THE ORAL HEALTH WORKFORCE DISTRIBUTION OF SCHOOL DENTAL SERVICES IN PAHANG, MALAYSIA

Mohd Atni MH[1, 2], Md Bohari NF[2], and Md Sabri BA[2].
[1]Oral Health Programme, Ministry of Health Malaysia, Level 5, Block E10, Parcel E, Precinct 1, Federal Government Administrative Centre, 62590 Putrajaya, Malaysia
[2]Centre of Population Oral Health & Clinical Prevention Studies, Faculty of Dentistry, Universiti Teknologi MARA, Sungai Buloh Campus, 47000 Sungai Buloh, Selangor

Correspondence:
Nor Faezah Md Bohari,
Centre of Population Oral Health and Clinical Prevention Studies,
Faculty of Dentistry, Universiti Teknologi MARA,
Sungai Buloh Campus,
47000 Sungai Buloh, Selangor
Email: norfaezah6843@uitm.edu.my

Abstract
Oral healthcare workforce planning is commonly limited to the calculation of dentist-to-population ratios. However, this approach overlooks several crucial variables, such as the burden of oral health needs. Workload analysis is implemented to gain a comprehensive understanding of the true oral health requirements. This study aims to enhance our comprehension of the workforce imbalance and its effect on the distribution of personnel serving School Dental Services (SDS) in Pahang. To achieve standardised workforce sizing for every school, the operator-to-student ratio, that is, the ratio of a single operator to the entire student body, is utilised. The collected data is then merged and computed into the ArcGIS Pro software for geospatial analysis. Statistical analysis is conducted through the utilisation of SPSS software. In Pahang, 10% (n=72) of schools have a low operator-to-student ratio, with 47 located in Kuantan. There is a significant difference in DMFT mean between rural (0.74; SD=0.60) and urban (0.86; SD=0.58) schools (p=0.02). Kuantan's urban schools have a significant operator burden, with a shortage of operators compared to other districts, amplifying the workforce distribution imbalance. Compared to urban areas, there is a greater ratio of one operator to the total student population in rural areas. However, schools with a higher number of students need more children to be treated per operator. The necessity for a fair workload-based distribution of SDS staff is evident.

Keywords: ArcGis Pro, School Dental Service, Workforce

Introduction

A sustainable healthcare system is when appropriate care is delivered at the right time, to those in greatest need, by the right number of people, in the right location (1, 2). Most of the time, workforce planning for oral healthcare services is limited to the dentist-to-population ratio calculations, a commonly used method that utilises population estimates to calculate the number of dentists needed in a population (3).

The dentist-to-population ratio method in workforce planning is the most commonly used method to measure how well various countries are doing in terms of the skilled workforce supply, although it is increasingly seen as a less reliable measure. It neglects to consider several essential elements, including the oral health need burden, which varies across nations, between areas within countries, and changes over time (3). School dental services (SDS) in Malaysia have long been acknowledged as a cost-effective nationwide oral health preventive strategy among schoolchildren where dental treatments are provided in schools together with oral health promotion activities (4). This programme, in addition to incorporating oral healthcare into the school environment, ensures accessibility to basic oral healthcare regardless of socioeconomic background, level of education, or sociocultural views of the schoolchildren (5).

Based on the Annual Report Oral Health Programme by the Ministry of Health, Malaysia, in 2019, the caries prevalence of 6-year-old, 12-year-old and 16-

year-old schoolchildren was 60.3%, 37.6% and 43.1%, respectively. Over the years, the caries prevalence for these three groups of schoolchildren has stayed at approximately the same level with no noticeable change (6). Hence, regular evaluation of the school's dental services is required. Apart from regular periodic assessments, additional SDS implementation evaluations are essential to measure the oral health outcomes to ensure the sustainability of the SDS (7). The Geographical Information System (GIS) is a subfield of geomatical science that uses geographical data by combining numerous methodologies (mapping, measuring, and managing) with other data inputs to get more robust information about a population. The GIS may then be used to convey the analysis outcomes (i.e., patterns in the data) through visually appealing, high-impact maps. These maps may tell stories and express connections in ways that conventional data display approaches may not be able to (8).

Inequity in health workforce distribution results from disparity of geographical concentrations of the health workforce (9). Health academics should examine methodologies that may detect specific geographical distribution features to understand the inequities in health workforce distribution better. Spatial statistics can be applied as it is an emerging tool focusing on distribution details and providing good visualisation (10). Findings from this research can be useful for policymakers to make decisions in reaction to a projected trend in untreated caries as the global population grows (11). This study examines the SDS workforce in relation to the workload for each school in Pahang using GIS tools.

Materials and Methods

This research is a cross-sectional study utilising secondary data from the Ministry of Health, Malaysia and was carried out from January 2022 until July 2022. The data used was from 2019, which reflects the condition before the COVID-19 pandemic. As we are gradually returning to the pre-COVID-19 times, it was preferable for this study to reflect the condition where the school service will return to normal.

Location of schools and dental clinics

The physical addresses and coordinates of each primary and secondary school in Pahang were obtained from the official website of the Department of Statistics, Malaysia. SDS workforce size was acquired for each school from the Oral Health Division of the Pahang Health State Department. Meanwhile, the data on the distance of the schools to the responsible dental clinic were obtained from Google Maps.

Types of SDS

A Static School Dental Clinic is where a dental clinic is built on the school premises. The school provides the necessary requirements and adaptations to the room. It is typically a single-dental chair clinic; however, two dental chairs may be accommodated if space is available. Another type of SDS is a Mobile Dental Team, where oral health personnel will travel to the schools by land or water to provide oral healthcare to the schoolchildren. A temporary clinic is built with the necessary equipment, such as portable autoclaves and mobile dental units (12).

Dental workload and workforce for each school

Data from each school were acquired from the Oral Health Division of the Pahang Health State Department. To calculate and standardise the workforce size for each school, the ratio of one operator to the total number of students is used (operator to student ratio). The operator consists of dentists and dental therapists. Data on the workload collected were the number of fillings, scalings, and extractions done per operator. Other treatment data, such as preventive treatment, was not collected.

Data integration and analysis

For the spatial analysis, all primary and secondary schools in Pahang visited by the school dental service were mapped using ESRI's ARCGIS Pro software through the official portal Living Atlas. Descriptive analysis was done to map and identify the distribution pattern of SDS oral health workforce according to size and distance to a dental clinic in Pahang. This software is also used for workforce and workload mapping. The statistical analysis was done using SPSS 28.0.

Results

Of 777 schools in the state of Pahang, only 730 schools have the complete data required for the spatial and statistical analysis. Forty-seven schools lack information regarding the workload and amount of dental treatment provided. These schools were excluded from the study. Table 1 shows the characteristics of Pahang schools included in the study. The number of rural schools in Pahang was 565 (77.4%), almost three times higher than the number of schools in the urban area 165 (22.6%). Primary schools accounted for 71.9% of the total number of schools, while secondary schools accounted for 28.1%. The operator-to-student ratio was 1:470 for the whole state of Pahang. Information regarding the workload is shown in the form of the number of dental treatments provided per operator. The quantity of treatment according to the type of treatment is divided by the number of operators to determine the workload per school. In a school where two operators perform and treat 60 tooth fillings, the filling treatment workload for each operator is 30. For each school in the state of Pahang, the mean number of fillings done by each operator is 57.5 (SD=55.1). The mean number of teeth extracted per operator is 16.5 (SD=20.5). Meanwhile, the mean scaling treatment per operator is 25.1 (SD=33.3).

Table 1: Characteristics of the Pahang schools and the SDS included in the study (n=730)

	Variables	n (%)	Mean (SD)
Location	Urban	165(22.6%)	
	Rural	565(77.4%)	
School Type	Secondary	205(28.1%)	
	Primary	525(71.9%)	
Dental Team Category	School Dental Clinic (Static)	67(9.2%)	
	Mobile Dental Team	663(90.9%)	
Distance responsible dental clinic to school (km)			16.73
Operator to student ratio			1:470
Days complete treatment			11
No. of filling done per operator for each school			57.5 (55.1)
No. of extraction done per operator for each school			16.5 (20.5)
No. of scaling done per operator for each school			25.1 (33.3)
Mean DMFT			0.9

Note: n=number of schools

As shown in Table 2, for school location, there was a significant difference in schools located in rural and urban areas (p=0.02). Schools in urban areas have higher mean DMFT than those in rural areas.

Table 2: Comparing urban and rural schools on mean DMFT

School Location (n)	Mean DMFT(SD)	p-value
Urban (165)	0.86(0.58)	0.02a*
Rural (565)	0.74(0.60)	

* Significant at p<0.05, a-Independent T-Test

The straight lines (red) in Figure 2 connect each school with the respective responsible dental clinic. In total, Pahang has 67 (9.2%) static school dental clinics, indicated by the purple circles in Figure 2. 663 schools are covered by mobile dental teams (90.9%) and are represented by the yellow circles. The sizes of both circles, yellow and purple, represent the ratio of operators to students. The bigger the size of the circle, the lower operator to student ratio hence more students to be treated for a single operator in a particular school.

From Figure 2, Kuantan district has the highest number of static school dental clinics (19 schools), followed by Temerloh (12 schools) and Raub (7 schools). Almost all of these school dental clinics are located near dental clinics compared to schools covered by the mobile dental team. Compared to other districts, Kuantan also has the greatest number of schools with the closest distance from the clinic. It is well known that the population in Kuantan is the highest compared to other districts. The distance between schools is also not too far compared to other districts, depicted by the overlap of circle symbols on the map. As shown in Figure 2, Jerantut has the farthest distance from the dental clinic to the school. The top 4 schools with the longest distance travelled by the dental team are in the Jerantut district. Most of the dental clinics that provide dental care for schools are located in the southern area of the Jerantut district. For the ratio of one operator to the number of students, most of the highest workload is from schools in the Kuantan district. The ratio of students to dental operators is generally larger in secondary schools located in urban regions as compared to those found in rural areas. This directly reflects the high overall population number that may be seen in urban areas.

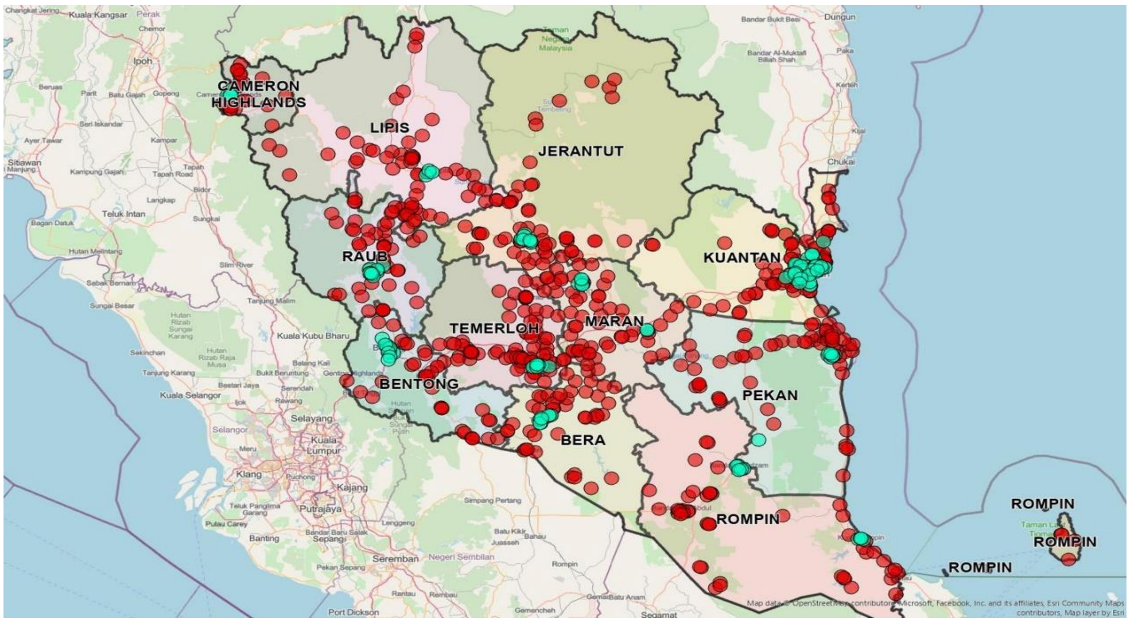

Figure 1: School distribution comparison between urban and rural schools.
(Red dots represent rural schools, and green dots represent urban schools)

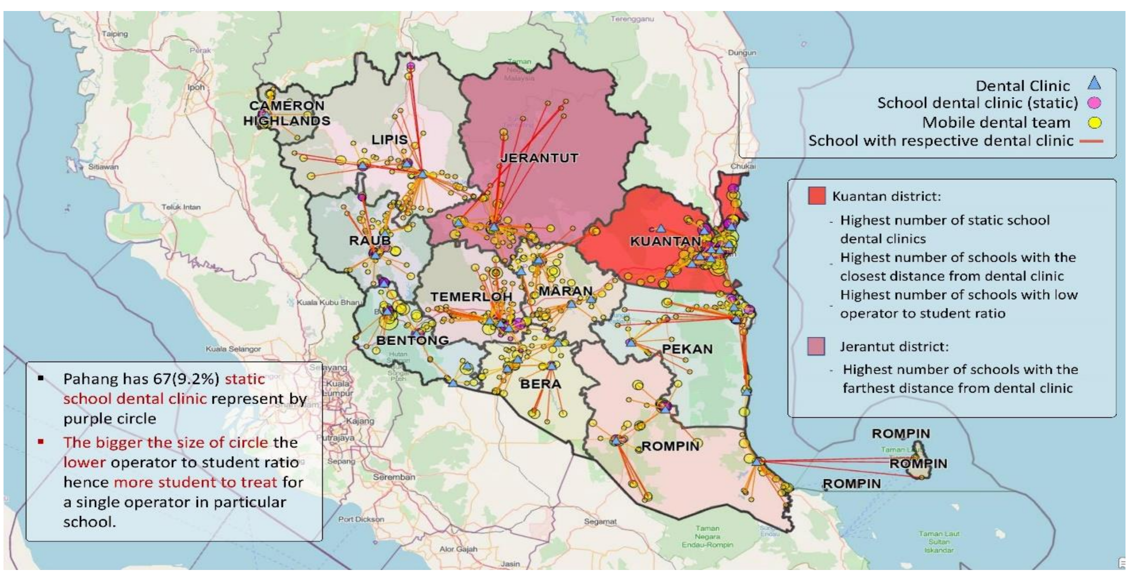

Figure 2: The distribution of types of dental teams (static and mobile) together with the size of the workforce for each team and distance of the school to the respective dental clinic.

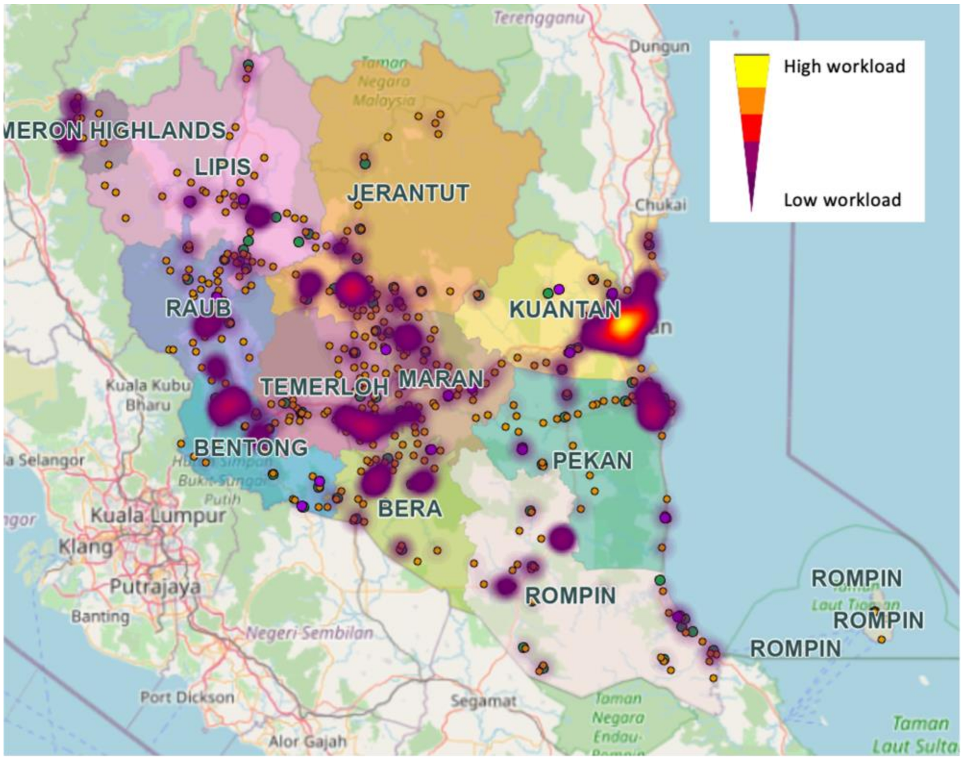

Figure 3: The workload of operators (fillings per operator) illustrated by a heat map showing different colour densities; bright yellow shows the highest workload of the operators than the surrounding areas.

The research took a more comprehensive approach by conducting an in-depth analysis that not only considered the operator-to-student ratio but also incorporated workload assessment. To accomplish this, the study utilised ArcGIS Pro software to generate heat maps illustrating workload density. These heat maps display varying levels of workload intensity across the geographic area under investigation. When examining these heat maps, it becomes apparent that areas with consistently brighter colours than their surroundings indicate hotspots with notably high workload density. Such hotspots may require focused attention and intervention to address the heightened demands on the local workforce.

Discussion

This study utilised heatmaps for the data analysis, which significantly pinpoints specific areas where additional resources or services may be necessary to support the local workforce adequately. By identifying these high-workload-density hotspots, the research provides valuable insights for decision-makers and policymakers. This information can guide the allocation of resources, aid in planning interventions, and help create a more balanced and sustainable work environment. Integrating workload density analysis through heat maps offers a powerful tool for assessing and addressing workforce needs, ultimately contributing to more effective resource management and intervention strategies (10).

It is essential to reduce inequality of health care services among people regardless of their socioeconomic status and racial background. This is where school dental service plays a vital role in reducing disparities and ensuring children's good oral health. School-based dental care systems of prevention and treatment have long been recognised as an effective dental public health care system for providing dental services for children (5). However, even with a good intention to reduce inequality in dental care, the school dental service still faces an unbalanced distribution of health personnel.

Kuantan, the state capital of Pahang, is the most populated district, with a population density of 185/km^2 compared to the other ten districts. Kuantan is the administrative and commercial centre of the state. Hence, most of the working age group in Pahang choose to reside in Kuantan for its high volume of trade and commerce activities of the local economy (13). Even though the number of schools in rural regions is much more than in urban areas, the overall student population per urban school is more prominent (14). Thus, this results in an increased workload for the SDS in Kuantan.

This is the reason most of the static school dental clinics are in urban areas with higher population densities than in rural areas. The requirement for a school to be a static school dental clinic is that it must have at least 1,000 students enrolled. The school provides the treatment room with the necessary modifications. It is usually a single-chair clinic but may accommodate two chairs if space permits. Such a clinic will have the convenience of providing the service in the school with proper infection control (12).

Jerantut's population density is just 13/km^{2,} making Jerantut the least populated district in Pahang (13). This distributed population stretches the oral health treatment offered to school students, and in exchange, the SDS personnel must cover a vast geographical area to provide necessary dental care. Nevertheless, the operator-to-student ratio per school in Jerantut in the rural and remote regions is higher, creating less workload for SDS. Geographical differences, resource accessibility and equity of healthcare services occur not only in Pahang but also in Taiwan, where most healthcare providers tend to be concentrated in urban areas. People living in remote regions suffer from a shortage of healthcare services due to geographic, traffic and socioeconomic status restrictions. This study revealed a similar phenomenon whereby most healthcare resources are allocated in the most populated area (15).

Every person has the right to healthcare systems that provide "equality of opportunity for persons to enjoy the best achievable level of health" (16). Access, in this sense, entails the physical availability of health services and their approachability, acceptability, cost and utilisation (17). Each component of this continuum of access and consumption must guarantee that healthcare delivery is compatible with people's needs (18). At an Organization for Economic Cooperation and Development (OECD) gathering of professionals on human capital planning, 20 nations presented that revealed maldistribution difficulties in healthcare distribution. Nevertheless, unlike in underdeveloped nations, wealthy nations may offset the impacts of maldistribution by increasing service accessibility via air transport (i.e., flying doctors' services) or telemedicine (19). Utilising technology in its infancy is costly. Even if the technology is fully matured for widespread use, it is still out of reach for developing countries. Using technologies such as telemedicine, high-income and industrialised nations may circumvent the issue of healthcare maldistribution (20, 21).

People with a higher level of education may be more effective at incorporating new technology (such as computers) into their day-to-day living and in the workplace. Over time, technologies (which may be introduced with varying degrees of complexity) tend to get simpler, and the optimal methods for using them are refined. This process of adaptation may make the technology more accessible to those with lower levels of education (20). The unbalanced distribution of health staff may lead to large disparities in health outcomes between rural and urban people.

For example, in Mexico, the average lifespan for the rural population is 55 years, whereas in an urban region, it is 71 years. In more developed countries, infant mortality is 20 per 1000 compared to 50 per 1,000 in the poorer states (9). The schools in urban areas have a higher workload and a low number of operators needed to complete the workload. In agreement with this research, a study from Thailand also indicated that the level of dental caries was much greater in Southern Thailand than in other areas and that the mean caries experience was higher among urban children than rural children. Urban children tend to have a significantly higher number of filled teeth compared to rural children (22). This could be attributed to the dietary and snacking habits (greater consumption of candies and sweetened drinks) among urban kids (23, 24).

The pervasive issue of the high dental care workload is exacerbated by the dental workforce shortage, particularly in underserved urban areas. As highlighted in a study by Gándara et al. (14), challenges in achieving a sufficient number of dentists include the uneven distribution of practitioners favouring urban areas, the deterrent effect of the high cost of dental education in regions with lower salaries, and the lack of incentives for dental providers to practice in underserved areas, coupled with limited access to care for vulnerable populations. Traditionally, workforce planning in dentistry has relied on simplistic measures like the dentist-population ratio, critiqued in a study by Ahern et al., for its inadequacy in considering crucial factors such as oral health needs, evolving service compositions, and delivery mechanisms (1).

To address shortages in areas densely populated with students, particularly in urban regions, strategic interventions are imperative. Infrastructure development involves investing in static dental clinics and facilities in underserved regions, aiming to attract and retain professionals (3). Additionally, targeted training and education programs for underserved regions, including rotations and internships, provide focused solutions (3, 9). Advocating for educational reforms that incentivise a primary healthcare-oriented training approach is crucial (9). Furthermore, the establishment of field residencies serves as a compelling strategy to encourage dental professionals to contribute to rural healthcare (9).

These multifaceted strategies comprehensively address disparities in dental workforce distribution, particularly benefiting underserved areas. Infrastructure development stands as a cornerstone for attracting and retaining dental professionals in regions with shortages. Simultaneously, targeted training programs, aligned with focused rotations, prepare dental practitioners specifically for practice in underserved regions. Educational reforms, involving incentives for service in underserved locations and aligning training with primary healthcare principles, contribute to a sustainable solution. The establishment of field residencies or internships as a mandatory part of training enhances the commitment of health professionals to serve in underserved regions, ensuring more widespread access to dental care.

In order to enhance students' oral health and ensure a streamlined treatment process, consider adopting a team-based dental care approach. This collaborative model involves coordinating various dental professionals, optimising their diverse skills, and enabling the referral of complex cases to nearby clinics when necessary (1, 3). Prioritising primary prevention for students can further alleviate the burden of complex cases. This strategy allows dental professionals to focus on delivering primary care treatment, ultimately fostering improved oral health outcomes for students (3). Telemedicine and telehealth technologies play a pivotal role in extending healthcare services to individuals in underserved areas, be it in rural or urban settings—a relevance echoed in the context of addressing oral health disparities. Through telemedicine, clinical healthcare services are delivered remotely using telecommunications and information technologies. This includes video consultations, remote patient monitoring, and the use of mobile health applications. Telehealth, a broader term, encompasses various healthcare services and information disseminated through these technologies (14).

In the context of oral health, the implementation of telemedicine and telehealth programs becomes a potent means to bridge gaps between underserved and served areas. It enables oral health practitioners to remotely connect with patients who lack local access to dental services (9, 14). This approach not only enhances health outcomes but also proves instrumental in curbing healthcare costs and broadening access to preventive and primary oral care. Furthermore, it serves as a strategic response to healthcare workforce shortages, enabling oral health providers to extend their reach without necessitating additional staff or facilities (14).

The concept of reorienting health services, as endorsed by the World Health Organization (WHO) since the adoption of the "Health for all by the year 2000" goal in 1978, involves a pivotal shift from curative care to preventive care. Highlighted in "Not enough there, too many here: understanding geographical imbalances in the distribution of the health workforce," ultimately, this reorientation aims to produce graduates better equipped and more willing to serve in underserved areas (9).

Furthermore, the imperative for primary prevention of oral and dental diseases, as emphasised in "Sultanate of Oman: building a dental workforce," underscores the necessity for appropriately trained dental personnel to promote health through general public policy and community initiatives. This signals a significant move toward a more comprehensive and preventive model of care (2). Aligning with this shift, "The equality of resource allocation in health care under the National Health Insurance System in Taiwan" suggests that reorienting health services towards a preventive and community-based approach could serve as a potential strategy to address the underlying factors contributing to the imbalance in healthcare resource allocation (15). These comprehensive strategies collectively aim to rectify dental workforce distribution imbalances, emphasising equitable oral healthcare access in underserved urban areas. While approaches may vary across countries and regions, the overarching objective remains steadfast: ensuring all populations have fair and inclusive access to comprehensive dental care.

Scientists from all around the globe agree on the significance of using fluoride toothpaste regularly to prevent dental cavities (25, 26). Nevertheless, a study in Belgium found that the use of fluoridated toothpaste did not differ according to socioeconomic status, which is in agreement with the high market share of fluoridated toothpaste sales (27). Research from England even revealed that children from poor socioeconomic regions placed more toothpaste on the brush and thus consumed more fluoride each toothbrushing session compared with children from high socioeconomic areas, and these differences were statistically significant (28). This might be the reason why rural school children have better oral health status and less workload for SDS compared to urban schools.

Regarding dietary influences on the prevalence of dental caries, the majority of population-wide initiatives to restrict sugar intake have been unsuccessful. The number of caries-free children in the Netherlands did not rise during the era when preventive dentistry focused on limiting sugar consumption. When fluoride became accessible, there was a sharp rise in the number of children without dental cavities. Throughout this time span, sugar intake remained consistent (29). When fluoride is applied twice daily with an adequate toothbrush, the relationship between sugar intake and caries incidence is considerably reduced or eliminated (30).

Conclusion

The geospatial analysis results indicate that an expanded dental staff is required to address the oral health demands of schoolchildren. There is a high ratio of one operator to total students distributed in the urban areas. The high number of students resulted in more students being treated per operator compared to the schools in rural areas. The need to equally distribute the SDS workforce based on workload is evident.

Acknowledgement

Ministry of Education, Malaysia Ministry of Health, Malaysia, Universiti Teknologi MARA, Sungai Buloh Campus, Selangor, Malaysia

Competing interests

The authors declare that they have no competing interests.

Ethical Clearance

The Medical Research and Ethics Committee (MREC), Ministry of Health Malaysia (MOH) has provided ethical approval for this study with the reference number of NMRR ID-22-00761-PSN (IIR). Clearance has also been obtained from the UiTM Faculty of Dentistry Research Ethics Committee with the reference number FRC/01/2022 (HE/7/13).

Financial support

The authors declare that they have not receive any funding for this research.

References

1. Ahern S, Woods N, Kalmus O, Birch S, Listl S. Needs-based planning for the oral health workforce - Development and application of a simulation model. Hum Resour Health. 2019; 17(1):1-9.
2. Birch S. Health human resource planning for the new millennium: inputs in the production of health, illness, and recovery in populations. Can J Nurs Res Rev Can Rech en Sci Infirm. 2002; 33(4):109-114.
3. Gallagher JE, Manickam S, Wilson NHF. Sultanate of Oman: Building a dental workforce. Hum Resour Health. 2015; 13(1):1-10
4. Othman N, Razak IA. Satisfaction with school dental service provided by mobile dental squads. Asia-Pacific J Public Heal. 2010; 22(4):415-425.
5. Jones RB. The School-Based Dental Care Systems of New Zealand and South Australia—a Decade of Change. J Public Health Dent. 1984; 44(3):120-124.
6. Ministry of Health M. Annual Report Oral Health 2019. Vol 2019. Available at: https://ohd.moh.gov.my/images/pdf/annual_rpt/annual_rpt19.pdf. Accessed 2 June 2022.
7. Linnan L, Steckler A. Process Evaluation for Public Health Interventions and Research: An Overview. Process Eval Public Heal Interv Res. 2002:1-23.
8. Mullner RM, Chung K, Croke KG, Mensah EK. Geographic information systems in public health and medicine. J Med Syst. 2004; 28(3):215-221.
9. Dussault G, Franceschini MC. Not enough there, too many here: Understanding geographical imbalances in the distribution of the health workforce. Hum Resour Health. 2006; 4:1-16.

10. Scott LM, Janikas M V. Spatial statistics in ArcGIS. Handb Appl Spat Anal. 2010; 27-28.
11. Kassebaum NJ, Bernabé E, Dahiya M, Bhandari B, Murray CJL, Marcenes W. Global burden of untreated caries: A systematic review and metaregression. J Dent Res. 2015; 94(5):650-658.
12. Ministry of Health M. Oral Healthcare for School Children in Malaysia. 2006. Accessed 2 June 2022.
13. Department of Statistics Malaysia. Available at: https://v1.dosm.gov.my/v1/index.php. Accessed 2 June 2022.
14. Gándara P, Gutiáez D, O'Hara S. Planning for the Future in Rural and Urban High Schools. J Educ Students Placed Risk. 2001; 6(1-2):73-93.
15. Kreng VB, Yang CT. The equality of resource allocation in health care under the National Health Insurance System in Taiwan. Health Policy (New York). 2011; 100(2-3):203-210.
16. Committee on Economic Social and Cultural Rights (CESCR). The right to the highest attainable standard of health. Gen Comment CESCR. 2000; 386(9995):738-739.
17. Leach MJ, Gunn K. The determinants of healthcare utilisation in regional, rural and remote South Australia: A cross-sectional study. 2022 Nov; 30(6):e4850-e4863.
18. Thomas SL, Wakerman J, Humphreys JS. Ensuring equity of access to primary health care in rural and remote Australia - what core services should be locally available? Int J Equity Health. 2015; 14(1):1-8.
19. Nouhi M, Fayaz-Bakhsh A, Mohamadi E, Shafii M. Telemedicine and its potential impacts on reducing inequalities in access to health manpower. Telemed e-Health. 2012; 18(8):648-653.
20. Glied S, Lleras-Muney A. Technological innovation and inequality in health. Demography. 2008; 45(3):741-761.
21. Williams JS, Walker RJ, Egede LE. Achieving Equity in an Evolving Healthcare System: Opportunities and Challenges. Am J Med Sci. 2016; 351(1):33-43.
22. Petersen PE, Hoerup N, Poomviset N, Prommajan J, Watanapa A. Oral health status and oral health behaviour of urban and rural schoolchildren in Southern Thailand. Int Dent J. 2001; 51(2):95-102.
23. Irigoyen ME, Luengas IF, Yashine A, Mejía AM, Maupomé G. Dental caries experience in Mexican schoolchildren from rural and urban communities. Int Dent J. 2000; 50(1):41-45.
24. Doley S, Srivastava M, Piplani A, Gupta R, Gautam Y, Singh C. Status of Dental Caries and Its Association with Oral Hygiene Practices among School-going Children of Rural and Urban Areas in Kamrup District of Assam. Int J Clin Pediatr Dent. 2022; 15(2):182-186.
25. Walsh T, Glenny AM, Worthington H V., Marinho VCC, Appelbe P. Fluoride toothpastes of different concentrations for preventing dental caries in children and adolescents. Cochrane Database Syst Rev. 2009; 3:1-175.
26. Bratthall D, Hänsel-Petersson G, Sundberg H. Reasons for the caries decline: what do the experts believe? Eur J Oral Sci. 1996; 104(4):416-422.
27. Van Nieuwenhuysen JP, Carvalho JC, D'Hoore W. Caries reduction in Belgian 12-year-old children related to socioeconomic status. Acta Odontol Scand. 2002; 60(2):123-128.
28. Zohoori F V., Duckworth RM, Omid N, O'Hare WT, Maguire A. Fluoridated toothpaste: Usage and ingestion of fluoride by 4- to 6-yr-old children in England. Eur J Oral Sci. 2012; 120(5):415-421.
29. Van C, Duggal MS. The role of diet in caries prevention. Int Dent J. 2001; 51:399-406.
30. Van Loveren C. Sugar Restriction for Caries Prevention: Amount and Frequency. Which Is More Important? Caries Res. 2019; 53(2):168-175.