Dentist Population Ratio of Bangalore City: Adequate or Inadequate - A Descriptive Study

Authors
Dr Dhanya.R1, Dr Harikiran A.G2, Dr Deepti Vadavi3
1Sree Mookambika Institute of Dental Sciences, Padanilam welfare trust, Kanyakumari district, Kulasekharam, Tamilnadu
2,3DAPM RV Dental College, JP Nagar 1st Phase, Bangalore, Karnataka
Corresponding Author
Dr Dhanya.R
Senior Lecturer, Sree Mookambika Institute of Dental Sciences, Padanilam welfare trust, Kulasekharam, Kanyakumari District, Tamilnadu
Email: drdhanyadev@gmail.com, Phone number: 8138884158

Abstract
Background: World Health Organization has raised the alarm that oral disease is one of the major public health problems. Current scenario indicates that the existing 180000 dentists are not sufficient to meet the oral health demands of population in India due to various reasons, one being misdistribution of dentists. Hence our study aims to estimate the Dentist Population ratio (DPR) of Bangalore City.

Methodology: The distribution of dentists in Bangalore City was estimated by calculating the Dentist Population Ratio. The number of dentists involved in private practice, govt. service and academics were calculated and compared with the population of Bangalore city. In order to look into the lacunae regarding the secondary data obtained from official sources, a mean correction factor was calculated from the manual survey in 8 wards of Bangalore City which were selected by random sampling.

Results: An official DPR of 1:2954 and corrected DPR of 1:1533 was estimated for Bangalore City. A total of 1843 dental clinics, 3687 dental practitioners, 28 government dentists, 1002 academicians were obtained after applying a mean correction factor of 2.6 and an average of 2 dentists per clinic.

Conclusion: The results of our study reveals that if any region in Bangalore City or Karnataka has a higher DPR than the WHO recommendation suffers from low availability of dentists, or reduced accessibility to dental services, it can be inferred that it is not due to a deficiency in the number of dentists, but due to a misdistribution of dental health care personnel.

Keywords: Misdistribution, Dentist Population Ratio, Oral Health, Dentists.

Introduction
Dentistry is one of those areas in health that has expanded the most in the recent years with the increase in the number of dental colleges all over the world. India is the largest producer of dental graduates with more than 25,000 new dental graduates each year adding to the existing numbers of dentists. Correspondingly, the number of Dentists in the country has also increased from hundreds to now nearing 180,000.1 There is about 3.5 times increase in the population since then and number of dentists has increased to more than
There is an ever increasing burden of oral diseases in India despite of 1.8 lakh dentists. This sheds light on the fact there is some limitation that needs to be sorted out to meet the oral health care needs of the population. The distribution of dentists in relation to the population is dramatically different from the distribution of dentists recommended by WHO being 1:7500. In Greece, dentist to population ratio show a trend from 1:1301 in 1982 to 1:987 in 1992 to 1:766 in 2007 and 1:582 in 2013. In Brazil, the dentist to population ratio was reported to be 1:874 in 2009. In Africa, the dentist-to-population ratio is approximately 1:150,000 against about 1:2,000 in most industrialized countries, which further highlights the global difference. The World Health Statistics 2004 show that in India the dentist to population ratio is 1:30000, 1:10,000 in urban areas and 1:150000 in rural areas. The dentist to population ratio has markedly improved from 1960s when it was 1:301,000. However, there is considerable variation in the distribution of dentists across various states. To date, the evidence to support this proposition has been limited, owing to a lack of reliable disaggregated data at the country level. Though there has been an increase in number of dental colleges, Dentist Population Ratio remains constant since 1990s. Hence it is the need of the hour to explore whether this DPR is due to lack in number of dentists serving the population or misdistribution of dentists.

Bangalore is one of the cities with the highest number of practicing dentists and 16 dental colleges. An estimation of Dentist Population Ratio is sure to inform the various stakeholders the questionable and unpredictable future of dentistry and to take positive steps in this regard. Hence this study aims to estimate the Dentist Population Ratio (DPR) in Bangalore City.

Materials and Methods
A descriptive study was conducted in Bangalore city for duration of one year from November 2014-2015.

Source of Data: Secondary Data regarding the Population and Dentists were obtained from the following sources:

Population: Details of the wards including the demographic characteristics (total population), area covered and other ward related information were obtained from Bruhat Bangalore Mahanagara Pallike [BBMP]-online source: Ward wise information system for citizens awareness [URL:http://www.vigeyegpms.in/bbmp/?module=public&action=wardinfo&wardid=195]

Dentists:
Details of Dental Clinics and Private Practitioners:
Clinic Establishment Centre Registry (BBMP-Heath and Sanitation Department in Bangalore governance observatory), Waste management agency in Bangalore-Maridi Eco, State Pollution Control Board

Details of Dentists working in Government Sector:
Directorate of Medical Education, Govt.of Karnataka

Details of Academicians:
16 Dental Colleges in Bangalore

Estimation of Dentist Population Ratio
Total number of dentists of Bangalore city involved in service delivery sector comprising of dental private practitioners, government dentists and academicians and Zone-wise and ward-wise population of Bangalore City was calculated from the sources as mentioned above. Secondary Data obtained from the various information sources may not be adequate to accurately estimate DPR owing to a number of reasons:

1. The existing list of Dental Clinics may not be comprehensible.
2. New Clinics might have opened/renewal of clinic registration might not have been done.
3. Unregistered Dental Clinics

Bangalore city is divided into 8 zones, according to the geographic stratification of revenue department of BBMP, which forms the sampling frame of this study. 198 wards exist in the Bangalore Corporation within the city limit. A manual survey was conducted in 8 randomly selected wards, 1 each from 8 zones of Bangalore City. Using this information, a correction factor was calculated. Correction Factor (CF) is a mathematical adjustment made to a calculation to account for any discrepancy between the observed and actual values, or any deviations in either the sample or method of measurement. From the data obtained from these 8 wards, the mean number of dentists per dental clinic was calculated.

DPR using data from official sources was calculated as Total number of dentists in Bangalore City/Total population of Bangalore City. Using the correction factors calculated from respective zones, zone-wise corrected DPR was calculated.

The mean correction factor for Bangalore city was calculated from the correction factors obtained for 8 zones, proportionately taken with respect to the total number of registered dental clinics in each zone. Using this mean correction factor, a corrected DPR of Bangalore City was estimated.

The association of DPR with socioeconomic status, area covered by ward and market demand for dental services was analyzed using Chi-square test.

Ethical clearance has been obtained to conduct the study from the institutional ethical review board (DAPM RV Dental College) [IRB No: 044/Vol-1/2013].

Results

A pilot study was conducted in JP nagar ward to check for any discrepancy between the number of dental clinics from official data and true number of dental clinics. Pilot study revealed that true number of dental clinics in JP nagar ward was 3.3 times the number of registered clinics obtained from official sources. Since the discrepancy between the official data and true number of dental clinics was found to be high, manual survey was done in randomly selected 8 wards, 1 each from 8 zones of Bangalore City.

The Ward-wise distribution of dental clinics in 8 randomly selected wards of Bangalore City was calculated (Table 1)

Correction factor was calculated as the ratio between the true number of dental clinics as per the manual survey and number of registered dental clinics according to official sources. From the data obtained from these 8 wards, it was found that most of the dental clinics had only 2 permanent dentists, the rest being visiting dentists who were academicians or those owning their own dental clinic. Only few dental clinics had 1 or 3 permanent dentists. So an average of 2 dentists per dental clinic was taken and number of academicians (AC) obtained from different dental colleges in respective zones was separately added to the list. The number of government dentists (GD) practicing in those zones, obtained from DME was also added to complete the list. Thus the list of total number of dentists in all 8 zones of Bangalore City was prepared. Thus the Zone-wise DPR was calculated (Table 2 and 3)

DPR of Bangalore City

The mean correction factor for Bangalore city was calculated from the correction factors obtained for 8 zones, proportionately taken with respect to the total number of registered dental clinics in each zone. The mean correction factor thus calculated was found to be 2.6. The total number of registered dental clinics in Bangalore as per the official data was 709 with an average of 2 permanent dentists per clinic. The total number of academicians of Bangalore city obtained from different dental colleges was 1002 and the total number of government dentists obtained from DME was 28. The population of Bangalore city obtained from official sources was found to be 7230555. The DPR of Bangalore City was calculated as follows and depicted in Table 4.
No:of registered dental clinics in Bangalore as obtained from Official Sources = 709
Estimated number of Dental Clinics in Bangalore after applying Correction Factor = 709 x 2.6 = 1843
Estimated total number of Dental Private Practitioners in Bangalore after applying Correction Factor = 709 x 2.6 = 3687
Estimated total no:of Dentists in Bangalore after applying Correction Factor = 3687 + 28 (GD) + 1002 (AC) = 4717
Hence Corrected DPR of Bangalore City was estimated as 4717/7230555 = 1:1533

Association of various characteristics of wards on DPR
The different characteristics of ward that can be associated with Dentist Population Ratio are socioeconomic status, area covered and market demand for dental services. Wards have been categorized on the basis of socioeconomic status and area covered. Market demand for dental services have been categorized on the basis of number of dental clinics functioning in each ward. Corrected DPR was used to determine these associations. DPR higher than 1:1500 was considered as high DPR, 1:1500-1:3000 as medium DPR and 1:3000 and below as low DPR. The socioeconomic status was significantly associated with DPR (p value-0.038). Proportion of wards with high DPR was significantly higher in wards with high and middle socioeconomic status compared to wards with low socioeconomic status. Proportion of wards with high DPR was higher in wards covering 0.5-3 sq.kms as compared to those above 3sq.kms. But association was not found to be statistically significant (p value -0.076).
Market demand for dental services as assessed by number of dental clinics in the ward was found to have a statistically significant association with DPR (p value<0.001). Proportion of wards with high DPR was more in wards with higher market demand (Table 5).

| Sl No | Bangalore City Zone | Ward No | Ward Name       | Number of Dental Clinics |
|------|---------------------|--------|-----------------|--------------------------|
|      |                     |        | Manual Survey   | Official sources         |
|      |                     |        |                 |                          |
| 1    | Bangalore South    | 153    | Jayanagar       | 32                       | 16                       |
| 2    | Bangalore West     | 99     | Rajaji Nagar    | 82                       | 17                       |
| 3    | Bangalore East     | 111    | Shanthala Nagar | 18                       | 10                       |
| 4    | Dasarahalli        | 15     | T Dasarahalli   | 29                       | 11                       |
| 5    | Bommanahalli       | 193    | Arakere         | 31                       | 7                        |
| 6    | Mahadevapura       | 52     | KR puram        | 8                        | 1                        |
| 7    | Bytaranapura       | 4      | Yelahanka Satellite | 43                     | 13                       |
| 8    | RR Nagar           | 184    | Uttarhalli      | 8                        | 1                        |

Table 2: Table Depicting zone-wise DPR of Bangalore City obtained from official sources

| Sl No | Zones in Bangalore | No :of Dental Clinics | Dentists | Population | DPR from Official sources |
|-------|--------------------|-----------------------|----------|------------|--------------------------|
|       |                    | PP  | GD  | AC  | Total |                   |                       |
| 1     | Bangalore South   | 364 | 728 | 5   | 667   | 1400                  | 1582711               | 1:1131                |
| 2     | Bangalore West    | 90  | 180 | 4   | 110   | 294                   | 1661753               | 1:5652                |
| 3     | Bangalore East    | 164 | 328 | 5   | 65    | 398                   | 1877635               | 1:4718                |
| 4     | Dasarahalli       | 23  | 46  | 2   | 0     | 48                    | 411056                | 1:8564                |
| 5     | Bommanahalli      | 36  | 72  | 3   | 58    | 133                   | 431867                | 1:3247                |
| 6     | Mahadevapura      | 5   | 10  | 4   | 54    | 69                    | 519663                | 1:7531                |
| 7     | Bytaranapura      | 17  | 34  | 3   | 0     | 37                    | 461934                | 1:12485               |
| 8     | RR Nagar Zone     | 10  | 20  | 2   | 48    | 70                    | 283936                | 1:4056                |
| 9     | Total             | 709 | 1418| 28  | 1002  | 2448                  | 7230555               | 1:2954                |

DC – Dental Clinics; PP- Private Practitioner; AC- Academician; GD- Government Dentist
Table 3: Table Depicting zone-wise corrected DPR of Bangalore City after applying the correction factor

| Sl No | Zones in Bangalore | No: of Dental Clinics | CF | Dentists | Population | Corrected DPR |
|-------|---------------------|-----------------------|----|----------|------------|---------------|
|       |                     |                       |    | DD | PP | GD | AC | Total |               |             |
| 1.    | Bangalore South     | 364                   | 2  | 1456 | 5  | 667 | 2128 | 1582711 | 1:744        |
|       | Bangalore West      | 90                    | 4.8| 864  | 4  | 110 | 978  | 1661753 | 1:1699       |
|       | Bangalore East      | 164                   | 1.8| 590  | 5  | 65  | 660  | 1877635 | 1:2845       |
|       | Dasaraballi         | 23                    | 2.6| 120  | 2  | 0   | 122  | 411056  | 1:3369       |
|       | Bommanahalli        | 36                    | 4.4| 317  | 3  | 58  | 378  | 431867  | 1:1143       |
|       | Mahadevapura        | 5                     | 8  | 80   | 4  | 54  | 138  | 519663  | 1:3766       |
|       | Bytaranapura        | 17                    | 3.3| 112  | 3  | 0   | 115  | 461934  | 1:4017       |
|       | RR Nagar Zone       | 10                    | 8  | 160  | 2  | 48  | 210  | 283936  | 1:1352       |
|       | Total               | 709                   | 2.6| 3687 | 28 | 1002| 4717 | 7230555 | 1:1533       |

DC – Dental Clinics; PP- Private Practitioner; AC-Academician; GD- Government Dentist; CF- Correction Factor

Table 4: Table Depicting DPR of Bangalore City

| Sl No | Total number of dentists involved in service delivery | Total Population | Estimated DPR |
|-------|------------------------------------------------------|-----------------|---------------|
|       | DC                                                   | PP              | AC | GD | Official | Corrected | Official | Corrected |
| 1.    | 709                                                  | 1843            | 1418| 3687| 1002     | 28         | 7230555  | 1:2954   |

DC – Dental Clinics; PP- Private Practitioner; AC-Academician; GD- Government Dentist; CF- Correction Factor

Table 5: Table depicting the association of various characteristics of ward on DPR using Chi-square Test

| Sl No | Characteristics of Ward | High DPR(>1:1500) | Moderate DPR(1:1500 to 1:3000) | Low DPR (<1:3000) | Total |
|-------|-------------------------|-------------------|---------------------------------|-------------------|-------|
|       |                         |                   |                                 |                   |       |
| Socioeconomic Status | Low                     | 2                 | 3                              | 5                 | 10    |
|       | Middle                  | 11                | 5                              | 1                 | 17    |
|       | High                    | 24                | 5                              | 10                | 39    |
|       | Total                   | 37                | 13                             | 16                | 66    |
| Area Covered Category(in sq.kms) | Low(0.5-3) | 31                 | 8                              | 9                 | 48    |
|       | Medium(3-6)             | 4                 | 1                              | 4                 | 9     |
|       | High(>6)                | 2                 | 4                              | 3                 | 9     |
|       | Total                   | 37                | 13                             | 16                | 66    |
| Market Demand For Dental Services( No:of Dental Clinics) | Low(1-4) | 24                 | 13                             | 16                | 53    |
|       | Moderate(4-8)           | 9                 | 0                              | 0                 | 9     |
|       | High(>8)                | 4                 | 0                              | 0                 | 4     |
|       | Total                   | 37                | 13                             | 16                | 66    |

P<0.05*- statistically significant

Discussion
An efficient dental workforce planning should possess adequate number of dentists ensuring uniform distribution in different geographical areas to have access to oral health care for all. DPR has been widely accepted as a useful tool for comparison between various countries, especially in relation to availability and accessibility to health care services. Workforce requirement is simply based on the size of the population, and desirable ratios are established on the basis of current situations, international comparison, recommended standards and extrapolation of past trends. 8 Bangalore, a place where people from different parts of India come and settle, the population is varying and has different characteristics. Number of people migrating in and out of Bangalore varies with time. So the DPR cannot be a constant value...
and would show small changes accordingly, thus
having a dynamic nature.

Our study reported a DPR of 1:2954 which was
calculated using data from official sources and a
corrected DPR of 1:1533 was calculated using
correction factor. This DPR was calculated after
accounting for unregistered dental clinics which
are not present in the official data. DPR estimation
in Bangalore city which houses 16 dental colleges
can create an evidence base in dental manpower
planning, which can be used for policy decision-
making to address mal-distribution by the
government

There is a drastic increase in the number of
dentists produced in India in the last 10 years
owing to the establishment of many new dental
colleges. Even if we take into consideration only
the list of registered private dental clinics as
available from official sources in Bangalore along
with the academicians and government dentists,
we get a DPR of 1:2954 which is nearly 2.54
times the WHO recommended DPR of 1:7500 and
the corrected DPR of 1:1533 which accounts for
the unregistered private dental clinics also is 4.9
times the WHO recommended DPR.

In 2004, Dentist-population ratio in India was
1:30,000 and had one dentist per 10000 people in
urban areas and one dentist per 1.5 lakh people in
the rural areas. However, the ratio suggested that
there were still not enough number of dentists in
India, but it was not the sole factor. There was one
more factor which could not be ignored - the
inequality in distribution of dentists.

It was suggested by a study emphasizing on
increasing unemployment among dental graduates
that government, ministry of education and other
stakeholders should take initiatives in increasing
job opportunities in rural areas that can aid in
creating a balance in the concentration of dentists
in urban and rural areas and to create new posts
dental graduates in government hospitals and
in Primary Health Centre.

The World Health Organization (WHO) provides
no ideal or desirable statistics, since the
distribution of dental health care personnel gets
strongly influenced by local factors such as
socioeconomic status of the population,
geopolitical factors as well as cultural and
epidemiological characteristics.

For example, in Iran, there were approximately
13,000 dentists nationwide. With a population of
71 million people, there was only one dentist for
every 5,500 people. In Canada, with 32 million
there were 18,287 dentists, or approximately one
dentist for every 1,800 inhabitants. In Europe, the
ratio was 1:1,561 inhabitants.

Corrected DPR in Bangalore obtained in our study
is similar to DPR of Australia (1:1680 in urban
areas) and the United States of America (1:2000).

Though we have 1 dentist for 1533 population,
whether the oral health problems are adequately
addressed in the city still remains a question.
Though there are 1843 dental clinics, whether all
the dental clinics report a net profit also remains
doubtful. These queries indicate the need to
foresee a probable distressing future of dentistry.

In India, Karnataka, Maharashtra and Kerala are
the states with the highest concentration of
dentists. The existing dentist-population ratio in
Kerala was 1:3866 which was much above the
ratio of 1:7,500 insisted by the World Health
Organization. The DPR in Karnataka, Tamil Nadu
dips to 1:3000. In Maharashtra DPR is 1:5978.

If any region in Bangalore City or Karnataka or
any of these states which has a higher DPR than
the recommendation suffers from low availability
of dentists, or reduced accessibility to dental
services, it can be inferred that it is not due to a
deficiency in the number of dentists, but due to a
misdistribution of dental health care personnel.

Conducting a manual survey without depending
completely on the available official list was a
strength of the study. Restricting the study to 8
wards owing to feasibility issues was a limitation
of the study.

Conclusion
The available DPR of India is 1:30,000, 1:10,000
in urban areas and 1:250000 in rural areas. Our
study revealed that in Bangalore City, DPR is
1:1533. Reported DPR of Karnataka state is 1:3000, much higher than WHO recommended figures. This clearly tells us that there is no deficiency in the number of dentists in the state and any failure to address the oral health challenges are due to other factors like misdistribution of dentists. The overall goal should be to ensure equitable access to oral care for all segments of the population while at the same time allowing for economically sustainable working conditions for dentists, both in public service and private practice. Thus it is important to conclude that manpower development as a concept and method should be able to take its rightful place as a tool for development in our country.

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