Journal of Dental Sciences 19 (2024) S156–S163

Available online at www.sciencedirect.com

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journal homepage: www.e-jds.com

Original Article

A nationwide study of the influence of training institutions in the postgraduate year training program for dentists on the future dental practice choices in Taiwan

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Received 24 October 2024
Available online 14 November 2024

KEYWORDS
Postgraduate year training program for dentists;
PGYD;
Dental workforce;
Training institutions;
Future practice choices;
Taiwan

Abstract *Background/Purpose:* The postgraduate year training program for dentists (PGYD) provides the comprehensive clinical training to bridge the gap between the academic education and the hands-on clinical practice. This study mainly explored the influence of training institutions on the future dental practice choices (in clinics or hospitals) after the completion of the PGYD program in Taiwan.
Materials and methods: A nationwide, register-based cohort analysis was conducted on all 3,966 PGYD trainees from July 2010 to April 2023. Data on the training time, institution type, and demographic characteristics were extracted from the PGYD and dentist registration systems. Chi-square tests and t-tests were used to assess the differences in the future dental practice choices and the PGYD training variables.
Results: For the PGYD training institutions, the dental clinics increased substantially, while the medical centers and teaching hospitals declined. The trainees who spent more time in the dental clinics were more likely to practice in the dental clinics, while those trained in the hospitals were more likely to choose the hospital-based practice ($P < 0.001$). The male dentists were more likely to practice in the dental clinics and the female dentists were prone to practice in the hospitals ($P < 0.001$).

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https://doi.org/10.1016/j.jds.2024.10.027

Conclusion: The type and duration of the PGYD training significantly influence the future dental practice choices, with trainees who undergo more clinic-based training tending to choose dental clinic practice. However, the hospital-level training remains crucial for the specialty development, and further policy efforts are needed to improve the imbalance in the dentist distribution.

Introduction

Healthcare systems rely fundamentally on a well-distributed and skilled workforce, and the dentists are a critical component of Taiwan's oral healthcare infrastructure. The dentists predominantly serve in the hospitals and the dental clinics across the country. As knowledge in the field of dentistry expands and societal demands diversify, the clinical dentists face increasing challenges that require the advanced skills and expertise, the structured programs such as the postgraduate year training program for dentists (PGYD) have become important to address these growing demands.[1] In Taiwan, the dental training is a continuous process involving several stages, beginning with the formal education, followed by the PGYD program, and leading to specialist training for those pursuing further specialization. The continuing education is also available to maintain professional standards and expertise.

The PGYD program, introduced in 2010, provides the comprehensive clinical training to bridge the gap between the academic education and the hands-on dental clinical practice. The program is divided into three main components: the basic training module (50 h of foundational seminars), the 18-month core training module (comprehensive dental care, community dentistry, oral & maxillofacial surgery, and emergency dental management), and the 6-month elective training module, which offers the advanced training in various specialties such as the endodontics, periodontics, prosthodontics, pediatric dentistry, and more.[2] The PGYD program is also a prerequisite for the dentists pursuing specialist training, supporting the development of dental specialties in Taiwan.[3]

Considering the training capacity of hospital dental departments, the program allows training institutions to include both the hospitals and the dental clinics, offering either individual or joint training approaches.[4] In 2022, 629 institutions were authorized to implement the PGYD program, including 94 hospitals and 535 dental clinics. A total of 923 dentists participated in the PGYD programs, with 450 in the PGYD1 and 473 in the PGYD2.[5]

Previous research on the impact of Taiwan's PGYD program has primarily focused on its effects on the dentists' choice of practice locations and the geographical distribution of dental professionals. Studies have examined how the PGYD influences the regional dentist distribution,[6] the impact of the PGYD on the dental institutions,[7] and the effectiveness of the training based on surveys of the trainee dentists.[8] These findings suggest that the market forces, rather than the PGYD itself, play a significant role in reducing regional imbalances in the dentist distribution.[6] Additionally, there has been a noted increase in the hospital-based dentists following the PGYD,[7] with the joint group training, particularly those combining the medical centers with remote dental clinics, showing the greatest potential for balancing dentist distribution across the Taiwan.[7] However, these studies are limited by small sample sizes[8] and the reliance on the secondary data,[6,7] which may not fully capture the effects of specific training courses or the time spent in the training institutions on the trainees' future dental practice choices. Therefore, further analysis is needed to better understand the impact of PGYD training on the future dental practice choices (in hospitals or clinics) and its influence on the distribution of dentists.

This study aimed to conduct a comprehensive analysis of the PGYD training system, focusing on the distribution of training institutions, the training time spent in different training institutions, and the impact of these factors on the future dental practice choices. The findings will help inform future policies for the dental training and workforce distribution.

Materials and methods

Study design

This study was a nationwide, register-based cohort analysis, including all dentists who participated in Taiwan's PGYD training program from July 2010 to April 2023. The study aimed to examine how the type and duration of training at the various levels of institutions influenced the dentists' future dental practice choices (in clinics or hospitals) one year and five years after the completion of the PGYD program. Additionally, the study explored the associations between the demographic factors such as the sex, age, or graduation dental school location (domestic or foreign) and dentists' future dental practice choices.

Data sources

Two major administrative databases were utilized for this study. The first was the PGYD registration system, managed by the Joint Commission of Taiwan (JCT), which recorded the detailed information about the training institutions, the faculty involved, and the training trajectories of the PGYD trainees. The authorized training institutions uploaded their data related to the qualifications of their trainers, the demographic information on the trainees, and the duration of the training in each PGYD module across different types of

institutions (medical centers, teaching hospitals, and dental clinics).

The second source was the "Medical Affairs Management System", managed by the Department of Medical Affairs under the Ministry of Health and Welfare (MOHW). This database recorded the practice details of all licensed dentists in Taiwan, including their demographic characteristics, the institution and region where they practiced, the start and end dates of their practice, and any subsequent changes in the dental practice location or status (e.g., moving to another city, opening a new dental clinic, or changing the practice settings). All licensed dentists were required to register in their local health department, and any changes in their dental practice status needed to be updated in this system. Linking these two databases using unique identifiers allowed the tracking of dentists' training histories and subsequent future dental practice settings.

All personally identifiable information was anonymized to ensure compliance with the privacy regulations. The ethical approval was obtained from the Institutional Review Board of Sin-Lau Hospital (Study No. SLH-112-B-003).

Study variables

Dependent variable

The main outcome variable was the dental practice settings, categorized as either dental clinics or hospitals, observed one year and five years after the completion of the PGYD program. We linked two databases and identified the dental practice setting level for the PGYD trainees one year and five years after the completion of the PGYD program, based on the final dental practice location within one year and five years of their PGYD completion date.

Independent variables

The independent variables included: (1) the training institution type which referred to the institution type where the dentists completed their PGYD training courses, classified as medical centers, teaching hospitals, or clinics; and (2) the training duration which was the total time spent by each trainee in different institution types and measured in the person-months.

The characteristics variables included: (1) the gender (male or female); (2) the age which was categorized as under 30 years of age and over 30 years of age at the time of completing the PGYD training program; and (3) The graduation dental school location, indicating whether the dentist graduated from a domestic or a foreign dental school.

Statistical analysis

For the descriptive analysis, we categorized the overall distribution of the active training institutions as the medical centers, teaching hospitals, and clinics in Taiwan between 2010 and 2022. This analysis focused mainly on the number of training institutions actively providing the PGYD training. For the training time analysis, we analyzed the total person-months spent by the PGYD trainees in different institution types, including the data of the specific PGYD modules and the levels of training institutions involved. For the gender-based analysis, we examined whether there were gender differences in the amount of time that the male and female trainees spent in different institution types. For the practice setting analysis, we used the chi-square test to assess the associations between the categorical variables (gender, age, and graduation dental school location) and the future dental practice choices (in clinics or hospitals). Independent t-test was used to compare the average training time across various types of training institutions between the dentists practicing in the hospitals and those practicing in the dental clinics. Finally, the logistic regression was used to determine the influence of the training institution type, the training duration, and the demographic factors on the future dental practice choices, with results reported as odds ratios (OR) and 95 % confidence intervals (CI). The model's fit was assessed using the c-statistic and the Hosmer—Lemeshow test. All statistical analyses were conducted using SAS 9.3.1 (SAS Institute, Cary, NC, USA), with the significance level set at $P < 0.05$.

Results

Distribution of training institutions

Table 1 shows the distribution of the PGYD training institutions in Taiwan from 2010 to 2022. Within the period from 2010 to 2022, the number of institutions grew from 78 in 2010 to 419 in 2022. The dental clinics showed a significant rise in their numbers, increasing from 42.31 % in 2010 to 83.77 % in 2022. Conversely, the medical centers decreased from 19.23 % to 3.58 %, and the teaching hospitals reduced from 38.46 % to 12.65 %. This shift reflects the growing dominance of the clinic-based training in the PGYD program from 2010 to 2022 (Table 1).

Course training time by the institution type

Table 2 breaks down the training time spent by the PGYD trainees across different institution types, measured in the

Table 1 Distribution of different types of training institutions in the postgraduate year training program for dentists (PGYD) by year.

Year	Numbers of training institutions	Medical center (%)	Teaching hospital (%)	Dental clinic (%)
2010	78	19.23%	38.46%	42.31%
2011	141	10.64%	31.21%	58.16%
2012	226	6.64%	22.12%	71.24%
2013	234	6.41%	21.37%	72.22%
2014	294	5.10%	17.69%	77.21%
2015	285	5.26%	18.60%	76.14%
2016	320	4.69%	17.50%	77.81%
2017	312	4.81%	17.95%	77.24%
2018	367	4.09%	14.71%	81.20%
2019	374	4.01%	14.97%	81.02%
2020	420	3.57%	13.81%	82.62%
2021	392	3.83%	14.80%	81.38%
2022	419	3.58%	12.65%	83.77%

person-months. General dentistry comprehensive training accounted for the largest share (65.05 % of the total training time), with 25.34 % of the training occurring in the medical centers, 31.76 % in the teaching hospitals, and 42.90 % in the dental clinics. The community dentistry training also showed a relatively balanced distribution across the three types of institutions. Some courses, such as the oral & maxillofacial surgery training, had over 50 % of training time in the medical centers, while others, like the endodontics training and the restorative dentistry, showed the majority of training occurring in the dental clinics (66.47 % and 58.66 %, respectively). Notably, some courses, such as oral & maxillofacial surgery or oral pathology, had little (0.08 %) or none (0 %) of the training time in the dental clinics, respectively (Table 2).

Gender differences in the training time across different institution types

Regarding the gender differences in the training time, the Fig. 1 shows that, over the 10 years, the male trainees consistently spent more time in the dental clinics (dotted pattern) compared to the teaching hospitals (light blue) and the medical centers (dark blue). The proportion of the training time in the dental clinics steadily increased, suggesting that the male trainees prefer the clinic-based training over the hospital-based training. In contrast, female trainees spent more time in the medical centers (dark red) and the teaching hospitals (light red) than in the dental clinics, with their dental clinic training time remaining relatively lower throughout the observation period.

Trainee characteristics and future dental practice choices

A total of 3966 trainees successfully completed the PGYD program between July 2010 and April 2023. Table 3 highlights the differences in these trainee characteristics and their dental practice settings one year and five years after the completion of the PGYD program. One year after the completion of the PGYD program, 51.7 % of the female trainees and 66.5 % of the male trainees practiced in the dental clinics. These proportions increased significantly five years after the PGYD training, with 68.8 % of the females and 74.4 % of the males working in the dental clinics. The differences between genders were statistically significant ($P < 0.001$).

The age also influenced the dental practice settings. One year after the completion of the PGYD program, 54.5 % of the trainees under 30 years of age practiced in the dental clinics, compared to 79.2 % of those over 30 years of age. After five years, these percentages rose to 68.7 % for the younger trainees and 83.9 % for the older trainees ($P < 0.001$).

Additionally, the location of graduation dental school also played a role. Foreign graduates were more likely to practice in the dental clinics, with 79.9 % of them practicing in the dental clinics one year after the completion of the PGYD program and 86.2 % of them five years later, compared to 58.0 % and 70.7 % of the domestic graduates, respectively ($P < 0.001$).

Finally, the trainees who spent more time in the medical centers and the teaching hospitals during the PGYD training were more likely to practice in the hospitals after the completion of the PGYD program, while those who spent more time in the dental clinics during the PGYD training were more likely to practice in the dental clinics both one year and five years after the completion of the PGYD program. The differences in the training time across various institutions were significant ($P < 0.001$).

As shown in the logistic regression analysis results (Table 4), the male dentists were less likely to choose the hospital-based practice one year after the completion of the PGYD program (OR = 0.82, $P = 0.009$), but this effect was not significant five years after the completion of the PGYD program. Older dentists (above 30 years of age) were more likely to choose the hospitals for the dental practice at both one year (OR = 1.73, $P < 0.001$) and five years

Table 2 Training time in the postgraduate year training program for dentists (PGYD) by the course and the level of institution.

Course names	Person-months	Course share (%)	Share in training institution		
			Medical center (%)	Teaching hospital (%)	Dental clinic (%)
General dentistry	74,454	65.05%	25.34%	31.76%	42.90%
Community dentistry	10,031	8.76%	27.91%	35.22%	36.87%
Endodontics	8,159	7.13%	14.44%	19.10%	66.47%
Oral & maxillofacial surgery and emergency	3,828	3.34%	56.77%	43.16%	0.08%
Advanced general dentistry	3,819	3.34%	11.70%	26.26%	62.03%
Prosthodontics	3,461	3.02%	29.07%	49.81%	21.12%
Periodontics	3,134	2.74%	36.31%	47.03%	16.66%
Oral & maxillofacial surgery	2,590	2.26%	52.24%	47.76%	0.00%
Orthodontics	1,819	1.59%	56.51%	37.16%	6.32%
Pediatric dentistry	1,713	1.50%	44.95%	42.67%	12.38%
Restorative dentistry	1,328	1.16%	24.40%	16.94%	58.66%
Oral pathology	115	0.10%	68.70%	31.30%	0.00%
Special needs dentistry	11	0.01%	45.45%	54.55%	0.00%

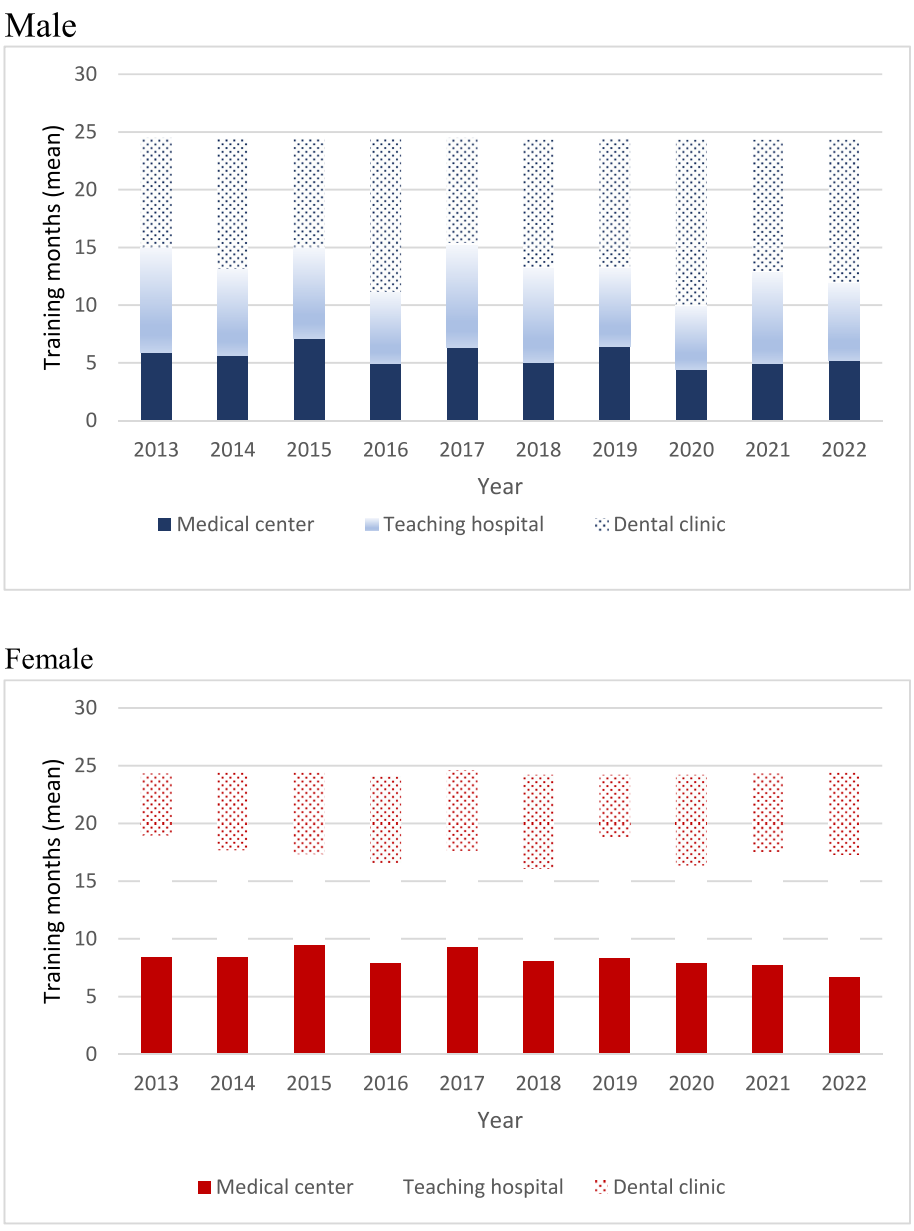

Figure 1 The trend of gender differences in the training time of the postgraduate year training program for dentists (PGYD) across different institution levels.

(OR = 1.37, $P = 0.009$) after the completion of the PGYD program. Foreign graduates were less likely to choose the hospitals for the future dental practice, especially five years after the completion of the PGYD program (OR = 0.67, $P = 0.032$). The clinic-based training was consistently linked to the lower odds of the dental practice in the hospitals at both one year and five years after the completion of the PGYD program ($P < 0.001$), while the medical center training showed no significant effect after controlling the training time spent in the dental clinics.

Discussion

This study analyzed the impact of the PGYD training program on the dentists' future dental practice choices in Taiwan, focusing on the influence of the training institution type and the training duration on the dentists' future dental practice choices. The findings indicate that the future dental practice choices (in clinic or hospital) is significantly shaped by where and how long the dentists undergo their training during the PGYD program. Specifically, those who spent more time in the dental clinics were more likely to choose the clinic-based practice, while those who were trained in the medical centers or the teaching hospitals tended to remain in the hospital-based practice. These trends persisted both one year and five years after the completion of the PGYD program.

Our study revealed a significant increase in the number of the clinic-based PGYD training institutions over time, with the dental clinics now comprising the majority of the training sites. Conversely, the proportion of the medical

Table 3 Differences in the characteristics and the training time between dentists practicing in the hospitals and those practicing in the dental clinics one year and five years after the completion of the postgraduate year training program for dentists (PGYD).

Variable	Total dentists after PGYD	One year after PGYD			Five years after PGYD		
		Dental clinics (N = 2356)	Hospitals (N = 1610)	*P*	Dental clinics (N = 2830)	Hospitals (N = 1136)	*P*
[a]Gender							
Female	1782 (44.9%)	51.7%	48.3%	<0.001	68.8%	31.2%	<0.001
Male	2184 (55.1%)	66.5%	33.5%		74.4%	25.6%	
[a]Age (year)							
Under 30	3077 (77.6%)	54.5%	45.5%	<0.001	68.7%	31.3%	<0.001
Over 30	889 (22.4%)	79.2%	20.8%		83.9%	16.1%	
[a]Graduation dental school							
Domestic	3608 (91.0%)	58.0%	42.0%	<0.001	70.7%	29.3%	<0.001
Foreign	358 (9.0%)	79.9%	20.1%		86.2%	13.8%	
[b]Training time (month)							
Medical center	6.75 (10.5)	4.4 (8.99)	10.19 (11.56)	<0.001	5.58 (9.82)	9.66 (11.55)	<0.001
Teaching hospital	8.24 (10.82)	6.05 (9.66)	11.46 (11.6)	<0.001	6.91 (10.17)	11.57 (11.64)	<0.001
Dental clinic	9.31 (11.17)	13.89 (11.25)	2.62 (6.85)	<0.001	11.83 (11.43)	3.05 (7.43)	<0.001

[a] refers to the use of numbers and percentages to describe the distribution of the dentists' characteristics (the gender, age, and the graduation dental school). Chi-square tests were applied to assess differences between the dentists practicing in the hospitals and those practicing in the clinics, and.

[b] indicates that the training time, expressed as means and standard deviations (in parentheses), was compared using the t-tests to evaluate the differences in the time spent in the various training institutions between the hospital and dental clinic practitioners.

centers and the teaching hospitals offering PGYD training decreased notably. This shift toward the clinic-based training may be attributed to the limited capacity of the hospital-based programs to accommodate the additional PGYD trainees, as well as the growing trend of the dental clinics adopting group dental practice models, which have enhanced their ability to provide the comprehensive general dentistry training.

Our findings, however, showed significant differences in the training courses offered by the institutions of various levels. While the courses such as "endodontics" and "operative dentistry" were more frequently provided by the clinics-level institutions, the majority of other elective courses were offered by the hospital-level institutions. Specialized courses, including "oral & maxillofacial surgery," "oral pathology," and "special needs dentistry," were exclusively available in the hospitals. This suggests that more specialized training is likely to remain within the hospital-based institutions to ensure the adequate resources and expertise for these parts of dental practice.

The PGYD training tends to vary across countries and regions, though many share the common influencing factors.[9] In Japan, the PGYD training became standardized and mandatory in 2006, allowing the trainees to train at either the single-type or group-type facilities. Despite more dental clinics collaborating with the dental school hospitals, the number of dentists training at the dental clinics has not significantly increased.[10] Taiwan shows a similar pattern. As seen in Table 1, the number of training institutions increased significantly since the launch of the PGYD program. However, the Fig. 1 revealed that the training time spent at the dental clinics by the male and female PGYD trainees did not have a substantial increase. This finding suggests that the medical centers and the

Table 4 The logistic regression of the influence of the training institutions on the future dental practice choices one year and five years after the completion of the postgraduate year training program for dentists (PGYD).

Variable	One year after PGYD				Five years after PGYD			
	Odds ratio	95%	CI	*P*	Odds ratio	95%	CI	*P*
Gender (male)	0.82	0.70	0.95	0.009	1.11	0.95	1.29	0.196
Age (above 30 years of age)	1.73	1.38	2.173	<0.001	1.37	1.08	1.73	0.009
Graduation dental school (foreign)	0.72	0.51	1.011	0.058	0.67	0.47	0.97	0.032
Dental clinic	0.89	0.89	0.902	<0.001	0.91	0.90	0.92	<0.001
Medical center	1.00	1.00	1.009	0.607	1.00	0.99	1.00	0.324

Note: The c-statistic of the logistic regression model for one year and five years after the completion of the PGYD program were 0.781 and 0.727, respectively. The Hosmer and Lemeshow test showed that the *P*-values were 0.630 and 0.015, respectively.

teaching hospitals continue to play an irreplaceable role in the PGYD training.

The distribution of the clinical training facilities influences the career paths of dental residents post-training. Countries like Thailand, the UK, the US, Canada, Sweden, New Zealand, and Australia have the distinct postgraduate dental training models.[11–13] In the United States, studies have demonstrated that the postgraduate dental training has a lasting influence on the dental practice patterns and enhances access to the dental care in the underserved communities. The varied nature of the PGYD training plays a key role in promoting health equity.[14,15] The results of this study indicate that the type of the PGYD training institution influences the future dental practice choices, but the impact on the geographic distribution, career paths, and service types requires further investigation.

Some researchers have pointed out that after the implementation of the PGYD program in Taiwan, the growth rate of the hospital-based dentists has outpaced that of the clinic-based dentists. Since the hospitals are predominantly located in the urban areas, it has been implied that the geographical distribution of the dentists in Taiwan has worsened after the PGYD program.[7] However, previous studies by the current authors showed that the proportion of the hospital-based dentists relative to the total number of dentists has not changed significantly and even decreased from 2017 to 2022.[16] In addition, previous studies have shown that the female dentists are more likely to choose to practice in the hospitals and in the urban areas.[17] Our study also found that the female PGYD trainees spent more time training in the hospitals compared to their male counterparts, and the proportion of the female dentists practicing in the hospitals one year and five years after the completion of the PGYD program was higher than that of their male peers. Therefore, the previously observed growth in the number of the hospital-based dentists may be a reflection of the increasing number of the female dentists, rather than an effect of the PGYD program itself.

This study found that the dentists who spent the longer training time in the hospitals were more likely to choose the hospital-based practice immediately after the completion of the PGYD program. However, five years after the completion of the PGYD program, this proportion dropped significantly, indicating that many dentists initially stay in the hospitals due to job vacancies, but a large number transition to the clinic-based practice over time. Even though these new dentists eventually choose to practice in the dental clinics, they tend to concentrate in the urban areas rather than in the underserved regions, indicating that this shift does little to improve the geographical imbalance of dental resources in Taiwan. Further policy intervention is necessary to incentivize new dentists to choose their future dental practice in the underserved areas.

To promote the development of dental specialties and achieve a balanced geographic distribution of dental workforce resources, it is recommended to prioritize the adoption of a joint training model in the future design of the PGYD training programs. This model should primarily rely on the hospitals to provide the comprehensive specialty training while partnering with the dental clinics or the training institutions in medically underserved areas to offer the localized community dentistry training. This approach may ensure both the quality of dental training and the equitable distribution of healthcare resources.

Declaration of competing interest

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

Acknowledgments

This study utilized registry data provided by the Ministry of Health and Welfare (MOHW), anonymized by the Health and Welfare Data Science Center (HWDC).

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