Distribution Discrepancies Between Male and Female Physicians in Urban and Rural Japan: A Twenty-Year Longitudinal Study from 1994 to 2014

Kazuki Kimura (kazuairforce36@gmail.com)  
Hiroshima University Hospital

Kazuo Inoue  
Teikyo University School of Medicine

Takahito Ando  
Teikyo University

Masanori Ito  
Hiroshima University Hospital

Research Article

Keywords: gender, geographic distribution, physician, year of experience, Japan

Posted Date: March 9th, 2023

DOI: https://doi.org/10.21203/rs.3.rs-2590368/v1

License: ©  This work is licensed under a Creative Commons Attribution 4.0 International License.  Read Full License
Abstract

Background
The Japanese medical education system produces 9,000 graduates per year, but the government still struggles with a shortage of physicians in rural areas, despite the implementation of several strategies. Our study examines this problem in detail during the period 1994–2014, comparing data on gender, years of medical experience, and demographic and geographic factors.

Methods
We analyzed the Physician Census from 1994, 2004, and 2014, examining data on physicians’ gender and the number of years since licensure. To correct the impact of municipal mergers, the analysis was aligned with the number of municipalities in 2014 (1741). We examined data from each physician (gender and years of medical experience) and analyzed the demographic and geographic distribution trend using Spearman correlation coefficients. We then used the Gini coefficient to evaluate the distribution change of physicians based on gender and years of experience.

Results
The number of physicians increased 1.29-fold over the 20-year observation period (1.23-fold for male physicians and 2.17-fold for female physicians), and the percentage of female physicians increased from 13.4–20.4%. The top one-third of the most populous municipalities were served by 79.4% of the physicians, and 87.7% of all physicians work in the top 1/3 municipalities in terms of population in 2014. The number of female physicians was higher at 91.8% compared to 86.8% for male physicians. The Spearman correlation coefficient examining the relationship between "ratio of physicians to total population" and "distance from prefectural capital" was 0.194–0.222–0.270. The Gini coefficient for all physicians was 0.315–0.298–0.298 (male physicians: 0.311–0.289–0.283, female physicians: 0.394–0.385–0.395). The Gini coefficients were lower for veteran physicians of both sexes than for younger physicians. The Gini coefficients for female compared to male physicians were higher in all age groups, showing that females had a denser population in urban areas.

Conclusion
The distribution of female physicians was lower in rural areas compared to their male counterparts. An improvement in policies to improve work–life balance for female physicians might encourage them to move to rural areas and alleviate the chronic shortage of medical care in these locations.

Background
To alleviate a shortage of physicians in the 1970s, during a period of economic growth, the Japanese government adopted the “one-prefecture, one-medical-school” policy, and the number of medical school students increased to 8,000. When students graduated from medical school, they tended to remain in the prefecture where they had studied, and there was an equal distribution of physicians throughout Japan. Because of a predicted birthrate decline and an excess of physicians, the number of medical school places was maintained for the next 30 years [1].

In 2004, a new post-graduate two-year clerkship program was created in which the participants rotated among multiple specialties [2], not always at their home university, which ultimately influenced where physicians were located when they went into practice. No longer did the younger generation continue an affiliation with their home university hospital but rather ended up working at city training hospitals. As a result, the number of young physicians practicing at university hospital medical departments decreased, and the clinical work at university hospitals continued to be covered by mid-career physicians. Although physicians now have more control over their own careers and access to case experience and research, this trend has further accelerated the shortage of physicians in rural areas [3].
Overall, the absolute number of physicians in Japan is considered low; among the Organization for Economic Co-operation and Development (OECD) countries, Japan has only about 60% of the OECD average of physicians (number of physicians per 100,000 population [4]. The capacity of medical schools has been increased to about 9,000, and some medical schools have introduced a regional quota system that requires graduates of medical school to work in rural areas; however, there is still a serious shortage of physicians in underpopulated regions [5].

Numerous papers have been published on the distribution of physicians in Japan, and, until the 2000s, many of them supported the idea that the uneven distribution of physicians throughout the country could be corrected by increasing the total number [6–8]. However, in recent years, there have been some studies that argue the opposite [9–11]. The Gini coefficient has been used as a tool in many papers to analyze the overall distribution of physicians.

Our earlier study found that the distribution of physicians to rural areas has been limited, despite the increase in the overall number of physicians since 2004 (after the clinical training system was implemented) [12]. Moreover, there has been a clear difference in the distribution of male and female physicians both demographically and geographically, with remote small-population municipalities most often being served by middle-aged male physicians, as demonstrated in some studies [13].

As shown in Table 1, the total number of physicians increased by 80,686 (46,457 males and 34,229 females) in the 20 years from 1994 to 2014. With the entry of female students into medical schools, the percentage of male students has dropped from 87.3% in 1994 to 79.6% in 2014.

<table>
<thead>
<tr>
<th>Year</th>
<th>1994</th>
<th>2004</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Physician</td>
<td>230,519</td>
<td>270,371</td>
<td>311,205</td>
</tr>
<tr>
<td>Variation (Rate) from 1994</td>
<td>39,852</td>
<td>117.3%</td>
<td>80,686</td>
</tr>
<tr>
<td>/100,000 population</td>
<td>184.4</td>
<td>211.7</td>
<td>244.9</td>
</tr>
<tr>
<td>Male</td>
<td>201,244</td>
<td>225,743</td>
<td>247,701</td>
</tr>
<tr>
<td>Female</td>
<td>29,275</td>
<td>44,628</td>
<td>63,504</td>
</tr>
</tbody>
</table>

While the increase in the percentage of female physicians may have an impact on the distribution of physicians, Japan still had the lowest percentage of female physicians among OECD countries as of 1994 [4]. Since the 2000s, women have accounted for approximately one-third of all medical school entrants, and the percentage has remained stable since then [14]. As of 2014, the last year of this study, the percentage of female physicians was 20.4%, and it will eventually rise to 30–35% if this trend continues.

When looking at the overall distribution of physicians, and based on the results of previous studies [12, 13], we assumed that gender and years of experience (years in practice after obtaining a medical license) are the most important factors influencing the distribution of physicians. We decided to study these two factors by post-licensure (years of experience) and by gender, using individual physician data.

**Methods**

We studied the three time points of 1994, 2004, and 2014 using e-stat, which is distributed as access-free open data provided by the Statistics Bureau of the Ministry of Internal Affairs and Communications [14]. Personal physician information, such as place of employment, age, gender, and number of years since being licensed, was obtained directly from the Ministry of Health, Labor, and Welfare.

Population indices were taken from the Japanese national census conducted every five years [16]. The population of the municipalities was adjusted to the size of the most recent census in 2014 (1,741 municipalities), although there were some municipalities with zero population in the 2015 census due to the Great East Japan Earthquake in 2011. Since the census year did

We conducted a detailed survey examining the changes in the number of physicians over the 20-year period from 1994 to 2014, with an emphasis on changes by gender and years of experience. The initial classification of years of experience was by five-year intervals, but, since our previous studies [13] have shown that the distribution of young physicians fluctuates greatly within the first 10 years of licensure, the survey was subdivided into smaller categories for physicians with less than 10 years of experience. The increase/decrease in physicians by gender and years of experience was also visually summarized using Lorenz curve and Gini coefficients, and factors that could affect the distribution of physicians were examined.

We hypothesized that five factors could significantly affect physician distribution: number of physicians to population, number of physicians, municipal population, distance (from the prefectural capital), and population density. We combined two of each of these five factors and calculated correlation coefficients using the Spearman correlation. Correlation coefficients were analyzed at three time points (1994, 2004, and 2014) for all physicians, male physicians, and female physicians. A total of 90 correlation coefficients were obtained.

We surveyed 47 prefectures in Japan (N = 47) at three time points to determine how many physicians are distributed in the most populous one-third of each prefecture (urban areas), divided into overall physicians, male physicians, and female physicians.

Finally, Gini coefficients for the three time points were obtained based on gender and years of experience. The number of physicians per 100,000 population was calculated for 1,741 municipalities using the population of each municipality listed in the national survey as the denominator. The Lorenz curves were sorted by the number of physicians per 100,000 population, with the cumulative municipal population (cumulative relative population) on the x-axis and the cumulative number of physicians in the medical profession (cumulative relative number of medical personnel) on the y-axis; the Gini coefficients were compared. The Lorenz curve is a commonly used method of analysis for social imbalance and can be visually understood by density on the x- and y-axes from the lower to the upper population groups [17].

The Gini coefficient is an integral value-based indicator derived from the Lorenz curve Fig. 1. It has the advantage of providing a visual representation of the Lorenz curve: if the Gini coefficient is close to 0, the Lorenz curve is in line with the ideal line (equal distribution), and if the Gini coefficient is close to 1, the Lorenz curve deviates from the ideal line (skewed distribution) [18].

In our previous study, we calculated the Gini coefficients for all physicians at three time points (1994, 2004, 2014); in this study, we calculated the Gini coefficients for male and female physicians based on years of medical experience after obtaining their licenses. This is the first attempt in Japan to investigate the distribution by gender and years of experience using individual physician questionnaires. Lorenz curves were plotted by gender and by years of post-licensure experience, and changes in Gini coefficients were determined over a 20-year period. Based on these results, we discussed the factors that have a significant influence on the distribution of physicians.

**Results**

We found notable results when we investigated whether gender differences affected the distribution of physicians. We investigated the correlations for each distribution using Spearman’s correlation coefficients for five indices: physician–population ratio (number of physicians per 100,000), number of physicians, municipal population, distance from the prefectural capital, and population density at the three time points.

Our previous studies have shown that physicians tend to be distributed in proportion to population. In this study, the correlation between the number of physicians and the municipal population was 0.943–0.948–0.952 for the period 1994–2004–2014, which was very high, and the correlation value increased. The number of physicians/distance also showed a low correlation of 0.436–0.460–0.484 compared to the correlation with population, but the correlation increased at all three time points.

The correlation for physician–population ratio/distance was 0.194–0.222–0.270, which was low but continued to rise, suggesting that physician distribution was influenced not only by population but also by distance. The correlation between the ratio of physicians to population and distance for female physicians was 0.397–0.411–0.440, which was higher than the overall correlation,
indicating that female physicians tend to be distributed in urban areas, and this tendency has become more pronounced in recent years.

We surveyed 47 prefectures to determine how many physicians are distributed in the top one-third of the population centers. The results are shown in Fig. 3. Extreme outliers were excluded when creating the box-and-whisker graphs (e.g., prefectures with university-affiliated hospitals located in the lower population quartiles). Examining the municipal population shows the increasing population move to areas with more density, with 77.7–78.9–79.4% (median) of residents distributed in the top one-third of the population centers over the course of each decade.

Paralleling this population trend, 86.0–86.7–87.7% (median) of physicians were distributed in the top one-third most populous areas. In the municipality with the highest distribution rate, 96.9% of physicians were concentrated in these areas as of 2014, highlighting the reality that the increased concentration of population in urban areas and the concentration of physicians are occurring simultaneously. In addition, 88.8–89.0–91.8% (median) of female physicians were concentrated in the most highly populated municipalities, which was a higher distributional concentration compared to male physicians.

The Gini coefficients for the number of physicians per 100,000 population were calculated and summarized by years of experience (years since obtaining medical license) and by gender in Fig. 4. The Gini coefficients for all physicians at the three time points in the study (1994–2004–2014) changed to 0.315–0.298–0.298. The Gini coefficients for physicians improved between 1994 and 2004 but remained constant between 2004 and 2014.

While the Gini coefficients for male physicians steadily decreased to 0.311–0.289–0.283, those for female physicians did not decrease (0.394–0.385–0.395). Looking at post-licensure (by years of experience), Gini coefficients tended to decrease with years of experience for both male and female physicians, but female physicians had overall higher Gini coefficients compared to male physicians.

The Gini coefficient for male physicians who had been licensed for more than 10 years tended to be lower than the overall Gini coefficient. In the 1994 and 2004 surveys, Gini coefficients were much lower for the group of physicians who were two to three years post-graduation, but no significant decrease was observed in 2014. We believe this shows how the start of the new clinical training system impacted physician distribution.

Discussion

We studied the urban and rural distribution of physicians, examining whether they were male or female and younger or more experienced. We analyzed individual physician data taken from a 20-year follow-up period using Lorenz curves and Gini coefficients. Our study adjusted the size of municipalities in 1994, 2004, and 2014 to the latest available data in 2014, so that the analysis was more realistic. The results showed significant differences in urban/rural distribution trends between male and female physicians and between experienced physicians and those who were more recent medical school graduates.

The 2014 analysis showed a large distribution discrepancy between the younger group of physicians compared to those who had been licensed for 30 years or more, with the two groups having Gini coefficients of 0.560 and 0.234, respectively. The 2014 coefficients for male and female physicians were 0.283 and 0.395, respectively, showing a large discrepancy between the genders. While the distribution of male physicians paralleled overall trends, female physicians had higher Gini coefficients, and even veteran female physicians had a lower distribution to rural areas. While there were higher numbers of veteran physicians of both genders in rural areas, gender differences remained Fig. 4, and experienced male physicians provided much of the care in those areas.

The percentage of female physicians in medical school continues to increase in Japan and globally. To sustain adequate numbers of physicians in rural areas, it is necessary to understand why many female doctors choose urban areas rather than remote areas when they go into practice. Previous studies have reported that female physicians struggle with work–life balance [19–21]. Since women must balance their careers with life events such as marriage, pregnancy, childbirth, and childcare, it is understandable that women would choose to work in urban areas where it is easier to take leave (e.g., general hospitals where it is easier to find a substitute doctor), work part-time, or work shorter hours. Urban areas also provide more career choices for those wishing to pursue a medical specialty or other paths in the medical field.
These findings show the need for future research on female physicians who wish to have a career while also choosing to have children and a family life. Of course, these choices affect the woman’s partner, who will also remain in the more populated areas. Men can contribute to their partners’ work–life balance by assisting in childcare and housework duties. Experienced medical professionals, like the authors of this paper, know the clinical field well and can provide advice to their younger colleagues.

Based on several reports [22–25], it is clear that all physicians are suffering from considerable physical and mental fatigue, both in Japan and globally, and that female physicians, in particular, are struggling to balance their careers with housework and child-rearing. A 2006 survey report on the employment rate of physicians reveals that while 90% of Japanese male physicians were employed, the rate for female physicians gradually declined after obtaining a medical license, and a quarter of female physicians were not working by the 10th year [26].

This trend was similar for women of child-bearing age in all occupations who were balancing the multiple demands in their lives. Childbirth (70.0%) and childcare (38.3%) were the main reasons for interrupting or leaving work [27].

Japanese physicians are free to choose their specialty after completing clinical training, and a 2012 Japanese survey showed that the specialties with the highest percentages of female physicians were dermatology (44.3%), ophthalmology (37.5%), and anesthesiology (36.3%) [26]. It is assumed that women will choose workplace environments that are conducive to the needs of female physicians and where it is easier for them to voice their concerns about work–life balance and find solutions.

In a survey of female physicians, 25.9% said understanding and atmosphere in the workplace were the number one conditions for being able to continue working while raising children [21]. Female physicians also tended to choose pediatrics (33.7%) and obstetrics/gynecology (31.5%), specialties that parallel their traditional roles in society. The least popular specialties for female physicians were surgery (7.1%), urology (5.0%), and orthopedics (4.4%) [26], indicating that female physicians are less likely to choose specialties that are strenuous, require a lot of overtime. An increase in the percentage of female physicians will not have a significant impact on the overall number of physicians, but the number of practitioners is expected to decrease significantly in specialties such as surgery, where the participation rate of female physicians is very low.

We believe the increasing numbers of female physicians should be supported so they can continue their career steps (including securing clinical and research posts when their careers are interrupted by life events). If the sustainability of rural hospitals is to be maintained, the challenge is to create an environment supporting a work–life balance that allows female physicians to work steadily while building their careers.

One of our proposals for a specific healthcare policy is to expand the system of general practitioners. The definition of “general practitioner” and the training process for general practitioners still need to be improved. However, female physicians who choose to become generalists can respond to the demand in rural areas while also raising a family [28–29]. However, it is also necessary to study how many female doctors might choose to become general practitioners.

This analysis also allowed us to visually assess the impact of the clinical training system in Japan. Most hospitals registered as clinical training institutes are university-affiliated hospitals and general hospitals located in urban areas, where there is more case experience, and these attract more trainees than corresponding regional core hospitals in rural areas.

In the past, most physicians within two years of graduation were assigned to university hospital departments after short-term training at medical school and were dispatched to regional medical institutions through personnel. However, physicians themselves are now able to freely choose their post-residency careers, which will further decrease the extent to which they choose to practice in rural areas. There is also a growing number of fields, such as preventative medicine and public health, that are available for physicians to choose from, and this trend should be further investigated.

The clinical training system for physicians has succeeded in removing the negative aspects of the past segmentation into specialties, broadening the scope and insight of individual physicians, and creating physicians who are capable of providing comprehensive care, resulting in improved access to medical care. However, when the policies that were thought to be right on a micro level are combined with the current situation in Japan, they have resulted in negative outcomes that could not have been predicted on a macro level, such as a shortage of doctors in rural areas, a concentration of young physicians in urban areas, and the fact that veterans are supporting local rural medical services.
Conclusion

Medical care in rural areas in Japan has become dependent on male physicians who have been in the field for many years. A large percentage of young physicians, and an even larger percentage of female physicians, choose to remain in urban areas. Many women choose urban areas because it is easier to sustain a work–life balance in practices where they can easily take time away from work to meet family demands. To sustain adequate healthcare for the population of rural Japan, it is necessary to create conditions in those regions that allow female physicians to develop their careers while achieving a work–life balance.

List Of Abbreviations

MHLW  Ministry of Health, Labor and Welfare
OECD  Organization for Economic Co-operation and Development

Declarations

Ethics approval and consent to participate

The Ministry of Health, Labor and Welfare (MHLW) provided us with individual data for this study, but the names of individuals were kept confidential. The requirement for informed consent was waived by the Ethics Committee of (Hiroshima university ethics committee: approval No. E-2047) because of the retrospective nature of the study. This research methods were carried out in accordance with relevant guidelines and regulations. The experimental protocols were approved by Hiroshima university ethics committee.

Consent for publication

Not applicable. This article does not contain any personal information.

Availability of data and materials

The data that support the findings of this study are available from the corresponding author, Kazuki Kimura, upon reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding

Not applicable

Authors' contributions

Kazuki Kimura constructed the study design and participated in the literature review, data analysis, data simulation, and manuscript drafting. Kazuo Inoue conceived of the study and constructed the study design and participated manuscript drafting. Takahito Ando participated in the data analysis and data cleaning. Masanori Ito supervised the conduct of this study. All authors discussed the results, commented on the manuscript, and gave their final approval.

Acknowledgements

We requested and received permission from the Ministry of Health, Labor and Welfare to use the data collected by the Survey of Physicians, Dentists, and Pharmacists.

References


**Figures**

![Graph](image-url)

Gini coefficient = Area (A) / *Triangle (B)

*Triangle (B) = 0.5
Figure 1

Lorenz curve and Gini coefficient

Figure 2

Comparison of Physician Gender Ratio in Japan in 1994 vs. 2014
Figure 3

Percentage of Physicians Working in the Top One-third Most Populous of Japan's 47 Prefectures

Figure 4


Supplementary Files
This is a list of supplementary files associated with this preprint. Click to download.

- FigS1Revised.tiff