       | 141 | 4.5  | 138 | 4.1   | 155 | 4.0  |
| 40–44       | 163 | 5.2  | 150 | 4.5   | 189 | 4.9  |
| 45–49       | 194 | 6.1  | 190 | 5.7   | 232 | 6.0  |
| 50–54       | 223 | 7.1  | 222 | 6.7   | 266 | 6.9  |
| 55–59       | 240 | 7.6  | 247 | 7.4   | 314 | 8.1  |
| 60–64       | 314 | 9.9  | 297 | 8.9   | 371 | 9.6  |
| 65–69       | 459 | 14.5 | 377 | 11.3  | 623 | 16.1 |
| 70–74       | 377 | 11.9 | 405 | 12.1  | 470 | 12.1 |
| 75–79       | 300 | 9.5  | 332 | 9.9   | 376 | 9.7  |
| 80–84       | 195 | 6.2  | 269 | 8.1   | 232 | 6.0  |
| >84         | 118 | 3.7  | 180 | 5.4   | 158 | 4.1  |

### 3. Ethics approval

The protocol of this study was approved by the Ethics Committee of Tokyo Dental College and Japanese Association for Dental Science (approval numbers, 1027 and 018, respectively) and was conducted in full accordance with the World Medical Association Declaration of Helsinki.
## Table 3: Comparison of annual number of tooth extractions in three data sources

| Age (years) | <15 | 15 - 19 | 20 - 24 | 25 - 29 | 30 - 34 | 35 - 39 | 40 - 44 | 45 - 49 | 50 - 54 | 55 - 59 | 60 - 64 | 65 - 69 | 70 - 74 | 75 - 79 | 80 - 84 | > 84 |
|-------------|-----|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| Total       | 68,467 | 45,630 | 46,153 | 21,901 | 11,659 | 8,856 | 3,765 | 1,980 | 1,930 | 1,880 | 1,830 | 1,780 | 1,730 | 1,680 | 1,630 | 1,580 |
| Source 1    | 51,084 | 35,667 | 35,019 | 16,990 | 9,377 | 7,100 | 2,800 | 1,470 | 1,430 | 1,390 | 1,350 | 1,310 | 1,270 | 1,230 | 1,190 | 1,150 |
| Source 2    | 47,166 | 30,762 | 31,062 | 15,007 | 8,563 | 6,875 | 2,700 | 1,385 | 1,345 | 1,305 | 1,265 | 1,225 | 1,185 | 1,145 | 1,105 | 1,065 |
| Source 3    | 23,080 | 16,662 | 16,592 | 8,007 | 4,563 | 3,875 | 1,500 | 815 | 815 | 815 | 815 | 815 | 815 | 815 | 815 | 815 |

1 Estimated number of tooth extractions was calculated by multiplying result reported in Statistics on Medical Care Activities in Public Health Insurance by 12 month.
2 CI: confidence interval
3 Source 1: Nationwide Survey of the Reasons for Permanent Tooth Extractions in Japan
4 Source 2: Statistics of Medical Care Activities in Public Health Insurance
5 Source 3: 4th NDB Open Data Japan

### Notes:
- Estimated number of tooth extractions was calculated by multiplying result reported in Statistics on Medical Care Activities in Public Health Insurance by 12 month.
- CI: confidence interval
- Source 1: Nationwide Survey of the Reasons for Permanent Tooth Extractions in Japan
- Source 2: Statistics of Medical Care Activities in Public Health Insurance
- Source 3: 4th NDB Open Data Japan
Results

The characteristics of the patients described in Source 1 are shown in Table 2. A total of 2,345 of the 5,250 dentists approached responded to the questionnaire (recovery rate: 44.8%), and data for 6,499 patients were analyzed. The mean age of the patients was 58.5 years (standard deviation [SD]: 18.8). A total of 7,957 teeth were extracted during the survey period. The mean number of tooth extractions per patient was 1.2 (SD: 0.6).

Table 3 shows a comparison of the annual number of tooth extractions reported in the 3 data sources. The values reported in Sources 2 and 3 regarding the total annual number of tooth extractions for the age groups of <15 years and 65–69 years were lower than the corresponding 95% lower confidence limits for the corresponding age groups in Source 1. Moreover, the Source 3 value for the age groups of 55–59 years and 70–74 years was lower than the corresponding 95% lower confidence limits reported in Source 1. Among men, the numbers reported in Source 3 for the age groups of <15 years, 65–69 years, and 70–74 years were lower than the corresponding 95% lower confidence limits reported in Source 1, while the Source 3 numbers for the age groups of 25–29 years and 40–44 years were higher than the corresponding 95% upper confidence limits reported in Source 1. Among women, the Source 3 numbers for the age groups of <15 years, 70–74 years, 75–79 years, and 80–84 years were lower than the corresponding 95% lower confidence limits reported in Source 1, while the Source 3 numbers for the age groups of 25–29 years, 40–44 years, 45–49 years, and 65–69 years were higher than the corresponding 95% upper confidence limits reported in Source 1.

Figure 1 shows the estimated mean numbers of annual tooth extractions across the Japanese population according to each
source. Regarding the total number of tooth extractions, Source 1 showed higher figures than Sources 2 and 3 for patients aged <20 years and 65–79 years, respectively; Source 2 showed the highest figures for patients aged 20–49 years and >80 years, respectively. Among men, Source 3 showed higher figures than Source 1 for patients aged 25–49 years and >84 years, respectively. Among women, Source 3 showed higher figures than Source 1 for patients aged 30–54 years. Despite the above discrepancies, however, all differences were less than 0.05 teeth/year.

Discussion

To our knowledge, this is the first study to date to evaluate the validity of the NDB data concerning the number of tooth extractions performed annually. The results revealed that the reported numbers of teeth extracted annually were relatively similar across all 3 data sources referenced. Although some differences were observed across several age groups, the differences in the mean annual numbers of tooth extractions were less than 0.05 teeth/year. Therefore, it is reasonable to assume that the NDB is a reliable source for determining the status of tooth extractions across the entire Japanese population.

Several studies have estimated mean numbers of annual tooth extractions across nationwide populations. Therefore, it is possible to compare the mean annual number of tooth extractions determined in the present study with those reported in past studies. Raval et al. reported that the mean number of annual tooth extractions across 64 patients who had received active periodontal treatment was 0.23 teeth/year. Meanwhile, in a study based on information obtained from 4 different university centers in Germany, Graetz et al. reported that the mean number of annual tooth extractions across 896 patients who received supportive periodontal treatment (SPT) was 0.11–0.15 teeth/year. The present results were similar to those of these earlier studies, even though the participants of this previous research had received SPT or maintenance. This suggests that the number of tooth extractions listed in the NDB offers a useful resource for exploring the relationship between tooth loss and other systemic diseases.

The number of present teeth has been reported to be associated with various factors, such as subjective physical health, medical costs, and cardiovascular disease. However, the sample sizes in these earlier studies were small, which possibly limits the reliability of the results. While the NDB contains a range of both medical and dental nationwide health care data, it does not contain information regarding the number of present teeth, because information regarding healthy teeth is not recorded in the receipts; therefore, it is currently difficult to obtain information regarding the number of teeth from the NDB. Nevertheless, the results of the present study showed that the number of tooth extractions could be reliably obtained through consultation of the NDB. An earlier study by this group using NDB data revealed that patients with diabetes mellitus had higher annual tooth loss than patients who had made medical claims for acute upper respiratory inflammation. Taking these two findings together indicates that the NDB offers a useful resource for determining the relationship between tooth loss and systemic disease.

Among relatively young patients (i.e., 25–50 years), the number of extracted teeth reported in Source 1 was less than those reported in the other two sources. It is possible that these differences are due to the characteristics of the dentists who provided the data for Source 1. These were general dental practitioners; therefore, they may have referred patients with wisdom tooth issues to specialists working at hospitals or dental universities. It has been reported that almost 80% of people who have had wisdom teeth extracted were under the age of 50 years when they underwent this procedure. Therefore, the total number of tooth extractions among this age group may have been underestimated in Source 1.

Meanwhile, among older age groups, the
number of extracted teeth reported in Source 1 was generally higher than that reported in the other two sources. This may be because the NDB does not contain information regarding uninsured treatments, only on those conducted under publicly funded health care. The National Survey on Public Assistance Recipients showed that, in 2018, 50% of the recipients of public assistance in Japan were over 65 years of age. Moreover, the results showed that the number of male recipients peaked at the age of 65 years, but the number of female recipients of public assistance increased with age. This suggests that the NDB figures for the number of annual tooth extractions among older age groups are affected by the procedures funded through public assistance. However, it is important to underline that the differences across the 3 data sources regarding the mean number of annual tooth extractions were less than 0.05 teeth/year. Therefore, there is no significant difference when using the NDB data compared to those from the other sources in determining the annual number of tooth extractions.

In conclusion, the present results indicate that the NDB offers a reliable source for considering the status of tooth extractions among the entire Japanese population. These findings could be useful for future researchers that wish to use the NDB to explore the association between tooth loss and other systemic diseases. However, researchers should be mindful that the NDB does not include certain types of crucial information such as that on the severity of diseases or lifestyle-related or socio-economic factors.

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