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Original Article

Analysis of trends and disparities in domiciliary dental care distribution in Taiwan from 2018 to 2023

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KEYWORDS

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Abstract *Background/purpose:* Domiciliary dental care (DDC) is essential for maintaining oral health in disabled and homebound patients who face barriers to accessing dental services. With Taiwan nearing super-aged society status, the demand for DDC is rising. However, comprehensive data on DDC availability and distribution across Taiwan are lacking. Hence, this study aimed to provide a comprehensive overview of the distribution of DDC across Taiwan's districts from 2018 to 2023, and to analyze the estimated ratios of disabled individuals per healthcare provider in each district.

Materials and methods: Data on DDC-providing hospitals and dental clinics from these years were obtained from government sources. Descriptive statistics quantified DDC facilities distribution and growth. The number of disabled individuals per district was used to estimate ratios of disabled persons to DDC facilities.

Results: DDC facilities increased from 47 in 2018 to 98 in 2023. Urban areas showed higher prevalence of DDC services, while some rural and offshore areas had limited or no access. Taichung and Kaohsiung had the highest numbers of DDC providers, while Penghu and Lianjiang had none. Ratios of disabled individuals to DDC facilities varied widely, with Taichung having the lowest ratio and Yunlin and Chiayi the highest. In conclusion, DDC availability in Taiwan has significantly increased, but geographical disparities persist.

Conclusion: These findings underscore the need for targeted policies and resource allocation to address gaps in DDC provision, particularly in underserved areas.

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Introduction

Access to oral healthcare services is critical for maintaining quality of life, yet disabled and homebound patients face significant barriers to receiving dental care.¹ Domiciliary dental care (DDC) addresses this issue by providing dental services and oral healthcare to patients in their own homes and residential facilities when they cannot access care at dental clinics.² The demand for DDC is increasing globally due to aging populations, growing numbers of dentate seniors, and rising prevalence of chronic diseases and disabilities that limit mobility.³

Taiwan is rapidly approaching super-aged society status, with projections indicating that the aged population will exceed 20 % of the total population by 2025.⁴ This demographic shift is driving an increasing demand for DDC services. Providing oral care in the home can improve oral health conditions, nutritional status, quality of life, and potentially reduce healthcare costs in vulnerable older adults and disabled individuals.^{5,6}

In recent years, the Taiwanese government has made efforts to promote DDC availability through policy initiatives and education.⁷ However, barriers remain in terms of accessibility and provider willingness to deliver in-home services.^{8,9} The integration of DDC into the broader healthcare system is crucial for better serving disabled and homebound patients, yet there is a lack of comprehensive data on the trends in DDC availability and distribution across Taiwan over time.

Hence, this study aims to provide a comprehensive overview of the distribution of DDC across Taiwan's districts from 2018 to 2023, and to analyze the estimated ratios of disabled individuals per healthcare provider in each district. We hope that the findings of this study will offer valuable insights for evidence-based policy-making and help guide the development of targeted interventions to enhance DDC accessibility and quality throughout Taiwan.

Materials and methods

This analysis utilized data on the number of healthcare facilities providing DDC in Taiwan from 2018 to 2023, as published on the government website. The data included counts of hospitals and dental clinics offering DDC services across each district in Taiwan. The year of 2021 was excluded due to the COVID-19 lockdown. Descriptive statistics quantified the distribution and growth of DDC facilities over time. Total DDC facilities were calculated annually by summing hospitals and dental clinics. Trends were evaluated by comparing the numbers and proportions of DDC facilities and the increments of total healthcare bodies across the sampled years. A geometrical spatial representation illustrated the number of healthcare bodies providing DDC across districts in 2023.

Additionally, data from the annual report on the number of disabled individuals in each district, published by the Ministry of Health and Welfare, were extracted.⁴ The ratio of disabled persons to each healthcare facility offering DDC services was estimated by dividing the disabled population by the number of DDC facilities in each district. This data was used to create a geometric spatial representation

illustrating the estimated number of disabled individuals per healthcare facility across districts in 2023.

Statistical analysis

The study variables were tested for normal distribution using the Shapiro–Wilk test, which revealed non-normally distributed data. Consequently, non-parametric tests were employed for the analyses. For the trend analysis of DDC facilities over time, the Wilcoxon signed-rank test compared the number of facilities each year to the baseline year (2018). The Friedman test was used to assess significant differences in the number of facilities offering DDC across the years, followed by post-hoc comparisons using the Wilcoxon each pair test. Additionally, the Kruskal–Wallis test was used to evaluate yearly distributions and increments of facilities across districts, as well as differences in facilities across the years within each district. Statistical significance was set at $P < 0.05$ for all tests. Data were analyzed using JMP Pro 16.

Results

Taiwan has witnessed a significant surge in the availability of DDC services over the past six years. Table 1 shows a significant increase in the number of hospitals and dental clinics offering this essential care, rising from 11 hospitals and 36 dental clinics to 20 hospitals and 78 clinics. Despite this overall growth, several districts, including Penghu and Lianjiang, had no healthcare facilities offering DDC throughout the six-year period. When comparing the growth of dental clinics and hospitals, Fig. 1 shows a significant rise in dental clinics in 2022 and 2023. The number of dental clinics providing DDC has significantly doubled during this period, while the increase in hospitals has been slightly less pronounced.

While the overall expansion of DDC services is encouraging, geographical disparities persist. Fig. 2 demonstrates that urban areas, including Taipei City, New Taipei City, Taichung, Kaohsiung, and Taoyuan, exhibited a higher prevalence of hospitals providing DDC services. As of 2023, Kaohsiung boasts 4 hospitals offering DDC, while other urban regions typically have 2–3 such facilities. In contrast, Miaoli, Nantou, Yilan, Chiayi, and Tainan have one hospital each providing DDC over the six year. Districts like Pingtung, Hualien, Taitung, Kinmen, Penghu, and Lianjiang saw no hospital offering DDC services during this period. Interestingly, Taichung and Taoyuan each saw one hospital stop providing DDC in 2023, marking a decline in the number of hospitals offering DDC in those areas.

When comparing the number of dental clinics offering DDC across districts over the years, Fig. 3 illustrates that 17 out of 20 districts in Taiwan provided DDC during this period. Most districts started with 1–4 dental clinics providing DDC in the early years. However, Kaohsiung and Taichung commenced with 10 and 11 clinics, respectively, and these numbers rose to 14 and 15 by 2023. Taipei saw the highest growth, with an increase of 9 dental clinics over the six-year span. When comparing the total number of healthcare providers offering DDC in 2023 versus 2018, Fig. 4 highlights a concentrated expansion in major urban

Table 1 Distribution of hospitals or dental clinics providing domiciliary dental care in each districts of Taiwan.

Administrative district	DDC facilities										6-year growth number
	Hospital					Dental clinic					
	2018	2019	2020	2022	2023	2018	2019	2020	2022	2023	
Yilan	1	1	1	1	1	0	0	2	2	2	2
Keelung	0	0	0	0	0	1	1	1	1	1	0
Taipei City	2	2	2	2	3	2	2	3	8	11	10
New Taipei City	2	2	2	2	3	1	2	2	3	4	4
Taoyuan	0	1	3	4	3	3	4	4	4	7	7
Hsinchu	0	0	0	0	0	1	2	2	2	2	1
Miaoli	0	0	0	1	1	0	0	1	3	3	4
Taichung	3	2	3	3	2	11	11	11	16	15	3
Changhua	0	0	0	0	0	2	4	4	4	4	2
Nantou	0	0	0	1	1	0	0	1	3	3	4
Yunlin	0	0	0	0	0	0	0	1	1	1	1
Chiayi	1	1	1	1	1	0	0	0	0	0	0
Tainan	1	1	1	1	1	3	3	3	3	3	0
Kaohsiung	1	2	2	4	4	10	10	14	13	14	7
Pingtung	0	0	0	0	0	1	1	1	2	2	1
Hualien	0	0	0	0	0	1	1	1	1	3	2
Taitung	0	0	0	0	0	0	0	1	2	2	2
Kinmen	0	0	0	0	0	0	0	1	1	1	1
Penghu	0	0	0	0	0	0	0	0	0	0	0
Lianjiang	0	0	0	0	0	0	0	0	0	0	0
Total	11	12	14	20*	20*	36	41*	53***	69***	78***	51

Table 1 shows the number of hospitals and dental clinics providing domiciliary dental care (DDC) in each district of Taiwan from 2018 to 2023. In 2023, the numbers of facilities rose significantly to 20 hospitals and 78 dental clinics, marking an increase of 51 healthcare facilities since 2018. Despite this overall growth, several districts, including Penghu and Lianjiang, had no healthcare facilities offering DDC throughout the six-year period. The data were analyzed using the Wilcoxon signed-rank test to detect differences from year 2018, * P -value < 0.05 , *** P -value < 0.0005 compared to year 2018.

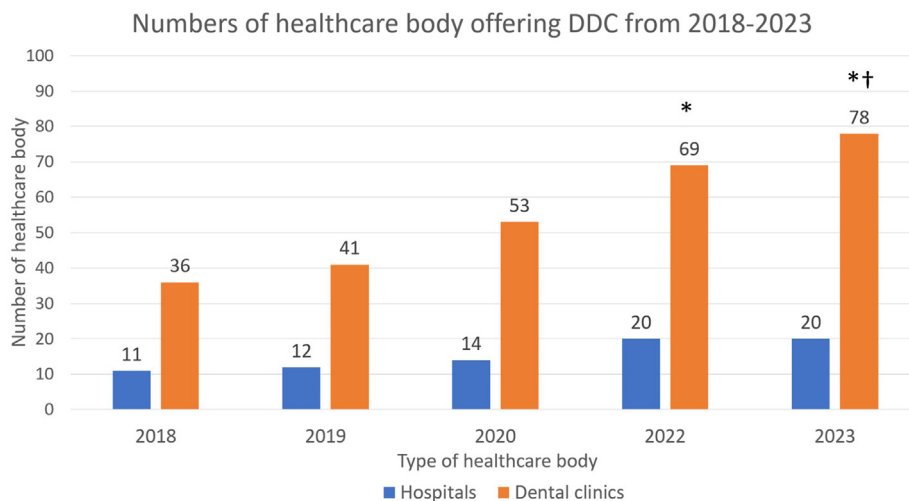


Figure 1 Numbers of healthcare body offering domiciliary dental care (DDC) from 2018 to 2023. The figure shows a steady increase in the number of healthcare facilities offering DDC in Taiwan over six years, with a significant rise in dental clinics in 2022 and 2023. The number of dental clinics providing DDC has significantly doubled during this period, while the increase in hospitals has been slightly less pronounced. The data were analyzed using the Friedman test, followed by Wilcoxon test for post-hoc comparison. * $P < 0.05$ compared to year 2018, † $P < 0.05$ compared to year 2019.

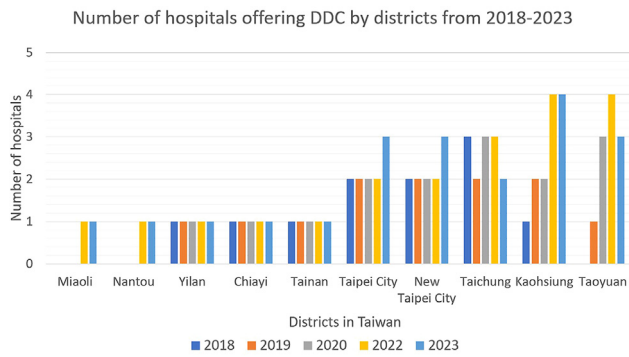


Figure 2 Number of hospitals offering domiciliary dental care (DDC) by districts across the years. Urban areas, including Taipei City, New Taipei City, Taichung, Kaohsiung, and Taoyuan, exhibited a higher prevalence of hospitals providing DDC services. As of 2023, Kaohsiung boasts 4 hospitals offering DDC, while other urban regions typically have 2–3 such facilities. In contrast, Miaoli, Nantou, Yilan, Chiayi, and Tainan have one hospital each providing DDC over the six year. Districts like Pingtung, Hualien, Taitung, Kinmen, Penghu, and Lianjiang saw no hospital offering DDC services during this period. Interestingly, Taichung and Taoyuan each saw one hospital stop providing DDC in 2023, marking a decline in the number of hospitals offering DDC in those areas.

areas, with Taipei City leading, followed by Kaohsiung and Taoyuan. Districts like Taichung, New Taipei City, Miaoli, and Nantou each saw an increase of 3–4 healthcare providers. The remaining districts, as depicted in the bar

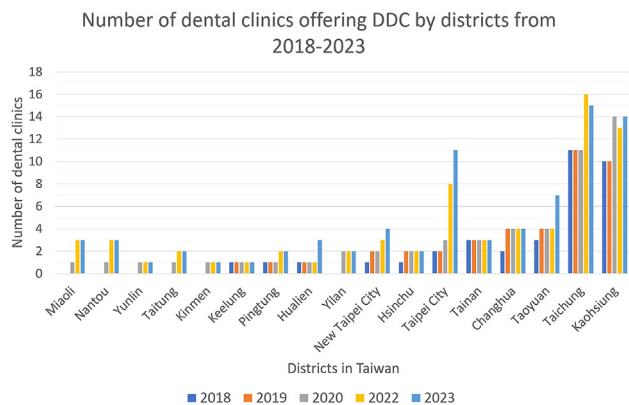


Figure 3 Number of dental clinics offering domiciliary dental care (DDC) by districts across the years. Out of 20 districts in Taiwan, 17 had dental clinics offering DDC during this period. Most districts started with 1–4 dental clinics providing DDC in the early years. However, Kaohsiung and Taichung began with 10 and 11 clinics, respectively, and these numbers rose to 14 and 15 by 2023. Taipei saw the highest growth, with an increase of 9 dental clinics over the six-year span.

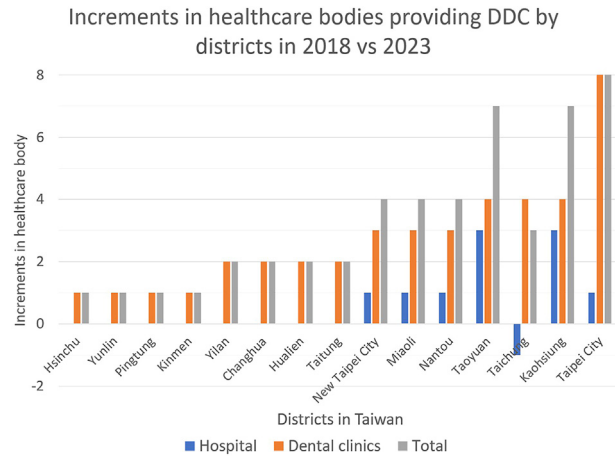


Figure 4 Increments in healthcare bodies providing domiciliary dental care (DDC) from 2018 to 2023. Taipei City recorded the highest increase in healthcare bodies offering DDC, followed by Kaohsiung and Taoyuan. Districts such as Taichung, New Taipei City, Miaoli, and Nantou saw an increase of 3–4 healthcare bodies each. The remaining districts, as shown in the bar chart, had an increase of 1–2 healthcare bodies.

chart, experienced a more modest increase of 1–2 healthcare bodies.

Figs. 5 and 6 present a geometric spatial representation of healthcare bodies providing DDC and the estimated number of disabled individuals per healthcare facility across districts in 2023. In Fig. 5, Taichung and Kaohsiung are shown to have the highest numbers of healthcare bodies offering DDC, followed closely by northern urban areas such as Taipei City, New Taipei City, and Taoyuan. In contrast, rural areas typically have fewer facilities, with numbers ranging from 1 to 4, and no healthcare providers are available in Penghu and Lianjiang. Fig. 6 further estimates the ratio of disabled individuals to each healthcare provider offering DDC, based on data from the Ministry of Health and Welfare. Taichung stands out with the lowest ratio of disabled persons per healthcare center, followed by Kaohsiung, Nantou, Taitung, Hualien, Miaoli, Taoyuan, and Taipei City. Conversely, Yunlin and Chiayi have the highest ratios, while Penghu and Lianjiang remain without accessible DDC services for disabled individuals.

Discussion

This study documented a significant increase in the provision of DDC services across Taiwan from 2018 to 2023. The number of hospitals and dental clinics offering DDC grew steadily each year, enhancing accessibility for disabled and homebound populations. Additionally, the geographic distribution of these services expanded during this period. These growth trends align with Taiwan's Long-Term Care Plan 2.0, initiated in 2017 as part of the government's efforts to develop and improve long-term care.¹⁰

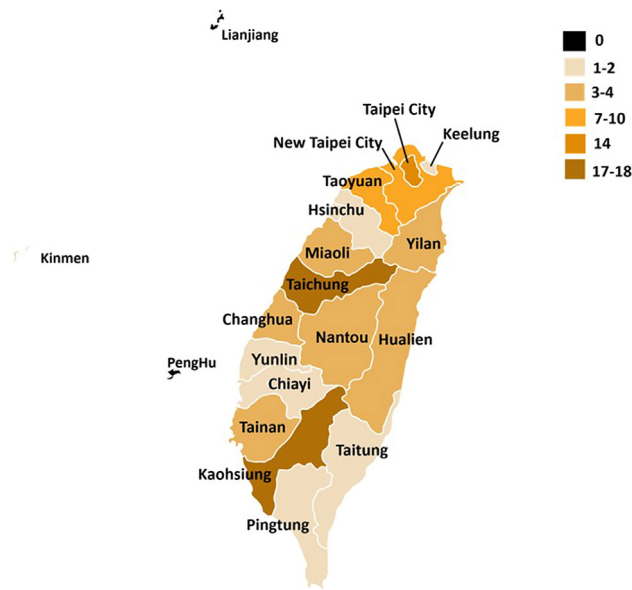


Figure 5 Geometric spatial representation illustrating the number of healthcare body providing domiciliary dental care (DDC) across districts in year 2023. Taichung and Kaohsiung have the highest numbers of healthcare bodies providing DDC, followed by northern urban areas such as Taipei City, New Taipei City, and Taoyuan. In other rural areas, the number of healthcare bodies providing DDC ranges from 1 to 4. Penghu and Lianjiang had none.

Upon closer examination, it becomes evident that dental clinics accounted for the majority of home services, likely due to their flexibility and lower operational costs compared to larger hospital settings.¹¹ The broader implementation in urban cities could be attributed to a confluence of factors: larger clusters of dental facilities, higher numbers of elderly requiring home care, closer proximity of professionals enabling home visits, and more resources to purchase portable dental equipment.^{2,9}

Nevertheless, despite these positive developments, significant gaps remain in certain districts, especially rural regions in eastern Taiwan and off-shore areas, which had limited or no access over the 6 years. To illustrate this disparity, in 2023, 11 out of 20 districts still had three or fewer DDC facilities, while Penghu and Lianjiang had none. This stark contrast corroborates previous research showing poorer oral health outcomes and unmet needs among homebound elderly in remote areas.¹² These persistent disparities may reflect ongoing shortages of dentists, insufficient human resources and caregiver support, and infrastructure limitations in these regions.^{10,13}

In addition to geographical disparities, it is crucial to consider the barriers faced by dental professionals in providing DDC. Key issues deterring professionals from providing DDC include feelings of inadequacy due to lack of training and challenges in handling complex medical conditions among DDC patients. Notably, one study found that only 36 % of government dentists had experience with DDC, citing insufficient competency as a top reason for not providing the service.⁹ Furthermore, other possible constraints include long travel distances, lack of public transportation, inadequate

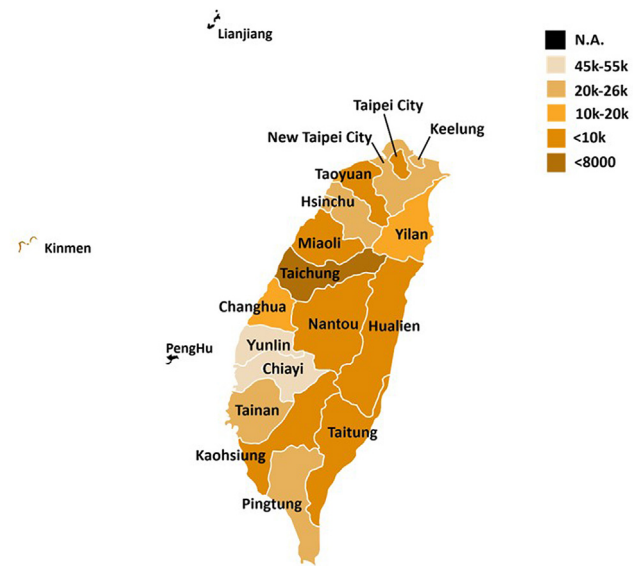


Figure 6 Geometric spatial representation illustrating the estimated number of disabled individuals per healthcare facility across districts in year 2023. Based on the annual report by the Ministry of Health and Welfare on the number of disabled individuals, we estimated the ratio of disabled persons to each healthcare body offering domiciliary dental care (DDC) services. Taichung has the lowest ratio of disabled persons per healthcare center, followed by Kaohsiung, Nantou, Taitung, Hualien, Miaoli, Taoyuan, and Taipei City. In contrast, Yunlin and Chiayi have the highest ratios. Notably, Penghu and Lianjiang have no accessible healthcare providers offering DDC services to this population. Values are presented in thousands (k = thousands).

roads hindering access to patients' homes, and lack of financial incentives for home visits.^{10,14} Another factor contributing to the uneven distribution of DDC services is demographic discrepancies. Districts with lower disabled populations likely have less demand and lack economies of scale for viable home care programs, creating a cyclical problem where limited services discourage dental professionals from specializing in DDC.¹¹ This pattern is evident in the 2023 data, where regions like Lianjiang and Penghu, with some of the lowest numbers of disabled persons (492 and 6069 respectively), had no healthcare bodies providing DDC. In contrast, cities with larger disabled populations (>100,000) such as Taichung, Kaohsiung and Taipei City had comparatively more DDC providers, illustrating how population density and demand can influence service availability.

Nonetheless, recent policy changes hold promise for improving equitable access. The continued expansion of the Long-Term Care plan 2.0 published by the Taiwan's Ministry of Health and Welfare, could further subsidize home dental care especially in rural regions.³ Additionally, ongoing promotion of domiciliary care training and education modules will increase the skilled workforce capable of delivering quality home services.^{7,11,15} Tele-dentistry models, utilizing portable imaging and tele-consultations, could also help to extend the reach of existing facilities in remote areas.¹⁴

While these progressions are promising, it is important to acknowledge a limitation of our study: we primarily focused on the number of disabled patients as a metric for DDC demand, which may not fully capture the complexity of service needs or the severity of disabilities in different regions. This simplification could potentially overlook nuanced factors influencing DDC distribution. Despite this limitation, our findings still provide valuable insights into the current landscape of DDC services in Taiwan.

To further enhance equitable distribution, additional policy efforts could focus on increasing financial subsidies and improving infrastructure for service delivery in rural regions. Ultimately, we hope this comprehensive analysis provides valuable insights for ongoing initiatives and policies aimed at improving the availability of DDC and enhancing oral health-care for Taiwan's aging and disabled populations.

In conclusion, while domiciliary dental care has expanded in Taiwan from 2018 to 2023, disparities persist across geographical regions. To address these disparities, continuing the training of dental providers and expanding the use of tele-dentistry can be effective strategies for bridging access gaps. Ultimately, regular monitoring of distribution trends can inform policy development to ensure optimal oral health for Taiwan's homebound population.

Declaration of competing interest

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

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