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The popularity of neurology in Spain: an analysis of specialty selection☆

J. Curbelo[a,*], J.M. Romeo[b], J.M. Galván-Román[a], J. Vega-Villar[c], E.H. Martinez-Lapiscina[d], P. Jiménez-Fonseca[e], T. Villacampa[f], F. Sánchez-Lasheras[g], A. Fernández-Somoano[h,i], J. Baladrón[j]

[a] *Servicio de Medicina Interna, Hospital Universitario La Princesa, Madrid, Spain*
[b] *Editor del blog MIRentrelazados*
[c] *Servicio de Radiodiagnóstico, Hospital Universitario de Getafe, Getafe, Madrid, Spain*
[d] *Hospital Clínic - Instituto de Ciencias Biomédicas August Pi i Sunyer, Barcelona, Spain*
[e] *Servicio de Oncología Médica, Hospital Universitario Central de Asturias, Oviedo, Spain*
[f] *Curso Atención Primaria Asturias, Oviedo, Spain*
[g] *Departamento de Matemáticas, Universidad de Oviedo, Gijón, Spain*
[h] *IUOPA-Área de Medicina Preventiva y Salud Pública, Departamento de Medicina, Universidad de Oviedo, Oviedo, Spain*
[i] *CIBER de Epidemiología y Salud Pública-CIBERESP, Instituto de Salud Carlos III, Madrid, Spain*
[j] *Curso Intensivo MIR Asturias, Oviedo, Spain*

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KEYWORDS
Neurology;
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Abstract
Introduction: Neurology is one of the medical specialties offered each year to residency training candidates. This project analyses the data associated with candidates choosing neurology residency programmes in recent years.
Methods: Data related to specialty selection were obtained from official reports by the Spanish Ministry of Health, Social Services, and Equality. Information was collected on several characteristics of teaching centres: availability of stroke units, endovascular intervention, national reference clinics for neurology, specific on-call shifts for neurology residents, and links with medical schools or national research networks.
Results: The median selection list position of candidates selecting neurology training has been higher year on year; neurology was among the 4 most popular residency programmes in 2016. Potential residents were mainly female, Spanish, and had good academic results. The median number of hospitals with higher numbers of beds, endovascular intervention, stroke units, and national reference clinics for neurology is significantly lower. This is also true when centres are analysed by presence of specific on-call shifts for neurology residents and association with medical schools or national research networks. The centres selected by candidates with the

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* Corresponding author.
E-mail address: curbelo1984@gmail.com (J. Curbelo).

highest median selection list position in 2012-2016 were the Clínico San Carlos, 12 de Octubre, and Vall d'Hebron university hospitals.
Conclusions: Neurology has gradually improved in residency selection choices and is now one of the 4 most popular options. Potential residents prefer larger centres which are more demanding in terms of patient care and which perform more research activity.

PALABRAS CLAVE
Neurología;
Formación;
Elección

Popularidad de Neurología en España: análisis de la elección de la especialidad

Resumen
Introducción: Neurología es una de las especialidades ofertadas a los opositores que acceden a la formación sanitaria especializada cada año. Este proyecto analiza los datos de elección de Neurología en los últimos años.
Material y métodos: Los datos de la elección se han obtenido de la publicación oficial del Ministerio de Sanidad, Servicios Sociales e Igualdad. Se ha recabado información de los distintos centros docentes con relación a la disponibilidad de unidad de ictus, intervencionismo endovascular, consultas de referencia nacional relacionadas con Neurología, guardias específicas para residentes y vinculación con facultades de medicina o redes de investigación nacional.
Resultados: La mediana de elección de número de orden para Neurología ha descendido anualmente, situando la especialidad en la convocatoria 2016 entre las cuatro más populares. Los electores son mayoritariamente mujeres de nacionalidad española y baremo académico alto. La mediana de los hospitales con mayor número de camas, intervencionismo vascular, unidad de ictus o consultas de referencia nacional es significativamente menor. Lo mismo sucede al analizar los centros según guardias específicas de Neurología para residentes o vinculación con facultades de medicina o redes de investigación nacionales. Los centros con menor mediana de número de orden para el periodo 2012-2016 fueron los hospitales universitarios Clínico San Carlos, 12 de Octubre y Vall d'Hebron.
Conclusiones: Neurología ha ido mejorando de manera progresiva en la elección de plazas de especialización, situándose entre las cuatro más populares. Los electores se decantan por centros grandes, de mayor complejidad asistencial y con intensa actividad investigadora.

Introduction

Neurology is the branch of medicine that focuses on the structure, function, and development of the nervous system (central, peripheral, and autonomic) and the musculoskeletal system, in normal and pathological states, using a wide range of clinical and instrumental techniques for the study, diagnosis, and treatment of related diseases.[1] To become a neurologist in Spain, students must earn a university degree in medicine and complete a 4-year specialised training programme (residency) in neurology.[2] Graduates must sit a competitive examination, held each year by the Spanish Ministry of Health, Social Services, and Equality (MSSSI, for its initials in Spanish); the examination is known as the MIR examination (which stands for ''médico interno residente,'' or specialist-in-training). All candidates scoring above the cut-off score are assigned a final score, with the examination score weighted 90% and academic performance in medical school weighted 10%. Academic performance is calculated based on the scores achieved in all courses and ranges from 1 (pass) to 4 (first-class honours); candidates holding a doctorate receive an additional point. Candidates are ranked by final score; those scoring higher appear higher on the list. The candidate ranking in first position has the highest final score and is therefore the first to select their preferred specialty and training centre.[3] The MSSSI is responsible for selecting and assigning places at training hospitals; the results are public. Neurology is one of the specialties offered every year. Analysing the process of specialty selection sheds light on which are the most popular specialties and training hospitals among candidates in Spain.[4,5] We analyse the supply and demand for neurology over the past years, compare it to other specialties, and provide a map displaying the autonomous communities and training hospitals selected by the candidates ranking highest in the selection list.

Material and methods

Data sources

Data related to specialty selection were gathered from official reports of final results and position allocation published by the MSSSI from 2007 to 2016 (2016 data correspond to

places officially assigned in 2017). We gathered data on sex, nationality, academic records, selection list position, and specialty selected.

The characteristics of the training hospitals were gathered from different sources. The number of beds at each centre was gathered from the Spanish Hospital Catalogue, published by the MSSSI,[6] the Spanish healthcare services portfolio, and each centre's resident training guidelines.[7] We also obtained information on university training from medical schools and on specific on-call shifts for neurology residents. The MSSSI's list of national reference units[8] was used to gather data on whether training hospitals were linked to national reference units for refractory epilepsy, multiple sclerosis, hereditary ataxia and paraplegia, vascular diseases of the spinal cord, rare neuromuscular disorders, rare diseases associated with movement disorders, complex disorders of the autonomic nervous system, brain neuromodulation, and surgery for movement disorders. Data on the availability of a stroke unit were gathered from the website of the Spanish Society of Neurology.[9] Information on the availability of endovascular stroke treatment and on-call neurologists was obtained from the latest edition of the National Strategic Plan for the Integral Treatment of Neurological Diseases (2011 data).[10]

To assess research activity, we gathered data on the centres included in the Research Network on Cerebrovascular Diseases (InvICTUS), the Spanish Multiple Sclerosis Network (REEM), and the Networking Research Centre on Neurodegenerative Diseases (CIBERNED).[11–13] We also considered the productivity and citation impact of researchers from each centre; researchers with an h-index above 37 were considered to be highly cited.[14]

Statistical analysis

The number of training places available varies between specialties, autonomous communities, and hospitals, and may vary from year to year. Therefore, we provide the number of places, as well as the mean, highest and lowest, and median selection list positions with the 25th and 75th percentiles. Comparisons used the median, to determine whether the distribution was asymmetrical, and non-parametric tests: the Wilcoxon test, Kruskall—Wallis test, and Spearman correlation coefficient. Proportions were compared using the chi-square test. Statistical significance was set at $P < .05$. Statistical analysis was performed using STATA 13.0 statistics software.

Results

A total of 64 145 specialist training places were assigned from 2007 to 2016; 1206 of these (1.88%) were in neurology departments. The annual number of places offered for neurology ranged from 107 in 2007 to 126 in 2009. The number of places increased progressively until 2009, when it started to decrease slightly in parallel with the total number of places. In 2016, numbers rose once more, with 123 places for specialisation in neurology, of a total of 6324 (1.94%).

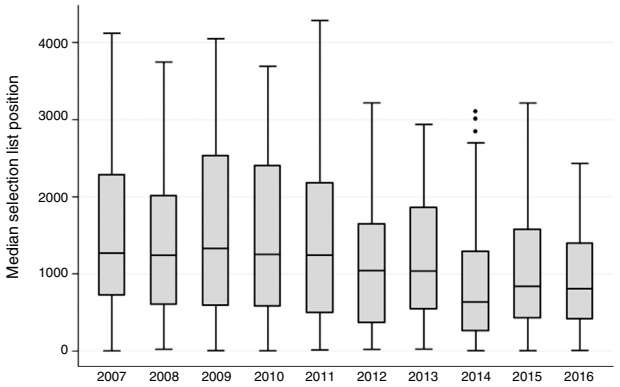

Figure 1 Median selection list position of candidates choosing neurology residency programmes, by year.

Between 2007 and 2016, the highest selection list position of a candidate choosing a neurology residency programme was 1, and the lowest was 5782. The median selection list position of candidates choosing neurology in that period was 1056; the mean position was 1265.3. In the latter 5 years, the mean and median selection list positions of candidates selecting neurology training programmes were 1039.2 and 866, respectively. Fig. 1 shows the median selection list position of candidates choosing neurology residency programmes, broken down by year, for the period 2007-2016. The lowest median selection list position was 1333 in 2009, the year that the largest number of neurology training places were available (126). The highest median selection list position was 636 in 2014; a similar number of places were offered that year (121). The median selection list position of candidates choosing neurology residency programmes has improved year on year, regardless of the number of training positions offered. This trend is statistically significant, with a Spearman correlation coefficient of −0.198 ($P < .001$).

According to aggregate data for the period 2012-2016, the median selection list position of candidates choosing neurology is the fourth highest among all medical specialties. In 2016, the median selection list position of candidates choosing neurology residency programmes continued to be the fourth highest among the 44 specialties offered, surpassed only by plastic surgery, dermatology and venereology, and cardiology. Fig. 2 lists all the medical specialties offered in 2016 according to the median selection list position of candidates choosing each specialty.

Fig. 3 shows the annual changes in the median selection list position of candidates choosing the 4 most popular specialties. Although neurology has remained the fourth most demanded specialty since 2007, the median selection list position of candidates has improved considerably. The median selection list position of candidates choosing the other 3 specialties has remained relatively stable, however.

Table 1 shows the characteristics of candidates choosing neurology residency programmes. Women account for 65.75% of all candidates during the period 2007-2016, and 60.95% of candidates choosing neurology for their residency; this difference is statistically significant ($P < .001$). Since 2007, more women than men have chosen neurology

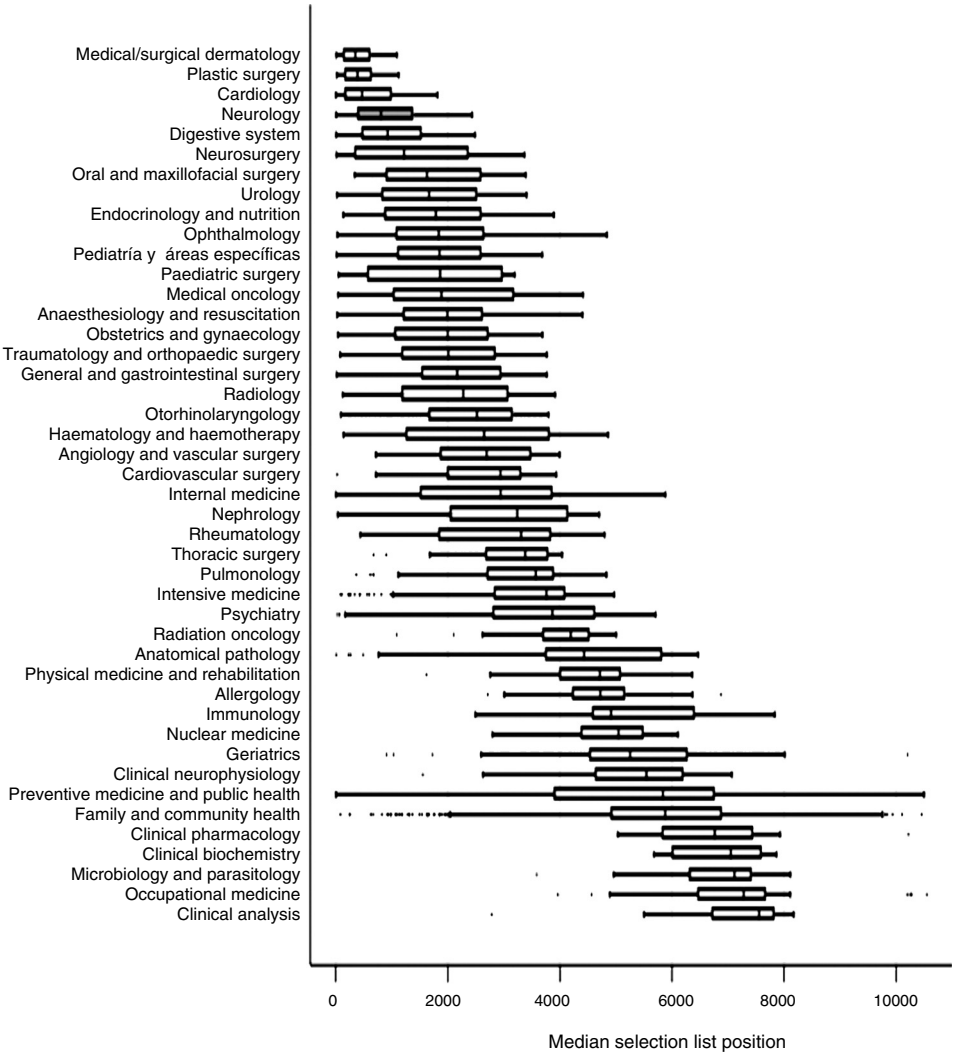

Figure 2 Medical specialties offered in 2016, arranged by median selection list position of candidates opting for each specialty.

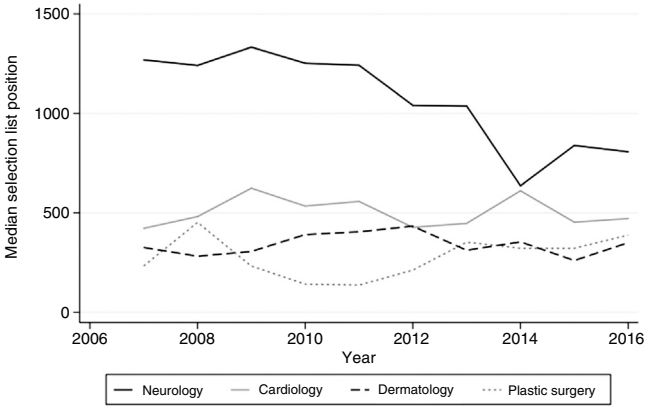

Figure 3 Year-on-year changes in the median selection list position of candidates choosing the 4 most popular specialties during the 2007-2016 period.

Table 1 Comparison of characteristics between candidates choosing neurology residency programmes and the remaining candidates for the period 2007-2016.

	Characteristics		
	Neurology	Other specialties	*P*
No. places	1206	62 939	
Women, n (%)	735 (60.95%)	41 440 (65.85%)	<.001*
Not a Spanish citizen	120 (9.95%)	13 919 (22.12%)	<.001*
Academic rating			<.001*
< 2	396 (32.84%)	39 539 (62.81%)	
2-3	713 (59.12%)	21 497 (34.16%)	
> 3	97 (8.04%)	1912 (3.04%)	

* Chi-square test.

residency programmes, with rates peaking in 2008 (70.94%). The only exception was 2016, where women accounted for only 43.09% of neurology residency candidates but represented 65.40% of all candidates.

Between 2007 and 2016, 21.89% of candidates were not Spanish citizens; the highest percentage was observed in 2009 (34.12%) and decreased thereafter, reaching the lowest percentage in 2016 (9.66%). The rate of candidates who were not Spanish citizens was considerably lower in

neurology: 9.95% for the 2007-2016 period ($P < .001$) and 4.07% in 2016.

Regarding academic records, only 3.13% of all candidates during the 2007-2016 period scored over 3, 34.62% scored 2 to 3, and most candidates (62.24%) scored below 2. However, 8.04% of candidates choosing neurology residency programmes scored over 3, 59.12% scored 2 to 3, and 32.84% scored below 2; differences in academic achievements between all candidates and neurology residency candidates were statistically significant ($P < .001$).

We analysed aggregate data from neurology training hospitals for the period 2007-2016 and found some characteristics to be associated with higher median selection list position of candidates: having more than 1000 beds as compared to having 500 to 1000 or fewer than 500 beds (776.5 vs 1083 and 1782; $P < .001$), availability of a stroke unit (864.5 vs 1807.5 for centres without stroke units; $P < .001$), availability of endovascular treatment for stroke patients (637.5 vs 1867 for centres not providing this treatment; $P < .001$), and specific on-call shifts for neurology residents (928 vs 1838 for centres without specific shifts; $P < .001$). Training hospitals with at least one national reference unit received residents with significantly higher selection list positions than those without (650 vs 1637; $P < .001$).

Training centres associated with medical schools (939 vs 1892 for non-associated centres; $P < .001$); those pertaining to the CIBERNED (471 vs 1304.5 for non-CIBERNED members; $P < .001$), InvICTUS (557 vs 1210 for non-members; $P < .001$), or REEM networks (443 vs 1235 for non-members; $P < .001$); and those employing researchers with an h-index above 37 (600.5 vs 1181.5 for centres not employing such researchers; $P < .001$) were selected by candidates with higher median selection list positions.

The Region of Madrid was the autonomous community offering the highest number of neurology residency places during the 2011-2016 period (160, 26.2% of all places), followed by Catalonia (94, 15.4%) and Andalusia (64, 10.5%). The autonomous communities offering the lowest numbers of places were Extremadura (10), Cantabria (10), and La Rioja (5).

By autonomous community, the Region of Madrid showed the highest median selection list position (430.5), followed by Catalonia (504.5) and the Basque County (840). Table 2 lists all Spanish autonomous communities, arranged from highest to lowest median selection list position of candidates, and indicates the hospital with the highest median selection list position for each autonomous community during the study period. In the cases of Cantabria and La Rioja, autonomous community and hospital data coincide since these communities only have one centre offering neurology residencies.

Table 3 shows the 10 Spanish hospitals attracting the neurology residency candidates with the highest selection list positions, according to aggregate data gathered since 2012. The top 3 hospitals are Hospital Universitario Clínico San Carlos, Hospital Universitario 12 de Octubre, and Hospital Universitari Vall d'Hebron; with median selection list positions of 48, 98.5, and 123, respectively.

Discussion

In the first issue of *Neurology*, published in 1951 by the then recently founded American Academy of Neurology, Pierce Bailey[15] made the following statement of intent in view of the loss of influence of neurology in the medical field in the United States: ''The time has come for neurology as a specialty to assume responsibility for the total medical treatment of neurologic patients.''

More than 6 decades later, neurology has become one of the 4 most demanded specialties among trainee physicians in Spain. Our data reveal a marked increase in this popularity. In fact, in 2016 neurology ranked fourth among all specialties; the last place of the 123 offered was filled by the candidate at selection list position 2433; this is the highest position for the final place on a neurology training programme for the entire study period.

The increasing demand for neurology residencies may be attributed to multiple causes. Firstly, neurology is no longer a satellite, vacillating between internal medicine and psychiatry, as it was characterised by Bailey in 1951.[15] It now encompasses a broad spectrum of nervous system and musculoskeletal disorders, incorporating psychological and psychiatric perspectives.[1] Neurologists are trained in basic clinical subject matter and emerging diagnostic techniques, including neuroimaging, neurosonology, neurophysiology, anatomical pathology, and genetics. This is consistent with the increasing incidence of cerebrovascular disease and the development of new approaches to diagnosis and treatment. Under the slogan ''time is brain,'' the introduction of stroke units has placed neurologists at the centre of multidisciplinary management of neurological diseases. Significant changes have also been observed in many other neurological diseases, including new treatment strategies for demyelinating diseases, motor disorders, epilepsy, headache, and neurodegenerative diseases. These developments are the result of intense research activity, a cornerstone of neurology as a specialty. We should emphasise the high level of subspecialisation in neurology, which includes such fields as neurointensive care.[16] These trends suggest that neurology will continue to be an attractive specialty in the coming years.

In addition to analysing the popularity of neurology, we aimed to describe the characteristics of candidates choosing this specialty and to analyse other factors that may have motivated their decision. Candidates choosing neurology residency programmes are mainly women, Spanish, and have good academic achievements. Candidates at higher selection list positions tend to choose larger centres offering more complex care, with more intense teaching and research activity. We found substantial differences between autonomous communities and between hospitals in the median selection list position of candidates choosing neurology training programmes, which suggests common preferences among candidates. All 10 hospitals selected by the candidates with the highest selection list positions have stroke units and continuous provision of neurology care, with specific on-call shifts for neurology residents. Furthermore, most of these hospitals have at least one national reference unit for the treatment of neurological diseases. In conclusion, the most popular centres are those representing the

Table 2 Spanish autonomous communities ordered from highest to lowest median selection list position of candidates choosing neurology training programmes (2012-2016). The table shows the hospital in each community with the highest median selection list position of candidates.

	Autonomous communities and hospitals offering neurology training programmes						
	n	Mean	Highest	Lowest	p25	Median	p75
Region of Madrid	160	558.9	3	2313	164	430.5	816.5
H.C.U. San Carlos	20	80.7	3	355	26	48	109
Catalonia	94	649.2	23	2645	268	504.5	897
H.U. Vall d'Hebron	15	276.8	23	769	70	123	427
Basque Country	24	862.5	20	2433	405	840	1107.5
H.U. de Donostia	5	548	38	1119	374	380	829
Asturias	14	934	92	2062	395	948.5	1398
H.U. Central de Asturias	9	568.7	92	1098	194	614	804
Cantabria	10	1103.3	596	1767	689	982	1483
H.U. Marqués de Valdecilla	10	1103.3	596	1767	689	982	1483
Aragon	19	1099.9	128	2216	463	1069	1865
H.U. Miguel Servet	10	736.9	128	1932	300	540	802
Murcia	20	1084.5	159	1935	701.5	1108	1479.5
H.C.U. Virgen de la Arrixaca	10	779.9	159	1163	503	871	1095
Galicia	29	1207	48	3103	318	1127	1877
C.H.U. Santiago de Compostela	9	389.1	48	1284	97	190	318
Valencia	45	1007.6	59	2473	379	1136	1569
H.U. i Politècnic la Fe	10	239.8	59	674	119	177.5	379
La Rioja	5	1494	901	2212	1069	1179	2109
H. de San Pedro	5	1494	901	2212	1069	1179	2109
Andalusia	64	1308.2	113	2997	800.5	1207	1750.5
H. Virgen del Rocío	14	820.2	305	1254	570	789.5	1175
Navarra	15	1389.1	313	2699	635	1349	1861
C.H. de Navarra	9	962.7	313	1803	569	938	1219
Balearic Islands	15	1451.2	68	2274	984	1670	2201
H.U. Son Espases	10	1118.2	68	1851	976	1042.5	1725
Castile-La Mancha	25	1736.7	149	3217	987	1697	2578
C.H.U. de Albacete	5	673.2	149	2171	175	259	612
Extremadura	10	1719.7	404	2759	1133	1780.5	2425
C.H. de Cáceres	5	1451.6	636	2218	1133	1436	1835
Castile-Leon	36	1968.1	758	2842	1530	2010.5	2429
H.C.U. de Valladolid	9	1466.4	758	2262	1210	1530	1690
Canary Islands	24	2062	67	3007	1486	2445.5	2800.5
H.U. de Canarias	4	1898.8	67	3007	825	2260.5	2972.5

C.H.: complejo hospitalario (hospital complex); C.H.U.: complejo hospitalario universitario (university hospital complex); H.: hospital; H.C.U.: hospital clínico universitario (university clinical hospital); H.U.: hospital universitario (university hospital); no.: number of places offered on training programmes in 2012-2016; p25: 25th percentile; p75: 75th percentile.

paradigm of integral neurological care, ranging from chronic outpatient care to neurointensive care, and combining traditional academic training with the latest developments in neuroscientific research.

However, many other external factors may also influence candidates' decisions; these include geographical location, career and salary prospects, perceived quality of life, the candidate's personality, and knowledge of or experience with the specialty during medical school.[17–20] Therefore, this study does not claim to analyse the healthcare or training quality of training hospitals, but rather to objectively analyse the popularity of neurology, as compared to other specialties, among residency candidates. Our results provide valuable information on the preferences of these

Table 3 Ranking of the top 10 hospitals attracting neurology residency candidates with the highest median selection list positions (aggregate data for 2012-2016).

	Top 10 hospitals in Spain during the 2012-2016 period						
	n	Mean	Highest	Lowest	p25	Median	p75
H.C.U. San Carlos	20	80.7	3	355	26	48	109
H.U. 12 de Octubre	20	118	7	259	60	98.5	161.5
H.U. Vall d'Hebrón	15	276.8	23	769	70	123	427
H.U. i Politècnic la Fe	10	239.8	59	674	119	177.5	379
H. de la Santa Creu i Sant Pau	13	250.2	57	538	116	198	372
C.H.U. Santiago de Compostela	9	389.1	48	1284	97	190	318
C.H. Universitario de Albacete	5	673.2	149	2171	175	259	612
H.U. Clínic de Barcelona	14	347.1	132	756	202	301.5	437
H.U. Ramón y Cajal	20	324.4	56	682	192	331	430.5
H.U. de Donostia	5	548	38	1119	374	380	829

C.H.: complejo hospitalario (hospital complex); C.H.U.: complejo hospitalario universitario (university hospital complex); H.: hospital; H.C.U.: hospital clínico universitario (university clinical hospital); H.U.: hospital universitario (university hospital); no.: number of places offered on training programmes in 2012—2016; p25: 25th percentile; p75: 75th percentile.

adventurous young people, eager to build the future of neurology.

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None declared.

Conflicts of interest

The authors have no conflicts of interest to declare.

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