

The impact of rural-exposure strategies on the intention of dental students and dental graduates to practice in rural areas: a systematic review and meta-analysis

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Background and objectives: The objective of this study was to assess the impact of strategies on the intention of dental students/graduates to practice in rural areas. The strategies included the recruitment of dental students from rural backgrounds and clinical rotations in rural areas during the training of dental students.

Materials and methods: The study undertook a systematic review and utilized meta-analysis to assess these strategies. International literature published between 2000 and 2015 was retrieved from three main search engines: Medline, Embase, and Scopus. The selected articles were scanned to extract the main content. The impact of the strategies was quantitatively assessed by meta-analysis, using the random-effect model. The pooled effect was reported in terms of odds ratios (ORs) with 95% confidence intervals. Sensitivity and subgroup analyses were performed. Publication bias was assessed by the Funnel plot and Egger's test.

Results: Seven of the initially selected 897 articles were included for the full review. The majority of the selected articles had been published in developed countries. The meta-analysis results revealed that the pooled OR of rural exposure on the intention to practice in rural areas was approximately 4.1, statistically significant. Subgroup analysis showed that clinical rotations in rural areas tended to have a slightly greater influence on rural dental practice than recruiting students from rural backgrounds (OR 4.3 versus 4.2). There was weaker evidence of publication bias, which was derived from small-study effects.

Conclusion: Enrolling students with rural backgrounds and imposing compulsory clinical rotation in rural areas during their study appeared to be effective strategies in tackling the shortage and maldistribution of dentists in rural areas.

Keywords: rural retention, rural background, dental students, dental graduates, systematic review, meta-analysis

Introduction

It is universally accepted that the health workforce is a critical component of health systems. An adequate volume of skilled health workers with equitable distribution significantly contributes to achieving health goals.¹⁻³ It is recommended that all countries should seek to achieve a health-workforce density of 2.28 doctors, nurses, and midwives per 1,000 population in order to ensure favorable health outcomes for their population.^{3,4} In this regard, the World Health Organization (WHO) has issued global recommendations to improve the recruitment and retention of a health workforce, particularly in rural and underserved areas.⁴ Of the 16 recommended interventions,

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those that have proved successful in many countries have been the recruitment of students from rural backgrounds and the establishment of teaching programs that encourage students to have rural experience during their studies.^{5,6}

While there is a fair amount of evidence in the fields of medicine and nursing, little is known about whether, or to what extent, the aforementioned strategies are still applicable to other health cadres.^{7–10} Dentists are one of the groups within the health workforce for which there is the least evidence; this is despite the fact that oral diseases are a major health problem worldwide. Petersen et al highlighted the fact that the burden of oral diseases is particularly heavy on disadvantaged populations, in both developing and developed nations.^{11–14} Although the WHO recommendations are intended to cover all types of health workers, the evidence that was used to generate the recommendations was mostly based on medicine and nursing. Of the 105 pieces of research presented in the WHO recommendations, only one was directly related to dentistry.¹⁵

Nonetheless, in recent years, there has been a growing body of research that has sought to assess the success of the aforementioned interventions in promoting the rural retention of dentists.^{16–18} However, there has not been any study attempting to compile all of this evidence in order to provide a robust answer about whether rural-retention strategies have “really” worked with regard to dentists. This study seeks to fill that knowledge gap by gathering evidence, via systematic review and meta-analysis approaches, to assess the impact of interventions promoting the retention of dentists in rural areas. It is hoped that the findings from this study will help to inform policy makers and academics interested in human resources for health planning, and that this may in turn assist them in implementing effective strategies to promote better recruitment and retention of dentists in rural areas. Furthermore, this study will help update the evidence of the validity of the WHO recommendations, six years after their initial publication. Note that the scope of this study is confined only to “rural exposure” strategies, ie, the recruitment of students from rural backgrounds, and the implementation of clinical rotations in rural areas during the training of dental students.

Materials and methods

A roundtable discussion was held by the authors to develop the review process, identify inclusion and exclusion criteria, and design the analysis plan. The review and meta-analysis findings were reported according to Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines.¹⁹

Search strategy

Potential articles were selected from two strands: a systematic search and a purposive search. In the systematic search, articles in the areas of medicine and dentistry were identified through three main search engines: Medline, Embase, and Scopus. In Medline, the search was performed through Medical Subject Headings (MeSH) and plain text. In Embase and Scopus, where MeSH searches are not applicable, an “exploding” search strategy was employed instead. The search was conducted in the keywords, abstracts, and titles of articles. The publication date was limited to studies published between January 1, 2000 and December 31, 2015. Due to limited capacity in language translation, studies written in any language but English were excluded. Truncations and wildcards were used in all search engines. The potential abstracts were retrieved from the library of the International Health Policy Programme, Ministry of Public Health of Thailand and its network libraries. Table 1 presents the search terms applied in each database.

In the purposive search, potential articles were retrieved from the website of the *Human Resources for Health* journal in the corresponding years. The search was focused on articles where the title keywords contained the terms “dentist” and “rural”. Additional references considered relevant to the review objective were also explored.

Study inclusion/exclusion

Abstracts of the articles initially retrieved from the search strategy were independently screened by two reviewers (RS and NC). Any disagreement between the two reviewers was resolved through discussion to reach a consensus. Articles that passed the initial screening were read in full to extract their key message to add to the data-extraction table. Eligible articles were included if they met all the following criteria: first, the study participants had to be either dental students or dental graduates; second, the main research method had to have been a quantitative approach; third, the study participants had to be divisible into two groups (an “exposure group” versus a “control group”); and fourth, the main outcome of interest had to be binary data, focusing on dental service in rural areas, either in terms of the intention to serve rural communities or real practice that already took place (“event” versus “no event”).

It should be noted that for convenience in communication, this study has outlined operational definitions of some important words/terms, which will be used from this point onward. “Exposure” participants refers to those participants with extensive experience in rural areas, either through

Table 1 Search terms used in Medline, Embase, and Scopus

Database	Search terms
Medline	((("Rural Health"[MeSH] OR "Rural Health Services"[MeSH]) OR rural[All Fields] OR (underserve[All Fields] OR underserved[All Fields] OR underserved[All Fields] OR underserves[All Fields]) OR remote[All Fields]) AND (("students, dental"[MeSH Terms] OR ("students"[All Fields] AND "dental"[All Fields]) OR "dental students"[All Fields] OR ("dental"[All Fields] AND "students"[All Fields])) OR "Students, Dental"[MeSH] OR "Education, Dental"[MeSH])) AND hasabstract[text] AND ("2000/01/01"[PDAT]: "2015/12/31"[PDAT]) AND "humans"[MeSH Terms] AND English[lang])
Embase	(exp rural health care/or exp rural population/or exp rural area/) AND (exp dental student/OR exp dental education)
Scopus	((TITLE-ABS-KEY (dental education)) OR (TITLE-ABS-KEY (dental student*))) AND ((TITLE-ABS-KEY (underserve*)) OR (TITLE-ABS-KEY (rural))) AND (LIMIT-TO (PUBYEAR, 2015) OR LIMIT-TO (PUBYEAR, 2014) OR LIMIT-TO (PUBYEAR, 2013) OR LIMIT-TO (PUBYEAR, 2012) OR LIMIT-TO (PUBYEAR, 2011) OR LIMIT-TO (PUBYEAR, 2010) OR LIMIT-TO (PUBYEAR, 2009) OR LIMIT-TO (PUBYEAR, 2008) OR LIMIT-TO (PUBYEAR, 2007) OR LIMIT-TO (PUBYEAR, 2006) OR LIMIT-TO (PUBYEAR, 2005) OR LIMIT-TO (PUBYEAR, 2004) OR LIMIT-TO (PUBYEAR, 2003) OR LIMIT-TO (PUBYEAR, 2002) OR LIMIT-TO (PUBYEAR, 2001) OR LIMIT-TO (PUBYEAR, 2000)) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (SUBJAREA, "DENT")) AND (LIMIT-TO (SRCTYPE, "j"))

having been brought up in rural areas or having experienced a program through school or university that provided opportunities to work, or practice, in a rural setting. Participants who did not fall into this category were considered "control" participants. For the study outcome, where participants (in the case of dental graduates) were providing dental services in rural areas, or where they showed a willingness/intention to practice in rural areas after graduation, this was described as "event", while "nonevent" meant that they were neither practicing in rural areas, nor had they demonstrated a willingness/intention to do so. In addition, the term "rural" in this review encompassed a wide range of settings, including but not limited to remote areas, underserved areas, charitable works servicing underserved populations, and community-based settings. The authors were fully aware of the fact that each study site has its own way of defining "rural". Given this situation, it is difficult to draw a rigid line indicating which setting should be regarded as "rural" and which should not. Accordingly, a more flexible approach was applied allowing for the interpretation of "rural" to be assessed according to each study's context. A remark to remind the reader of the operational definition of how each study defined the term "rural" is displayed in the data-extraction table.

Articles were excluded from the review if they met any one of the following criteria: populations of interest were neither dental graduates nor dental students; the main data-collection technique used was a qualitative approach; the main message was not related to the intention of dental students/graduates to practice in rural communities; the study participants could not be classified into "exposure" and "control" groups; the outcome of the study demonstrating the binary difference between "event" and "nonevent" was lacking (note that a study exploring participants' satisfaction with dental rural service in terms of satisfaction scores [using

the Likert scale, for instance] without specifying a cutoff point for the authors to distinguish between an "event" and a "nonevent" also met this exclusion condition); and finally, articles where the information shown in the study abstract was insufficient to assess the relevance of the research to this review's objective. All potential articles were then checked for duplication. EndNote software version X4 was used to store and manage recruited studies in a computerized format.

Assessment of study quality

The authors assessed the risk of bias and the quality of the selected studies without calculating a composite score or imposing a cutoff score to eliminate articles of apparently poor quality. Reasons for not using a cutoff score are outlined. Unlike in clinical trials, for observational studies (like all articles selected here), there has not been agreement on the critical elements for evaluating susceptibility to bias. Sanderson et al suggested that there were more than 86 tools for evaluating the quality of observational studies.²⁰ Furthermore, an article that appears to have poor quality from a checklist score may actually be less biased, because most scoring systems, such as the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guideline, assess the quality of "reporting" rather than the rigor of study design and methodology.²¹ Even in clinical trials, Jüni et al recommended that the use of summary scores to identify studies of high quality might be problematic: relevant methodological aspects of each study should be assessed individually.²² Therefore, in this study, the risk of bias and methodological limitations of the selected articles were described qualitatively in the data-extraction table, in order to remind the readers of possible biases that might influence the accuracy of the review results.

Statistical analyses

Main analysis

Meta-analysis was performed using the random-effect (RE) model (DerSimonian–Laird method).²³ Since almost all the selected articles were cross-sectional studies, the pooled and individual effects were reported in terms of odds ratios (ORs) with 95% confidence intervals (CIs). *P*-values less than 0.05 were considered statistically significant. As suggested by Borenstein et al, the authors considered the RE model to be a more appropriate choice than the fixed-effect (FE) model in this setting. This was because, firstly, it was assumed that there might be a considerable degree of heterogeneity between studies, resulting from intrinsic differences in the health care systems of each country. Furthermore, the RE model does not impose a restriction of common effect size like the FE model. This grants the RE model greater power of generalizability than the FE model.²³ Nonetheless, the pooled effect calculated by the FE model is briefly presented in the sensitivity-analysis subsection to allow the reader to compare the results between the two models. The degree of heterogeneity between studies was assessed by the I^2 statistic. All calculations were performed by Stata 12.

Sensitivity and subgroup analyses

Sensitivity analysis was conducted by changing the effect size from OR to risk ratio (RR). While OR is more commonly used than RR in many observational studies, there is a risk of serious divergence between OR and RR when a study of interest has an extremely large effect. In such circumstances, OR might lead to an overestimation of the RR.²⁴ The sensitivity analysis also helped test whether the rural-exposure strategies were still robust, given a change in measurement of effect size. In addition, subgroup analysis was performed by dividing the selected articles into two groups: studies that explored the effect of a rural background on dental students/graduates, and studies that explored the effect of curricula or teaching programs that aimed at increasing the experience dental students had of rural areas.

Assessment of publication bias

Publication bias was assessed by two means: a visual inspection by funnel plot and Egger's test. Egger's test has been by far the most widely used approach for assessing small-study effects (a tendency for the effects estimated in small groups of students to differ from those estimated in larger studies). The result of Egger's test are presented in terms of bias coefficient, which is derived from a regressing standard normal deviate of the effect estimated against its standard error.²⁵

Ethical approval

As this is a review manuscript where data were retrieved from open sources, the study was waived for applying for approval by the ethics committee of the Institute of the Development of Human Research Protections, Thailand.

Results

An overview of the study-selection process is illustrated in Figure 1. A total of 897 articles were retrieved for initial screening: 716 articles from the systematic search (317 from Medline, 74 from Embase, and 325 from Scopus) and 181 articles through the purposive search. After the dropping of 202 duplicated articles and eight articles where the authors' details were not available, 687 articles were left for initial abstract screening. Of the 687 articles, eleven met the inclusion criteria and were then read in full to assess their relevance to the review's objective. The κ -coefficient for between-rater agreement came out at 0.4, indicating a fair level of agreement between the two reviewers ($P < 0.001$).²⁶ The eleven articles were read in full, and of these, seven were identified that had sufficient information to be included in the meta-analysis. An example of the excluded articles was the study by Rohra et al, which investigated the association between community-based dental education and dentists' attitude toward treating patients from underserved populations.²⁷ Although the article's abstract appeared to meet the review's inclusion criteria, its full text showed that the study participants were assessed for their attitudes by Likert-scale questionnaires: this made it difficult to distinguish the "event" participants from the "nonevent" participants.²⁷

Of the seven articles included for the final review, five were from high-income countries (three from the US and two from Australia).^{28–32} Only two studies were conducted in middle-income countries: South Africa and Thailand.^{33,34} Three articles explored the influence of rural origins of dental students/graduates,^{32–34} while the other four articles investigated the impact of special didactic programs or rural placements after graduation.^{28–31} It should be noted that the definition of "rural" varied across studies. For instance, McMillan and Barrie defined "rural" in South Africa as any administrative area that was smaller than a town or city,³³ whereas Thammatacharee et al considered the term "rural" to refer to all districts, other than provincial capitals, in all Thai provinces outside Greater Bangkok.³⁴ All the selected articles demonstrated some degree of bias, as they were conducted in uncontrolled settings where randomization was not feasible. A cross-sectional design was the most commonly used approach. Detailed characteristics and potential

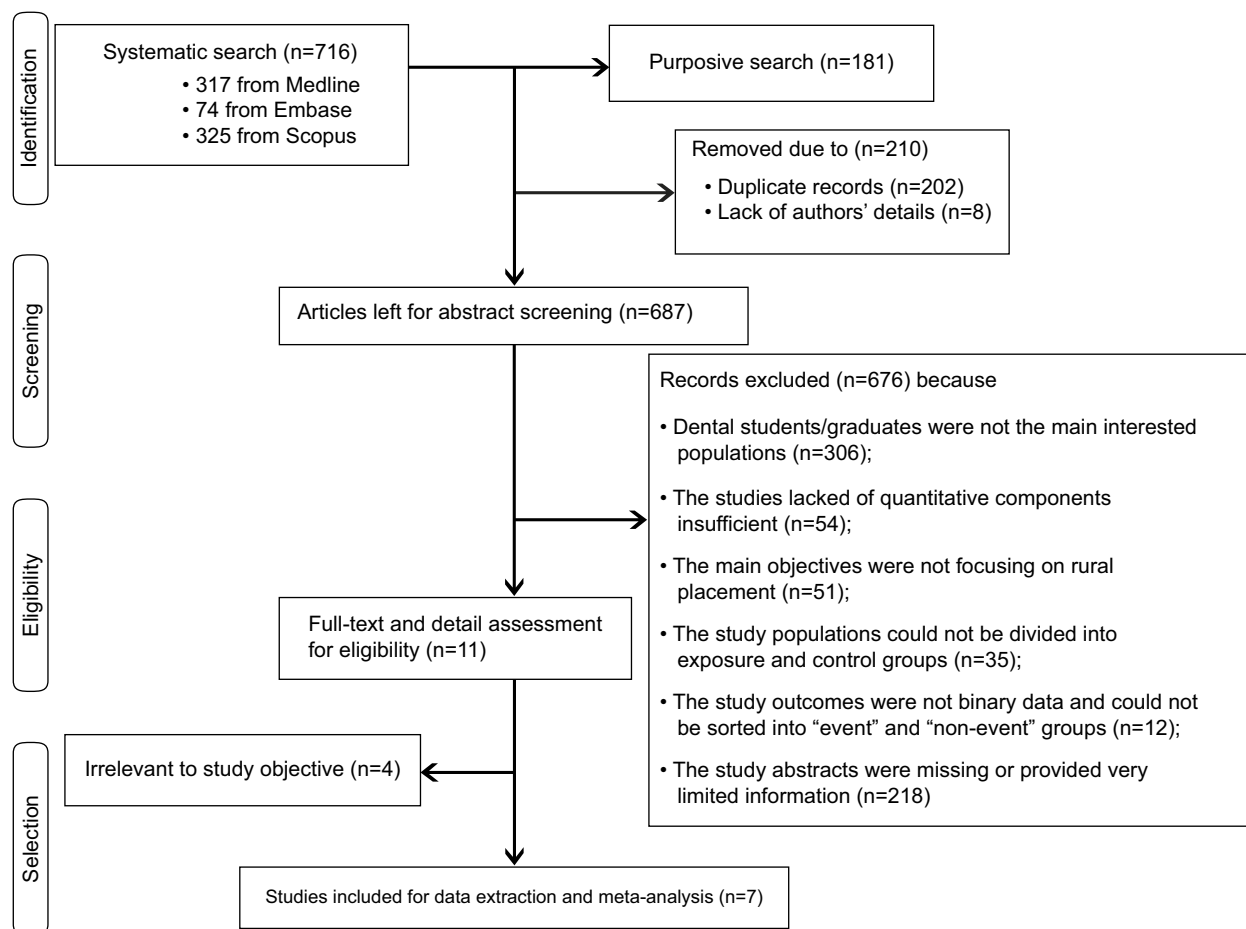


Figure 1 Overview of the article-selection process.

biases of each study are displayed in data-extraction tables (Tables 2 and 3). The number of participants varied considerably between studies. The lowest number of participants was found in Johnson and Blinkhorn ($n=62$).²⁹ McFarland et al enrolled the largest number of participants ($n=1,361$).³²

Overall, experience of living or working in rural areas appeared to have a positive impact on intention to practice in rural areas. The ORs in most studies varied from 2.2 to 6.9. The only exceptions were found in Johnson and Blinkhorn, where there was only one person from the “exposure” group that experienced the “event”, and this situation led to a huge OR of 56.4. Note that the ORs presented here might be slightly different from those presented in the original studies, since they were recalculated by the authors after excluding missing data and regrouping each study’s participants according to the review objective. The RE model meta-analysis revealed that the pooled estimate of the ORs of all seven studies was approximately 4.1, with statistical significance (as evidenced by the 95% CI of 2.6–6.5). The I^2 statistic was as large as 66%, which reflected a substantial degree of heterogeneity ($P=0.007$). Therefore,

because of this considerable degree of heterogeneity, the application of the RE model is considered a valid approach (Table 4; Figure 2).

The FE model (data not shown) had a slightly different result, with the pooled estimate increased to 4.3. A potential explanation for this slight difference from the RE model is that the FE model gave greater weight to articles with a larger volume of participants.

The sensitivity analysis was conducted by changing the measurement of the pooled estimate from OR to RR. The pooled RR (2) appeared to be about half the size of the pooled OR (4.1) but still had statistical significance. The I^2 statistic became larger in the sensitivity analysis (92.1), illustrating that the RE model had greater validity than the FE model in this situation (Figure 3).

Subgroup analysis showed that the teaching programs that helped increase rural experience in dental students tended to have a marginally greater impact on intention to serve rural communities than the interventions that aimed to recruit more students with a rural background (OR 4.3 versus 4.2), but both strategies still had a statistically significant impact (Figure 4).

Table 2 Data-extraction table presenting key characteristics of each study

Study	Site	Design	Participants	Data collection	Exposure	Event	Definition of "rural"
DeCastro et al ²⁸	USA	Cross-section	Dental graduates	Self-administered questionnaire	Alumni of the Community-Oriented Dental Education (CODE) program	Reporting interest in helping communities after graduation	Underserved area where the distance from schools is about 145–195 km
Johnson and Blinkhorn ²⁹	Australia	Cross-section	Dental students	Self-administered questionnaire	Fourth-year students who participated in a rural placement program	Intention to work in rural location after they graduate	Not clearly described
McFarland et al ³²	USA	Retrospective cohort	Dental graduates	Tracking alumni records	Rural background (based on domicile where respondents were brought up or the location of their high school)	Currently working in a rural county after graduation	Counties with populations of 50,000 or fewer
McMillan and Barrie ³³	South Africa	Cross-section	Dental students	Self-administered questionnaire	Rural background (based on domicile where respondents were brought up)	Intention to work in rural areas	Administrative areas smaller than a town or city
Johnson and Blinkhorn ^{30,b}	Australia	Cross-section	Dental graduates	Tracking records of dental graduates from the Australian Health Practitioner Regulation Agency	Graduates who participated in rural placement program	Currently working in rural areas	Area with a population of fewer than 100,000
Thammatacharee et al ³⁴	Thailand	Cross-section	Dental graduates	Self-administered questionnaire	Rural background, defined as having been brought up in a rural area during the first 15 years of life	Intention to practice in a community (district) hospital given, not contract-bound	Nonprovincial capital district of any province outside Greater Bangkok
McQuistan et al ³¹	USA	Cross-section	Dental graduates	Self-administered questionnaire	Participating in Community-Based Dental Education (CBDE) program (a 10-week rotation in community health centers or nursing homes)	Current involvement in charitable dental service in community	Not clearly described

Notes: ^aQuestionnaire did not directly ask respondents about their intention to serve rural areas. The respondents were asked to report whether they agreed that "interest to serve the communities" was an important factor in selecting a workplace after graduation. ^b2008 data not included, since in 2008 the clinical rotation program had not been fully implemented.

The funnel plot demonstrated quite a symmetrical distribution of the dots (representing the effect size of each study) on either side of the vertical line (representing the pooled estimate). The only exception was found in Johnson and Blinkhorn, where the OR seemed to be an outlier.²⁹ The seemingly symmetrical appearance of the plot suggested weak evidence of publication bias. Egger's test also supported this notion, because the bias coefficient did not significantly deviate from zero (coefficient 0.06, $P=0.961$; data not shown). The interpretation of Egger's test was that if the coefficient deviated from zero, with statistical significance, then publication bias could not be ruled out. This point will be discussed further (Figure 5).

Discussion

This review is one of the very first studies in the human resources for health research field that has attempted to

estimate the impact of rural experience on the placement of dental graduates in remote and rural areas through a meta-analysis approach, which is commonly accepted in medical and public health fields as the highest level of evidence.³⁵ However, while meta-analysis is widely accepted as the means to obtain the highest level of evidence, the authors are aware that this is dependent on the quality of the individual studies that make up the meta-analysis. The key findings suggested that dental students/graduates with rural experience tended to have an approximately fourfold higher probability of practicing in rural areas than those without rural experience (or about twofold higher possibility if the effect was measured by RR).

As highlighted in the introduction, research on the retention of dental professionals in remote and rural areas is quite sparse relative to similar research regarding medical and nursing professionals.^{7–10} Therefore, this study helps fill the

Table 3 Potential biases and methodological limitations in each study

Study	Critical limitations or potential biases
DeCastro et al ²⁸	<ul style="list-style-type: none"> The question used to gather information on practice settings might be subject to misinformation bias. For instance, “community-based practice setting” could describe either a private practice in a community or a public community health center. The questionnaire asked a respondent to report if he/she agreed with the statement that interest in serving rural areas was the key factor in their workplace selection, rather than asking his/her willingness to practice in rural areas.
Johnson and Blinkhorn ²⁹	<ul style="list-style-type: none"> There was the potential for recall bias and judgment error because the timing for completing the questionnaire was different between the exposure and control groups.
McFarland et al ³²	<ul style="list-style-type: none"> The college instigated numerous special programs to encourage rural placement of graduates. However, the study showed only the effect of a rural background on students, while other measures to encourage rural placement were not assessed. The study did not clearly indicate whether the practice after graduation referred to the job placement immediately after graduation or the job placement of graduates at the time of completing the study.
McMillan and Barrie ³³	<ul style="list-style-type: none"> Respondents who were unsure of their future workplace were not included in the analysis (n=11). The study participants were dental students from different years. About a quarter (n=80) of participants were first-year students. The first-year students’ willingness to work in rural areas might have changed when they became final-year students.
Johnson and Blinkhorn ³⁰	<ul style="list-style-type: none"> As the study explored the records of the workplace location of dental graduates at just one point in time, this might have been subject to bias, since job vacancies for dentists varied by month.
Thammatacharee et al ³⁴	<ul style="list-style-type: none"> The survey was conducted at the annual health-workforce meeting arranged by the Ministry of Public Health (MOPH). This is the meeting where the MOPH assigns new graduates to available workplaces. Taking an MOPH post is obligatory for all doctors and dentists graduating from public institutions. Graduates who intend to enter private practice right after graduation are required to pay a fine and need not attend the workplace-selection meeting. Therefore, the survey might have encountered selection bias.
McQuistan et al ³¹	<ul style="list-style-type: none"> The nonevent group comprised a mixture of participants, ie, those not providing charitable service and those providing charitable service, but not in a community setting. The study did not clearly indicate the operational definition of “community” setting. The survey suffered from a large volume of nonrespondents (response rate ~41%).

Table 4 Number of “exposure” and “control” participants in each study

Study	Total participants, n	Exposure participants, n	Control participants, n	Exposure participants with event, n	Exposure participants without event, n	Control participants with event, n	Control participants without event, n
DeCastro et al ²⁸	111	46	65	38	8	39	26
Johnson and Blinkhorn ²⁹	62	32	31	31	1	11	20
McFarland et al ³²	1,361	708	653	361	347	107	546
McMillan and Barrie ³³	284	14	270	11	3	94	176
Johnson and Blinkhorn ³⁰	77	30	47	13	17	7	40
Thammatacharee et al ³⁴	202	45	157	35	10	97	60
McQuistan et al ³¹	541	427	114	320	107	61	53

knowledge gaps on this subject in the field of dental professionals, and the methodology applied serves as an example for health-system researchers of how to gather and analyze evidence to answer real-life policy-research questions.

In addition, this discovery helps provide evidence to support the WHO guidelines for improving the retention of health workers in remote and rural areas.⁴ The WHO guidelines previously gave the level of evidence in recommendation item A1, “enrolling students with rural background”, and item A3, “clinical rotations in rural areas during studies”,

as “moderate” and “very low”, respectively. Moreover, the strength of recommendation for the implementation of these strategies was ranked as “conditional” rather than “strong”.⁴

Given this study’s findings, it is suggested that enrolling rural students and imposing clinical rotation during study years in the WHO guideline should be regarded as “strong evidence” support. The countries with health-workforce shortages in rural areas should be “strongly” encouraged to implement these strategies.

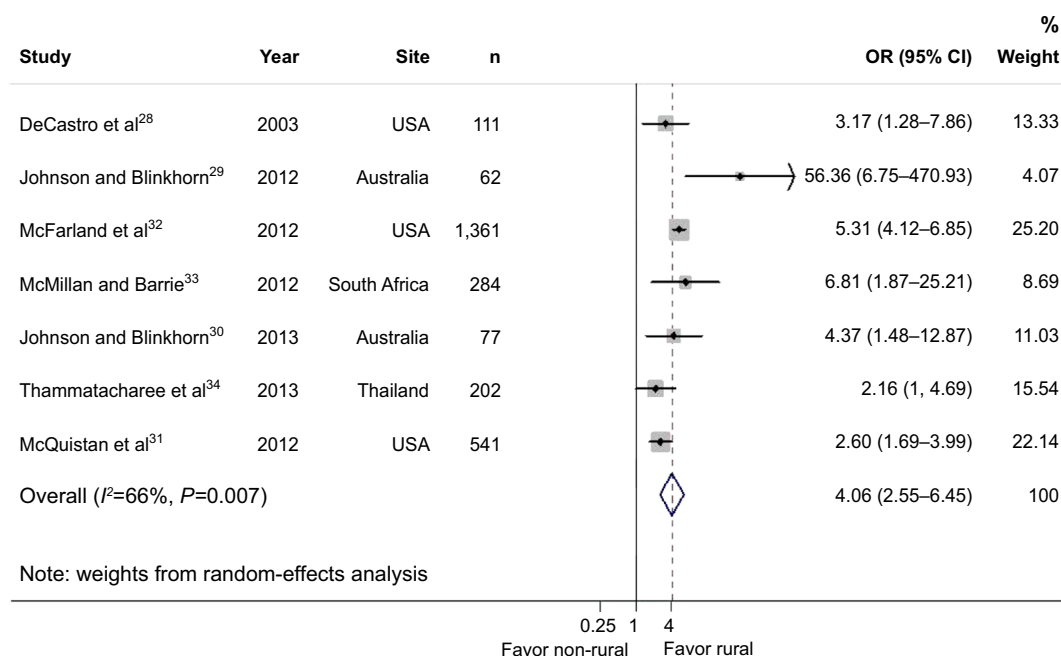


Figure 2 Meta-analysis of all seven studies with random-effect model, showing results in terms of OR.

Abbreviations: OR, odds ratio; CI confidence interval.

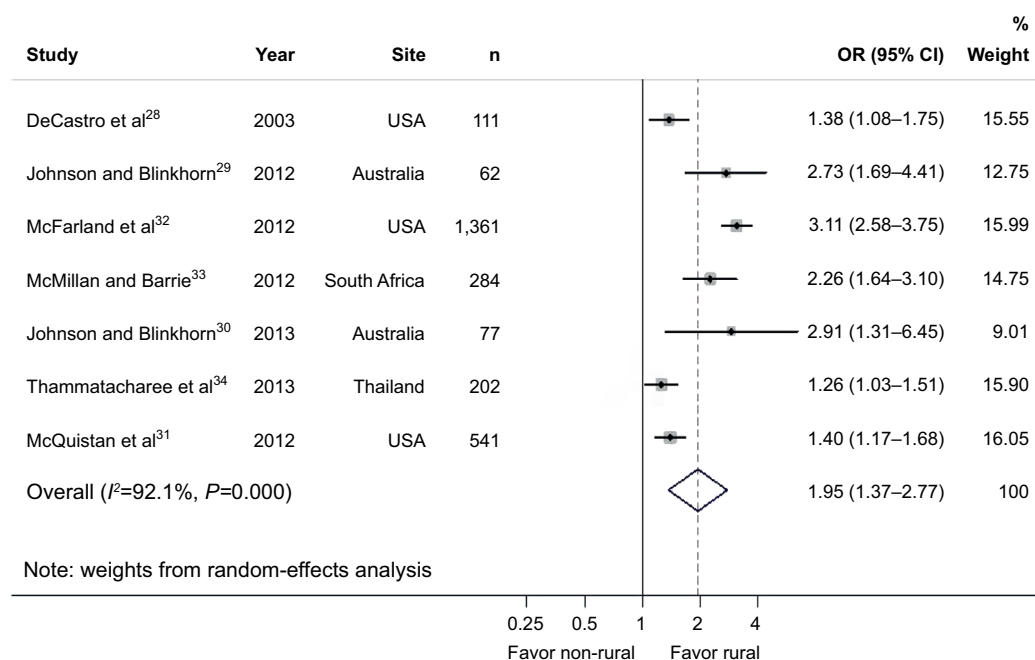


Figure 3 Meta-analysis of all seven studies with random-effect model, showing results in terms of RR.

Note: A P -value of 0.000 is a P -value of less than 0.001 due to the standard STATA output.

Abbreviations: RR, risk ratio; CI confidence interval.

A range of qualitative literature also shed light on how and why rural experience shaped the attitudes that dental students had toward rural work. For instance, Abuzar et al reported that clinical rotations in rural areas provided “worthwhile” and “enjoyable” experiences for dental students. These experiences also helped dental students appreciate and understand the specific oral health needs of underserved populations.³⁶

Aside from the increase of “rural spirit” in dental students, Mashabi and Mascarenhas³⁷ and Formicola and Bailit³⁸ suggested that clinical rotations in rural areas had important benefits in increasing basic skills, self-confidence, and speed in dental practice.^{37,38} Another related advantage of rural clinical rotations was a better understanding of practice management, including the roles of clinical and administrative staff.³⁷

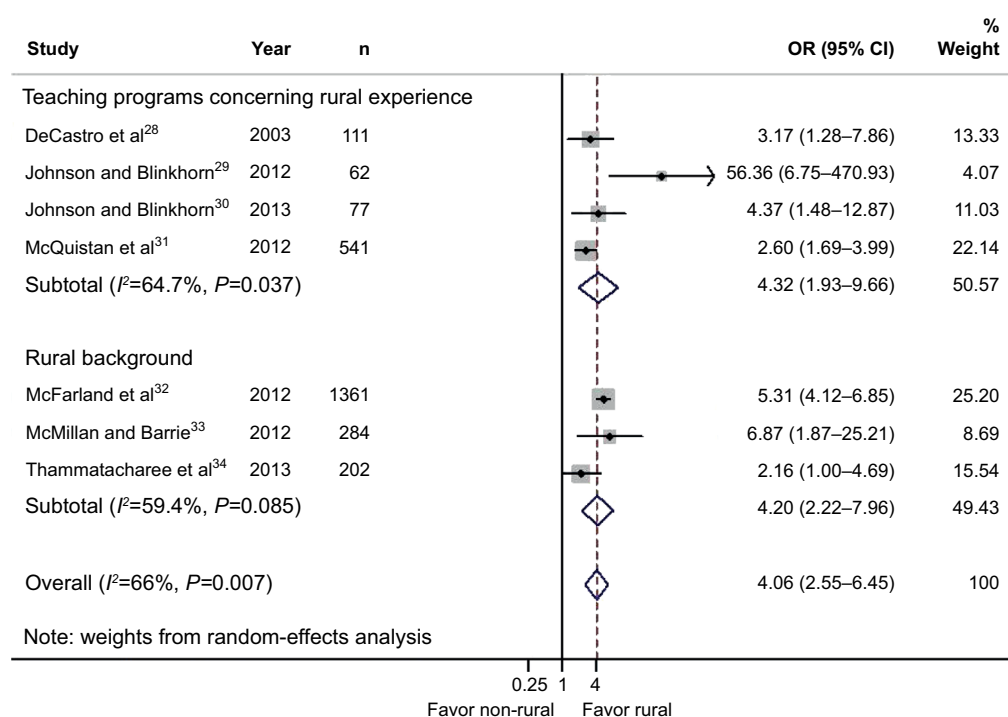


Figure 4 Subgroup meta-analysis between rural background and rural clinical rotation.

Abbreviations: OR, odds ratio; CI confidence interval.

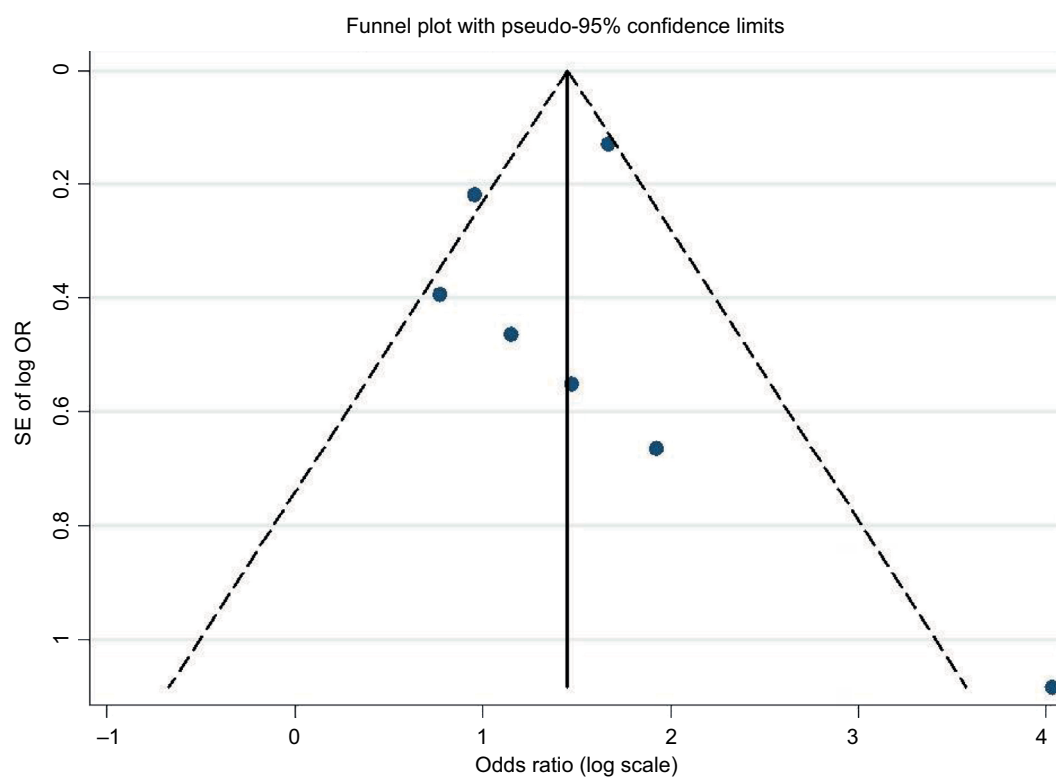


Figure 5 Funnel plot of the seven studies.

Abbreviations: SE, standard error; CI confidence interval.

Despite the rigorous review protocol and statistical analyses, this study still encountered some key limitations. Even though three well-known databases were searched, there is a possibility that important studies were missed, particularly those published in domestic journals or in gray-literature databases (so-called citation bias). It should be remembered that only studies published in English were considered for selection. Among the seven selected articles, there was only one study, Thammatacharee et al,³⁴ that was conducted in a country where English is not the official language, and articles from some regions, ie, Europe and Africa, were still missing. Therefore, it is quite likely that language bias exists in the review. Though the funnel plot and Egger's test suggested weak evidence of publication bias, this does not mean that all sources of publication bias were ruled out. Egger's test is helpful in detecting publication bias that is derived from the small-study effect, ie, the possibility of including small studies with spuriously inflated estimates in the review, while ignoring those without statistically significant effects, which had a lower possibility of being published.³⁹ However, other causes of publication bias have not been addressed. Finally, to apply the review findings to real-world policy implementation, one must be fully aware that the strategies of enrolling students from rural backgrounds and providing clinical rotations in rural areas are not a silver bullet for tackling the shortage and maldistribution of the health workforce. Other supporting measures, which are beyond the scope of this study, such as the continuous development of health staff, adequate financial incentives, and sufficient outreach support, should also be implemented concurrently. Future reviews and meta-analyses that explore the impact of these mutually supportive measures are recommended.

Conclusion

Enrolling students with rural backgrounds and imposing clinical rotation in rural areas during study years appeared to be effective strategies in tackling the shortage and maldistribution of dentists in rural areas. The evidence from the meta-analysis revealed that students with rural exposure tended to have a fourfold-higher chance of proceeding to or intending to serve rural populations than those without exposure to rural areas. This phenomenon is most likely due to the fact that rural experience enabled students better to understand the oral health needs of underserved populations and at the same time improved their clinical knowledge and skills. Future reviews and meta-analyses that explore the impact of other supporting measures aside from these strategies are recommended.

Author contributions

RS, NC, and WP designed the study. RS and NC were responsible for data collection and analysis. RS, NC, and AD crafted the first draft of the manuscript. All authors contributed toward data analysis, drafting and critically revising the paper and agree to be accountable for all aspects of the work.

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Disclosure

The authors report no conflicts of interest in this work.

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