Concentration of Undergraduate Dental College Admissions in Areas with High Health and Human Development in India

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Abstract: The aims of this study were to determine if dental colleges are clustered in selective states in India and if population to dental college admissions (seats) is correlated with regional health, economic, and human development in that country. There are 29 states and seven union territories in India, with 301 dental colleges. This study used publicly available data from the Dental Council of India, Comptroller and Auditor General of India, Ministry of Health and Family Welfare, and Institute of Applied Manpower Research of the Government of India. Non-parametric tests were used to test for associations. In academic year 2013-14, a total of 293 approved and recognized colleges were in existence, and a total of 23,780 seats were available in all dental colleges. Close to 54% of all dental colleges and 55% of all dental college seats were clustered in five states. The mean population per dental college seat was 94,324 (median was 46,898, and range was a minimum of 2,432 to a maximum of 780,139). The population to one dental college seat decreased significantly as the health and human development index increased (p<0.05). The results showed that dental colleges are clustered in a few states, leaving multiple states in India with no dental colleges. Dental colleges appear to be located in states with high health, economic, and human development indices, thus doing little to address the imbalance in dentist to population ratios in states that are disadvantaged in terms of health, economics, and human development.

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India with its burgeoning population and changes in economic policies over the past decade is poised for tremendous growth in the coming years.1,2 This country has one of the world’s fastest growing economies with an average annual GDP growth of close to 6%.3 India has a universal health care system and a parallel private medical sector. While the quality and access to health care in urban areas are deemed good, there are marked barriers to access to health care in rural settings.4,5 This is even more pronounced with regards to dental care, with high unmet demand for dental care services in rural areas of India.6,8 It has been estimated that there are 250,000 people for one dentist in rural areas.9 The last two decades have witnessed the opening of several new dental colleges in India,10-12 but little is known about the impact of these new colleges on access to oral health care in rural areas.

As a first step to address this problem, it would be pertinent to examine the geographic regions where these dental colleges are located. As of May 2014, there were a total of 28 states and seven union territories in India and a total of 301 dental colleges in 26 states and union territories. In June 2014, the state of Andhra Pradesh was divided into two states: Telangana and Andhra Pradesh. Consequently, there are now 29 states and seven union territories. The aims of this study were to provide estimates of the number of dental colleges, dental college admissions (into the first year of Bachelor of Dental Surgery programs), and geographic location of dental colleges in India and to determine if dental colleges are located in selective states. Specifically, this study examined if population to dental college admissions (seats) is correlated with regional health, economic, and human development in India.

Materials and Methods

The study was granted Institutional Review Board exempt status by The University of Iowa Human Subjects Review Office (number 201405761). The study used publicly available data from the websites of the Dental Council of India,10 Comptroller and Auditor General of India,11 Ministry of Health and Family Welfare of the Government of India,13 the census of the Government of India,14 and Institute of Applied Manpower Research of the Government of India.15
The Dental Council of India was constituted under the Act of Parliament Dentists Act (XVI of 1948) in 1949 with amendments made in 1992. This body provides general oversight of dental education in India and is responsible for maintaining the uniform standards of dental education and for granting permission to start dental colleges, introduce new programs in dental colleges, and set the number of admissions in dental colleges. The website of the Dental Council of India provides an online tool that was used to obtain the list of dental colleges, location of dental college, ownership/control of dental college (government or private institution), annual number of admissions (seats) into the Bachelor of Dental Surgery program in each college, and current status of dental college (recognized, permitted, or not approved/permitted). As of May 12, 2014, college admissions and status data were available for the academic year 2013-14.

The Comptroller and Auditor General of India is the audit institution of India. This institution was established to conduct audits in the public sector and provides accounting services in accordance with the Constitution of India. For this study, data on the number of dental colleges and audit of dental colleges and dental education were obtained from the Report of the Comptroller and Auditor General of India for the year ended March 2011, Union Government (Civil), Autonomous Bodies Performance Audit No. 14 of 2012-13.

The Ministry of Health and Family Welfare is charged with health policy in India and deals with all health care-related programs. The Medical Council of India and Dental Council of India are under the administrative control of the Ministry of Health and Family Welfare. Census data and key indicators on health were obtained from the websites of the Census of the Government of India and the Ministry of Health and Family Welfare, respectively.

The Institute of Applied Manpower Research is an autonomous institution that works in collaboration with the Planning Commission of the Government of India. This body is responsible for preparing the five-year plans of India and financing the programs that implement the plans. Data on health index, economic index, and human development index (HDI, a composite statistic of life expectancy, education, and income indices) were obtained from the India Human Development Report of 2011. This report provides state/union territory-specific data on health index, economic index, and HDI. The most updated state/union territory-specific data for use in this study was from 2007-08. There is a six-year time lag between the indices data and the dental college data; however, no significant changes are expected in the indices data for that six-year period.

Health index, economic index, and HDI data by individual states and union territories were (as of May 12, 2014) available for 22 states and union territories. One HDI is computed for all the northeastern states (excluding Assam). A total of 26 states/union territories had dental colleges. For those states/union territories for which health index, economic index, and HDI data were not available, the data for state in closest proximity were used. In this study, for the union territory of Chandigarh, the data for Punjab were used; for Pondicherry, the data for Tamil Nadu were used; and for Daman and Diu, the data for Gujarat were used. For Manipur, composite data for all northeastern states were used. All three indices are scored on a scale from 0.00 to 0.99 with higher scores indicating better health, economic, and human development. The mean health index for the entire country was 0.563, while the mean economic index and HDI were 0.271 and 0.467, respectively. States with an HDI of ≥0.800 are designated as very high/high human development states, while those with an HDI of 0.500 to 0.799 are medium development and those with an HDI <0.500 are low development states. Based on these criteria, none of the states/union territories in India is a very high/high development state.

Data from the websites of the Dental Council of India, Comptroller and Auditor General of India, Ministry of Health and Family Welfare of the Government of India, and Institute of Applied Manpower Research of the Government of India were compiled and entered into an SPSS datasheet. Simple descriptive statistics and charts were used to present the data. Data were compiled for each state/union territory in India. The variables of interest were number of dental colleges (in 1993 and 2013-14), number of dental college seats (admissions into the Bachelor of Dental Surgery program), population per dental college seat for each state/union territory (computed by dividing the state/union territory-specific population by the total number of dental college seats available in that particular state/union territory), health index, economic index, and HDI. In 1993, an amendment to the Dental Act (Sections 10A, 10B, and 10C) was introduced to limit the growth in number of dental colleges in India. This is the reason data from 1993 were used to compare with the currently available data (as of May 2014 for academic year 2013-14).
Results

In academic year 2013-14, a total of 301 dental colleges in 26 states and union territories were in existence. Of these, admissions were halted in one college, one college was to be closed, and six colleges were not permitted to admit any further students. The final sample for this study thus consisted of 293 colleges. Of these, 42 were government colleges, and 251 were private colleges.

The distribution of colleges by state and union territory is shown in Figure 1. Close to 54% of all colleges were located in only five states: Karnataka (15.4% of all colleges), Maharashtra (11.3%), Tamil Nadu (9.6%), Uttar Pradesh (9.2%), and Andhra Pradesh (8.2%). A majority of the states/union territories had a significantly higher number of private colleges compared to government dental colleges (p=0.001, Wilcoxon signed-rank test).

The distribution of number of first-year admissions (seats) in the Bachelor of Dental Surgery programs across states/union territories is shown in Figure 2. A total of 23,780 seats were available in all dental colleges (2,420 in government colleges and 21,360 in private colleges). Across the states, there was a significantly higher number of total seats in private colleges than in government colleges (p<0.0001, Wilcoxon signed-rank test). There was a significant amount of clustering of dental college seats in five states (55.2% of all seats were in the states of Karnataka, Maharashtra, Uttar Pradesh, Tamil Nadu, and Andhra Pradesh).

Based on 2011 census information, the total population of India is 1.2 billion, of which 833 million reside in rural areas and 377 million in urban areas. Population by each state and union territory is shown in Figure 1. Data on health index, economic index, and HDI by state/union territory are shown in Figure 3. The mean health index for the entire country was 0.563, while the mean economic index and HDI were 0.271 and 0.467, respectively. Of the 26 states/union territories that had dental colleges, eight had a health index of <0.563, and eight had an economic index of <0.271. Out of the 26 states/union territories that had dental colleges, 15 were designated as having medium human development (HDI 0.500 to 0.799), and 11 were designated as low human development states (HDI <0.500).

Population per one dental college seat was computed for each state (Figure 4). These data were highly skewed, with the mean population being 94,324 per one dental college seat (median was 46,898 and range was a minimum of 2,432 to a maximum of 780,139 per one dental college seat). There was a significant trend in the correlation between population to one dental college seat and health index (Figure 5). The population to one dental college seat was significantly higher for states/union territories with a health index below the national average (p=0.006, Mann Whitney U test). The population to
The population per dental college seat was 126,160 in states/union territories with an economic index <0.271 and 80,174 in states/union territories with an economic index ≥0.271. The population per dental college seat was significantly higher for states/union territories with an economic index below the national average (p=0.004, Mann Whitney U-test) (Figure 6). The population per dental college seat reduced as the HDI increased (Figure 7). An independent sample test (Mann Whitney U test) examining the distribution of population to one dental college seat by medium versus low HDI states/union territories showed a statistically significant difference (p<0.0001). States/union territories with a medium HDI had an average of 34,778 population to one dental college seat, while states with a low HDI had an average of 175,523 population to one dental college seat.

Bivariate linear regression analyses were used to examine the associations between population to one dental college seat and health index, economic index, and HDI. The results showed that, as the health index increased, the population to one dental college seat reduced significantly (p=0.02). As the economic index increased, the population to one dental college seat reduced, but this association was not statistically significant (p=0.06). There was a significant reduction in population to one dental college seat as the HDI increased (p=0.04). The results of the correlation analysis between population to one dental college seat and health index, economic index, and HDI were as follows: health index -0.503 correlation coefficient (p=0.009), economic index -0.535 correlation coefficient (p=0.005), and HDI -0.545 correlation coefficient (p=0.004). As the three indices increased, the population to one dental college seat reduced (p≤0.004).
Since the inception of the first dental college, there has been a gradual increase in the numbers of dental colleges and dental graduates across the states of India. In 1950, there were three dental colleges (all government); in 1980, there were 22 dental colleges (17 government and five private), and in 2000, there were 134 dental colleges (30 government and 104 private). In 1960, a total of 1,370 dentists graduated from these dental colleges, and in 1970 about 8,000 dentists graduated. Close to 20,000 dentists graduated in 1990. There were 75 dental colleges in India in the year 1993. An amendment to the Dental Act (Sections 10A, 10B, and 10C) was approved that year to limit the growth in number of dental colleges. Despite this amendment, the two decades since 1993 saw a significant increase in the number of dental colleges.

The distribution of total number of dental colleges in 1993 and 2013-14 is shown in Figure 8. In 1993, there were a total of 75 dental colleges in 19 states and union territories, while the number in 2013-14 was 293 in 26 states and union territories (p<0.0001, Wilcoxon signed-rank test). Over this 20-year period, 23 states/union territories had an increase in number of dental colleges, while one had a reduction in number of dental colleges and there was no change in two states/union territories.

**Discussion**

The first autonomous dental college in India was established in 1920, and the first private dental college was established in 1966. Since the inception of the first dental college, there has been a gradual increase in the numbers of dental colleges and dental graduates across the states of India. In 1950, there were three dental colleges (all government); in 1980, there were 22 dental colleges (17 government and five private), and in 2000, there were 134 dental colleges (30 government and 104 private). In 1960, a total of 1,370 dentists graduated from these dental colleges, and in 1970 about 8,000 dentists graduated. Close to 20,000 dentists graduated in 1990. There were 75 dental colleges in India in the year 1993. An amendment to the Dental Act (Sections 10A, 10B, and 10C) was approved that year to limit the growth in number of dental colleges. Despite this amendment, the two decades since 1993
Figure 3. Health, economic, and human development indexes by state/union territory (2006-07)


Figure 4. Population to one dental college seat by state/union territory
Figure 5. Population to one dental college seat by health index

Figure 6. Population to one dental college seat by economic index
witnessed the launch of over 200 dental colleges. Even though the number of dentists graduating annually has increased steadily, owing to the opening of new private dental colleges in the 1990s and 2000s, the World Health Organization-recommended dentist to population ratio of 1:7,500 has never been achieved. This imbalance is particularly pronounced in the rural areas of India where close to 69% of the total population reside. For example, in 2004, there was one dentist for every 10,000 persons in the urban areas, while in the rural areas there was one dentist for every 250,000. The overall dentist to population ratio was 1:30,000.

Results from my study show that in 2013-14 there were 293 dental colleges, with the majority of them being private dental colleges and a total admission capacity of 23,780 students. This shows that the overall number of dentists graduating from dental colleges annually will be maintained over the next few years. However, what is concerning is that close to 54% of all dental colleges and 55% of all dental college admissions are concentrated in only five large states. India has 28 states and seven union territories (as of May 2014). Results from this study show that seven states (Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura) and two union territories (Andaman and Nicobar Islands and Lakshadweep) did not have a single dental college. All seven states without a dental college are located in the northeastern part of India. For the entire northeastern region, there were only two dental colleges (one each in Assam and Manipur). This finding clearly shows an imbalance in the location of dental colleges. Despite a close to threefold increase in the number of dental colleges from 1993 to 2013-14, most of the states in the northeastern regions still lack any dental colleges. While my study examined the number of dental colleges and undergraduate dental admissions in the states, the current dentist to population ratio in states with few or no dental colleges (northeastern regions) was not examined. A formal needs assessment of those states and geographic regions needs to be completed by the state dental society bodies and Ministry of Health and Family Welfare to identify access to care problems. Future studies must examine these issues.

This study found a clear concentration of dental colleges in the states of Maharashtra, Andhra
Pradesh, Karnataka, Tamil Nadu, and Uttar Pradesh. This pattern only exacerbates the access to dental care issues in the northeastern regions, while oversupplying the market with dentists in the states with the most dental colleges. In several states, dental college admission policies dictate that only students who are residents of the state are eligible for admission. Consequently, students in the northeastern regions would be ineligible to obtain admission into dental colleges in other regions of India. Considering there are only two dental colleges in the entire northeastern region, in the long term there will not be enough dentists to provide oral health care in these regions.

These results showed that the population to dental seat metric was skewed significantly in favor of states with relatively higher health index and human development index. States/union territories that had a higher health index and human development index had fewer persons for each dental college seat compared to those with lower indices. This trend was also noticed for the economic index but it was not statistically significant. This finding demonstrates that though there has been an increase in the number of dental colleges and dental college admissions, the most vulnerable populations are unlikely to reap the benefits. People residing in poorly developed states are likely to face barriers to accessing dental care owing to the lack of sufficient dental colleges in their localities.

These findings have broad health policy implications. The Ministry of Health and Family Welfare, the individual state governments, and the Dental Council of India should establish a pathway for establishing more dental colleges (either private
or government) in these poorly developed states to address the imbalance. The individual state governments particularly have a key role to play as they are tasked with the responsibility of assessing the need for starting dental colleges depending on regional population attributes. Clearly, there are several states that need new dental colleges as well as other states that need no further dental colleges. A policy change to consider is to allow foreign-trained dentists to practice in areas with low dentist to population ratios. Currently, to practice in India, the Dental Council of India mandates that the dentist should have obtained a Bachelor of Dental Surgery degree from a recognized dental college in India or from recognized foreign dental schools. There are no estimates on the number of foreign-trained dentists practicing in India, so their impact on dental care access could not be examined in this study.

India has seen an exponential increase in the number of dental colleges from 1993 to 2013-14, a vast majority of which are private dental colleges. It is not clear from this study what caused this increase, but the concentration of dental college admissions in states with high health and human development indices suggests that it was not a needs-based decision to address dental care for the underserved. On the contrary, the increase in number of dental colleges and their location appear to be driven by economic decisions. While there is a need for establishment of new private dental colleges in areas with low development as it would be unviable for the government to start such a large number in a short span of time, issues regarding the quality of private dental colleges, the intent to start these institutions, the student body obtaining admission into these colleges, the availability of qualified faculty members to teach, and the overall education and training offered by these colleges should not be overlooked. In a recent report by the Comptroller and Auditor General of India, multiple severe deficiencies in private dental colleges were noted. These included shortage of faculty based on prescribed norms, deficiencies in infrastructure, lack of attached hospitals, and inadequate number of patients, dental chairs, and equipment. This report also raised concerns about inconsistencies in oversight of dental college inspections. The Comptroller and Auditor General of India reported several instances of faulty reporting of faculty numbers and noted that, in several colleges, the shortage of qualified faculty members exceeded 50%. This report also pointed out that several dental colleges admitted more than the approved number of students into their programs.

This study has several limitations that should be kept in mind when interpreting the findings. A retrospective cross-sectional design was used to examine the association between population per undergraduate dental college admission in the states and the indices for health, economic, and human development. The nature of the study design and the data used precludes establishing a clear cause and effect relationship. The data used were obtained from multiple sources and were not collected specifically for the purpose of this study. As with any secondary datasets, any errors or inconsistencies in collection of data will yield biased estimates. This study examined a limited set of variables and correlated population to dental college admissions with various indices. Consequently, the role of omitted variable bias should not be discounted. Data on health, economics, and human development indices from 2007 were correlated with data from 2013-14. There was a six-year time lag between the indices data and the dental college data. It is anticipated there were not significant changes in the indices during the six-year period. Nevertheless, any changes in the health, economic, or human development indices over this period will yield biased estimates. Finally, this study only examined number of dental colleges, number of dental college admissions, and population to dental college seats. A formal needs assessment of access to care issues was not conducted. Future studies should explore these at least in states and geographic regions that this study identified as having minimal diffusion and concentration of dental colleges.

Conclusion

The last two decades witnessed an exponential increase in the number of dental colleges in India. A large number of these were private dental colleges. The increase in number of dental colleges is clustered around a few states, leaving multiple states in India with no dental colleges. This study sought to determine if new dental colleges and resulting increases in number of dental college admissions (population to dental college seats) were correlated with health, economic, and human development indices. It would have been beneficial if the increase in number of dental colleges improved access to care or if the new colleges were opened in states that were disadvantaged (in terms of health, economy, and human development). Instead, the concentration of dental colleges appears to be in states with high
health and human development indices, thus doing little to address the imbalance in dentist to population ratios in states that are poorly developed in terms of health and human development. In the future, dental colleges should be opened in areas identified to be disadvantaged in terms of health and human development in order to improve access to oral health care for all populations in need.

Disclosure
The author reports no conflicts of interest related to this study.

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