ACHSM Asia-Pacific Journal of Health Management

REVIEW ARTICLE

GEOGRAPHIC INEQUALITIES IN THE DISTRIBUTION OF DENTISTS: A SCOPING REVIEW

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ABSTRACT

BACKGROUND:

Equity in health refers to ensuring that individuals have timely and sufficient access to healthcare services when needed. Human resources are a vital component of healthcare organizations, and they play a crucial role in improving people's access to services. Dentists, in particular, are essential healthcare professionals as oral and dental health significantly impacts overall societal health. This study aims to investigate the key factors contributing to the inequality in the distribution of dentists.

METHODS:

A scoping review was conducted, systematically searching three databases—Scopus, PubMed, and WOS—using relevant keywords until January 2023. A total of 565 preliminary results were screened, and 447 titles and abstracts were reviewed. Ultimately, 23 full-text articles were included in the analysis. Qualitative content analysis and thematic network were used to synthesize the extracted data.

RESULTS:

Thematic analysis of the evidence yielded four main themes that contribute to inequality in the distribution of dentists: the development of the inequality situation, methods for analyzing inequality, causes of inequality, and potential solutions to address inequality.

CONCLUSION:

Policymakers should gain an understanding of the determinants that contribute to inequality and how these factors manifest in their respective countries. Policymakers can work towards achieving a more equitable distribution of dentists by directing resources towards policies and measures that improve access to oral and dental services. This will ultimately enhance overall societal access to oral healthcare services.

KEYWORDS

Inequality, dentist, oral and dental health

BACKGROUND

Healthcare systems rely on various resources, including human resources, equipment, and facilities, to deliver services effectively. Among these resources, human resources are recognized as the most crucial asset for any organization [1]. The proper utilization of human resources is a key driver for societal growth and development [2]. Skilled healthcare professionals are considered the backbone of the healthcare system, contributing significantly to its functioning. In recent years, policymakers have placed substantial emphasis on this aspect and have implemented management policies focused on human resources as part of healthcare system reforms to enhance access to healthcare services [3].

Equity in healthcare refers to the timely and adequate access to healthcare services for individuals in need. Access to healthcare is a crucial indicator of quality of life and sustainable development [4]. Despite substantial resources being allocated to the health sector, there exists a significant gap between available resources and the actual requirements, underscoring the importance of efficient resource utilization. Merely increasing resources does not guarantee equity; it is essential to ensure their proper distribution. One of the key challenges faced by healthcare policymakers is achieving equal access and equitable distribution of human resources. Studies have revealed an imbalance in the distribution of healthcare professionals [5,6], leading to geographical disparities and disrupting the composition of specialized healthcare providers, resulting in resource wastage and posing challenges in evaluating healthcare services [7].

Healthcare managers should consistently assess and evaluate health resources and their distribution to improve community health. One significant challenge that has gained attention in recent years is the presence of profound inequalities in the healthcare workforce [8]. In particular, the shortage and improper distribution of dentists pose one of the greatest problems and challenges in the healthcare sector globally. Inequality in dental services is a public health concern, as research indicates unequal access to dental care services. While individuals should have appropriate access to healthcare services, studies demonstrate that dental care utilization is not evenly distributed across different countries [9,10].

In other words, access to oral and dental healthcare services faces significant barriers in every country. Shortages and insufficient numbers of trained dental professionals are common obstacles. This issue is observed in both developing and developed countries [11]. Various studies have shown that the distribution of dentists worldwide is uneven, and people's access to dental services varies across different countries. For instance, in Australia, the distribution of dentists is also imbalanced due to the influence of economic, social, and geographical factors [12]. Furthermore, research indicates that although the number of dentists has increased in recent years, their distribution has been inappropriate [13,14].

Research indicates that the performance of different regions within each country varies, and regions with proper resource distribution have experienced better growth and development [15]. Identifying the current status of access to services and the distribution of human resources is the first step in reducing inequality in this field. Numerous studies have been conducted worldwide using various techniques in this area [16-22]. However, since each study focuses on a specific country and approaches the subject from different perspectives, there is a need to review and summarize the diverse results. This study aims to examine the factors influencing geographical inequality in the distribution of dentists worldwide, providing a scientific and research foundation for future studies in the field of policymaking and equitable distribution of dentists, benefiting other researchers and policymakers.

METHOD

The present study is a review of articles related to "geographic inequalities in the distribution of dentists in different countries." We have utilized a scoping review methodology as it allows for the inclusion of literature with heterogeneous designs and samples [23]. Furthermore, this type of review study enables the identification of key factors associated with the concept and the creation of a comprehensive map of the available evidence on the subject [24].

DEFINING THE RESEARCH QUESTION

While the research question helps establish the study's scope, a scoping review follows an iterative process. Thus, the research question for this study was developed gradually through the literature review. The main focus of our study is to examine inequalities in the distribution of

dentists. Therefore, the research question guiding this study is: "What are the geographic disparities in the distribution of dentists?"

FINDING RELEVANT STUDIES

First, suitable keywords were extracted using terminologies such as MeSH and subject headings from the Library of Congress. Additionally, a quick search was conducted to enrich the keywords, and the titles, abstracts, and indexes of relevant articles were reviewed. Inequality, distribution, and dentist were the main keywords used for article search. Other keywords are listed in Table 1. Boolean operators were also used to formulate the search strategy based on the keywords provided in the table. All the keywords within each row were combined using "OR," and then the rows were combined using "AND." Subsequently, the rows were paired to increase search sensitivity. In the next stage, databases were searched. Credible foreign databases including PubMed, Scopus, Web of Science, and Google Scholar were searched. In addition to electronic searching, manual searching was also performed.

TABLE 1: SEARCH STRATEGY

NO	Construct	Search field/Limits
#1	Inequalities OR health care disparities OR inequity OR fair	In: Topic (Title, Abstract, Keywords)
#2	Distribution OR allocation OR "Gini coefficient"	In: Topic (Title, Abstract, Keywords)
#3	"Dental workforce" OR Dentists OR "Dentists-to-population ratio" OR "health workforce" OR "health human resource" OR "health manpower"	In: Topic (Title, Abstract, Keywords)

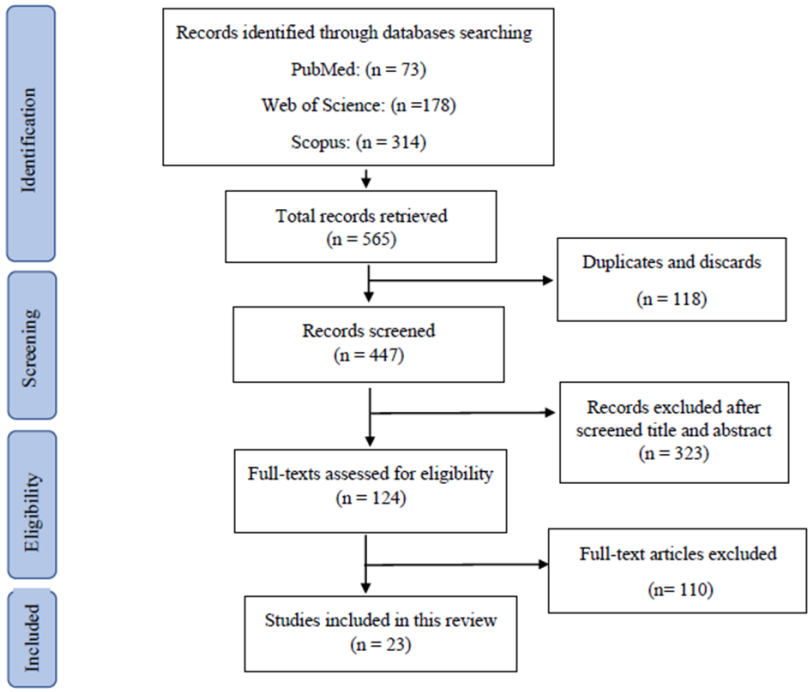
INCLUSION CRITERIA AND STUDY SELECTION

The titles, abstracts, and full texts of the studies that met the inclusion criteria of the current scoping research were reviewed. The relevant evidence found during the search process was documented using Endnote 20 software. At this stage, inclusion criteria included relevance to the research objective, publication in English, authenticity, and availability of full text Initially, two independent reviewers from the research team (ZZ, MKH) screened the titles of papers based on the outcome of interest. Among 565 articles, 418 studies were accepted for further assessment after excluding irrelevant titles. The abstracts of the remaining papers were then reviewed by two reviewers, and those that did not meet the study's aim were excluded. In cases of disagreement, a third reviewer (EKH) was consulted. This resulted in the selection of 124 full-text articles for further appraisal. Finally, two reviewers examined the full-text papers, and 35 studies, including 23 articles on inequalities in the distribution of dentists, were included in the study. The process of paper selection for this study is illustrated in Figure 1, which presents a PRISMA flowchart.

COLLATING AND SUMMARIZING THE DATA

quantitative analysis was conducted using Microsoft Excel Version 16, while qualitative thematic analysis was performed using MAXQDA version 10. Thematic analysis [25] was carried out as follows: First, the research team familiarized themselves with the data by reviewing all extracted information multiple times and comparing it with the original texts. Next, preliminary codes were identified based on the research question and outcome of interest. The team then engaged in an interpretive analysis of these initial codes, organizing them into subthemes and main themes. Subsequently, the team thoroughly reviewed the identified themes, combining, refining, separating, or discarding initial themes as needed. Finally, the team defined and labeled the themes and their related subthemes based on the relevance of the contents. The main themes and their related subthemes can be found in Table 2, which provides a comprehensive overview of the identified themes.

FIGURE 1: PRISMA FLO DIAGRAM



RESULTS

Our searches yielded 565 results, out of which 23 articles were included in the scoping review. Among these studies, a total of 17% were conducted in the United States, 13% in Canada, 13% in Iran, and 13% in Japan. Furthermore, the majority of the studies included in the scoping review were cross-sectional and retrospective in nature (Figure 2). The demographic characteristics of the included articles are provided in the appendix.

The results of the thematic analysis led to 4 main themes and 10 sub-themes related to inequalities in the distribution of dentists, which are presented in Table 2.

FIGURE 2: STUDY DESIGN

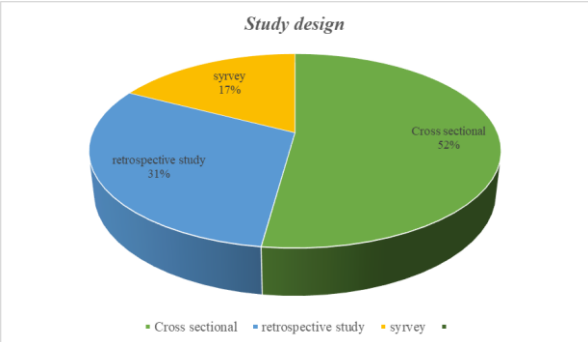


TABLE 2: EXPLORING INEQUALITY IN THE DISTRIBUTION OF DENTISTS

Themes	Subthemes	Codes
Developing the inequality situation	Demographic profile	Gender
		Age
		Income level
		Education
	Geographical attributes	Private or public
		Urban to the rural population
		The population of various regions
		East-to-West regions
		North to South regions
Approaches to Analyzing Inequality	Descriptive method	Population statistics
	Analytical method	Indicators of inequality
		GIS analysis
Causes of inequality	Human factors	Lack of opportunity for career advancement and professional growth
		Lack of interprofessional communication
		Lack of experience in different clinical cases
		Lack of teamwork
	Physical factors	Hard-working conditions
		Insufficient facilities and facilities
	Financial factors	Lack of economic incentives
		Insufficient salary
	Political factors	Lack of decentralization
		Lack of insurance coverage
Solutions to inequality	Managerial solutions	Vertical integration of services
		Dentist training
		Local decision making
		Create a strong support system
		Providing and promoting dental insurance coverage
	Financial solutions	Convenient refund system
		Providing financial incentives and subsidies to dentists

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1. DEVELOPING THE INEQUALITY SITUATION

The theme of explaining the inequality status aims to identify various characteristics based on which the inequality status is described in multiple articles. In this regard, demographic and geographic characteristics are considered categories within this concept.

1.1 Demographic profile

The findings from the included articles in the study indicate that certain demographic profile have a significant impact on the distribution of dentists, leading to inequalities. These characteristics include gender [26], age [27], income level [14, 27-33], and educational level [28, 32]. Approximately 34% of the articles highlight disparities in the provision of dental services due to variations in income across different regions. Additionally, it is noteworthy that socioeconomically disadvantaged areas have a lower concentration of active dentists.

Moreover, it was observed that there is a gender imbalance among employed dentists in deprived areas, with a higher representation of males compared to females. Gender emerges as a notable factor influencing the inequality in dentist distribution. Furthermore, research studies have indicated that a disparity in distribution is associated with a higher prevalence of highly educated individuals within the dental workforce.

1.2 Geographical attributes

Geographical attributes play a significant role in the unequal distribution of dentists across different regions. The findings of the study suggest that the population of specific areas has a notable impact on the availability and quantity of dentists [14, 28, 29, 33-41]. Furthermore, research indicates that urban areas experience a greater expansion of dental clinics and a higher number of dentists compared to rural areas [14, 19, 26, 31, 38-40, 42-45]. Moreover, evident disparities in dentist distribution are evident in large countries, with northern regions receiving fewer services compared to southern regions, and eastern regions facing fewer services compared to western regions [42, 34, 35, 19, 41]. Additionally, the nature of healthcare facilities, whether private or public, also contributes as a significant factor in the inequality of dentist distribution [31, 39].

2. APPROACHES TO ANALYZING INEQUALITY

This section examines the analysis methods employed in various studies and the measurement of inequality. The results indicate that the articles included in this study utilized both descriptive and analytical approaches to assess inequality. The review findings reveal that although 43% of the articles relied on descriptive methods such as dentist-to-population ratios [26, 14, 27, 34, 35, 37, 39-43], other studies attempted to measure inequality in dentist distribution using analytical indicators such as the Gini coefficient, Robin Hood index, and IRSD analysis [14, 29, 31, 32, 38-40, 44], as well as GIS analysis [28, 36, 30, 19, 37, 45, 33].

3. CAUSES OF INEQUALITY

This section examines multiple factors that contribute to the emergence of inequality in dentist distribution. Among these factors, studies indicate that human, physical, financial, and political reasons are among the most significant causes of inequality and hindered access to dental services.

3.1. Human Factors

The results of studies have indicated that the lack of career advancement and professional growth opportunities for dentists, absence of professional networking with other dentists, limited clinical experience in various cases [43], and inadequate possibilities for teamwork [38] in underserved areas with smaller populations are among the primary reasons for unequal dental practitioner activity within a region.

3.2. Physical Factors

Based on research findings, it has been observed that the majority of dental workforce prefer to practice in urban areas. Factors that may contribute to these professional preferences include challenging working conditions [39, 43], unfavorable facilities such as poor commuting and transportation options, lack of various amenities including suitable educational facilities for dentists' children, absence of recreational and entertainment facilities, lack of childcare facilities, and overall discomfort in daily life in rural areas [39, 40, 43].

3.3. Financial Factors

The findings of this study indicate that inadequate financial incentives, limited income, and insufficient wages for dentists are among the primary reasons for the low participation of dental practitioners in underserved and rural areas [40].

3.4. Political Factors

This investigation highlights that one of the significant barriers to achieving an equitable distribution of dentists across different regions is the prioritization of decision-making and planning for dental services in urban areas [40]. Moreover, inadequate insurance coverage for individuals in rural and underserved areas, along with a lack of dental service availability, contributes to reduced utilization of dental care by the population, leading to lower income for dentists and their lack of interest in practicing in these areas [28, 45].

4. SOLUTIONS TO INEQUALITY

This section encompasses all the solutions aimed at minimizing the inequity in the distribution of dental care. Among them, various studies have identified managerial and financial approaches as the most effective, alongside cultural and social strategies.

4.1. Managerial Solutions

Based on research findings, vertical integration of services by combining oral health and dental care interventions with public health and primary care has proven to be an effective solution in tackling the inequity in dentist distribution [31]. Additionally, allocating educational

positions in universities for students from underserved areas to practice in their own regions after graduation, along with an overall increase in dental training, can be a valuable solution [14,31]. Moreover, establishing robust support systems for service delivery in underserved and rural areas and simultaneously decentralizing decision-making to local authorities can alleviate many underlying causes of inequity in dentist distribution [31]. Additionally, enhancing the coverage of dental services in terms of population, services provided, and affordability has also been recognized as a highly effective solution [14].

4.2. Financial Solutions

It can be anticipated that addressing the inequity in dentist distribution can be improved through economic incentives such as budget allocation and offering additional remuneration for dental treatment [14,35,36,40]. Implementing suitable reimbursement programs for service contracts in underserved areas can also contribute to reducing the inequity in dental care distribution [30, 44].

DISCUSSION

Inequality is a significant concept for health policymakers, and the field of oral health and dentistry can face inequality for various reasons. The comprehensive findings of this study provide an overview of the injustice in the distribution of dentists and the reasons behind it, which can lead to inequality in oral health services.

Based on the current results, certain individual and demographic characteristics such as gender [26], age [27] income level [14, 27-33], and education level [28, 32] can have an impact on the inequality in the distribution of dentists, leading to the emergence of injustice in the distribution of dentists and, consequently, inadequate access to dental services for individuals. Grytten et al. also mentioned in their article that there were inequalities in the provision of public dental services resulting from income disparities between regions [27]. Additionally, Ahmad emphasized the positive relationship between the density of dentists and income and educational level [28]. On the other hand, the population size of different areas influences their income level, and the income of each region determines the preferences of dental workforce to work in underserved areas with a smaller population. Furthermore, inequality in the distribution of dentists is evident in rural areas compared to urban areas, and despite the greater need for dental services in underserved and rural areas, the number of service centers and practicing dentists in these areas is lower. Akhtar et al. stated that there are more dentists in large cities compared to rural areas, and there is a significant difference in the healthcare workforce between cities and rural areas [42]. Additionally, dentists are concentrated in major urban centers. Moreover, the findings of the current study demonstrate differences and inequalities in the distribution of dentists in geographically vast regions and countries with dispersed population distribution, with the eastern regions compared to the western and northern regions showing variations in different areas. The findings of Hashimura and Young studies were consistent with the findings of this study [35, 41].

In this context, it is not feasible for private clinics to operate in areas with a low population due to the need for a certain patient volume. Additionally, the substantial financial burden of installing advanced equipment for specialized dental procedures poses a challenge for small private dental clinics.

In addition to the aforementioned determining factors, the research highlights the significance of human, physical, financial, and policy factors as the primary drivers of inequality in dentist distribution. Dentists in underserved, low-population, or rural areas show less interest in practicing due to limited career prospects, a lack of professional networking opportunities, limited exposure to diverse dental cases, and the inability to work collaboratively. Emami and Mozhdehifard studies also support these findings [38, 43]. Moreover, the declining rural populations, accompanied by urbanization, impact income levels and pose economic challenges for maintaining dental practices in low-population areas, contributing to the unequal distribution of dentists. Additionally, the absence of basic amenities, lack of children's schools and local facilities, as well as residing in remote mountainous areas and isolated islands, along with overall harsh living conditions, further contribute to the observed inequality in dentist distribution across various regions. Okawa's study demonstrates the influence of adequate facilities, amenities, and fair compensation on dentist distribution [40]. In this context, centralized decision-making, the limited ability for local policymaking, and the exclusion of dental activities from the purview of healthcare authorities responsible for improving dental access all have significant policy implications for the unjust distribution of dentists. Susi and Okawa also arrived at similar conclusions in their respective studies [39, 45].

The present study also examines the necessary solutions to overcome the underlying causes of injustice in dentist distribution. In remote and rural areas, government support for dental services, improvement of dental care, and the establishment of public dental clinics are essential. In areas lacking dental professionals, economic incentives such as budget allocation and extra compensation for dental treatment can be expected to improve the situation. To ensure the availability of expensive dental equipment in rural clinic settings, it may be necessary to establish a system where local authorities and dental associations can contribute to equipment procurement budgets, enabling individuals to access services similar to those available in urban areas. Integrating dental services with public health services and expanding dental service coverage are also key strategies for addressing the injustice in dentist distribution. Additionally, increasing the training of dental professionals and allocating specific quotas for native individuals to study and practice dentistry are highly effective measures.

Based on the findings, it can be concluded that the socio-economic status of different regions, the urban-to-rural population ratio, total population in the areas, and inadequate facilities, amenities, and compensation in regions with lower populations and rural areas are the most significant factors influencing the unfair distribution of dentists in various areas. These findings provide valuable insights for policymakers to better understand the determinants and their interrelationships, enabling them to design effective interventions to reduce inequality in dentist distribution. Moreover, this study goes beyond theoretical comprehension and lays the foundation for future research, including the evaluation of the impact of each determinant factor on dentist distribution inequality and the assessment of the effectiveness of specific solutions in addressing the underlying causes of unfair dentist distribution at the local level.

LIMITATIONS:

In this investigation, we included articles employing various design and analysis methods to examine inequality in the geographical distribution of dentists. This inclusion may pose challenges in synthesizing the data. However, the design of the study encompasses an approach to assess and incorporate heterogeneous studies. Furthermore, while we made every effort to review all relevant studies on inequality in dentist distribution, access to all pertinent studies on dental services from sources such as websites was not available, and there is a possibility of missing some evidence. Lastly, the final limitation pertains to the generalizability and applicability of the results. In other words, the determinants of inequality may carry different weights among diverse country contexts.

CONCLUSION

The findings of this study highlight the importance of policymakers recognizing and understanding the factors that contribute to inequality in the distribution of dentists. By acknowledging these determining factors and their impact on access to dental services, policymakers can develop targeted strategies to address the issue effectively.

Allocating resources towards policies and initiatives that enhance people's access to dental services is crucial. Comprehensive insurance packages can play a significant role in ensuring affordable and comprehensive dental care for all individuals, regardless of their socio-economic background. This includes coverage for preventive care, routine check-ups, and necessary dental treatments.

In addition to insurance coverage, focusing on the equitable distribution of dental facilities is essential. This involves ensuring that dental clinics and practices are geographically accessible, particularly in underserved and rural areas. Also, to enhance community access to dental services, it is recommended to explore the utilization of digital/tele dentistry solutions. These innovative technologies, such as teleconsultation, tele dentistry platforms, and remote monitoring tools, have the potential to bridge geographical barriers and improve outreach to underserved populations. Finally, by improving the availability of dental facilities in these regions, individuals will have better access to necessary dental care and reduce the disparities in dentist distribution. Furthermore, supporting dentists who choose to practice in impoverished and low-income areas is vital. Providing incentives, such as loan forgiveness programs or financial assistance, can encourage dentists to work in underserved communities. This support not only addresses the shortage of dental professionals in these areas but also helps improve oral health outcomes and reduce inequalities.

Overall, policymakers should prioritize efforts to promote a fairer distribution of dentists and improve access to dental services for all individuals. By considering comprehensive insurance coverage, equitable distribution of dental facilities, and support for dentists in underserved areas, they

can contribute to reducing inequalities in oral healthcare and enhancing overall population well-being.

DECLARATIONS

Acknowledgments: Not Applicable

Availability of Data and Materials: All data generated or analyzed during this study are included in this published article and its supplementary information files.

Funding: There was no funding.

Ethics approval and consent to participate: Not applicable.

Consent for publication: Not applicable.

Competing interests: There was no conflict of interest.

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APPENDIX - SUPPLEMENTARY

TABLE S1: DEMOGRAPHIC CHARACTERISTICS OF ARTICLES

Row	First Author	Year	Research Objective	Research Type	Research Community	Country
1	Ahmad (27)	2014	To identify disparities in the availability of dentists in Canada's largest urban center, Toronto, and explore whether distributional disparities are associated with underlying factors, such as affordability as measured by average household income.	Cross-sectional	Dentists	Canada
2	Ahmed (25)	2011	Determining the proportion of the health and medical human resource to the population	Survey	Providers of health services in the city and the countryside	Bangladesh
3	Akhtar (41)	1986	Estimating the ratio of healthcare personnel to the population	Cross-sectional	Health human resources	India and Zambia
4	Emami (42)	2016	To examine and map the distribution patterns of the dental workforce in Quebec, Canada	Cross-sectional	Dentists	Canada
5	Feng (33)	2017	Examining dental workforce access and utilization of dental services in Appalachia	Retrospective study	Dentists	US
6	Gallagher (13)	2018	To provide a contemporary analysis of HROH by examining the size and distribution of the dental workforce according to the WHO region and in the most populous countries	Cross-sectional	Health human resources	25 most populous countries in the world
7	Grytten (26)	2001	To identify possible factors associated with the marked geographical variation in the supply of public dental services in Norway	Retrospective study	Dentists	Norway
8	Hashimura (34)	2019	Determining the number of dentists per population	Survey	Dentists	Japan
9	Horner (35)	2007	To identify regional inequities in dental provider location and suggest an innovative methodology that could be useful in establishing new dental facilities that are geographically accessible	Cross-sectional	Dentists	US

Row	First Author	Year	Research Objective	Research Type	Research Community	Country
10	Jean (28)	2020	Analyze the dentist to population ratio relative to socio-economic profile to identify areas of workforce shortages and inform the policy direction of workforce recruitment strategies and public dental service planning	Cross-sectional	Dentists	Australia
11	Jo (29)	2020	To investigate the relationship between deprivation and distance to NHS dental providers in Scotland, Wales, and Northern Ireland	Cross-sectional	Dentists	Scotland, Wales, Northern Ireland
12	Jo (19)	2021	To illustrate, identify and assess a contemporary model of the geographic distribution of specialist dentists about population age groups and rurality	Cross-sectional	Dentists	Great Britain
13	Kiadaliri (14)	2013	To assess the pure and social disparities in the distribution of dentists across the provinces in Iran in 2009	Cross-sectional	Dentists	Iran
14	Krause (36)	2005	To analyze the availability of dentists in Mississippi by county over four decades to determine the geographic distribution of dentists, shifts in their distribution over time, and how this distribution relates to population demographics	Retrospective study	Dentists	US
15	Kruger (30)	2011	To examine the distribution of private dental practices in WA, especially in rural and remote areas	Cross-sectional	Dentists	Australia
16	Mozhdehifard (37)	2019	To evaluate the status of oral health promotion services and inequality assessment of total inequality in oral health workforce distribution in Iran based on distribution indices	Retrospective study	Fifty universities of medical sciences	Iran
17	Northcott (43)	1980	Estimated distribution of physicians and dentists in the Alberta area	Retrospective study	Physicians and dentists	Canada
18	Okawa (38)	2013	To clarify the geographic distribution of specialist orthodontists and dentists who provide orthodontic services in Japan	Survey	Dentists	Japan
19	Okawa (39)	2014	To examine whether the increase in the number of dental clinics in Japan has led to an improvement in their geographic distribution	Survey	Dentists	Japan

Row	First Author	Year	Research Objective	Research Type	Research Community	Country
20	Sefiddashti (31)	2016	To determine the trend of inequality in the allocation of human resources in the health sector in Tehran between 2007 and 2013	Cross-sectional	Health human resources	Iran
21	Susi (44)	2002	to analyze issues of provider availability and accessibility in Ohio using a geographical information system, or GIS	Retrospective study	Dentists	US
22	Young (40)	2018	Determining trends and patterns of supply and distribution of health personnel in eight countries	Retrospective study	Dentists	Eight European countries
23	Yuen (32)	2018	to determine the distribution of primary dental clinics in S~ao Paulo city	Cross-sectional	Dentists	Brazil