Projections of dentistry workforce up to 2040 in Kurdistan Region, Iraq

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ABSTRACT

Background: Planning of the dental workforce, especially the number of dentists, requires the data of exact dental workloads. This study aims to project the dental workforce from 2020 to 2040, based on a survey of the actual workload of 4060 dentists in 2022. Methods: In 2022, a database of 4060 current dentists obtained from the archive of Kurdistan Dental Association, Kurdistan Region of Iraq (KRI). Descriptive analysis of workforce projection and densities per 100,000 population from 2020 to 2040 was performed, and perceived workforce challenges/possible solutions were calculated. Linear regression modeling based on the Human Development Index (HDI), age of graduate dentists, and dental college data was used to predict dentist density. Results: The dentist-to-population ratio (dentists per 100,000 people) was 63.22 in 2022. The supply of dentists was 800 per year from 8 dentistry colleges from 2027 to 2040, and is expected to increase for the next 15 years. Because of lower (steady) population growth estimates for KRI and higher numbers of graduates from the dentistry colleges, it is estimated that the dentist-to-population ratio will increase to 1065 by the year 2040. Conclusion: An oversupply of dentists and steady population growth will result in a surplus of dentists. This research highlights the fact that there is an urgent need for an organized national human resource planning system to control the supply and demand for dental manpower, to ensure a uniform distribution of manpower and provide future directions to policy makers.

1. Introduction

The availability of dentists creates a condition for the dental care to be accessible and certainly affects dental service demand, as per the idea of supplier-induced demand. One of the most popular metrics to determine the dentistry workforce is the dentist to population ratio. According to the WHO, the dentist-population ratio should be 1:7500 to provide optimum dental health care to the population. The dentist-population ratio in European countries ranges from 50.7 to 70.3 per 100,000 population. Moreover, the highest and lowest dentist population ratios have been reported in Japan (77) and China (1,2), respectively. In the Kingdom of Saudi Arabia, the dentist-population ratio is 1: 1288.16, whereas in Kuwait, the dentist to 1000 population ratio was 0.3326 in 2006. In Egypt, however, in 2014, the distribution of dentists per 1000 population was random and the ratio was reported to be 0.18. In the U.S., there were 201,117 dentists practicing dentistry in 2020, which means that there were 61.0 dentists per 100,000 population. The current workforce density of dentists (per 10,000 population) in Africa remains very low (0.44 in 2023) and substantial differences were reported from one region to another. For example, in the Seychelles, the ratio was reported to be 4.297, while a 0.003 ratio was reported in South Sudan. Lastly, in India the ratio was found to be 1:10,271. It is apparent that the dentist population ratio varies from one country to another and possibly from one region to another within the same country.

Apparently, a shortfall in the dentistry workforce would affect the dental services received; therefore, the health care ministry needs to engage in meticulous development of planning. The plan for dental education, dental care services, and financing should be integrated into the process of developing the dentistry workforce. Certainly, the agenda of health care policy makers should reflect a sound plan based on the needs of the population.

In 2000, the Kurdistan Dental Association (KDA) was founded as a professional association dedicated to supporting its members, acting as
their national voice, offering them a range of social and scientific programs and sense of community. Regarding the dentistry education programs in Kurdistan Regional government, Iraq (KRI), eight colleges of dentistry (three public and five private) are recognized by the KRI Ministry of Higher Education and Scientific Research.

KRI consists of three Governorates, namely Erbil, Sulaymaniyah and Duhok Governorates, with a total population of 2,861,701 in 1997 (Erbil: 1095992, Sulaymaniyah: 1362739, and Duhok: 402970). For 2023, according to Ministry of Planning data, KRI’s population projection had increased to 6,557,680 (Erbil: 2,281,913, Sulaymaniyah: 2,629,600 and Duhok: 1,646,165).

In 2000, the number of dentists in KRI was 30, while this number had increased to 4064 by 2022. KRI has a reasonably open economy and stable security; therefore, economic development, modernization, and globalization have had a big impact on peoples’ appreciation for health care. This can be related to the fact that as people become educated and have higher incomes, this ultimately affects their appreciation for their general health care as well as their oral health care.

The increase in the number of colleges of dentistry as well as the increase in the number of students enrolled per year would highly affect the dentistry workforce. Certainly, the increase in dentistry workforce to the ratio reported by WHO would be of paramount importance for dental care services for the KRI population. However, increase in the dentistry workforce is not the sole factor in improving the dental health care. Other important elements need to be taken into consideration. For example, the need to balance supply and demand for related dental workers and their dental service’s productivity must be taken into account.

In KRI, new challenges related to dentistry workforce planning are emerging. On one hand, KRI government since 2016 has employed no new graduates; on the other hand, the number of dentistry colleges and their annual enrollment of students have increased. Further challenges include reskilling the dental workforce for altered responsibilities and providing more dentistry infrastructure for the population to deliver the optimum dental health care for the population.

Numerous cross-sectional studies evaluating the availability of dentists and focused on a certain period have been carried out in industrialized nations with high dentist-to-population ratios. In the Middle East, a study detailed the evolution of Oman’s dental workforce and forecasted the emerging patterns. However, studies that evaluate the accessibility of dentists in developing nations have yet to be examined.

In developing countries with high dentist to population ratios and limited economic resources, longitudinal studies are required to evaluate the availability of dentists. These studies would improve our understanding of the effects on the dental health care service of increasing both the number of dentists graduating per annum and the number of dentistry colleges. Additionally, these studies can provide an insight into other factors (other than dentistry workforce) in improving the dental health care services for the population by redirecting the financial support for increasing the dentistry workforce toward improvement in skills of the already available dentists and dentistry infrastructure. Hence, the aims of this study were to show the increase in the dentistry workforce in KRI from 2000 to 2022, and to project the KRI’s future dentistry workforce demand up to 2040.

2. Methods

2.1. Dentistry data

The data for the current study were collected from the three governorates in the Kurdistan Region of Iraq, namely Erbil, Sulaymaniyah and Duhok Governorates. The data on dentists were collected from Kurdistan Dental Association as an independent professional organization serving the dentistry field. This organization is the only official organization for dentist registration and provides official access to all dental practices in the KRI and all dentists who graduated (within or outside of KRI) should be registered to obtain practice permission. The number of dentists employed by the government and number of dental chairs were obtained from the Oral and Health Department of the Ministry of Health of KRI. Lastly, the numbers of undergraduate students were obtained from all Colleges of Dentistry in both public (University of Sulaimani, Hawler Medical University, and University of Duhok) and private (Gihan University-Erbil, Tishk International University, Qiawan International University, Komar University of Science and Technology, American University of Sulaimani) universities which are registered and accredited officially with the Ministry of Higher Education and Scientific Research in KRI. The study proposal was approved by the ethical committee of the College of Dentistry at the University of Sulaimani (Approval number: 221/23). The data were accessed by official letters from the College of Dentistry, University of Sulaimani to both Kurdistan Dental Association and Ministry of Planning in KRI and the consent was not obtained as the data analyzed anonymously.

2.2. Population data

According to information obtained from the United Nations Population Fund, Central Organization for Statistics and Information Technology of Iraq and the Ministry of Planning, Kurdistan Region Statistics Office in KRI, the total population at the time of collecting data for this study (year 2023) would number 6,557,680. These data obtained by official letter from.

2.3. Dentist and population projection

The projected number of dentists in each specific year was calculated by adding the number of dentists to the previous year with the average annual growth rate for dentists during the years 2020–2040. Additionally, population projections from 2020 to 2040 were calculated based on an average annual population natural increase rate, namely the difference between the fertility rate and the mortality rate per 1000 population per annum. Prediction of the Kurdish national population in KRI from 2020 to 2040, based on the average population natural increase, was found to be 2.2 %.

The dentist to 10000-population index was applied by dividing the total number of dentists into the population of the country and multiplying by 100000.

2.4. Statistical analysis

The numbers of dentists (general and specialist dentists) and dental chairs were tabulated according to the dentists’ age, location and working area. Furthermore, the numbers of undergraduate dental students were calculated for both public and private universities. The dentist and population data were both presented in GraphPad prism sheets and the disparity between the projected number of dentists needed and the available KRI dentists was calculated together with the percentages for each year by GraphPad Prism software (Version 9.1.1 GraphPad Software, San Diego, CA, USA).

3. Results

The majority of dentists (60 %) were below 35 years old, followed by 31.4 % in the 45–54 age group, 7.1 % aged 45–55 years, and 0.3 % older than 55 years (Fig. 1).

In Ministry of Health hospitals, there were 512 dental chairs and 1352 dentists in primary health centers and specialized dental clinics across KRI in 2022. The distribution of dentists according to their working places is shown in (Table 1). The majority of the dentists are general practitioners (73 %). Based on this data, in the KRI, the ratio of dentists to dental chairs is 2.64.

In the KRI there are three public universities and five private universities, with 360 dentists employed as academic staff in the three...
public universities. Whereas, the private universities mostly use academic staff from public universities, specialist dentists from the Ministry of Health or employ international personnel. The data on number of undergraduate students across the universities in KRI showed an increase in number of students on an annual basis, resulting in a total of 3133 students in 2022, distributed over five years of study (Table 2).

The number of dentists in the KRI has increased sharply over the past 20 years. For example, in 2000, there were only 30 dentists and this number had increased by 135.4%–4064 in 2022 (Fig. 2 A). However, the population growth has been steady over the past 20 years.

The number of dentists registered in KRI was 4064 (Erbil: 1941, Sulaymaniyah: 1527 and Duhok: 596) in 2022, with a dentist to 100,000 population ratio of 63.22991. Out of 4064 registered dentists in KDA, only around half (2000 dentists) were employed (Table 3).

As shown in (Table 3), if the supply of dentists continues to increase and the population growth rate remains at the same comparatively low level (Fig. 2 B), the unadjusted number of dentists per 100,000 population will increase from 63.229 in 2022 to 1065.5 in 2040 (Fig. 3 A). Thus, our new analysis predicts a large increase in the number of dentists relative to the population due to lower (steady) population growth estimates and higher numbers of graduates from the dentistry colleges.

In the current study, five scenarios of the numbers of graduate dentists from universities were analyzed (Fig. 3 B). It is apparent that if this current situation of 800 graduates in total (from public and private universities) per year persists, by 2040 there will be 1643 dentists per 100000 population. If this number were to be reduced by half (400 graduate dentists) there would be 1155 dentists per 100000 population. If the number of graduates were to be reduced to 300, then there would be 1033 dentists per 100000 population. Whereas, if the number of graduate dentists were to be reduced to 100, then there would be 78 dentists per 100000 population (Fig. 3 B).

4. Discussion

This study aimed to examine the supply and demand for dentists in KRI. The demand was based on a dentist-to-population ratio of 1:100000 (equivalent to 65.8 dentists per 100000 population, which was the adjusted ratio in 2022). To the best of our knowledge, this is the first study to comprehensively examine such dentistry projections for KRI and Iraq. The main findings of the study, based on analysis of the current dentist workforce and the projected supply of new graduates during the period 2022–2040, indicated that the supply of dentists in KRI in the year 2040 would be equivalent to 140.4 dentists per 100000 population, which is an oversupply of dentists beyond the demand. This finding highlights the critically low levels of understanding of how to serve the KRI’s steadily growing population, where the dentist workforce is sharply increasing.

In almost all of the developed countries, the dentist to population ratio is 88 per 100000 population. For example, corresponding numbers in other countries are as follows: 61 in the U.S., 52.7 in UK, 85.8 in Germany, 64.7 in France, 51 in Slovakia, and 81.3 in Sweden. There are also apparent differences in the numbers of dentists per population according to World Health Organization (WHO) data. Its figures were as follows: 1.440 in the Americas, 2.013 in Europe, 7.786 in Western Pacific, 15.138 in South East Asia (15,138), 5.541 in Eastern Mediterranean (5,541), and 41.943 in Africa. In KRI, the ratio was found to be 1.615 in 2023, which is in line with the WHO recommendation.

This study found that in 2022 the majority of dentists were below 35 years old and those older than 55 years old formed only about 0.3 % of the dentistry workforce, a result commensurate with that reported in a study on dentist labor force projections for 2005 to 2020 in Australia.

Table 1
Numbers of dental chairs and dentists across KRI in public ministry of health hospitals in 2022.

<table>
<thead>
<tr>
<th>Universities</th>
<th>Number of dentists as teaching staff</th>
<th>First Stage</th>
<th>Second Stage</th>
<th>Third Stage</th>
<th>Fourth Stage</th>
<th>Fifth Stage</th>
<th>Total number of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Universities</td>
<td>284</td>
<td>415</td>
<td>406</td>
<td>316</td>
<td>237</td>
<td>245</td>
<td>1619</td>
</tr>
<tr>
<td>Private Universities</td>
<td>76</td>
<td>437</td>
<td>429</td>
<td>325</td>
<td>175</td>
<td>148</td>
<td>1514</td>
</tr>
<tr>
<td>Total</td>
<td>360</td>
<td>766</td>
<td>835</td>
<td>641</td>
<td>412</td>
<td>393</td>
<td>3133</td>
</tr>
</tbody>
</table>

Table 2
Numbers of Public and Private Universities and their Student Numbers in 2022.

<table>
<thead>
<tr>
<th>Cities of KRI</th>
<th>Number of Chairs</th>
<th>Number of Dentists</th>
<th>Remote area</th>
<th>General practitioner</th>
<th>Specialists</th>
<th>Total</th>
<th>Ratio of dentists/dental chairs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vocational trainer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulaimani</td>
<td>172</td>
<td>0</td>
<td>36</td>
<td>262</td>
<td>111</td>
<td>409</td>
<td>2.37</td>
</tr>
<tr>
<td>Garmian</td>
<td>16</td>
<td>0</td>
<td>11</td>
<td>22</td>
<td>2</td>
<td>35</td>
<td>2.18</td>
</tr>
<tr>
<td>Raparin</td>
<td>25</td>
<td>2</td>
<td>16</td>
<td>12</td>
<td>4</td>
<td>44</td>
<td>1.76</td>
</tr>
<tr>
<td>Hawler</td>
<td>174</td>
<td>0</td>
<td>0</td>
<td>590</td>
<td>114</td>
<td>704</td>
<td>4.04</td>
</tr>
<tr>
<td>Koya</td>
<td>24</td>
<td>0</td>
<td>5</td>
<td>17</td>
<td>2</td>
<td>24</td>
<td>1.06</td>
</tr>
<tr>
<td>Duhok</td>
<td>95</td>
<td>0</td>
<td>39</td>
<td>84</td>
<td>13</td>
<td>136</td>
<td>1.43</td>
</tr>
<tr>
<td>Total</td>
<td>512</td>
<td>2</td>
<td>107</td>
<td>987</td>
<td>246</td>
<td>1352</td>
<td>2.64</td>
</tr>
</tbody>
</table>
Fig. 2. (A) Increase in number of KRI dentists from 2000 to 2022, (B) Projection of dentist and population numbers in KRI from 2020 to 2040. The red line represents the number of dentists, based on the supply. The blue line represents the population projection.
Of course, this result can be attributed to the increase in numbers of dentists graduating from dentistry colleges. The opening of new dentistry colleges is shown to have a substantial impact on the number of dentists. However, the projected increase in numbers of dentists is not paralleled by increases in the population rate and supply demand. The number of graduates will significantly increase after 2022 as five new private dentistry colleges have opened and the increase in dentistry colleges over 25 years.

It has been reported that this surplus of dentists resulted in unemployment and lowered the quality of oral health services. Thus, the Indian government decided to decrease this oversupply of dentists by reducing the number of dentistry colleges across the country. However, care should be taken during such decisions to maintain an adequate number of dentists available to the population, in line with the WHO standard ratio. A study by El Tantawi et al. assessed the dentist availability in Egypt and reported that the national dentist to 100000 population ratio was 140.4 in 2040, which highlights the oversupply of dentists in KRI. The same issue was reported in other countries, for example, in Chile the projected dentist oversupply was reported to be 77.5% following an increase in the number of dentistry colleges from 5 to 34 over 15 years (30), and in India a surplus number of 100000 dentists was estimated after a 10-fold increase in dentistry colleges over 25 years.

Since a career in dentistry involves at least four decades of labor, decisions about workforce education and training will have an impact for a long time. Based on the previously mentioned projections, there is a significant rise in population expected in the African and Asian regions during the next 75 years. Consequently, if proper measures are not taken, the population-to-dentist ratios may deteriorate. In response to this challenge, some nations, including India, have opened a large number of private dentistry colleges (currently 206 dentistry colleges operating). Nevertheless, there are risks associated with this, as there are not enough opportunities for recent graduates, which raises the possibility of migration to high-income nations despite the need for oral health care in the local area.

Although the projections for dentists are driven by a number of variables that can change significantly, the impact of population size and number of dentists in KRI should be considered within the healthcare system. Concerted efforts are necessary to retain graduates in the KRI workforce and encourage KRI dentists to settle in governorates with chronic shortages of dentists as no new dentists have been employed in the public sector by the Ministry of Health since 2016. Furthermore, the following actions are necessary: first, the existing law of compulsory service for recent graduates in Ministry of Health of KRI requires revision; second, collaboration is required between Ministry of Planning, Ministry of Health, and Ministry of Higher Education in KRI and KDA to take account of population growth rates and number of graduates; third, investment is needed in dentistry infrastructure and types of oral health services to provide better care for the population; lastly, the oral health system needs to be improved and lower annual costs per patient maintained, to encourage dentists to treat more patients in order to sustain earnings that support their practice and education in dentistry.

This study addresses the problem of oversupply of dentists in regard to the dentist to population ratio and projections to 2040 by recommending that no new colleges of dentistry should be opened in either public or private universities in the foreseeable future and the total number of dentists graduating from all colleges should not exceed 200 dentists from 2027 to meet FDI/WHO standards. Currently, the dentistry colleges are producing new dentists at a greater rate than the growth in the population. If these trends continue, there is likely to be a dentist surplus of between 32% and 110% by 2040.

This study has some limitations, such as the unavailability of data for making comparisons according to dentists’ gender and the lack of recent measurement of population numbers in Iraq, meaning that all the data were retrieved from Ministry of Planning and mainly based on data from the Ministry of Commerce as all Iraqi individuals receive food on a monthly basis. Nevertheless, this is the first study to comprehensively examine the structure of the dentistry workforce in KRI and Iraq and highlight the associated problems.

5. Conclusion

This study suggests that a steady supply of 800 dentists per year is expected for the years from 2027 to 2040, whereas the population will grow slowly during that period; thus, the dentist-to-population ratio will increase dramatically to 1643 dentists per 100,000 population by 2040. To ensure a balance of supply and demand for dentists, oral health care authorities should regularly examine oral health care related policies with help from a standing advisory group and further attention should be paid to the dentistry infrastructures to provide the best oral health care services for the population.

Ethics approval

The study proposal was approved by the ethical committee of the College of Dentistry at the University of Sulaimani (Approval number: 221/23).

Data availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Author contributions

RMT and SSG: conceptualization. HMI and RMT: investigation. HMI and SSG: methodology. SSG and HMI: formal analysis. RMT: project administration. RMT and HMI: writing – original draft. SSG, RMT and
Fig. 3. (A) Projection of the dentist to population ratio, (B) Five scenarios of dentist to population ratio.
HMI: writing – review and editing. All authors contributed to the article and approved the submitted version.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References