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Original Article

Ethnicity, gender, and geographical distribution of dentists in Taiwan in 1939 (Showa 14)

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Abstract *Background/purpose:* Taiwan's dentistry entered into a new era of modernization and flourished during the Japanese colonial period. However, we know very little about the composition of dentists at that time. This study attempted to analyze the ethnicity, gender, and geographical distribution of dentists in Taiwan in 1939 (Showa 14).

Materials and methods: The methods of documentary analysis and secondary data analysis were adopted to find the composition of dentists during the late Japanese colonial period through a name list of contract dentists for the Postal Savings Insurance published in August 1939 (Showa 14) by the Taiwan Government Transportation Department Information Bureau.

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Results: The total number of contract dentists was 368, accounting for 86.79% of the 424 practicing dentists in Taiwan in 1939 (Showa 14). Of the 368 contract dentists (328 males and 40 females), 225 (61.14%) were Taiwanese and 143 (38.86%) were Japanese. Among the 8 prefectures in Taiwan, Tainan Prefecture had the largest number of dentists (97), followed by Taipei (84) and Taichung (78) prefectures. The number of contract dentists per 100,000 people was 6.24, equivalent to 16,021 people served by each contract dentist in 1939 (Showa 14). The chi-square test for the trend analysis of gender distribution indicated a significantly higher proportion of male than female contract dentists in either Taiwanese or Japanese ethnic group.

Conclusion: In the late Japanese colonial period, the number of Taiwanese dentists exceeded that of Japanese dentists. Furthermore, there were more male than female dentists in either the Taiwanese or the Japanese population.

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Introduction

The modern medicine and the medical education system for cultivating physicians were first introduced to Taiwan during the Japanese colonial period (1895–1945). After several stages, Taiwan's medical development and medical education system have continued to improve and mature, and have become the driving force behind Taiwan's medicine and the important cornerstone of Taiwan's public health development. Although the Japanese colonial government of Taiwan did not establish an education system for cultivating dentists during the Japanese colonial period. With the development of overall modern medicine, Taiwan's modern dentistry also developed.^{1,2}

The earliest official record of dental practice in Taiwan was in 1896 (Meiji 29) when Dr. Chiyomatsu Sakai applied for a license to open a dental clinic on the main street in Taipei City. Due to the increase in the number of Japanese dentists coming to Taiwan for practice and the number of Taiwanese dentists graduating from the Japanese dental schools returning to Taiwan for practice, Taiwan's dental system was still booming in the late Japanese colonial period. The island-wide Taiwan Dental Association (TDA) and Taiwan Academic Dental Association (TADA) were established in 1916 (Taisho 5) and 1929 (Showa 4), respectively. Until the end of the World War II (1945), the number of dentists in Taiwan reached 738, including 493 Taiwanese dentists.^{3–6}

In the past, there were few studies on the distribution of dentists in Taiwan during the Japanese colonial period. Although researchers can find the number of dentists in Taiwan during the Japanese colonial period from the official statistics of the Japanese colonial government, there are few statistics based on the characteristics of dentists (such as their ethnicity and gender).⁷ The Taiwan Government Transportation Department Information Bureau entered into an agreement with the TDA in July 1939 (Showa 14) to compile a name list of contract dentists for the Postal Savings Insurance, which was issued in August 1939 (Showa 14). The name list presented the names and practice addresses of contract dentists in each prefecture in Taiwan. Through the rules of names, we could determine the ethnicity (Taiwanese or Japanese) and gender of each

dentist. This study attempted to analyze the ethnicity, gender, and geographical distribution of dentists in Taiwan in 1939 (Showa 14) based on this list of contract dentists. We further compared their differences in the number of contract dentists per 100,000 people, the number of people served by each contract dentist, the ratio of Japanese people to Taiwanese people, and the ratio of Japanese contract dentists to Taiwanese contract dentists among the 8 prefectures and among the 5 regions in Taiwan.

Materials and methods

This study used the methods of documentary analysis and secondary data analysis to find the composition of dentists (including their ethnicity, gender, and geographical distribution) and of population during the late Japanese colonial period. The population data was open to access and could be collected from the related websites. The name list of contract dentists for the Postal Savings Insurance published in August 1939 (Showa 14) by the Taiwan Government Transportation Department Information Bureau was analyzed in this study. The content of the name list of contract dentists included the names and practice addresses of TDA member dentists by prefectures of Taiwan. Due to the agreement between the government and the TDA, these member dentists became the contract dentists for the Postal Savings Insurance. According to the rules of names, the ethnicity (Taiwanese or Japanese) and gender of each dentist could be identified. Furthermore, we downloaded the Taiwan's health and demographic information of 1939 stored in the Taiwan Database for Empirical Legal Studies, and extracted the population data by prefectures of Taiwan.

Furthermore, the whole area of Taiwan was divided into five regions: the northern, central, southern, and eastern regions and offshore islands. The northern region ($n = 2$) included Taipei Prefecture and Hsinchu Prefecture. The central region ($n = 1$) included Taichung Prefecture only. The southern region ($n = 2$) included Tainan Prefecture and Kaohsiung Prefecture. The eastern region ($n = 2$) included Hualien Prefecture and Taitung Prefecture. The offshore islands ($n = 1$) included Penghu Prefecture only (Fig. 1). Based on the number of contract dentists, we drew the



Figure 1 Map of Taiwan's first-level administrative regions from 1926 to 1945. There were 8 prefectures in Taiwan during this period. In this study, the regions of Taiwan were defined as follows. Taipei and Hsinchu were the northern region of Taiwan. Taichung was the central region. Tainan and Kaohsiung were the southern region. Hualien and Taitung were the eastern region. Moreover, Penghu was the offshore islands.

Lorenz curve and calculated the Gini coefficient to understand the geographical distribution of dentists. When the number of dentists per 100,000 people in each prefecture or region was completely even, the Lorenz curve was a diagonal line through the origin, called the equal distribution line. However, the more uneven was the geographical distribution of dentists, the more the Lorenz curve deviated from the equal distribution line. Besides, the actual value of the Gini coefficient was only between 0 and 1. In this study, the larger was the Gini coefficient (closer to 1), the more uneven was the geographical distribution. On the contrary, the smaller was the Gini coefficient (closer to 0), the more even was the geographical distribution.^{8,9}

The research data collected by the above methods were stored in excel files and used for the descriptive statistics. Moreover, the chi-square test was used for trend analysis of gender distribution. The *P*-value less than 0.05 was considered to be significant.

Results

According to the Taiwan Database for Empirical Legal Studies, the total number of practicing dentists was 424 in

1939 (Showa 14). We used the data of the name list of contract dentists for the Postal Savings Insurance for analysis in this study, because the number of the contract dentists as well as the gender and the ethnicity of each contract dentist could be identified from these data. The total number of contract dentists was 368, accounting for 86.79% of the 424 practicing dentists in 1939 (Showa 14). This suggested that the vast majority of practicing dentists at that time possessed the welfare measure of the Postal Savings Insurance. There were 8 prefectures in Taiwan during the Showa era. Of the 8 prefectures of Taiwan, Taipei and Hsinchu belonged to the northern region, Taichung the central region, Tainan and Kaohsiung the southern region, and Hualien and Taitung the eastern region of Taiwan. Moreover, Penghu was the offshore islands (Fig. 1). The results of our analyses were described as follows.

The distribution of Taiwanese and Japanese contract dentists in each prefecture and each region of Taiwan in 1939 (Showa 14)

Of the 368 contract dentists (328 males and 40 females), 225 (61.14%) were Taiwanese and 143 (38.86%) were

Japanese. Among all prefectures of Taiwan, Tainan Prefecture had the largest number of dentists (97, 26.36%). Of these 97 dentists (84 males and 13 females), 76 (78.35%) were Taiwanese and 21 (21.65%) were Japanese. Taichung Prefecture had the highest proportion of female dentists (14.10%, 11/78), while Hualien, Taitung, and Penghu prefectures had none of female dentists.

Moreover, Taiwanese dentists were mainly concentrated in Tainan Prefecture, accounting for 33.78% (76/225) of the total number of Taiwanese dentists. Among Taiwanese dentists, Taichung Prefecture had the highest proportion of female dentists (17.54%, 10/57). On the other hand, Japanese dentists were mainly concentrated in Taipei Prefecture, accounting for 41.26% (59/143) of the total number of Japanese dentists. Among Japanese dentists, Taipei Prefecture had the highest proportion of female dentists (6.78%, 4/59) (Table 1).

Based on the prefecture level, the Gini coefficient was 0.07 in overall, while the Gini coefficients of Taiwanese and Japanese dentists were 0.23 and 0.29, respectively. Based on the gender, the Gini coefficients of Taiwanese, Japanese, and overall female dentists (0.33, 0.40, and 0.32, respectively) were all higher than those of male dentists (0.22, 0.18, and 0.06, respectively) (Table 1).

Among all regions of Taiwan, the southern region had the largest number of dentists (154, 41.85%). Of these 154 dentists (134 males and 20 females) in the southern region of Taiwan, 114 (74.03%) were Taiwanese and 40 (25.97%) were Japanese. The central region had the highest proportion of female dentists (14.10%, 11/78), while the eastern region and offshore islands had none of female dentists. Moreover, Taiwanese dentists were mainly concentrated in the southern region, accounting for 50.67% (114/225) of the total number of Taiwanese dentists. Among Taiwanese dentists, the central region had

the highest proportion of female dentists (17.54%, 10/57). On the other hand, Japanese dentists were mainly concentrated in the northern region of Taiwan, accounting for 49.65% (71/143) of the total number of Japanese dentists. Among Japanese dentists, the northern region had the highest proportion of female dentists (5.63%, 4/71) (Table 1).

Based on the region level, the Gini coefficient was 0.14 in overall, while the Gini coefficients of Taiwanese and Japanese dentists were 0.23 and 0.07, respectively. Based on the gender, the Gini coefficients of Taiwanese, Japanese, and overall female dentists (0.30, 0.25, and 0.23, respectively) were all higher than those of male dentists (0.21, 0.07, and 0.13, respectively) (Table 1).

The ratios between population and contract dentists among Taiwanese and Japanese in each prefecture and each region of Taiwan in 1939 (Showa 14)

There were totally 5,895,864 people in Taiwan in 1939 (Showa 14). The number of contract dentists per 100,000 people was 6.24, equivalent to 16,021 people served by each contract dentist (Table 2). For Taiwanese ethnic group, there were totally 5,524,990 people. The number of contract dentists per 100,000 people was 4.07, equivalent to 24,556 Taiwanese people served by each contract dentist. For Japanese ethnic group, there were totally 323,148 people. The number of contract dentists per 100,000 people was 44.25, equivalent to 2260 Japanese people served by each contract dentist. Moreover, the ratio of Japanese people to Taiwanese people was 0.06, while the ratio of Japanese contract dentists to Taiwanese contract dentists was 0.64 (Table 2).

Table 1 The numbers of Taiwanese and Japanese contract dentists by gender for the Postal Savings Insurance in each prefecture and each region of Taiwan in 1939 (Showa 14).

| Location | Number (%) of Taiwanese dentists | | | Number (%) of Japanese dentists | | | Number (%) of all dentists | | |
|---------------------------------|----------------------------------|------------|-------------|---------------------------------|----------|------------|----------------------------|------------|-------------|
| | Male | Female | Total | Male | Female | Total | Male | Female | Total |
| Prefecture (n = 8) | | | | | | | | | |
| Taipei | 21 (9.33) | 4 (1.78) | 25 (11.11) | 55 (38.46) | 4 (2.80) | 59 (41.26) | 76 (20.65) | 8 (2.17) | 84 (22.83) |
| Hsinchu | 21 (9.33) | 1 (0.44) | 22 (9.78) | 12 (8.39) | 0 | 12 (8.39) | 33 (8.97) | 1 (0.27) | 34 (9.24) |
| Taichung | 47 (20.89) | 10 (4.44) | 57 (25.33) | 20 (13.99) | 1 (0.70) | 21 (14.69) | 67 (18.21) | 11 (2.99) | 78 (21.20) |
| Tainan | 64 (28.44) | 12 (5.33) | 76 (33.78) | 20 (13.99) | 1 (0.70) | 21 (14.69) | 84 (22.83) | 13 (3.53) | 97 (26.36) |
| Kaohsiung | 32 (14.22) | 6 (2.67) | 38 (16.89) | 18 (12.59) | 1 (0.70) | 19 (13.29) | 50 (13.59) | 7 (1.90) | 57 (15.49) |
| Hualien | 3 (1.33) | 0 | 3 (1.33) | 6 (4.20) | 0 | 6 (4.20) | 9 (2.45) | 0 | 9 (2.45) |
| Taitung | 1 (0.44) | 0 | 1 (0.44) | 2 (1.40) | 0 | 2 (1.40) | 3 (0.82) | 0 | 3 (0.82) |
| Penghu | 3 (1.33) | 0 | 3 (1.33) | 3 (2.10) | 0 | 3 (2.10) | 6 (1.63) | 0 | 6 (1.63) |
| Gini coefficient | 0.22 | 0.33 | 0.23 | 0.18 | 0.40 | 0.29 | 0.06 | 0.32 | 0.07 |
| Region of Taiwan (n = 5) | | | | | | | | | |
| Northern | 42 (18.67) | 5 (2.22) | 47 (20.89) | 67 (46.85) | 4 (2.80) | 71 (49.65) | 109 (29.62) | 9 (2.45) | 118 (32.07) |
| Central | 47 (20.89) | 10 (4.44) | 57 (25.33) | 20 (13.99) | 1 (0.70) | 21 (14.69) | 67 (18.21) | 11 (2.99) | 78 (21.20) |
| Southern | 96 (42.67) | 18 (8) | 114 (50.67) | 38 (26.57) | 2 (1.40) | 40 (27.97) | 134 (36.41) | 20 (5.43) | 154 (41.85) |
| Eastern | 4 (1.78) | 0 | 4 (1.78) | 8 (5.59) | 0 | 8 (5.59) | 12 (3.26) | 0 | 12 (3.26) |
| Offshore islands | 3 (1.33) | 0 | 3 (1.33) | 3 (2.10) | 0 | 3 (2.10) | 6 (1.63) | 0 | 6 (1.63) |
| Gini coefficient | 0.21 | 0.30 | 0.23 | 0.07 | 0.25 | 0.07 | 0.13 | 0.23 | 0.14 |
| Overall | 192 (85.33) | 33 (14.67) | 225 (100) | 136 (95.10) | 7 (4.90) | 143 (100) | 328 (89.13) | 40 (10.87) | 368 (100) |

Table 2 The numbers of Taiwanese and Japanese population and their ratios between population and contract dentists for the Postal Savings Insurance in each prefecture and each region of Taiwan in 1939 (Showa 14).

| Location | Taiwanese | | | Japanese | | | Overall | | | Ratio C | |
|---------------------------------|------------|------|--------|------------|-------|------|-------------------------|------|--------|------------|----------|
| | Population | A | B | Population | A | B | Population ^a | A | B | Population | Dentists |
| Prefecture (n = 8) | | | | | | | | | | | |
| Taipei | 995,844 | 2.51 | 39,834 | 138,625 | 42.56 | 2350 | 1,159,648 | 7.24 | 13,805 | 0.14 | 2.36 |
| Hsinchu | 775,730 | 2.84 | 35,260 | 18,714 | 64.12 | 1560 | 796,340 | 4.27 | 23,422 | 0.02 | 0.55 |
| Taichung | 1,267,921 | 4.50 | 22,244 | 41,592 | 50.49 | 1981 | 1,313,419 | 5.94 | 16,839 | 0.03 | 0.37 |
| Tainan | 1,431,733 | 5.31 | 18,839 | 49,404 | 42.51 | 2353 | 1,488,429 | 6.52 | 15,345 | 0.03 | 0.28 |
| Kaohsiung | 795,244 | 4.78 | 20,927 | 46,930 | 40.49 | 2470 | 848,892 | 6.71 | 14,893 | 0.06 | 0.5 |
| Hualien | 115,864 | 2.59 | 38,621 | 17,875 | 33.57 | 2979 | 135,615 | 6.64 | 15,068 | 0.15 | 2 |
| Taitung | 77,348 | 1.29 | 77,348 | 6879 | 29.07 | 3440 | 85,001 | 3.53 | 28,334 | 0.09 | 2 |
| Penghu | 65,306 | 4.59 | 21,769 | 3129 | 95.88 | 1043 | 68,520 | 8.76 | 11,420 | 0.05 | 1 |
| Region of Taiwan (n = 5) | | | | | | | | | | | |
| Northern | 1,771,574 | 2.65 | 37,693 | 157,339 | 45.13 | 2216 | 1,955,988 | 6.03 | 16,576 | 0.09 | 1.51 |
| Central | 1,267,921 | 4.50 | 22,244 | 41,592 | 50.49 | 1981 | 1,313,419 | 5.94 | 16,839 | 0.03 | 0.37 |
| Southern | 2,226,977 | 5.12 | 19,535 | 96,334 | 41.52 | 2408 | 2,337,321 | 6.59 | 15,177 | 0.04 | 0.35 |
| Eastern | 193,212 | 2.07 | 48,303 | 24,754 | 32.32 | 3094 | 220,616 | 5.44 | 18,385 | 0.13 | 2 |
| Offshore islands | 65,306 | 4.59 | 21,769 | 3129 | 95.88 | 1043 | 68,520 | 8.76 | 11,420 | 0.05 | 1 |
| Overall | 5,524,990 | 4.07 | 24,556 | 323,148 | 44.25 | 2260 | 5,895,864 | 6.24 | 16,021 | 0.06 | 0.64 |

A: The number of contract dentists per 100,000 people.

B: The number of people served by each contract dentist.

C: The ratio of Japanese people to Taiwanese people or the ratio of Japanese contract dentists to Taiwanese contract dentists.

^a It should be noted that the total population included Taiwanese people, Japanese people, and foreigners.

Among all prefectures of Taiwan, Tainan Prefecture had the largest population (1,488,429 people, 25.25%), while Penghu Prefecture had the smallest population (68,520 people, 1.16%). However, Penghu Prefecture had the largest number of contract dentists (8.76) per 100,000 people, while Taitung Prefecture had the smallest number of contract dentists (3.53) per 100,000 people. For Taiwanese ethnic group, Tainan Prefecture had the largest population (1,431,733 people, 25.91%), while Penghu Prefecture had the smallest population (65,306 people, 1.18%). However, Tainan Prefecture had the largest number of contract dentists (5.31) per 100,000 people, while Taitung Prefecture had the smallest number of contract dentists (1.29) per 100,000 people. For Japanese ethnic group, Taipei Prefecture had the largest population (138,625 people, 42.90%), while Penghu Prefecture had the smallest population (3129 people, 0.97%). However, Penghu Prefecture had the largest number of contract dentists (95.88) per 100,000 people, while Taitung Prefecture had the smallest number of contract dentists (29.07) per 100,000 people. Moreover, the ratios of Japanese people to Taiwanese people were relatively high (between 0.09 and 0.15) in Taipei (0.14), Hualien (0.15), and Taitung (0.09) prefectures. Moreover, in Taipei, Hualien, and Taitung prefectures, the ratios of Japanese contract dentists to Taiwanese contract dentists were 2.36, 2, and 2, respectively (Table 2).

Among all regions of Taiwan, the southern region had the largest population (2,337,321 people, 39.64%), while the offshore islands had the smallest population (68,520 people, 1.16%). However, the offshore islands had the largest number of contract dentists (8.76) per 100,000 people, while the eastern region had the smallest number of contract dentists (5.44) per 100,000 people. For Taiwanese

ethnic group, the southern region had the largest population (2,226,977 people, 40.31%), while the offshore islands had the smallest population (65,306 people, 1.18%). However, the southern region had the largest number of contract dentists (5.12) per 100,000 people, while the eastern region had the smallest number of contract dentists (2.07) per 100,000 people. For Japanese ethnic group, the northern region had the largest population (157,339 people, 48.69%), while the offshore islands had the smallest population (3129 people, 0.97%). However, the offshore islands had the largest number of contract dentists (95.88) per 100,000 people, while the eastern region had the smallest number of contract dentists (32.32) per 100,000 people. The ratios of Japanese people to Taiwanese people were relatively high in the northern (0.09) and eastern (0.13) regions. Moreover, in the northern and eastern regions, the ratios of Japanese contract dentists to Taiwanese contract dentists were 1.51 and 2, respectively (Table 2).

The numbers (proportions) of Taiwanese and Japanese population and contract dentists by gender in Taiwan in 1939 (Showa 14)

The total population were 5,895,864 people in Taiwan in 1939 (Showa 14). The male population (3,002,320, 50.92%) was slightly larger than the female population (2,893,544, 49.08%) (Table 3). It should be noted that the total population included Taiwanese people, Japanese people, and foreigners. For ethnicity, there were totally 5,524,990 Taiwanese people and 323,148 Japanese people. Among Taiwanese people, the number of males (2,802,502, 50.72%) was slightly larger than that of females (2,722,488, 49.28%). Among Japanese population, the number of males (169,307, 52.39%) was larger

Table 3 The numbers (proportions) of Taiwanese and Japanese population by gender or contract dentists by gender for the Postal Savings Insurance in Taiwan in 1939 (Showa 14).

| Group | Item | Number (proportion) | | | The trend analysis of gender distribution in either Taiwanese or Japanese ethnic group by the chi-square test | |
|-------|-------------------------------|---------------------|--------------------|-----------|---|---------|
| | | Male | Female | Total | Group | P-value |
| | Contract dentists | | | | | |
| A | Taiwanese contract dentists | 192 (85.33%) | 33 (14.67%) | 225 | A vs B | <0.01 |
| B | Japanese contract dentists | 136 (95.10%) | 7 (4.90%) | 143 | D vs E | <0.001 |
| C | All contract dentists | 328 (89.13%) | 40 (10.87%) | 368 | | |
| | Population | | | | A vs D | <0.001 |
| | | | | | B vs E | <0.001 |
| D | Taiwanese population | 2,802,502 (50.72%) | 2,722,488 (49.28%) | 5,524,990 | C vs F | <0.001 |
| E | Japanese population | 169,307 (52.39%) | 153,841 (47.61%) | 323,148 | | |
| F | Total population ^a | 3,002,320 (50.92%) | 2,893,544 (49.08%) | 5,895,864 | | |

^a It should be noted that the total population included Taiwanese people, Japanese people, and foreigners.

than that of females (153,841, 47.61%). Moreover, regarding Taiwanese or Japanese contract dentists, the number of male contract dentists was both much larger than that of female contract dentists (Tables 1 and 3).

The chi-square test for trend analysis of gender distribution between Taiwanese and Japanese contract dentists ($P < 0.01$) as well as between Taiwanese and Japanese population ($P < 0.001$) showed significant differences, indicating the significantly higher proportion of male contract dentists and population in Japanese ethnic group. Moreover, the same comparison between Taiwanese contract dentists and population, between Japanese contract dentists and population, as well as between all contract dentists and the total population also showed significant differences (all P -values <0.001), indicating the significantly higher proportion of male than female contract dentists in either Taiwanese or Japanese ethnic group (Table 3).

Discussion

Since the first licensed dentist opened his dental clinic in Taipei City, Taiwan's dentistry has officially entered into the modern era. Until the end of the Japanese colonial period (1945), the number of registered dentists in Taiwan reached 738.^{3–6} According to our previous research, a hundred years ago, Taiwan's dental technology has already taken on the appearance of modern dentistry.³ However, most studies on the development of dental manpower in Taiwan, from the Japanese colonial period to the present day, are limited to the number and geographical distribution of dentists. We know very little about the composition of dentists (such as ethnicity and gender distribution) and their social and cultural background (such as the background and factors for Taiwanese to study dentistry or Japanese dentists to practice in Taiwan).

The official data during the Japanese colonial period usually include only statistics on the number of dentists in each administrative region, and researchers can only analyze the number and geographical distribution of dentists at that time from official statistics (secondary data analysis method).⁷ However, through appropriate historical materials (documentary analysis method), researchers still have the opportunity to use historical research methods to find the composition of dentists in the early years. During the Japanese colonial period, the Postal Savings Insurance System included a welfare measure provided to the insured people, which was a discount on medical services negotiated between the government and the medical association or dental association. The government would make a list of the names and practice addresses of participating physicians or dentists and provide it to the insured people for reference. Therefore, in this study, we used the name list of contract dentists for the Postal Savings Insurance issued in August 1939 (Showa 14) to analyze the composition of dentists (including their ethnicity, gender, and geographical distribution) at that time. These contract dentists accounted for 86.79% (368/424) of the total practicing dentists, indicating that the composition of contract dentists was representative of nearly all practicing dentists. Thereby, it is reasonable to use the ethnicity, gender, and geographical distribution of contract dentists in 1939 (Showa 14) to reflect the composition of dentists in the late Japanese colonial period.

In this study, we explored the ethnicity (Taiwanese and Japanese), gender, and geographical distribution of dentists in Taiwan in 1939 (Showa 14). It was already in the late Japanese colonial period, and the number of practicing dentists was relatively larger than that in the early Japanese colonial period. At that time, these licensed dentists were mainly Taiwanese dentists who went to Japanese dental schools for studying dentistry and then returned to

Taiwan for practice after graduation, and Japanese dentists who came to Taiwan for practice.^{4–6} There were more Taiwanese dentists than Japanese dentists who accounted for only 64% of the total number of Taiwanese dentists. This means that studying dentistry in Japan and pursuing a career as a dentist had gradually become one of the ways for Taiwanese families with financial means to raise their children in those days. In addition, the Taiwanese dentists were concentrated in Tainan, while the Japanese dentists were concentrated in Taipei. This was related to the difference in the distribution of Taiwanese and Japanese population in Taiwan at that time.

Taiwan's medical system has established a healthcare system dominated by male physicians and female nursing staff since its inception.¹⁰ Although most of dentists were males in the Japanese-ruled Taiwan, the proportion of female dentists among Taiwanese (14.67%, 33/225) was higher than that among Japanese (4.90%, 7/143). Taichung Prefecture had the highest proportion of female dentists among Taiwanese (17.54%, 10/57). This should be related to the social and cultural differences between the two ethnic groups, and further researches are needed to explore the reasons. However, the educational environment of Taiwanese girls in the Japanese-ruled Taiwan was polarized. In those days, there were not many opportunities for girls to receive higher education, while those from wealthy families with financial means could receive higher professional education through certain channels. Although Taiwanese young girls could not get the opportunity to study medicine in Taiwan, they could choose to study medicine in Japan if they wanted to. Most of them chose girls' medical schools, followed by girls' dental schools and girls' pharmacy schools.¹¹ The first Taiwanese woman who studied in a girls' dental school in Japan returned to Taiwan for practice in 1928 (Showa 3). This was eight years later than the first Taiwanese who studied dentistry in Japan and returned to Taiwan for practice in 1920 (Taisho 9).¹⁰ Until now, however, the gender distribution of dentists in Taiwan has still been dominated by male dentists.

The proportion and number of Japanese dentists (7.69%, 11/143) practicing in the eastern region and offshore islands of Taiwan were higher than those of Taiwanese dentists (3.11%, 7/225). It may be related to the policy of the Japanese colonial government that deliberately planned the Japanese to develop the eastern region and offshore islands of Taiwan. Therefore, this had the effect of balancing the geographical distribution of dentists in overall. It was also verified from the analysis results of the Gini coefficient in this study. Based on the prefecture level ($n = 8$), the Gini coefficient in overall (0.07) was lower than those of Taiwanese dentists (0.23) and Japanese dentists (0.29). However, it should be noted that the calculation of the Gini coefficient is based on the lower-level administrative regions (the larger the sample number), the closer the Gini coefficient value is to the real situation.⁸ This study is based on the first-level administrative regions ($n = 8$) for calculation.

Currently, there are four major dentist occupation problems: an oversupply of dentists, an uneven distribution of dentists, a concentration of dentists in the metropolitan areas, and a manpower structure dominated by male dentists.^{10,12} As of January 2023, the number of practicing dentists in Taiwan was as many as 16,533, while the Gini

coefficient based on the first-level administrative regions ($n = 21$) was 0.30. As high as 80.81% (13,360/16,533) of dentists were concentrated in the municipalities.¹³ Moreover, in 2021, the proportion of female dentists in Taiwan was 30.65% (4860/15,857).¹⁰ It is generally believed that when the number of dentists per 100,000 people reaches 50 in a region, it means that there are enough dentists to meet the demand for dental health services in this region. In fact, Taiwan has reached this standard as early as the end of 2010, and further reached 71.1 dentists per 100,000 people in 2022. Furthermore, Taiwan faces a huge disparity in dental manpower between urban and rural areas. In 2019, there were 12 counties (the first-level administrative regions) with less than 50 dentists per 100,000 people, accounting for 25.9% of the total population.¹⁴ By 2022, the number of counties with less than 50 dentists per 100,000 people dropped to 10, accounting for 19.2% of the total population in Taiwan.¹³

Looking back to the Japanese-ruled Taiwan, in 1939 (Showa 14), there were only 424 practicing dentists, while the number of practicing dentists per 100,000 people was only 7.19. The number of Taiwanese dentists exceeded that of Japanese dentists. Furthermore, there were more male than female dentists in either the Taiwanese or the Japanese population. However, there was an extreme ethnic difference. In Japanese ethnic group, some prefectures had the number of contract dentists per 100,000 people of more than 50 (such as Hsinchu, Taichung, and Penghu), even better than that of rural areas in the present-day Taiwan. Compared with now, Taiwan's population has grown to reach 4-fold of the original quantity, while the number of dentists has surged to nearly 40-fold of the original quantity. This indicates that the career of dentist is highly favored by the Taiwan's social value system, especially after the implementation of national health insurance (NHI) in 1995. However, becoming a dentist has also become a multi-faceted and highly competitive process.^{15–17} Since the implementation of NHI, the medical environment and manpower structure changed, and the number of dentists increased rapidly. Although the proportion and number of female dentists has increased, the manpower structure has long been dominated by male dentists. The dentist manpower data show that the shortage of dentists in rural areas in Taiwan has been improved slightly in the recent years. However, the problems of uneven geographical distribution of dentists and their over-concentration in the metropolitan areas are still serious. Furthermore, with the declined birthrate and population growth, the problem of oversupply of dentists is likely to continue to worsen.

Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

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