

Trends in the geographic distribution of dental clinics in Japan

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Aim: In Japan, along with the increase in the number of dentists, the number of dental facilities has continuously increased as well. This study aimed to examine whether the increase in the number of dental clinics in Japan has led to an improvement in their geographic distribution. **Methods:** We analysed the number of dental clinics and population in all municipalities in Japan as of 2000, 2005 and 2010. We obtained data on the population from the population census and data on the number of dental clinics from the Survey of Medical Institutions. The number of municipalities was 3,258 in 2000 but had dropped to 1,750 by 2010 due to municipal mergers so population and dental data for other years were recalculated based on 2010 municipal boundaries. Lorenz curves and Gini coefficients were used to assess the distribution of dental clinics per 100,000 persons. **Results:** The mean number of dental clinics per 100,000 persons among all municipalities was 49.9 in 2000, 52.2 in 2005 and 53.4 in 2010. The Gini coefficient for the clinics in the whole country was 0.172 in 2000, 0.164 in 2005 and 0.153 in 2010. **Conclusion:** The results suggest that the regional inequalities in the availability of dentists have been reduced gradually as the number of dental clinics has increased.

Key words: dental clinic, dentist, population, distribution, geographic location, health policy

Introduction

To solve a shortage and the uneven distribution of dentists in Japan, new dental schools were established to increase the number of dental students in the 1970s and '80s (Ministry of Health and Welfare, 1986). This reduced regional disparities in the availability of dentists during the 20 years from 1980 to 2000 and increased the number of dentists (Okawa *et al.*, 2011; Toyokawa *et al.*, 2010). However, approximately one quarter of municipalities with a population of 5,000 or fewer inhabitants still suffered from a lack of dentists as of 2000 (Okawa *et al.*, 2011). With regard to postgraduate dental training, which started in April 2006, Hirata *et al.* (2009) reported that postgraduate dental trainees were distributed unevenly compared to general practicing dentists. Since postgraduate dental trainees are registered at hospitals attached to colleges or schools of dentistry, or hospitals located in urban areas, the measured disparity in their distribution between urban and rural areas is higher than the reality. Thus, when considering access to dental care, it is necessary to assess the geographical distribution of dental care facilities to establish policies to provide equitable dental services to residents in all regions.

In Japan, dental clinics account for 98.4% of dental care facilities whereas hospitals providing dental care account for only 1.6% (Ministry of Health and Welfare, 2010). While the number of dental care facilities has increased along with the rise in the number of dentists, the regional distribution of dental care facilities has been reported in only a few studies. Yamamoto (2006) examined the regional distribution of dental clinics in Fukuoka Prefecture and reported that regional disparities between municipalities reduced between 1985 and 2000. However, there has been no study of the

distribution of dental care facilities throughout Japan. This study aimed to assess changes in the geographic distribution of dental clinics across the whole of Japan between 2000 and 2010.

Methods

Japan is divided into 47 prefectures, each of which consists of numerous municipalities such as cities, towns, villages and wards. In this study, we used the population data recorded for each Japanese municipality in 2000, 2005 and 2010 from the well-established national census (Ministry of Internal Affairs and Communications, Statistic Bureau, 2010). The number of municipalities in 2000 was 3,255, which was reduced to 1,750 in 2010 through annexation. The number of dental clinics for each municipality was estimated from data of the Survey of Medical Institutions conducted by the Ministry of Health, Labour and Welfare (2010). To accurately compare the population and the number of dental clinics for the years 2000, 2005 and 2010, the population and dental data for the earlier years were recalculated based on 2010 municipal boundaries.

In the current study, the Lorenz curve and Gini coefficient, originally used in economic research to assess income disparities (Todaro, 1989), were chosen to describe the geographic distribution of dental clinics. First, the number of dental clinics/100,000 population was calculated for each municipality. The density of dental clinics obtained for each municipality was then arranged in ascending order and the Lorenz curve was plotted with the cumulative population proportion (%) on the horizontal axis and cumulative proportion of dental clinics (%) on the vertical axis. If dental clinics are distributed equally among communities, the

Table 1. Geographic distribution of dental clinic in Japan between 2000 and 2010

	2000	2005	2010
Population (x1,000)	126,926	127,768	128,057
Number of dental clinics	63,360	66,732	68,384
Dental clinics per 100,000 people	49.9	52.2	53.4
Gini coefficients	0.178	0.171	0.164

Table 2. Changes in the number of dental clinics per 100,000 people in municipalities by size of population from 2000 to 2010

Size of population of municipality*	n	Median number of dentists in each municipality (25 th , 75 th percentiles)			Change in median between 2000 and 2010
		2000 [†]	2005 [†]	2010	
Under 5,000	238	30.8 (18.4, 43.7)	35.0 (18.9, 50.6)	36.3 (20.8, 54.9)	5.5
5,000 to 9,999	244	32.1 (32.1, 44.0)	34.8 (27.0, 47.1)	35.6 (27.8, 47.7)	3.5
10,000 to 29,999	462	34.9 (27.5, 42.1)	36.8 (30.0, 44.7)	38.4 (31.4, 46.5)	3.5
30,000 to 49,999	245	37.6 (33.0, 42.8)	39.5 (34.6, 45.6)	40.9 (36.0, 47.6)	3.3
50,000 to 99,999	272	40.6 (35.1, 45.8)	42.7 (37.4, 48.5)	43.9 (38.8, 50.2)	3.3
100,000 and over	289	46.8 (41.7, 52.9)	49.1 (43.3, 55.3)	50.6 (45.0, 56.2)	3.8

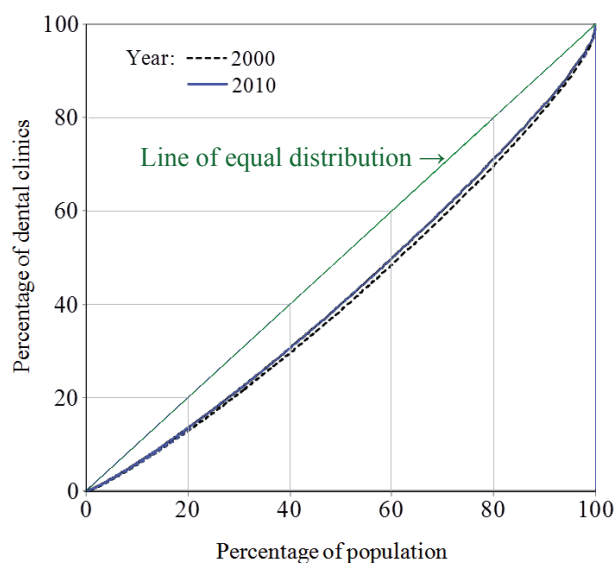
* Size of population of municipality classified based on the 2010 population

† The 2000 and 2005 municipal boundaries were adjusted to those of 2010 for this analysis

Table 3. Percentage of municipalities with no dental clinics by population for the years 2000, 2005 and 2010

Size of municipality	n	2000	2005	2010
Under 5,000	238	21.8	22.3	21.4
5,000 to 9,999	244	0.8	0.4	0.7
10,000 and over	1,268	0	0	0

Lorenz curve will pass through the origin as a diagonal line, but if the distribution is unequal, the curve will fall below the diagonal line. The Gini coefficient is defined as the proportion of the area surrounded by the diagonal line and the Lorenz curve, to the area below the diagonal line. It ranges from 0 to 1 and a higher value indicates a greater disparity. Finally, the number of dental clinics/100,000 population was compared between municipalities classified by population size and regional differentials were then investigated. The percentages of municipalities with no dental clinics as of 2000, 2005 and 2010 were analysed by the size of the population and any changes were noted. Data analyses were performed with IBM SPSS v20 and Microsoft Excel 2010.

**Figure 1.** Lorenz curve of dental clinic distribution

Results

Table 1 shows the total population and Gini coefficients for dental clinics in Japan from 2000 to 2010. Over the decade the number of clinics increased by approximately 7.9%, there was a 7.0% increase in the ratios of dentists/100,000 population and the Gini coefficients indicated an improvement in their distribution. Based on data for all municipalities in 2000 and 2010, Figure 1 displays Lorenz curves for dental clinics and shows the curve moving towards the line of equal distribution.

Table 2 presents the median value and 25th and 75th percentiles of the number of dental clinics/100,000 population in each municipality classified by population size, for the years 2000, 2005 and 2010. The change in the median between 2000 and 2010 of dental clinics/100,000 population for municipalities with a population of under 5,000 was 5.5, while that of municipalities with a population of more than 5,000 was from 3.3-3.8. Table 3 shows the percentage

of municipalities with no dental clinics by the size of the population. About one-fifth of small communities with a population of under 5,000 had no dental clinics and the values showed little change from 2000-2010.

Discussion

In our survey, the number of dental clinics per 100,000 population increased over the ten years between 2000 and 2010. According to Location Theory or the *spillover effect*, an increase in the number of doctors leads to competition resulting in the spread of doctors into less competitive, especially rural, areas (Newhouse *et al.*, 1980; Newhouse, 1990). Due to the increase in the number of dentists over the twenty years from 1980 to 2000, practicing dentists have spread more evenly (Okawa *et al.*, 2011; Toyokawa *et al.*, 2010). These developments are suggested to have occurred in accordance with the location theory. In our survey, we observed that, since 2000, the Gini coefficients have gradually decreased and the number of dental clinics per 100,000 population has increased most significantly in municipalities with a population of under 5,000, suggesting that dental clinics, like dentists, have spread into rural areas.

While the distribution of dental clinics has improved, dental clinics were still absent in 21% of municipalities with a population of 5,000 or fewer inhabitants as of 2010. It may be said that further improvement of this situation is limited to some degree. In such areas, opportunities to receive dental care are limited, although people have access to any dental care facility in the Japanese medical care insurance system. As for limiting factors, these include social factors such as declining rural populations and disadvantages in terms of convenience of everyday life, children's schools and other local amenities, as well as geographic factors, such as locations in mountainous areas and on remote islands. Furthermore, there are economic limitations to maintaining businesses in areas with small populations. In short, it is not viable for private clinics to operate, as they require a certain number of patients. The installation of advanced equipment to perform specialised dental procedures carries a serious monetary burden on small private dental clinics. In such remote rural areas, it is necessary to provide support, such as improving visiting dental care services and opening public dental clinics. In areas lacking dentists other than remote rural areas, the situation can be expected to improve through economic incentives, such as funding and additional remuneration for dental treatment. To supply expensive dental equipment in clinics in rural areas similar to that in urban areas, it may be necessary to establish a system in which the local municipality and nearby dental associations fund the purchase of equipment so it can be shared among facilities.

Due to municipal mergers, the number of municipalities had dropped by approximately half between 2000 and 2010. Generally, regional disparities are reduced in line with

the decrease in the number of municipalities; however, the influence of municipal mergers can be ignored in this study, because the boundaries of the municipalities in 2000 and 2005 were adjusted to those existing in 2010.

It must be noted that this study has some limitations. First, we examined the geographic distribution of dentists according to the population size in each municipality. However, residents may receive dental care in adjoining municipalities outside their administrative districts. In areas with few dental care facilities, it is necessary to conduct surveys incorporating such cases. The availability of transport, which markedly influences access to dental care, must also be examined. While the number of dental clinics per 100,000 persons in municipalities with a population of 5,000 or fewer inhabitants has increased, this has been partly due to a decline in the local population in some areas, incidentally improving the ratio. Therefore, it is necessary to monitor the distribution of dental clinics taking a long-term perspective.

Acknowledgement

This work was supported by JSPS KAKENHI Grant Number 23593095.

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