



Contents lists available at ScienceDirect

Saudi Pharmaceutical Journal

journal homepage: www.sciencedirect.com



Original article

# The characteristics and distribution of dentist workforce in Saudi Arabia: A descriptive cross-sectional study



Abdulaziz A. AlBaker<sup>a</sup>, Yazed Sulaiman H. Al-Ruthia<sup>b,\*</sup>, Mohammed AlShehri<sup>b</sup>, Samar Alshuwairikh<sup>b</sup>

<sup>a</sup> Department of Prosthetic Dental Sciences, College of Dentistry, King Saud University, Riyadh, Saudi Arabia

<sup>b</sup> Department of Clinical Pharmacy, College of Pharmacy, King Saud University, Riyadh, Saudi Arabia

## ARTICLE INFO

### Article history:

Received 3 June 2017

Accepted 13 September 2017

Available online 14 September 2017

### Keywords:

Dental workforce

Dentists-to-population ratio

Oral health

Saudi Arabia

Dentists

## ABSTRACT

**Background:** The Kingdom of Saudi Arabia has shown steady growth in the dental workforce over the last 20 years. Although the number of dental colleges has significantly increased in the last decade, there is not any study so far that described the status of the licensed dentist workforce in the kingdom. The present study aimed to explore the demographic distribution and professional characteristics of licensed dentist workforce in Saudi Arabia.

**Methods:** This was a descriptive cross-sectional study using the Saudi Commission for Health Specialties (SCFHS) database to identify the number of licensed dentists in Saudi Arabia as well as their professional and demographic characteristics as of December 2016. The data was categorized based on gender, nationality, dental specialty, health sector, geographic location, and professional rank.

**Results:** The number of licensed dentists working in the kingdom as of December 2016 was 16887 dentists, and the vast majority of them are professionally registered as general dentists (70.27%). The percentage of general dentists among the professionally registered female dentists is significantly higher than their male counterparts (79.71% vs. 64.80%;  $P < 0.001$ ). Only 22.08% of the dentists working in the kingdom are Saudi. Most of the dentist workforce in the kingdom are male (61.06%). The mean age of the Saudi dentists is slightly but significantly younger than non-Saudi dentists (37.7 vs. 40.7 years;  $P < 0.001$ ). Over 80% of the Saudi dentists are working in the regions of Riyadh, Makkah, and Eastern province. About 66% of the Saudi dentists are working in the public health sector in comparison to only 20.46% of the non-Saudi dentists ( $P < 0.001$ ).

**Conclusions:** Most of the dental care in Saudi Arabia is provided by non-Saudi dentists in both private and public health sectors. With the rising unemployment rate among Saudi dentists, the governmental bodies that are responsible of dental labor market regulations such as the ministries of health, economy and planning, and labor should come up with a policy to gradually but carefully replace the non-Saudi dentists in both public and private sectors with Saudi dentists.

© 2017 The Authors. Production and hosting by Elsevier B.V. on behalf of King Saud University. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## 1. Introduction

Oral health is a critical and integral part of the overall health and well-being (American Dental Association, 2006). Many health conditions can affect the oral health resulting in acute or chronic orofacial pain, oral sores, throat and oral cancer, oral defects such

as cleft palate and lip, tooth decay and tooth loss, and periodontal (gum) disease (Preamble to the Constitution, 1946). Individuals are not considered healthy if they do not have a good oral health. To improve and maintain an optimal oral health, a trained, knowledgeable and comprehensive oral healthcare team is required in every country. Therefore, the World Health Organization (WHO) has stated in its 2006 report the following: “developing capable, motivated, and supported health workers is essential for overcoming bottlenecks to achieve national and global health goals. Healthcare is a labor-intensive service industry at the heart of every health system, the workforce is central to advancing health” (World Health Organization, 2006).

Significant barriers exist in every country to ensure that their population receive basic healthcare including oral healthcare

\* Corresponding author at: P.O. Box 2454, Riyadh 11451, Saudi Arabia.

E-mail address: [yazeed@ksu.edu.sa](mailto:yazeed@ksu.edu.sa) (Y.S.H. Al-Ruthia).

Peer review under responsibility of King Saud University.



Production and hosting by Elsevier

(Nash et al., 2008). Ignorance, poverty, and lack of adequate numbers of trained and educated healthcare workers are common barriers. Furthermore, the lack of financial resources in developing countries greatly limits their ability to provide quality dental education and training to fill the gap in dental care in their countries (Nash et al., 2008). Even in developed countries, financial resources are not always efficiently allocated to guarantee that their populations have access to healthcare including dental healthcare (Nash et al., 2008).

The Kingdom of Saudi Arabia has shown rapid growth in the educational sector including dental education. The college of dentistry was established at King Saud University back in 1976. Thereafter, King Abdulaziz and King Faisal universities have opened dental colleges in the western and eastern regions, respectively. However, the number of dental colleges has increased from three to four colleges in whole kingdom back in the year of 2000 to over 20 colleges of dentistry nowadays. This dramatic increase in the number of dental colleges in the kingdom, which happened in less than a decade, resulted in a significant increase in the number of dental graduates. Expectedly but unsurprisingly, those graduates are finding it harder nowadays to find a job in the public health sector something that was not heard of in the past. However, the good news is that the increase in the number of dental graduates will hopefully bring the ratio of dentist-to-population in the kingdom down. In 1987, the number of practicing dentists in the kingdom was 786 (dentists-to-population ratio, 1:8906) (Shalhoub and Badr, 1987). As per recent ministry of health statistics data released in 2014, the number of dentists was 12,785 (dentist-to-population ratio, 1:2666), which indicates a growth rate of 4.11 dentists per 10,000 inhabitants in Saudi Arabia (MOH, 2014). Previous studies reported that the Organization for Economic Cooperation and Development (OECD) member countries, excluding Scandinavian countries and Greece, have variable dentists-to-population ratio from 5 to 8 with an average of 6.1 dentists per 10,000 inhabitants (Organisation for Economic Co-operation and Development, 2011; Organisation for Economic Co-operation and Development, 2009). In addition, most of the European countries have dentists-to-population ratios ranging from 5.07 to 7.3 (Organisation for Economic Co-operation and Development, 2011; Organisation for Economic Co-operation and Development, 2009). Among Asia-Pacific countries, China has the lowest dentists-to-population ratio of 0.12, and Japan has the highest dentists-to-population ratio of 7.7 per 10,000 inhabitants (Huang et al., 2013).

Saudi Arabia has shown a rapid population and economic growth that demands an increase in the dental workforce and job opportunities to the fresh dental graduates. Future dental workforce plans should focus on how to achieve a balanced demographic distribution of dental practitioners and creating job opportunities to the Saudi dental graduates. The present study aimed to examine the status of demographic distribution and characteristics of dentist workforce in Saudi Arabia.

## 2. Methods

To explore the current status of dentist workforce in Saudi Arabia, the Saudi Commission for Health Specialties (SCFHS) was approached and officially requested through formal communications between King Saud University college of dentistry and the SCFHS to provide data on the status of the licensed dentist workforce in the kingdom including the following variables: (1) number of dentists; (2) geographic locations of dentists; (3) specialties of dentists; (4) professional ranks of dentists; (5) dentists' age and gender; (6) place of work; and (7) nationality. The SCFHS is the official regulatory body responsible of the registration and licensure of healthcare providers in the kingdom (Saudi Commission for Health

Specialties, 2009). The data was further organized and classified based on the healthcare sector that the licensed dentist works in (e.g., private and public healthcare sector). In addition, the geographic location of the dentists was categorized into 13 categories based on the administrative subdivisions of the kingdom into 13 regions. The nationality of dentists was categorized into Saudi, if they were Saudi citizens, or non-Saudi if they were not Saudi citizens. Descriptive statistics including frequency and percentage was calculated to characterize the study sample. Statistical significance was defined at an  $\alpha$  of 0.05. All analyses were performed using SAS, version 9.2 (SAS Institute Inc., Cary, NC, USA). The study was approved by the Institutional Review Board (IRB) of the College of Dentistry at King Saud University in November 2016.

## 3. Results

There are 16,887 licensed dentists in the SCFHS database as of December 2016. The Saudi dentists only represent 22.09% of the licensed dental workforce in the kingdom, which translates into 3720 dentists. Table 1 details the characteristics and distribution of licensed dentists in the SCFHS database based on their nationality. The mean age of the licensed dentists is 40.09 years with the Saudi dentists being slightly but significantly younger than their non-Saudi counterparts (37.7 vs. 40.76 years;  $P < 0.001$ ). The majority of the licensed dentists in Saudi Arabia are males (61.06%) with no significant difference in the percentage of males and females between the Saudi and non-Saudi dentists. Almost 70% of the licensed dentists in Saudi Arabia are working in the three main regions of the kingdom (Riyadh, Makkah, and Eastern province). Approximately 81% of the licensed Saudi dentists are working in the three aforementioned regions compared to 65.81% of the non-Saudi dentists ( $P < 0.001$ ). Around 80% of the non-Saudi dentists are working in the private health sector compared to only 33.65% of the Saudi dentists ( $P < 0.001$ ). The percentage of Saudi dental specialists, who are working in the public health sector, is significantly higher than their non-Saudi counterparts (24.77% vs. 8.30%;  $P < 0.001$ ). On the other hand, the percentage of non-Saudi dental specialists in the private health sector is significantly higher than their Saudi counterparts (19.15% vs. 11.47%;  $P < 0.001$ ).

Table 2 shows the professional registration in the SCFHS for both Saudi and non-Saudi dentists. The majority of licensed dentists in Saudi Arabia are professionally registered as general dentists. The percentage of general dentists among the non-Saudi dentists is significantly higher than their Saudi counterparts (71% vs. 67.7%;  $P < 0.001$ ). Most of the licensed dentists who are professionally registered as dental registrars are non-Saudi (78.12% vs. 21.88%;  $P < 0.001$ ). There are 356 licensed dentists who are professionally registered as senior dental registrars in the kingdom, and almost 70% of them are non-Saudis. Although the percentage of licensed Saudi dentists who are professionally registered as dental consultants among the Saudi dentists is significantly higher than their non-Saudi counterparts (9.36% vs. 6.54%;  $P < 0.001$ ); their percentage of total number of licensed dental consultants in the kingdom is lower (28.86% vs. 71.13%). There are 660 licensed dentists who are professionally registered as dental residents, and the non-Saudis represent 78.94% of them. There are also licensed dentists who are professionally registered in the SCFHS as non-practicing, visiting, and others as shown in Table 2. As shown in Fig. 1, the percentage of registered male dentists is predominantly higher than female dentists across all of the SCFHS professional ranks.

As shown in Fig. 2, the percentage of dental specialists among the licensed Saudi dentists is higher compared to their non-Saudi counterparts (36.25% vs. 27.45%). Also, the percentage of dental

**Table 1**  
The characteristics and distribution of Saudi and non-Saudi dentists across the Saudi regions.

Specialty	Nationality		P-value	Total N (%)
	Saudi N (%)	Non-Saudi N (%)		
Age	37.7 ± 8.7	40.76 ± 9.47	* <0.001	40.09 ± 9.39
Gender				
Male	2292(61.45)	8019(60.95)	0.581	10311(61.06)
Female	1438(38.55)	5138(39.05)		6576(38.94)
Regions				
Riyadh	1507(40.04)	3704(28.15)	* <0.001	5211(30.86)
Makkah	947(25.39)	3020(22.95)		3967(23.49)
Madinah	214(5.74)	888(6.75)		1102(6.53)
Qassim	52(1.39)	716(5.44)		768(4.55)
Eastern Province	578(15.50)	1936(14.71)		2514(14.89)
Asir	188(5.04)	1024(7.78)		1212(7.18)
Tabuk	47(1.26)	354(2.69)		401(2.37)
Ha'il	31(0.83)	355(2.70)		386(2.29)
Northern Borders	5(0.13)	126(0.96)		131(0.78)
Jizan	73(1.96)	301(2.29)		374(2.21)
Najran	47(1.26)	311(2.36)		358(2.12)
Al-Baha	23(0.62)	184(1.40)		207(1.23)
Al-Jawf	18(0.48)	238(1.81)		256(1.52)
Sector				
Private	1255(33.65)	10465(79.54)	* <0.001	11720(69.40)
Public	2475(66.35)	2692(20.46)		5167(30.60)
Specialist Dentists in Public Sector	924(24.77)	1092(8.30)	* <0.001	2016(11.94)
Specialist Dentists in Private Sector	428(11.47)	2519(19.15)	* <0.001	2947(17.45)

Note: data are expressed as mean ± standard deviation for age and frequency and percentage for the other variables.

\* P-value < 0.05.

**Table 2**  
The professional registration of Saudi and non-Saudi dentists in different.

Professional registration	Nationality		P-value	Total N (%)
	Saudi N (%)	Non-Saudi N (%)		
General Dentist	2525(67.69)	9343(71.01)	* <0.001	11868(70.27)
Resident	139(3.73)	521(3.96)	* <0.001	660(3.91)
Registrar	595(15.95)	2124(16.14)	* <0.001	2719(16.10)
Senior Registrar	109(2.92)	247(1.87)	* <0.001	356(2.11)
Consultant	349(9.36)	860(6.54)	* <0.001	1209(7.16)
Non-Practicing	6(0.16)	35(0.26)	* <0.001	41(0.24)
Visiting	6(0.16)	14(0.11)	* <0.001	20(0.12)
Other	14(0.37)	0(0.00)	* <0.001	14(0.083)

Note: data are expressed as frequency and percentage.

\* P < 0.05.

specialists among the licensed Saudi male dentists is slightly higher than their Saudi female counterparts (37.26% vs. 34.63%). Fig. 3 shows the percentages of licensed non-Saudi dentists in both private and public health sectors in each region. The percentages of licensed non-Saudi dentists who are working in the public health sector fall under 20% in the three main regions of the kingdom (Riyadh, Makkah, and Eastern province), and go as high as 46% in Al-Baha region. Fig. 4 shows the percentages of licensed dental specialists and general dentists among non-Saudi dentists who are working in the public health sector in each region. Overall, most of the licensed non-Saudi dentists who are working in the public health sector in the kingdom are registered as general dentists with few exceptions such as in Madinah and the Northern borders regions.

Table 3 shows the numbers and percentages of Saudi and non-Saudi dentists in each dental specialty from the 11 different specialties in the SCFHS database. The majority of the licensed dentists are registered as general dentists (70.61%). The percentage of prosthodontists among the licensed Saudi dentists is significantly higher than their non-Saudi counterparts (14.26% vs. 6.71%;

$P < 0.001$ ); however, the percentage of non-Saudi prosthodontists of the total number of licensed prosthodontists in the kingdom is higher than their Saudi counterparts (62.40% vs. 37.60%). Likewise, the percentages of pedodontists and periodontists among the licensed Saudi dentists is significantly higher than their non-Saudi counterparts (4.66% vs. 2.05%;  $P < 0.001$ ) and (3.27% vs. 2.01%;  $P < 0.001$ ), respectively. However, the percentages of non-Saudi pedodontists and periodontists of the total number of licensed pedodontists and periodontists in the kingdom is higher than their Saudi counterparts (60.81 vs. 39.19%) and (68.48% vs. 31.52%), respectively. The percentage of oral maxillofacial surgeons among the licensed non-Saudi dentists is significantly higher than their Saudi counterparts (5.72% vs. 4.34%;  $P < 0.001$ ) and they represent 82.28% from the total number of licensed oral maxillofacial surgeons in the kingdom. There are only 17 licensed oral maxillofacial radiologists in the kingdom and only three of them are Saudis. The percentage of orthodontists among the licensed non-Saudi dentists is significantly higher than their Saudi counterparts (8.63% vs. 6.38%;  $P < 0.001$ ), and they represent 82.67% of the total number of licensed orthodontists in the kingdom. Although the

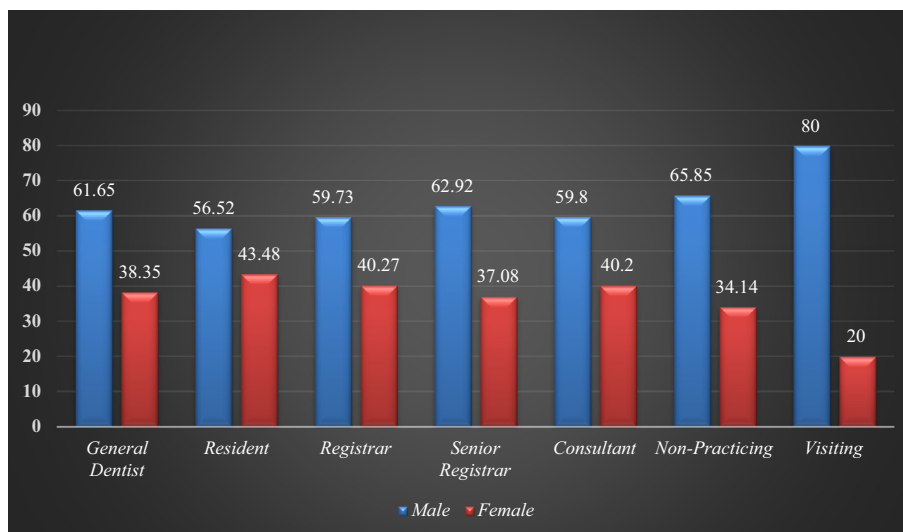


Fig. 1. The professional registration of dentists across gender (%).

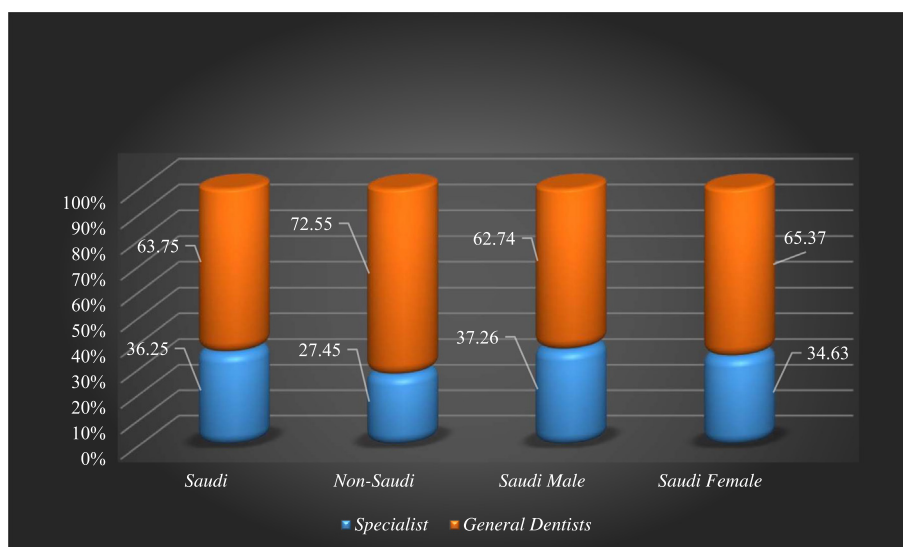


Fig. 2. The percentages of dental specialists and general dentists among Saudi, Non-Saudi, and Saudi male and female dentists.

percentage of endodontists among the licensed non-Saudi dentists is significantly lower than their Saudi counterparts (1.93 vs. 4.18%;  $P < 0.001$ ), they represent 61.95% of the total number of licensed endodontists in the kingdom. There are also some dentists with other dental specialties such oral maxillofacial pathology, dental biomaterials, and dental public health, and the non-Saudi dentists represent the majority of them.

As shown in Table 4, the number of licensed male dentists in each specialty is higher than their female counterparts regardless of their nationality with the exception of dental biomaterials in which the numbers of male and female dentists are equal. However, the percentage of female general dentists among the licensed female dentists in the kingdom is significantly higher than their male counterparts (79.71% vs. 64.80%;  $P < 0.001$ ). Moreover, the percentage of female pedodontists among the licensed female dentists in the kingdom is slightly but significantly higher than their male counterparts (2.93% vs. 2.43%;  $P < 0.001$ ). Another observation that can be noticed in Table 5, is that the percentage of licensed dental specialists who are practicing in the public health sector is higher than their counterparts in the private health sector.

However, this does not hold true for orthodontists. The percentage of licensed orthodontists who are practicing in the private health sector is significantly higher than their counterparts in the public health sector (9.19% vs. 5.73%;  $P < 0.001$ ). Fig. 5 shows the distribution of dentists from different specialties across the Saudi regions for both Saudi and non-Saudi dentists.

According to the general authority for statistics demography survey of 2016, the total population of the kingdom of Saudi Arabia is 31,742,308. Table 6 shows the ratios of licensed Saudi dentists and dentists overall to the Saudi population, non-Saudi population, and total population in each Saudi region. The dentist to total population ratio was the highest in Riyadh region (1:1536) and the lowest in Jizan region (1:4101). The Saudi dentist to total population ratio was the highest in Riyadh region as well (1:5309) and the lowest in Al-Jawf region (1: 27639).

#### 4. Discussion

This study presented the status of demographic distribution and characteristics of dentist workforce in the kingdom of Saudi Arabia.

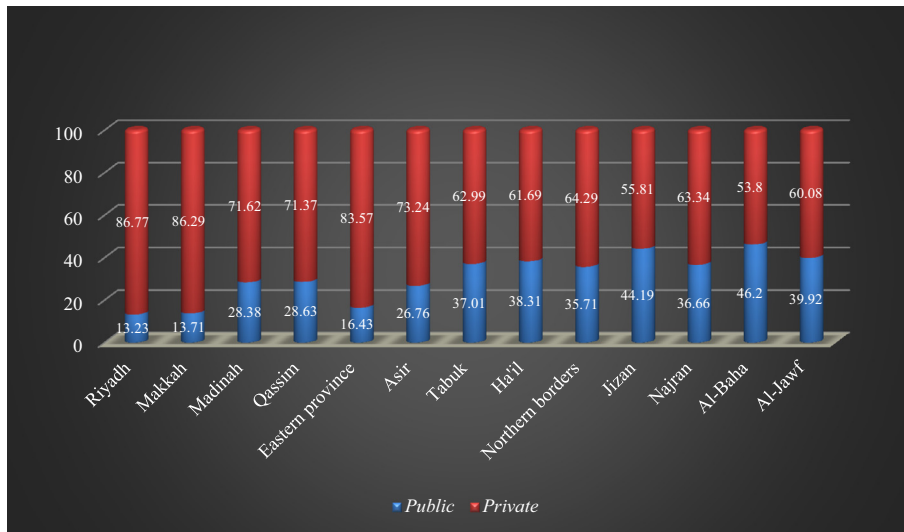


Fig. 3. The percentages of non-Saudi dentists in public and private health sectors across the Saudi regions.

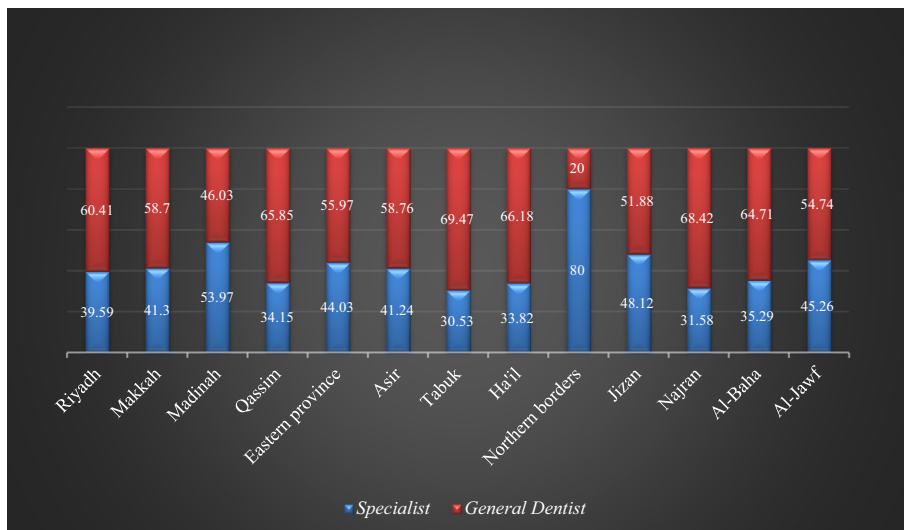


Fig. 4. The percentages of dental specialists and general dentists among non-Saudi dentists in the public health sector in each region.

**Table 3**  
The distribution of Saudi and non-Saudi dentists in different specialties.

Specialty	Nationality		P-value	Total N (%)
	Saudi N (%)	Non-Saudi N (%)		
General Dentist	2378(63.75)	9546(72.55)	<0.001	11924(70.61)
Prosthodontics	532(14.26)	883(6.71)	<0.001	1415(8.38)
Pedodontics	174(4.66)	270(2.05)	<0.001	444(2.63)
Periodontics	122(3.27)	265(2.01)	<0.001	387(2.29)
OMS	162(4.34)	752(5.72)	<0.001	914(5.42)
OMFR	3(0.08)	14(0.11)	<0.001	17(0.10)
OMP	33(0.88)	72(0.55)	<0.001	105(0.62)
Orthodontics	238(6.38)	1135(8.63)	<0.001	1373(8.13)
Endodontics	156(4.18)	254(1.93)	<0.001	410(2.43)
Dental Biomaterials	3(0.08)	9(0.07)	<0.001	12(0.07)
DPH	45(1.21)	82(0.62)	<0.001	127(0.75)

Note: data are expressed as frequency and percentage.

Abbreviations: OMS = Oral Maxillofacial Surgery; OMFR = Oral Maxillofacial Radiology; OMP = Oral Maxillofacial Pathology; DPH = Dental Public Health.

\* P < 0.05.

**Table 4**

The distribution of male and female dentists in different specialties.

Specialty	Gender		P-value	Total N (%)
	Male N (%)	Female N (%)		
General Dentist	6682(64.80)	5242(79.71)	*<0.001	11924(70.61)
Prosthodontics	1012(9.81)	403(6.13)	*<0.001	1415(8.38)
Pedodontics	251(2.43)	193(2.93)	0.047	444(2.63)
Periodontics	272(2.64)	115(1.75)	*<0.001	387(2.29)
OMS	778(7.54)	136(2.07)	*<0.001	914(5.41)
OMFR	11(0.11)	6(0.09)	0.757	17(0.10)
OMP	69(0.67)	36(0.55)	0.326	105(0.62)
Orthodontics	1030(9.98)	343(5.22)	*<0.001	1373(8.13)
Endodontics	289(2.80)	121(1.84)	*<0.001	410(2.43)
Dental Biomaterials	6(0.05)	6(0.09)	0.431	12(0.07)
DPH	84(0.81)	43(0.65)	0.238	127(0.75)

Note: data are expressed as frequency and percentage.

Abbreviations: OMS = Oral Maxillofacial Surgery; OMFR = Oral Maxillofacial Radiology; OMP = Oral Maxillofacial Pathology; DPH = Dental Public Health.

\* P &lt; 0.05.

**Table 5**

The distribution of dentists in different specialties across private and public sectors.

Specialty	Sector		P-value	Total
	Private N (%)	Public N (%)		
General Dentist	8773(74.85)	3151(60.98)	*<0.001	11924(70.61)
Prosthodontics	721(6.15)	694(13.43)	*<0.001	1415(8.38)
Pedodontics	242(2.06)	202(3.91)	*<0.001	444(2.63)
Periodontics	207(1.76)	180(3.48)	*<0.001	387(2.29)
OMS	482(4.11)	432(8.36)	*<0.001	914(5.42)
OMFR	9(0.08)	8(0.15)	0.141	17(0.10)
OMP	48(0.41)	57(1.10)	*<0.001	105(0.62)
Orthodontics	1,077(9.19)	296(5.73)	*<0.001	1373(8.13)
Endodontics	201(1.72)	209(4.04)	*<0.001	410(2.43)
Dental Biomaterials	3(0.03)	9(0.17)	*<0.001	12(0.07)
DPH	49(0.42)	78(1.51)	*<0.001	127(0.75)

Note: data are expressed as frequency and percentage.

Abbreviations: OMS = Oral Maxillofacial Surgery; OMFR = Oral Maxillofacial Radiology; OMP = Oral Maxillofacial Pathology; DPH = Dental Public Health.

\* P &lt; 0.05.

The findings of this study should provide the baseline data about the licensed dentist workforce and help in designing a balanced demographic distribution of dental practitioners in the kingdom. Furthermore, the present study showed a gradual increase in the dental workforce in the kingdom over the last two decades. The total population of licensed dentists in Saudi Arabia is 16,887 as of December 2016 compared to 786 and 12,785 dentists in the year of 1987 and 2014, respectively (Shalhoub and Badr, 1987; MOH, 2014). Most of the dental care in the kingdom was and still provided by non-Saudi dentists. The percentage of foreign dentists out of the total number of licensed dentists in the kingdom is high compared to other countries. In Bahrain, only 24.1% of foreign dentists had to fulfil the total dental care demands of the country (Ahmed et al., 2000). However, in Kuwait, foreign dentists constituted 55.6% of the dental workforce (Al-Jarallah et al., 2010).

Although foreign dentists represent 77.91% of the total number of licensed dentists, which indicates that there is a shortage of Saudi dentists to meet the dental care demand in the kingdom, the unemployment rate among the fresh dental graduates is surprisingly high. This can be attributable to multiple factors such as the significant increase in the number of dental graduates between the year of 2000 and 2016. The number of public dental colleges now is 17 compared to only 3 colleges back in 2000. Further, most of the licensed Saudi dentists are practicing in the public health sector (66.35%), which might be due to several reasons such as the high salaries and higher level of job security in this sector compared to the private health sector. In addition, the ability of

the Saudi dentists to compete in the market with the foreign dentists is limited due to employers' preference to employ non-Saudi who usually work more hours for less pay. Therefore, we believe that the joint decision by the ministries of labor and health to halt the recruitment of foreign dentists was a wise decision and a step in the right direction.

Most of the licensed dentists in the kingdom are general dentists (70.6%). This holds true for both the Saudi and non-Saudi dentists in which the percentages of general dentists among them are 63.75% and 72.55%, respectively. The high percentage of general dentists among the Saudi dentists can be attributable to several reasons, however, many believe that the limited number of residency positions in the SCFHS bears the brunt of that. Moreover, the argument that most of the foreign dentists in the kingdom are specialists and therefore it would be hard to replace them with the Saudi dentists in both the private and public health sectors was proven to be wrong according to this study's findings. Only 27.45% of the non-Saudi licensed dentists in the kingdom are specialists. Moreover, with the exception of the Northern borders region, most of the licensed non-Saudi dentists who are practicing in the public health sector are general dentists.

The demographic distribution and characteristics of the licensed dentist workforce in the kingdom can be compared to other countries. For example, only 105 (0.6%) of the licensed dentists in the kingdom were specialized in oral maxillofacial pathology. Similarly, a previous study conducted in Taiwan reported that about 79.7% of the dentists practiced general dentistry and only 1%

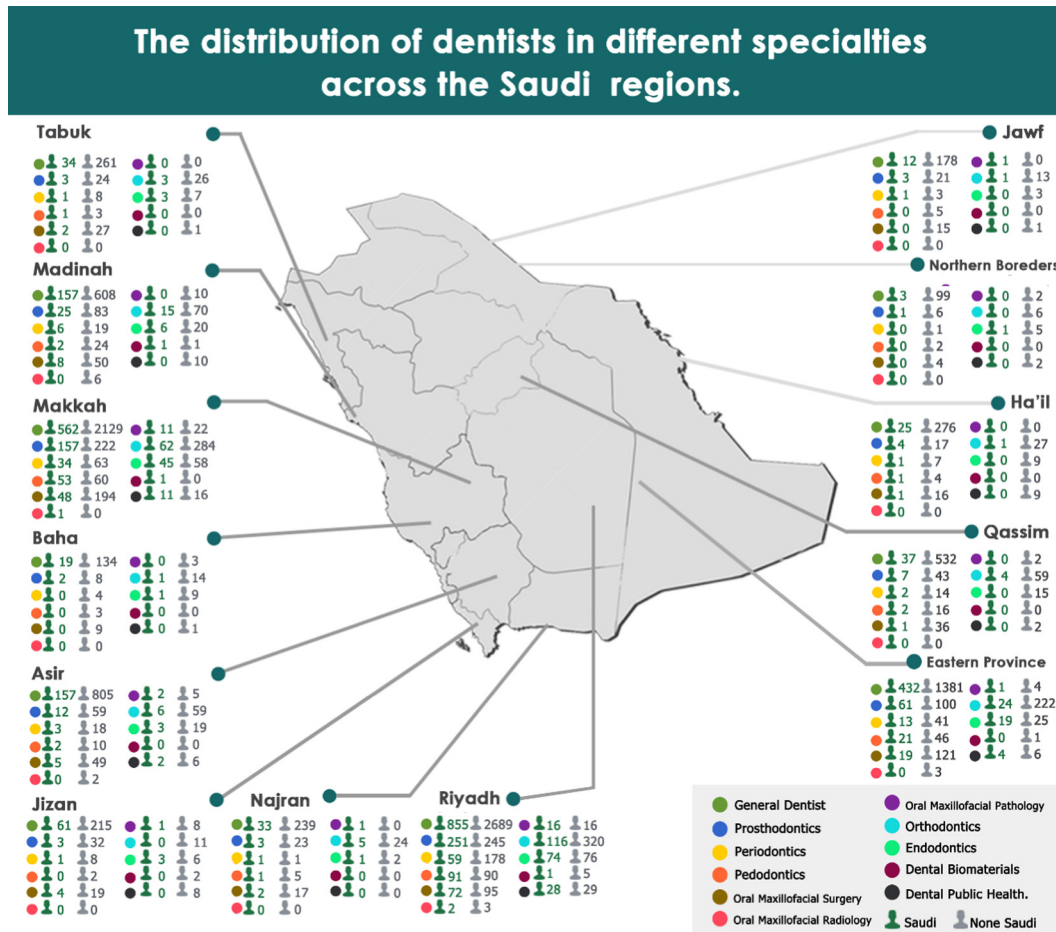


Fig. 5. The distribution of licensed dentists from different specialties across the Saudi regions for both Saudi and non-Saudi dentists.

**Table 6**  
The ratios of Saudi dentist and dentist overall to the Saudi, non-Saudi, and total populations in different regions.

Regions	Saudi population	Non-Saudi population	Total population	Saudi dentist to total population ratio	Saudi dentist to Saudi population ratio	Dentist to total population ratio
Riyadh	4,579,570	3,422,530	8,002,100	1:5309	1:3039	1:1536
Makkah	4,440,571	3,884,733	8,325,304	1:8791	1:4689	1:2099
Madinah	1,353,102	727,334	2,080,436	1: 9721	1:6323	1:1888
Qassim	991,032	396,964	1,387,996	1: 26,692	1:19,058	1: 1807
Eastern province	3,087,687	1,692,932	4,780,619	1: 8271	1: 5342	1:1901
Asir	1,719,950	444,222	2,164,172	1:11,511	1: 9149	1:1786
Tabuk	710,699	180,223	890,922	1:18,955	1: 15,121	1:2222
Ha'il	529,012	155,607	684,619	1:22,084	1: 17,065	1:1774
Northern borders	285,486	73,749	359,235	1: 71,847	1: 57,097	1:2742
Jizan	1,187,284	346,396	1,533,680	1: 21,009	1: 16,264	1:4101
Najran	430,711	138,621	569,332	1: 12,113	1: 9164	1:1590
Al-Baha	376,204	90,180	466,384	1: 20,277	1: 16,356	1:2253
Al-Jawf	373,662	123,847	497,509	1: 27,639	1: 20,759	1:1943

Information about the population of each Saudi region was taken from the Saudi General Authority for Statistics demography survey of 2016.

of them were specialists in oral maxillofacial pathology (Huang et al., 2013). In another study, about 39% of the dentists in Australia were specialized in orthodontics compared to only 8.13% of the licensed dentists in Saudi Arabia (Australian Research Centre for Population Oral Health, 2010). The majority of dentists with specialty were in Riyadh, Makkah, and Eastern province. In addition, most of dentists in general dentistry were in Riyadh (29.7%), Makkah (22.6%), and Eastern province (15.1%). Similarly, a previous

study conducted in Australia reported that the highest number of specialists and general practitioners were in the Australian Capital Territory (Australian Research Centre for Population Oral Health, 2010). In addition, the lowest number of specialists and general dentists were in remote/very remote areas (Australian Research Centre for Population Oral Health, 2010). Similarly, in the present study, the lowest number of specialists and general dentists were in the remote areas such as the Northern borders region.

The gender distribution is one of the important factors for planning dentist workforce in any country (Dubois et al., 2006). Licensed female dentists represent only 38.94% of the total licensed dentist workforce in the kingdom with no significant difference in their percentage among the Saudi and non-Saudi dentists. Also, the percentage of specialist dentists among the Saudi female dentists is lower than their male counterparts (34.63% vs. 37.26%). Since most of the college graduates in the kingdom are female, this raises some questions about the number of seats allocated to female applicants in the colleges of dentistry in the kingdom as well as the number of residency positions available for female dentists in the SCFHS. However, the percentage of female dentists from the total dentist workforce in other countries are not quite different. In Taiwan, the percentage of female dentists was reported to be 24.2% (Huang et al., 2013). Another study reported lower proportion of female dentists in Greece (Koletsis-Kounari et al., 2011). In the European Union, 17 countries had a proportion of female dentists ranging from 48% to 88%, while nine countries had a proportion ranging from 25% to 40% (Kravitz and Treasure, 2008). In addition, Liu et al. reported a lower proportion of female dentists compared to male dentists in China (43.7% vs 56.3%) (Liu et al., 2016).

In comparison to India where only 5% of the Indian dentists are working in the public health sector, most the licensed Saudi dentists (66.35%) are working in the public health sector (Vundavalli, 2014). Also, in Australia most of the dentists are working in the private health sector compared to only 33.63% of the Saudi dentists who are working in this sector (Australian Research Centre for Population Oral Health, 2010). In the present study, most of the licensed Saudi dentists are practicing in the urban areas such as Riyadh, Makkah, and Eastern province. Similarly, a previous study reported that most dentists (53%) are practicing in urban areas, followed by suburban (34%), and rural area (13%) (Brunton et al., 2012). Another study reported a little higher proportion of dental professionals in the urban areas than rural areas (9.70 vs 3.77 per 10,000 population) in China (Liu et al., 2016).

As per world health organization, the dentists-to-population is the main core indicator to assess adequate number of healthcare professionals relative to the population (Huang et al., 2013). Saudi Arabia has shown improved dentists-to-population ratio from 1:8906 in 1987 to 1:1880 in 2016. The current dentists-to-population ratio in Saudi Arabia is 5.3 per 10,000 people, which indicates a better dentists-to-population ratio compared to most of the developing countries and Asia-Pacific countries. Among Asia-Pacific countries, China has the lowest dentists-to-population ratio of 0.12 per 10,000 people, and Japan has the highest dentists-to-population ratio of 7.7 per 10,000 people (Huang et al., 2013). Other studies reported that the OECD member countries, excluding Scandinavian countries and Greece, have varied dentists-to-population ratios ranging from 5 to 8 with the average of 6.1 per 10,000 people (Organisation for Economic Co-operation and Development, 2011; Organisation for Economic Co-operation and Development, 2009). In addition, most of the European countries have dentists-to-population ratios ranging from 5.07 to 7.3 per 10,000 people (Organisation for Economic Co-operation and Development, 2011; Organisation for Economic Co-operation and Development, 2009). Among the Middle East countries, Bahrain has the lowest dentists-to-population ratio of 1.5 per 10,000 people, and Qatar has the highest dentists-to-population ratio of 5.8 per 10,000 people (Gallagher et al., 2015). However, this ratio of one dentist to 1880 people in the kingdom is variable across regions. For example, the dentist to total population in Riyadh region is the highest in the kingdom (1:1536) and the lowest in Jizan region (1:4101). Further, the ratio of Saudi dentist to total population is significantly lower than the ratio of dentist overall to total population. For example, the Saudi dentist to total popula-

tion ratio in Riyadh region is the highest in the kingdom (1:5309) and the lowest in Al-Jawf region (1:27,639). This underscores the need to employ Saudi dentists in the peripheral regions such as Al-Jawf and Jizan to fulfil the dental care demands in these regions.

Although this study is the first to the best of our knowledge to investigate the dentist workforce characteristics and demographic distribution in the kingdom, it has several limitations. As with all such studies, inaccuracies due to incorrect or incomplete documentation may occur in the details of dentists working in Saudi Arabia as provided by the SCFHS. Further, this study only included the licensed dentists in the SCFHS, therefore, no conclusion should be drawn regarding the total number of dentists in Saudi Arabia based on this study's data only. In addition, some recognized dental specialties such as restorative dentistry was not documented in the SCFHS database. Therefore, using this data to plan and allocate the future dental workforce in Saudi Arabia may not be ideal.

## 5. Conclusion

The kingdom of Saudi Arabia has shown steady growth in the dental workforce in last 20 years. Every year there is an increase in the number of dental graduates who are currently experiencing difficulties in finding suitable jobs for themselves. Most of the licensed dental care in the kingdom is provided by foreign general dentists, therefore, replacing them with Saudi general dentists might be one of the solutions to address the rising unemployment rates among the fresh dental graduates. Further, the fact that most of the Saudi dentists are registered as general dentists may shed the light on the size of the accredited SCFHS residency programs in dentistry, where very limited number of dentists can join relative to the number of Saudi dentists in the kingdom. Therefore, the SCFHS should work together with the major health care sectors in the kingdom such as the ministry of health and the large academic institutions to expand the accredited residency programs in different dental specialties. Also, there should be joint initiatives by the ministries of health, labor, and education to carefully plan the number of dental graduates every year from both public and private colleges of dentistry. Finally, the low ratios of dentist-to-population in the peripheral regions should be addressed by both the ministries of labor and health to fulfil the dental care demands in these regions.

## Acknowledgments

The authors acknowledge financial support from the College of Pharmacy Research Center and the Deanship of Scientific Research, King Saud University (Riyadh, Saudi Arabia).

## Disclosure

Authors of this study have nothing to disclose concerning possible financial or personal relationships with commercial entities that may have a direct or indirect interest in the subject matter of this study.

## References

- Ahmed, A.A., Fateha, B., Benjamin, S., 2000. Demand and supply of doctors and dentists in Bahrain, 1998–2005. *East Mediterr. Health J.* 6 (1), 6–12.
- Al-Jarallah, K.F., Moussa, M.A., Al-Duwairi, Y., Zatar, E., Al-Khanfar, K.F., 2010. The dentist workforce in Kuwait to the year 2020. *Community Dent. Health* 27 (3), 178–183.
- American Dental Association, 2006. The oral-systemic connection: an update for the practicing dentist. A special supplement to the *Journal of the American Dental Association*. *J. Am. Dent. Assoc.* 137, 15–40S.
- Australian Research Centre for Population Oral Health, 2010. Dental specialists in Australia. *Aust. Dent. J.* 55 (1), 96–100.



- Brunton, P.A., Burke, T., Sharif, M.O., Muirhead, E.K., Creanor, S., Wilson, N.H., 2012. Contemporary dental practice in the UK: demographic details and practising arrangements in 2008. *Br. Dent. J.* 212 (1), 11–15.
- Dubois, C.A., McKee, M., Nolte, E., 2006. Analyzing trends, opportunities, and challenges. In: Dubois, C.A., McKee, M., Nolte, E. (Eds.), *Human resources for health in Europe*. European Observatory on Health Systems and Policies. Open University Press, Brussels, p. 15.
- Gallagher, J.E., Manickam, S., Wilson, N.H., 2015. Sultanate of Oman: building a dental workforce. *Hum. Resour. Health* 13, 50.
- Huang, C.S., Cher, T.L., Lin, C.P., Wu, K.M., 2013. Projection of the dental workforce from 2011 to 2020, based on the actual workload of 6762 dentists in 2010 in Taiwan. *J. Formos. Med. Assoc.* 112 (9), 527–536.
- Huang, C.S., Cher, T.L., Lin, C.P., Wu, K.M., 2013. Projection of the dental workforce from 2011 to 2020, based on the actual workload of 6762 dentists in 2010 in Taiwan. *J. Formos. Med. Assoc.* 112 (9), 527–536.
- Koletsis-Kounari, H., Papaioannou, W., Stefaniotis, T., 2011. Greece's high dentist to population ratio: comparisons, causes, and effects. *J. Dent. Educ.* 75 (11), 1507–1515.
- Kravitz, A.S., Treasure, E.T., 2008. *Manual of Dental Practice*, 2008. Council of European Dentists, Brussels.
- Liu, J., Zhang, S.S., Zheng, S.G., Xu, T., Si, Y., 2016. Oral health status and oral health care model in China. *Chin. J. Dent. Res.* 19 (4), 207–215.
- MOH, 2014. Ministry of Health. Available at: <<http://www.moh.gov.sa/en/Ministry/Statistics/Pages/default.aspx>> (accessed 15.11.14).
- Nash, D., Ruotoistenmäki, J., Argentieri, A., Barna, S., Behbehani, J., Berthold, P., et al., 2008. Profile of the oral healthcare team in countries with emerging economies. *Eur. J. Dent. Educ.* 12 (Suppl. 1), 111–119.
- Organisation for Economic Co-operation and Development, 2009. *Health at a glance 2009*. OECD Indicators, Paris, France.
- Organisation for Economic Co-operation and Development, 2011. Health care resource. Retrieved from: <[http://stats.oecd.org/Index.aspx?DataSetCodeZHEALTH\\_REAC](http://stats.oecd.org/Index.aspx?DataSetCodeZHEALTH_REAC)> (accessed 01.05.12).
- Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference, New York, 19–22 June 1946. <<http://www.who.org>> (last accessed 16 May 2007).
- Saudi Commission for Health Specialties (SCFHS): *Professional Classification Manual for Health Practitioners*, 5th ed. Riyadh, Saudi Arabia, 2009.
- Shalhoub, S.Y., Badr, A.A., 1987. Professional dental education in the Kingdom of Saudi Arabia—an overview. *Odonto-Stomatol. Trop.* 10, 205–212.
- Vundavalli, S., 2014. Dental manpower planning in India: current scenario and future projections for the year 2020. *Int. Dent. J.* 64 (2), 62–67.
- World Health Organization, 2006. *Working together for health: the world health report*. Geneva, Switzerland: WHO.