

Professional dental care provision systems for persons with disabilities by prefecture in Japan

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Objective: The number of persons with disabilities has increased and aged. Although it is important to maintain good oral health to extend healthy life expectancy, it is difficult for such people. This study aimed to analyze regional disparities in dental care provision systems for disabled people and to propose measures for the establishment of an appropriate system. **Basic research design:** To examine regional disparities in dental care provision systems for persons with disabilities, the number of practicing dentists and dental clinics per 100,000 population, dentists certified by the Japanese Society for Disability and Oral Health, and institutions with certified dentists per 100,000 disabled persons for each prefecture were calculated. The Gini coefficient of each was also calculated to visualize and analyze regional disparities. **Result:** The Gini coefficients were 0.09 and 0.07 for practicing dentists and dental clinics and 0.32 and 0.28 for the certified dentists and institutions with the certified dentists, respectively. Dental institutions for the disabled abounded in the three metropolitan areas: Tokyo, Aichi, and Osaka, and their density tended to be lower in northern and southern Japan. In prefectures with few such institutions, there was no correlation between the number of institutions and prefectural residents' income, and some prefectures had similar incomes but had many institutions. **Conclusion:** The distribution of dental care to the disabled is highly uneven in Japan, therefore, a system needs to be established to address this issue.

Keywords: Certification, distribution, dentists, population, dental care for disabled

Introduction

The rate of aging in Japan is the highest worldwide, which can be attributed to advanced medical care (Cabinet Office Annual, 2018). The life span of persons with disabilities has also increased (Ministry of Health, Labour and Welfare, 2018). There have been numerous reports associating oral and general health, and good oral health is associated with life expectancy (Miura *et al.*, 2005; Mattila *et al.*, 1989). This is true with or without a disability. As oral diseases increase with age, it is expected that the need for dentistry among persons with disabilities also increases (López *et al.*, 2017). It can be difficult for persons with disabilities to perform oral self-care, and they often cannot maintain good oral hygiene (Lee *et al.*, 2019). Mori *et al.* (2008) also reported that persons with disabilities have more missing teeth than healthy people. For these reasons, it is necessary to create a social system where persons with disabilities have easy access to professional dentistry. Geographic access for people with disabilities will be easier at nearby dental offices, but appropriate care may not be available in a general dental office, depending on the nature or degree of disability, which may require specialized knowledge and treatment.

The promotion of regular dental care for persons with disabilities was prescribed in the Act Concerning the Promotion of Dental and Oral Health, 2011, but the system for providing such care has not yet been fulfilled (Japan Dental Association, 2011). However, there have been no studies of the systems for providing dental care

to persons with disabilities in Japan, and it is not clear what systems are in place.

Therefore, we investigated the geographical distribution of dentists certified by the Japanese Society for Disability and Oral Health (known as Certified Dentists, CD) and medical institutions with CD to receive referrals of persons with disabilities whose needs are beyond those that can be met by general practitioners, as human and institutional resources providing dental care to persons with disabilities. Additionally, in the light of the relationship between dental visits and income (Listl *et al.*, 2011), we investigated whether there was a similar relationship in dental care for persons with disabilities. The study aimed to identify regional disparities in dental care systems for persons with disabilities. Such information would help in proposing measures to establish an appropriate system.

Methods

We examined the distribution of CDs across the 47 prefectures of Japan.

The number of persons with disabilities was defined as the number of persons having disability certificates. The number of disability certificates issued in each prefecture was obtained from the System of Social and Demographic Statistics, Prefectural Data FY2015. In Japan, disability certificates are issued for each person with physical, intellectual, and mental disabilities. The number of practicing dentists per 100,000 population (PD density) in each prefecture was obtained from the

Survey of Physicians, Dentists, and Pharmacists (2016), the number of dental clinics per 100,000 population (DC density) of each prefecture from the Survey of Medical Institutions (2018), and the prefectural income per capita from the Prefectural Accounts FY2016. The number of CD in each prefecture as of August 1, 2019, and the number of institutions where CD were working (including hospitals, clinics, and DC) in each prefecture as of December 19, 2019, were obtained from Japan Society for Disabilities and Oral Health website. Information on the location of dental schools was obtained from the Ministry of Education, Culture, Sports, Science and Technology.

Correlation coefficients were used to analyze the relationship between the population and the number of persons with disabilities, the population and practicing dentists, the population of persons with disabilities and CD, and the prefectural income and the number of institutions with CD. To examine regional disparities in dental care provision, the PD density, the number of CD per 100,000 persons with disabilities (CD density), DC density, and the number of institutions with CD per 100,000 persons with disabilities (density of institutions with CD) were calculated for each prefecture. Lorenz curves were used to plot the cumulative percentage of resources against the cumulative percentage of the population. Gini coefficients were used to quantify inequality in resource availability (Ogwang, 2000). The Gini coefficient is the ratio of the area bounded by Lorenz curve and diagonal (absolute equality line) to the area of the triangle below the diagonals and is expressed between 0 and 1, with larger values indicating greater inequality. This method is often used to compare disparities in medical resources (Okawa *et al.*, 2013; Okawa *et al.*, 2019).

To visualize regional disparities, we mapped PD density, CD density, DC density, density of institutions with CD, and the number of dental schools in each prefecture.

Microsoft Excel 2016 (Microsoft Corp., Redmon, WA, USA) was used to calculate the correlations and the Gini coefficients, and the free GIS software MANDARA 10 (KTGIS.net, Saitama, Japan) for mapping.

We used publicly available data, with no personal information, thus the Ethics Review Committee of the Tokyo Dental College found no need for ethics review certification (Examination No. 863).

Results

Table 1 shows the total population of Japan, the number of persons with disabilities (total of certified physically, intellectually, and mentally disabled), practicing dentists, CD, DC, and institutions with CD.

The mean PD density per prefecture was 72.9 (min 54.7, max 118.2), CD Density was 13.6 (min 2.0, max 31.8), DC Density was 49.9 (min 38.6, max 77.2), and density of institutions with CD was 6.7 (min 0.9, max 16.2). The correlation coefficients of population and the number of persons with disabilities was 0.969, population and the number of practicing dentists was 0.970, and the number of persons with disabilities and the number of CD was 0.915.

Figure 1 presents the Lorenz curves for PD density, CD density, DC density, and density of institutions with CD across all prefectures. The respective Gini coefficients were 0.09, 0.32, 0.07 and 0.28.

Table 1. Survey data in Japan

Population (2016)	126,932,000
Persons with disabilities (2015)	7,116,731
Physically disabled	5,194,473
Intellectually disabled	1,009,232
Mentally disabled	913,026
Practising dentists (2016)	101,551
Certified dentists (2019)	1,202
Dental clinics (2018)	68,613
Institutions with certified dentists (2019)	499

Figure 2 maps the PD density, CD density, DC density, density of institutions with CD, and the location of dental schools by prefecture. The density of institutions with CD tended to be lowest in northern areas, followed by the southern areas of Japan. Even in prefectures with dental schools in the northern part of Japan, the density of institutions with CD was not necessarily high. Even in prefectures with relatively high CD density, the density of institutions with CD could be low.

Figure 3 correlates prefectural income with the number of institutions with CD. In five prefectures with more than 30 institutions with CD—Tokyo, Aichi, Kanagawa, Osaka, Hyogo—the correlation coefficient with prefectural income was 0.998, showing a strong correlation. However, 42 prefectures with less than 30 institutions showed no trend.

Discussion

In these data, the correlation between population size and the number of persons with disabilities remained constant. There were also strong correlations between the population and the number of practicing dentists and between the number of persons with disabilities and the number of CD. Therefore, we calculated the Gini coefficient and mapped it to examine the regional distribution by prefecture. Consistent with a previous study (Okawa *et al.*, 2011; Okawa *et al.*, 2014), there was little regional disparity in PD density and DC density.

However, dental care for the growing numbers and ages of persons with disabilities is a social problem today in Japan. The development of human and institutional resources related to dental care for persons with disabilities is needed immediately. The Act Concerning the Promotion of Dental and Oral Health, 2011, requires the provision of periodic dental healthcare to persons with disabilities be ensured (Kamijyo, 2012).

The mapping indicated that prefectures with poor access from three major metropolitan areas (the capital area in Tokyo, the Chubu metropolitan area in Aichi Prefecture, and the Kinki area of Osaka Prefecture), and prefectures with no dental school tended to have fewer resources for providing professional dental care to people with disabilities. This tendency was especially strong in northern Japan. Even in prefectures with relatively high CD density, the density of institutions with CD could be low. This is probably because CDs are concentrated in small number of dental institutions. This concentration

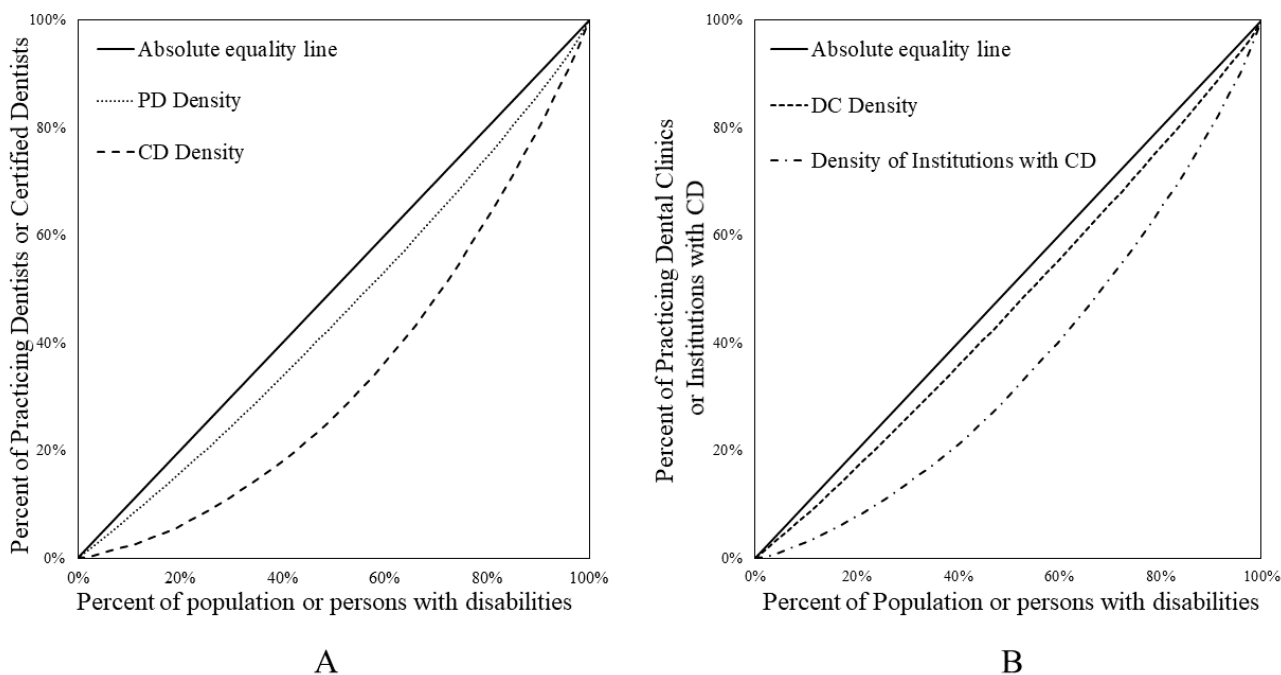


Figure 1. Lorenz curves of the numbers of practicing or certified dentists, dental clinics or institutions with CD in relation to the proportion of the population and persons with disabilities. PD density: number of practicing dentists per 100,000 population. CD density: number of Certified dentists per 100,000 persons with disabilities. DC density: number of dental clinics per 100,000 population. Density of institutions with CD: number of institutions with certified dentists per 100,000 persons with disabilities.

of resources may be effective in a narrow area, but it will restrict geographic access in a larger region such as a prefecture or country, especially for people who face access problems (Gerreth *et al.*, 2016). It is desirable to ensure that medical institutions are widely spread for persons with disabilities. The Gini coefficients indicate that the regional disparity of the dental care system for persons with disabilities was larger than that of the general dental care system. Thus, professional dental care for persons with disabilities is more limited than for healthy persons.

The relationships between prefectural income and institutions with CD presented contrasting results. In five prefectures, where there were more than 30 institutions with CD, the correlation coefficient was extremely high ($r_s = 0.998$), whereas the others were variable. The location of these five prefectures corresponded to the three metropolitan areas. Four of these prefectures had dental schools. An important finding was that the prefectural income of three out of five prefectures was equivalent to that of the other 42. Therefore, if CD were available, it would be possible to secure institutions with CD according to the prefectural income.

Increasing the number of CDs would help establish a professional dental care system for persons with disabilities. However, it is difficult to train many CDs in a short period due to the training requirements and facilities needed for certification (Japanese Society for Disabilities and Oral Health, 2019). Each prefecture has at least one institution with a CD. Hence, a system should be established to ensure that persons with disabilities have access to CDs, depending on the level of treatment required. In other words, regular dental check-ups and simple treatments at neighbouring DC, which are the primary

medical institutions, and a system should be established to refer patients who cannot be treated at these clinics to institutions with CD. This system should not be left to the actions of individual institutions and dentists but should be created by the prefectural administration. Such a referral system will also need optimal and accessible transport infrastructure.

As is the case with all research, these data should be interpreted with care. The number of persons with disability certificates was taken to represent the number of persons with disabilities, but some people with disabilities may have multiple certificates, while others may have none. However, it is unlikely this approach appreciably over-estimates the number of persons with disabilities or introduces bias, as indicated by the strong correlation between population size and the number of persons with disabilities. The census dates differed for each dataset, and past data on the numbers of CDs and institutions with CD were not available from the Japanese Society for Disability and Oral Health. Therefore, the data used were from different years. However, there have been no major changes over the years. We also had no way to count dentists who specialised in dentistry for persons with disabilities who did not have a certification. This number may be constant geographically and it will be equally difficult to count them in the future when evaluating dental care systems.

We plan to investigate the public dental care plans of each prefecture and accessibility to each authorized medical institution to allow us to make specific recommendations for more accessible dental care systems for persons with disabilities.

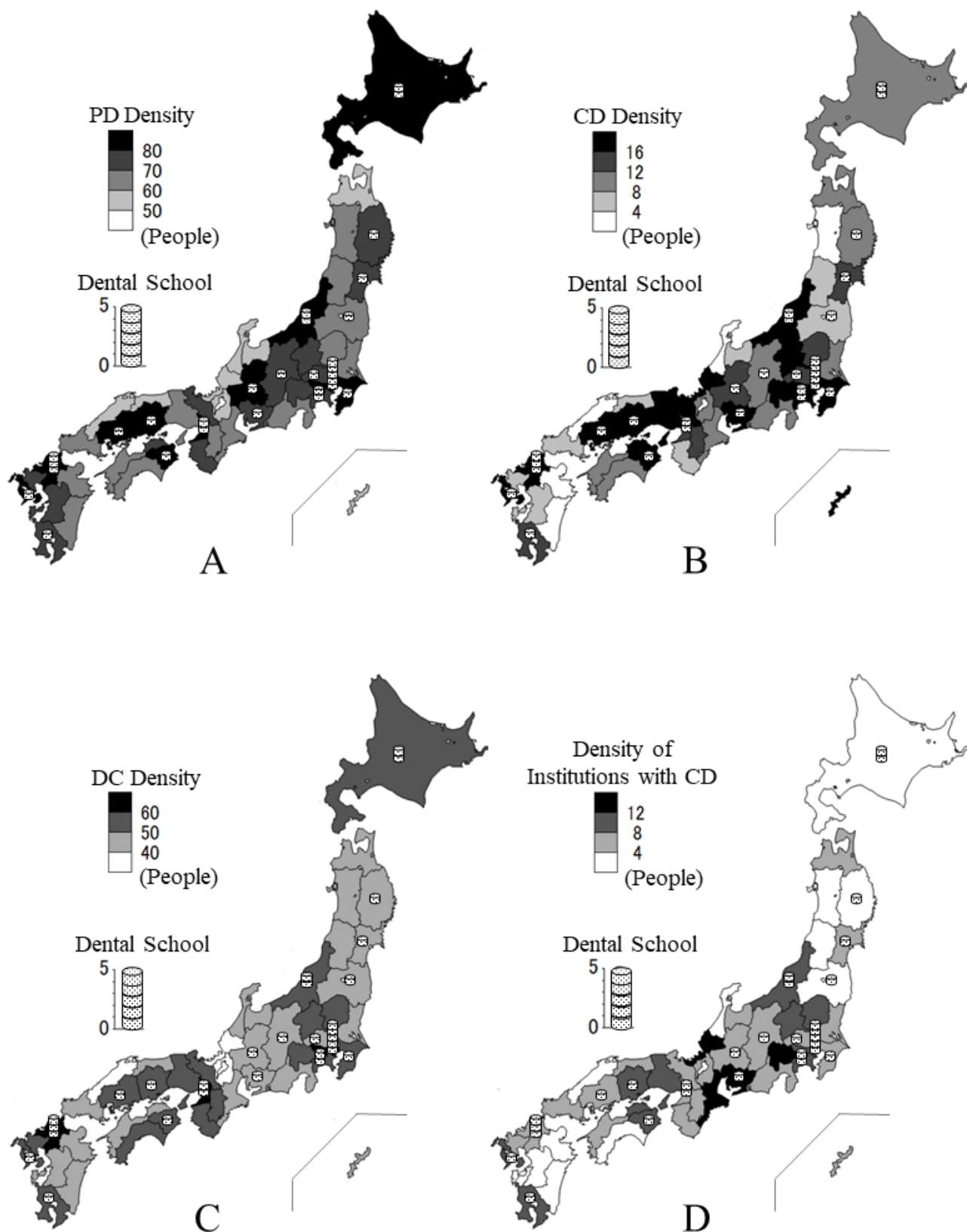


Figure 2. Density of dentists and institutions in each prefecture. PD density: number of practicing dentists per 100,000 population. CD density: number of Certified dentists per 100,000 persons with disabilities. DC density: number of dental clinics per 100,000 population. Density of institutions with CD: number of institutions with certified dentists per 100,000 persons with disabilities.

Conclusion

Regional disparities in dental care systems for persons with disabilities mean that it is necessary to establish a system to supplement them. These findings provide useful information for establishing an appropriate dental care system for persons with disabilities.

Conflicts of Interest

The author declare that they have no conflicts of interest.

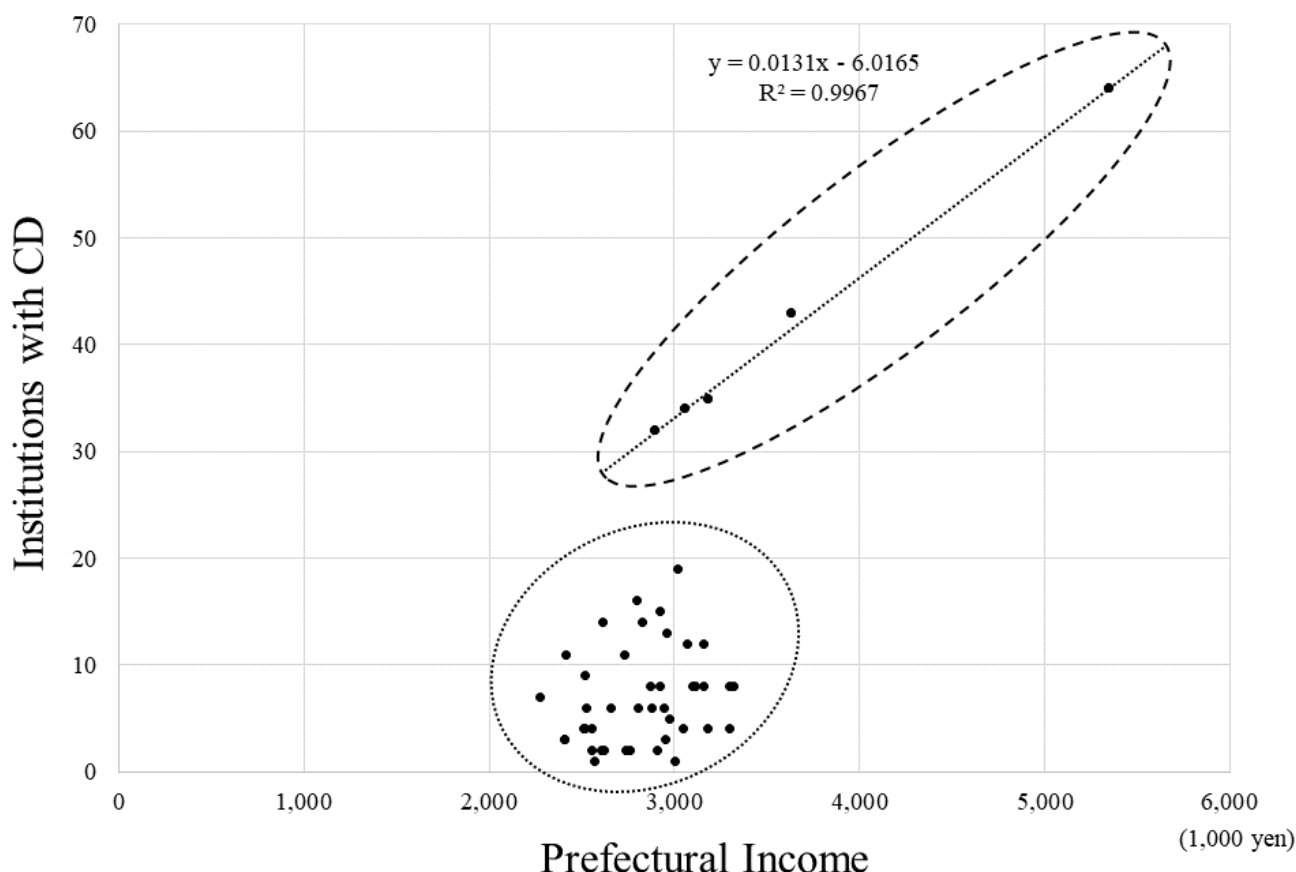


Figure 3. Correlation of prefectural income and the number of institutions with certified dentists.

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