

## Review

# Are There Enough Neurosurgeons in Saudi Arabia?

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## Abstract

### Background

Neurosurgery became a separate surgical subspecialty relatively recently when compared to other branches of medicine. The adequate number of neurosurgeons per capita has always been a debate. In 1977 the “Study on Surgical Services for the United States” report (SOSSUS) proposed that the number of neurosurgeons should be 1 per 100,000 populations [1]. Manpower requirement in medicine is being evaluated continuously. Thus, the evaluation of each country’s requirement of neurosurgeons is a necessity. To our knowledge, no previous studies in Saudi Arabia or in the Arab World that calculated the Population Neurosurgeon Ratio (PNR) have been published. Therefore, the need to calculate the number of neurosurgeons and their distribution in Saudi Arabia is essential.

### Objective

The aim of this report is to review the statistics of neurosurgeons in Saudi Arabia, estimate the PNR, and compare it with other international population ratios in addition to evaluate PNR in different Cities and regions within the country.

### Method

Data were collected from the Saudi Council for Health Subspecialties, Saudi Association of Neurological Surgeons, Central Department of Statistics and Information and through personal contact information in 2016 in Saudi Arabia. PNR was then calculated for different regions and cities and for the whole country as an average.

### Results

The Kingdom of Saudi Arabia has a population of 27.136.977 and a total of 207 qualified neurosurgeons of multiple nationalities. 62 neurosurgeons (29.9%) are Saudi nationals. Other common nationalities were Egyptian nationals (29.9%). The Kingdom has a mean of one neurosurgeon per 131096 populations. The highest number of PNR being Khamis Mushait (PNR 1: 512599) and, the lowest in AlKhobar (PNR 1: 32,138).

### Conclusion

The Neurosurgical workforce and manpower planners should

consider the vast territories of Saudi Arabia and the demographic distribution in the future of neurosurgeons’ employment, accompanied by providing acceptable facilities to maintain international standard of service.

**Keywords:** Neurosurgery; Neurosurgeons Per Population; PNR; Neurosurgeons, Saudi Arabia

### Introduction

From a geographic perspective, Saudi Arabia is considered the largest country in the Middle East, 2<sup>nd</sup> in Arab world, 4<sup>th</sup> in Asia and 12<sup>th</sup> worldwide with an area of 2,240,000 sq. km [2]. The population of Saudi Arabia is 27.136.977 people including both Saudi nationals and non-Saudi nationals [3,15]. Neurosurgery as a sub-specialty is a relatively new branch in medicine. The sufficient workforce of neurosurgeons for any given population is controversial. It differs from community to community and historically from era to era. As early as the first half of the twentieth century, Harvey Cushing, the father of modern neurosurgery, stated that the Population Neurosurgeon Ratio (PNR) of one per million would be plenty [4,14]. Countries outside North-Atlantic Countries (USA, Canada and Western Europe), historically had a much smaller neurosurgical practice at least in terms of number of available neurosurgeons [5,18]. The number of neurosurgeons serving these countries has grown enormously. The number of neurosurgeons reported worldwide in 1993 was 23940; over 16,300 of them practiced outside North-Atlantic countries [2,5]. The

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presence of modern Neurosurgery and qualified neurosurgeons for the Middle East started in the second half of the twentieth century [5,18]. Neurosurgery began as a separate specialty in Turkey in 1951. Prior to this, neurosurgical procedures had been performed by general surgeons [5,17]; Samuel Boctor, Ibrahim Higazi, and Osman Hassan who formerly trained in England and the United States practiced neurosurgery in Egypt to practice neurosurgery in early 1952 [5]. Neurosurgery as a practice commenced in Iran in the early 1950s by N.O. Ameli who was trained in England and Ebrahim Samiy who was trained in Germany [5]. Until 1961, minor neurosurgical problems in Jordan were treated by general surgeons while patients with complex problems were sent to Lebanon for neurosurgical treatment [5]. Neurosurgery was recognized in Jordan when Antoine Tarazi finished his training in Montreal, Canada in 1961 [5]. In 1964, the Saudi Ministry of Health opened the first neurosurgery section as part of the general surgery department in Riyadh Central Hospital in Riyadh (the capital city), and recruited a neurosurgeon from India, Dr. Abdulraheem, to lead

it [6]. In 1976, the practice of neurosurgery entered an important phase of its progress when a new department was opened at King Faisal Specialist Hospital, Riyadh, under the chairmanship of Dr. Kaden, an American neurosurgeon. Professor Fox, from the United States, and Dr. Osama Almefty, (a Syrian-born) American neurosurgeon, joined the department [6]. In 1983, Dr. Khalaf Al Moutaery (Figure 1), the first Saudi (German-qualified) neurosurgeon began an era of advanced neurosurgery at Riyadh Armed Forces Hospital. The Department was provided with the latest, most sophisticated equipment such as CT scanner, MRI and nuclear medicine<sup>6</sup>. In 2006, The Saudi Association of Neurological Surgeons was established in Riyadh and was headed by Professor Zain Alabdeen Jamjoom (Figure 2). In 2012, The Saudi Young Neurosurgeons Group was initiated in Riyadh (Figure 3) and was headed by Dr. Ali Aljuzair (Figure 4). In 1977, a “Study on Surgical Services for the United States” report (SOSSUS) proposed that the adequate (PNR) is 1:100.000 [4]. The actual ratio has always been higher than suggested [1].

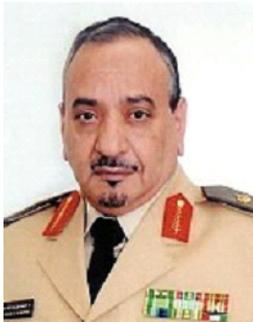


Figure 1: Dr. Khalaf Almutairey, First Saudi Neurosurgeon



Figure 2: Prof. Zain Alabdeen Jamjoom, Founder and first president of Saudi Association of Neurological Surgeons



Figure 3: Group Photo of Saudi Young Neurosurgeons first meeting



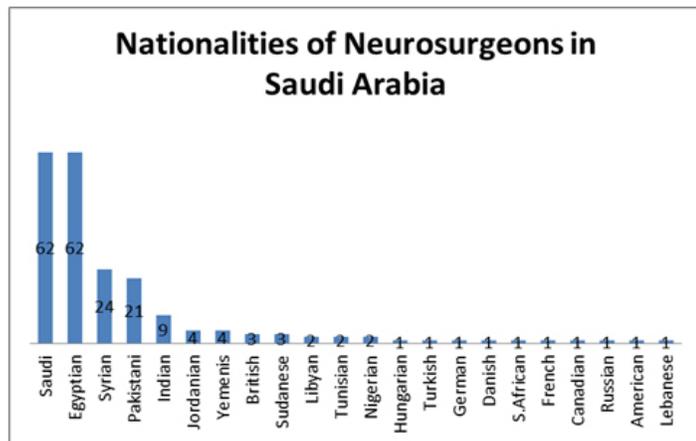
Figure 4: Dr. Ali Aljuzair, Founder and first president of Saudi Young Neurosurgeons Group.

**Method**

A cross sectional study was performed with data collected from different sources; Saudi Council for Health Subspecialties, Saudi Association of Neurological Surgeons, Central Department of Statistics and Information and through personal contact information from 2010 to 2016. We looked at the all board-certified neurosurgeons that practice neurosurgery in the governmental and private sectors as board certified neurosurgeons. PNR was then calculated in cities, Saudi Provinces, and for the country.

**Results**

Our results showed that Saudi Arabia has 207 certified neurosurgeons of multiple nationalities [7-9] (Figure 5). The total population of Saudi Arabia was 27.136.977 by the national central department of statistics and information. Saudi nationals form 18.707.576 (68.9%) and Non-Saudi nationals form 8.429.401 (31.1%). The PNR comes to 1: 131096, Saudi nationals forming 62 neurosurgeons (29.9%) while non-Saudi nationals forming 145 neurosurgeons (70.1%). Egyptian nationals’ neurosurgeons forming the majority with 62 neurosurgeons (29.9%), followed by Syrian nationals with 24 neurosurgeons (11.5%), Neurosurgeons of the Pakistani nationality were 21 surgeons (10.1%), Indian nationals were 9 neurosurgeons (4.3%), neurosurgeons from Jordan and Yemen were 4 (1.9%) each, Libyan nationals, Nigerian nationals and Tunisian nationals were 2 neurosurgeons (0.9%) each. Finally, neurosurgeons from United States, Canada, Denmark, France, Germany, Hungary, Lebanese, Russia, South Africa and Turkey were one from each (0.48%) of the total number of neurosurgeons in the Kingdom.



**Figure 5:** Number of Different Nationalities of Neurosurgeons in Saudi Arabia

Table 1 shows, Riyadh having the highest number of 77 neurosurgeons (1: 68241), Jeddah has 33 neurosurgeons (1: 104735), AlKhobar has 18 neurosurgeons (1: 32138), Dammam has 15 neurosurgeons (1: 60239), AlMadinah has 14 neurosurgeons (1: 84340),

AlHafuf, Taif, Makkah, and have 7 neurosurgeons each and a PNR(1: 151873), (1: 141130), and (1: 239338) respectively, ending with the lowest number of 5 neurosurgeons in AlQassim (1: 243171) [7-9].

**Table 1:** Shows the cities having more than 5 neurosurgeons

City	Population	# of neurosurgeons	PNR
Riyadh	5254560	77	68241
Jeddah	3456259	33	104735
AlKhobar	578500	18	32138
Dammam	903597	15	60239
AlMadinah	1180770	14	84340
AlHafuf	1063112	7	151873
Taif	987914	7	141130
Makkah	1675368	7	239338
AlQassim	1215858	5	243171

Table 2 shows Abha (1: 122183), AlJubail (1: 189474). Followed by AlBaha (1: 205944), Majmaah (1: 66642), Tabuk (1: 395767), Yanbu (1: 149337), and Qatif (1: 262091) having 2 neurosurgeons per city. And finally, with only 1 neurosurgeon per city lies Hafr AlBatin (1: 389993), Jaizan (1: 341277), Khamis Mushait (1: 512599), Qurayyat (1: 147550), and finally Sukakah with a PNR of (1: 242813).

**Table 2:** Shows the cities having less than 5 neurosurgeons

City	Population	# of neurosurgeons	PNR
Jaizan	1365110	4	341277
Abha	366551	3	122183
Jubail	378949	3	189474
AlBaha	411888	2	205944
Majmaah	133285	2	66642
Qatif	524182	2	262091
Tabuk	791535	2	395767
Yanbu	298675	2	149337
Hafr AlBatin	389993	1	389993
Khamis Mushait	512599	1	512599
Qurayyat	147550	1	147550
Sukakah	242813	1	242813

**Discussion**

When it comes to comparing PNR internationally Figure 6 shows a significant gap among continents and countries [21] with no clear explanation. We can see that Japan has the lowest PNR worldwide of (1:17000) [10,19] whereas Malawi has zero neurosurgeons and a population of 11.5 million scoring the worst and highest PNR globally [11]. Meanwhile Spain and Panama both have a similar suggested PNR of (1:100000) and (1:110000) but a huge difference

in population, (44 million) and (3.3 million) [10].

Saudi Arabia is in the middle range of Asian Countries with a PNR of 1: 131096 with a population of 27 million and 207 neurosurgeons, falling short missing the suggested adequate PNR by 64 neurosurgeons.

What makes the matter more complex is that out of the 207 neurosurgeons populating the Kingdom there are only 62 Saudi Neurosurgeons. Neurosurgery in Saudi Arabia is dependent largely on Non-Saudi Expatriates (145 neurosurgeons). Counting only the Saudi neurosurgeons the PNR will quadruple to reach (1:437693) which is four times worse than the suggested PNR. This means that there is a tremendous deficiency in the number of Saudi neurosurgeons.

Although the objective of the study was to report of the statistics of neurosurgeons in Saudi Arabia and to measure the reliability and capability of the neurosurgeons, expatriate neurosurgeons are providing vitally needed effort and as a country, looking abroad to cover the shortage should be a temporizing measure, as the country needs to have a more reliable source of staff for many reasons including the perspective of attrition.

Even if the strategy is to cover the current PNR deficiency as it stands today, knowing that neurosurgical training programs take at least 6 years, disregarding the time needed for sub-specialization and the time needed to find training program acceptances for applicants in addition to disregarding the attrition rate and the population growth: Saudi Arabia needs at least to train 20 residents per year so we can have 60 neurosurgeons in 12 years' time (2025 AD) to cover the deficit of today (2016) to reach a PNR of 1:100000 [16,20,24].

Saudi Arabia needs to invest much more on the training in neurosurgery both locally by improving upon the existing qualified training programs and internationally to accommodate the increasing national demand. The number of trainees should be increased at this point at least for the period necessary to overcome the current and future needs that rise each year.

Despite that Saudi Arabia's population growth rate had fallen from 2.62% between 1995 and 2000 to 2.12% between 2005 and 2010 and projected to continue falling, it is calculated that the population will still grow by 2025 to be around 34,000,000 [13]. This would indicate the number of neurosurgeons needed then should be 340.

The PNR differs in Saudi Arabia from province to Province. Figure 7 shows the city of Riyadh having the highest number of neurosurgeons with a PNR of 1: 68,241, meanwhile the number of neurosurgeons in AlKhobar is lower than Riyadh by 59 (28.9%), it has a better PNR of 1: 32,138 being the lowest in the Kingdom

which means that there is an over population of neurosurgeons in AlKhobar. Figure 8 shows the huge difference in PNR among the 9 major cities in Saudi Arabia with the worst PNR in AlQassim and Makkah and best PNR in Alkhobar and Dammam. On the other hand, Table 2 shows Khamis Mushait with 1 neurosurgeon has the highest PNR of 1: 512599 [7-9]. Table 2 also demonstrates the 13 cities have less than 5 neurosurgeons per city. The highest number of neurosurgeons in these cities is 4 being in Jaizan. Meanwhile Hafr AlBatin, Sukakah, and Khamis Mushait have only 1 neurosurgeon per city [8,9]. From the analyzed data we can see that 183 (88.4%) of the 207 neurosurgeons are found in the big cities where tertiary hospitals and good facilities could be found.

Our study had a few limitations, first, although the number stated in this article is for all board qualified neurosurgeons according the classification of Saudi Commission for Health Specialties, the authors could not determine the level and independency of the neurosurgical practice of each surgeon; as some of them are full consultants and some are senior registrars. Other limitations include that we could not calculate the number of surgeries performed by each center nor it could measure the quality of neurosurgery in each city of Saudi Arabia. These factors play a major role in the outcome of patient care. Also, the number of referrals from one city to another was not able to be obtained. Moreover, it did not cover the number of surgical procedures performed by a single neurosurgeon per year. Lastly, although we know the exact number of neurosurgical trainees in the Saudi Board under the supervision of the Saudi Commission for Health Specialties, we could not determine the number of Saudi trainees abroad, especially that there are many sponsoring agencies in the country that would send trainees on scholarships abroad in North Atlantic Countries.

## Conclusion

The PNR is 1: 131096, which is higher than the suggested adequate PNR ratio of 1; 100.000 [2,4,7-9]. So, to achieve that ratio, the number of neurosurgeons needs to be increased to reach 271 neurosurgeons [7-9]. Strategies need be formulated to find ways to increase the number of qualified neurosurgeons. by increasing the increase of the number of Saudi neurosurgeons to meet the country's needs. Strategies include, improving the number of qualified neurosurgical training centers to cover all the Saudi regions in addition to sending some trainees abroad to have a mixed flavor of training to augment the number and quality of practicing future neurosurgeons. There is a need to equate the PNR between provinces and cities by creating better exchange, referral and outreach programs.

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