Community Dental Health (2019) **36,** 241–244
Received 17 December 2018; Accepted 9 April 2019

doi:10.1922/CDH_4521Okawa04

Geographic distribution of dental specialists permitted to advertise dental practices in Japan

Okawa, Y.[1,2], Hirata, S.[2]

[1]*Department of Dental Hygiene, Faculty of Health Care Science, Chiba Pref ectural University of Health Sciences;* [2]*Department of Social Dentistry, Tokyo Dental College*

Objective: The purpose of this study was to determine the geographic distribution of dental specialists permitted to advertise dental practices in Japan. ***Method:*** We identified the populations of 349 secondary medical zones nationwide from the 2015 population census, as well as the number of dentists in five specialties, namely oral surgeons, pedodontists, periodontists, dental anesthesiologists, and dental radiologists, who had been permitted to advertise dental practices, from a 2016 survey of physicians, dentists, and pharmacists. We determined the placement rate, Lorenz curve, and Gini coefficient for dentists in each specialty in order to describe their geographic distributions. ***Results:*** The placement rates of at least one of these types of dentist in each secondary medical zone were 73.9% for oral surgeons, 66.2% for pedodontists, 60.5% for periodontists, 31.8% for dental anesthesiologists, and 18.3% for dental radiologists. The Gini coefficients were 0.397, 0.400, 0.491, 0.650, and 0.761, respectively. ***Conclusion:*** The dentists in each specialty were few in number and were unequally distributed among the zones, but less so for oral surgeons and pedodontists. Dental anesthesiologists and radiologists were located primarily at university hospitals in urban areas and, therefore, were more unequally distributed.

Keywords: *dentists, dental specialty, population, distribution, geographic locations*

Introduction

Japan experienced a dearth of dentists and their unequal regional distribution from the late 1950s to the 1960s (Ministry of Health and Welfare, 1986). To resolve these issues, efforts were made between 1970 and 1980 to increase both the number of dental schools and the number of new students (Tokei Kyokai, 2012). This resulted in concern over a future excess of dentists and, at the end of the 1980s, the policy was adjusted to reduce their number (Ministry of Health and Welfare, 1986). This policy has continued since 2000, but the number of dentists has continued to increase (Ministry of Health, Labour and Welfare, 2009), leading to a more equal geographic distribution of both dentists and their clinics (Toyokawa *et al*., 2010; Okawa *et al*., 2011; Okawa *et al*., 2014).

Recently, in Japan, dental specialization has become prevalent for the purposes of increasing the availability of dental care and improving its quality. Among many specialty and certified dentists, five dental specialties are officially recognized by the Ministry of Health, Labour and Welfare (2013) and their practitioners are permitted to advertise dental practices. These are oral surgeons, pedodontists, periodontists, dental anesthesiologists, and dental radiologists. In particular, oral surgeons, pedodontists, and periodontists offer advanced and specialized care in a community-based manner, and play very important roles. Orthodontist certification systems established by three academic societies (Japanese Orthodontic Society, The Japan Institute of Orthodontists and Japan Association for Adult Orthodontics) have been adopted in Japan. However, these three academic societies have not established common standards for specialists and, as a result, orthodontic specialists are not permitted to advertise. Similarly, the system for accredited specialists has continued to improve quality in the area of conservative dentistry and prosthodontics, but these specialists are also not permitted to advertise.

There are several reports on the geographic distributions of dental specialists. A survey conducted in the U.S. reported an unequal regional distribution of oral and maxillofacial surgeons and periodontists (Waldman and Kucine, 2009; Waldman and Chaudhry, 2009). The recent GIS study on the distribution of dental health specialist locations in Sri Lanka showed an uneven geographic distribution of the total 55 specialist dental locations and 74 attributed specialist sites (Wijewardena *et al*., 2018). In Japan, the geographic distribution has been reported only for orthodontists (Okawa *et al*., 2014). For dentists in other specialties, geographic distributions have not been thoroughly studied.

The objective of the present study was to identify the regional distribution of the five dental specialties permitted to advertise dental practices in Japan, where the social environment is greatly changing in terms of the increasing number of dentists, the increasing level of dental medicine, the aging of society and low birth rate.

Method

There are 47 prefectures in Japan, encompassing 1,724 municipalities (as of 2016). These municipalities constitute

Correspondence to: Dr. Yoshikazu Okawa, Department of Dental Hygiene, Faculty of Health Care Science, Chiba Prefectural University of Health Sciences, 2-10-1 Wakaba, Mihama-ku, Chiba 261-0014, Japan. Tel: +81-043-296-2000, Fax: +81-043-272-1716, Email: yoshikazu.okawa-cpuhs.ac.jp.

primary medical zones that provide medical services closely related to residents' daily lives by managing their health, preventing diseases, and treating common diseases. A secondary medical zone, as specified in the Medical Care Act, consists of several municipalities. There are 344 secondary medical zones. These zones are defined to ensure a system providing medical care associated with hospital admission, as well as being used as units for locating health centers. A tertiary medical zone is defined to ensure a system providing advanced and specialized medical care within each prefecture. The present study investigated the geographic distribution of dental professionals in the secondary medical zones. The reasons for this include the fact that a smaller number of dentists in the individual specialties were registered and that specialty dentists, including oral surgeons, have more opportunities to provide dental care to patients referred from general dentists.

We used the 2015 population census (Ministry of Internal Affairs and Communications, Statistic Bureau, 2016) to identify the populations of secondary medical zones. Dentists are required to report the location of their clinic and the name of their clinical department to the Ministry of Health, Labour, and Welfare every two years. The results are published for each secondary medical zone as a survey of physicians, dentists, and pharmacists (Ministry of Health, Labour and Welfare, 2017). The most recent survey of the five specialties (oral surgeons, pedodontists, periodontists, dental anesthesiologists, and dental radiologists) permitted to advertise dental practices was conducted in 2016. These dentists are licensed if they meet the requirements established by their individual academic societies, but not by the nation.

We determined the placement rates for dentists in each specialty in all secondary medical zones in order to investigate their geographic distributions. We also generated a Lorenz curve and calculated a Gini coefficient (Morrow, 1977). First, we determined the numbers of dentists per 100,000 population in each secondary medical zone, and sorted the zones in ascending order. We then plotted the proportion of the population on the horizontal axis and the proportion of dentists on the vertical. If the dentists were equally distributed in proportion to the population for each secondary medical zone, then the Lorenz curve would describe a diagonal line. Otherwise, it would be beneath this line. The Gini coefficient is defined as the ratio of the area between the diagonal line and the observed Lorenz curve to that below the diagonal line, and is expressed as a fraction between 0 and 1. The higher the coefficient, the more unequal the distribution. Given that the numbers of dentists in individual specialties per 100,000 population demonstrated a biased rather than a normal distribution, we expressed the coefficients as median and percentile. Data analyses were performed with IBM SPSS 20 (IBM, Armonk, NY, USA) and Microsoft Excel 2010 (Microsoft Corp., Redmond, WA, USA).

Data used in this study were open access and freely available. Ethical clearance was therefore not required.

Results

Table 1 shows the entire population and the individual numbers of dentists engaged in dental practice, oral surgeons, pedodontists, periodontists, dental anesthesiologists, and dental radiologists in Japan in 2016. It shows that the number of oral surgeons (2083) was the highest, while those of dental anesthesiologists and radiologists were smaller than the total number of secondary medical zones (344).

Table 1. Population and numbers of specialty dentists in Japan

	2016
Population (thousands)	127,095
Engaged in dental practice	101,304
Oral surgeons	2,083
Pediatric dentists	1,261
Periodontists	1,179
Dental anesthesiologists	363
Dental radiologists	186

Table 2 presents the placement rate for dentists in each specialty according to the population scales of the secondary medical zones. In all zones, the placement rates were 59% or higher for oral surgeons, pedodontists, and periodontists, whereas they were about 25.6% and 8.3% for dental anesthesiologists and radiologists, respectively. The placement rates were higher in the zones with larger populations for all specialties. In the zones with a population of ≥ 300,000 but < 500,000, the rates were 98.0% for oral surgeons, 84.7% for pediatric dentists, and 75.5% for periodontists. Especially in the zones with a population of ≥ 500,000, placement rates were about 100% for these three specialties. The rates for dental anesthesiologists and radiologists were higher in the zones with ≥ 500,000 people.

Figure 1 shows the Lorenz curves of the distributions of dentists in each specialty across all 344 secondary medical zones. The Lorenz curves for oral surgeons and pedodontists are similar and are nearest to the diagonal line passing through the origin. The curve for periodontists is slightly distant from these two curves. Oral surgeons, pedodontists, and periodontists were thus readily available to more than 80% of the population. In contrast, the curves for dental anesthesiologists and radiologists were far from the diagonal line. This indicates that dentists in these specialties were not readily available to about 40% and 60%, respectively, of the cumulative population.

Table 2. Placement rates for specialty dentists by population of secondary medical zones

Population (thousands)	*n*	*Proportion of specialty dentists (%)*				
		Oral surgeons	*Pediatric dentists*	*Periodontists*	*Dental anesthesiologists*	*Dental radiologists*
< 100	84	44.0	29.8	19.0	6.0	2.4
100 - 200	79	70.9	49.4	55.7	11.4	1.3
300 - 500	98	98.0	84.7	75.5	34.7	12.2
≥ 500	82	100.0	100.0	98.8	76.8	51.2
Total	312	76.9	60.3	59.0	25.6	8.3

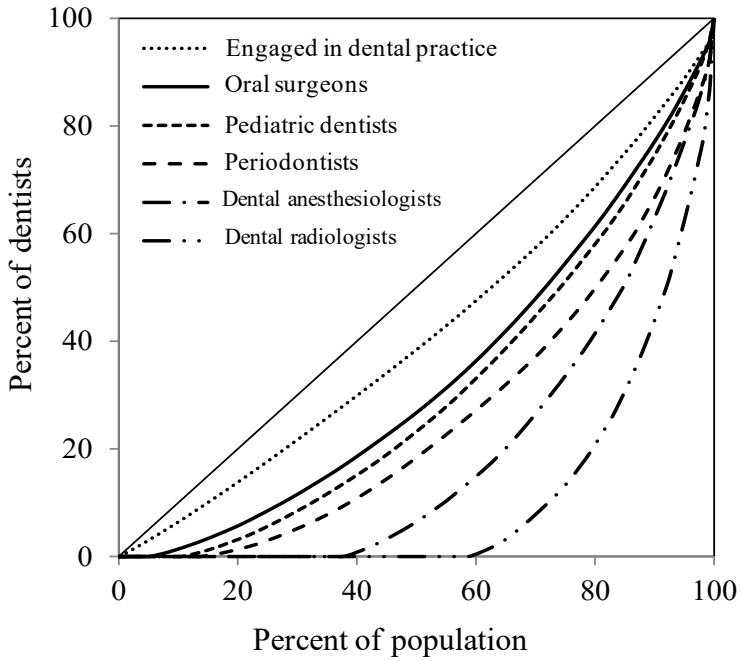

Figure 1. Lorenz curves for distribution of dentists and specialists across secondary medical zones

Table 3. Number of specialty dentists and Gini coefficient per 100,000 population in secondary medical zones

	Numbers of dentists per 100,000 population			
	25th percentile	*Median*	*75th percentile*	*Gini coefficient*
Engaged in dental practice	55.3	63.0	71.0	0.174
Oral Surgeons	0.6	1.2	2.0	0.333
Pediatric dentists	0	0.6	1.1	0.386
Periodontists	0	0.5	0.9	0.478
Dental anesthesiologists	0	0	0.2	0.606
Dental radiologists	0	0	0	0.775

The medians per 100,000 population for dentists in each specialty were 1.2 for oral surgeons but 0 for both dental anesthesiologists and radiologists (Table 3). The Gini coefficients were 0.333 for oral surgeons and pedodontists, but 0.606 and 0.775 for dental anesthesiologists and radiologists, respectively.

Discussion

On the basis of the Lorenz curves and Gini coefficients, we observed a marked difference in how unequal the regional distributions were among dentists in the five dental specialties. Oral surgeons, pedodontists, and periodontists, who have more opportunities to provide dental care to community residents, were readily available to more than 80% of the population, according to the Lorenz curves. This indicates that community requirements for dental care have been partly addressed. However, the Gini coefficient for periodontists is higher, so we may need to promote equalization of their distribution.

In contrast, dental anesthesiologists perform general anesthesia and systemic management and, thus, commonly work at institutions equipped with dental devices and instruments intended for these purposes. In addition, dental radiologists need to use X-ray imaging systems, such as CT or MRI, when conducting imaging examinations for dental diseases. Therefore, because dentists in these two specialties work at larger-scale hospitals, including university hospitals, in metropolitan areas, it is unavoidable that their regional distributions be markedly unequal.

The placement rate for dentists in each specialty was particularly low (≤ 44%) in the secondary medical zones with < 100,000 population, for several reasons. Firstly, the population decrease and aging of society have accelerated in these zones, and the tendency toward concentration of the population in metropolitan areas is growing, so it may be unavoidable to a certain degree that the distribution of specialty dentists is also biased toward urban areas. In particular, pediatric dentists prefer to open private clinics in urban areas with large populations of children. Secondly, since urban residents have higher incomes than rural ones, specialty dentists prefer to open private clinics in these areas under the system permitting the free opening of dental clinics. Thirdly, these dentists are more likely to work in urban areas where they can have more opportunities to receive training in their specialty and where satisfactory equipment is available. Finally, when emphasizing cultural and social factors, including convenience in daily life and

their children's educational circumstances, these dentists would generally desire to work or open a clinic in an urban area. Similar findings have been reported in other countries: the results of Australian surveys showed an apparent association between year of graduation and practice location, with more experienced dentists working in urban and higher socio-economic areas (Gurbuxani *et al*., 2012).

Over 80% of dentists in Japan work in clinics, with many in charge of a wide range of medical treatment as so-called general dentists. The proportion of specialists that can advertise is almost 60% for physicians, but very low for dentists (less than 10%). The Medical Care Act in Japan permits general dentists to open dental clinics as "dental and oral surgery", "dental pediatrics", and "orthodontics" in addition to "general dentistry", even if they have not been licensed as a specialty dentist. Unlike medical care, dental care is less differentiated by specialty. General dentists offer extractions, minor surgery, pediatric dental care, and periodontal care in order to adapt to community needs. However, dentists in any specialty will play a large role in addressing future advances in dental medicine and improving the quality of community-based healthcare. The number of successful applicants for the national examination for dentists has been reduced to about 2000 annually since 2014 (Ministry of Health, Labour and Welfare, 2018), and therefore the number of dentists and dental specialists is unlikely to increase rapidly in the future. Therefore, oral surgeons, pedodontists, and periodontists should be placed at least in all secondary medical zones with a population size of 100,000 or more.

This study had a limitation in that it investigated the geographic distribution of specialty dentists based on the populations of secondary medical zones. However, the demand for dental medicine may be determined by not only the population size, but also several other factors including the age structure of the population, their income level, dental knowledge, prevalence of dental diseases, proportion of people seeking dental care among community residents, and dentists' preferences regarding their workplace. We should also explore the effects of these factors.

To promote policies related to dental medicine, it is valuable to identify any regional variation in the distribution of specialty dentists. Such geographic distributions will change over time, and thus we will also need to monitor specialty dentists in Japan.

Conclusion

Our results suggest that the geographic distribution of dental specialists permitted to advertise dental practices in Japan is influenced by secondary medical zone population sizes. The dentists in each specialty were few in number and were unequally distributed among the zones, but less so for oral surgeons and pedodontists. Dental anesthesiologists and radiologists were located primarily at university hospitals in urban areas and, therefore, were more unequally distributed. Although studying the geographic distribution of dental specialists provides valuable information for developing dental policies, it remains necessary to conduct research continuously in the future, since the geographic distribution may change over time.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

References

Gurbuxani, A., Kruger, E. and Tennant, M. (2012): Geographic redistribution of practice location of graduate dentists: a six-year retrospective analysis (2004-2009). *Australian Dental Journal* **57**, 85-9

Kosei Tokei Kyokai (2012): Health state of the nation, annual report. Tokyo: Kosei Tokei Kyokai.

Ministry of Health and Welfare (1986): The future number of dentists in Japan - Final report of the study committee on future demand for dentists. Tokyo: Koku Hoken Kyokai.

Ministry of Health, Labour and Welfare (2009): Annual Health, Labour and Welfare Report 2008-2009: Changes in the Number of Dentists. https://www.mhlw.go.jp/english/wp/wp-hw3/dl/2-038.pdf.

Ministry of Health, Labour and Welfare (2013): http://www.mhlw.go.jp/topics/2013/05/tp0531-1.html (in Japanese)

Ministry of Health, Labour and Welfare (2018): Changes in the Number of the applicants who passed the national examination for dentists. https://www.mhlw.go.jp/stf/seisakunitsuite/bunya/0000085959.html (in Japanese)

Ministry of Internal Affairs and Communications, Statistic Bureau (2016): 2015 population census of Japan. https://www.stat.go.jp/english/data/kokusei/index.html.

Ministry of Health, Labour and Welfare (2017): Survey of physicians, dentists and pharmacists in 2016. https://www.e-stat.go.jp/stat-search/files?page=1&toukei=00450026&tstat=000001030962.

Morrow, J. (1977): Toward a more normative assessment of maldistribution. The Gini index. *Inquiry* **14**, 278-292.

Okawa, Y., Hirata, S., Okada, M. and Ishii, T. (2011): Geographic distribution of dentists in Japan. *Journal of Public Health Dentistry* **71**, 236-240.

Okawa, Y., Hirata, S., Sueishi, K. and Ishii, T. (2013): Geographic distribution of specialist orthodontists and orthodontic providers in Japan. *Orthodontic Waves* **72**, 142-147.

Okawa, Y. and Hirata, S. (2014): Trends in the geographic distribution of dental clinics in Japan. *Community Dental Health* **31**, 62-64.

Toyokawa, S. and Kobayashi, Y. (2010): Increasing supply of dentists induces their geographic diffusion in contrast with physicians in Japan. *Social Science & Medicine* **71**, 2014-2019.

Waldman, H.B. and Kucine, A.J. (2009): Update on the Distribution of Oral and Maxillofacial Surgeons 1995 to 2006. *Journal of Oral and Maxillofacial Surgery* **67**, 1667-71.

Waldman, H.B. and Chaudhry, R.A. (2009): Update on the changing numbers and distribution of periodontists. *Journal of Periodontology* **80**, 711-8.

Wijewardena, B., Ranasinghe, N., Kruger, E. and Tennant M. (2018): The distribution of dental health specialist locations in Sri Lanka. *Community Dental Health* **35**, 241–246