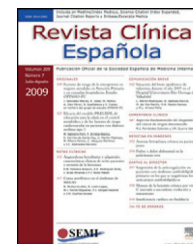


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ORIGINAL ARTICLE

Ranking Spain's Medical Schools by their performance in the national residency examination

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Abstract

Background: Medical school graduates in Spain must take a uniform national exam (called "examen MIR") in order to enter postgraduate training in a specialty. Its results offer a unique opportunity to rank medical schools according to this exam.

Objectives: We measured differences in the MIR exam results among Spanish medical schools and assessed the stability of the MIR-based rankings for the period 2003–2011.

Results: In the year 2011 a total of 6873 residency positions nationwide were offered by the Spanish Ministry of Health, Social Services and Equality. These positions covered 47 specialties distributed over 231 training centers. A total of 11,550 medical graduates (including 1997 foreign graduates) took the MIR examination. Marked differences among medical schools were evident. The median graduate from medical school #1 and #29 occupied the positions 1477 and 5383, respectively. These figures correspond to a standardized ranking of 21 out of 100 for medical school #1 (that is, 1477/6873; half of medical school #1 obtained better [below position 21%] and half worse [over position 21%] results) and a standardized ranking of 70 out of 100 for medical school #29. While 81% of the medical school #1 graduates were amongst the best 3000 MIR exams and only 5% above the 5000 position the corresponding figures for medical school #29 graduates were 21% and 44%, respectively. The ranking position of the 29 medical schools was very stable between the years 2003 and 2011.

Conclusion: There are marked differences in medical schools in Spain and these differences are very consistent over the years 2003–2011.

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PALABRAS CLAVE

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médicas;
Facultad de Medicina;
Ranking de
universidades

Clasificación de las facultades de medicina españolas según sus resultados en el MIR**Resumen**

Antecedentes: En España, los graduados de las Facultades de Medicina deben tomar someterse a nacional uniforme (llamado «MIR») con el fin de ingresar a la formación de posgrado en una especialidad médica. Sus resultados ofrecen una oportunidad única para clasificar las Facultades en términos de calidad.

Objetivos: Medir la presencia y la significación de las diferencias en los resultados del MIR entre las facultades de medicina españolas, y evaluar la estabilidad de las clasificaciones basadas en los resultados de la prueba MIR para el período 2003–2011.

Resultados: Se observaron diferencias significativas, persistentes y consistentes en los rankings basados en los resultados de la prueba MIR. El graduado promedio de la Facultad con mejores resultados queda clasificado en el percentil 21 en todo el país, mientras que el graduado promedio de la Facultad con peores resultados queda clasificado en el percentil 70.

Conclusión: Existen marcadas diferencias en las Facultades de Medicina en España, y estas diferencias son muy consistentes durante los años 2003 a 2011.

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Introduction

The international ranking of universities has attracted considerable attention since 2003, when the Academic Ranking of World Universities (ARWU), also known as the Shanghai Ranking, first appeared. Since then, the Leiden Ranking, the QS World University Ranking, the Times Higher Education Ranking, the CHE-Ranking, the SCImago Institutions Rankings, and the Ranking Web of World Universities^{1–3} have attempted to compare universities by quality, output or excellence.

In Spain, as in several other European countries, medicine is the only university degree that is followed by a uniform national examination. The MIR (for *Médico Interno Residente*) exam is the Spanish national examination provided by the Ministry of Health, Social Services and Equality and that determines the employability of the medical school graduate to select his or her specialty.^{4,5} Students in Spain desiring to be doctors go directly from secondary school to a medical school (*Facultad de Medicina*) at a university, the equivalent of an extended undergraduate course of study in an American university. The medical curriculum is expected to last six years and ends with a *licenciatura* or degree in medicine. To obtain a residency place in any specialty, the candidate must take the MIR exam and based on the score the specialty and Hospital is chosen. Before 2010, the candidate's score on the national MIR exam contributed 75% to his overall ranking in the national competition for residency training positions, while his medical school grade point average determines the remaining 25%. Afterwards those percentages changed to 90% and 10%, respectively.

The results of the national MIR exam offer a unique opportunity to make quantitative, objective comparisons among Spanish medical schools. No inter-university comparison based on the MIR exam, nor any study of the trends in MIR scores over time, have been published. This study's aims are to assess the presence and magnitude of differences in the MIR exam results among Spanish medical schools and to analyze the variability of Spain's medical schools

ranking based on the MIR exam results between 2003 and 2011.

Data and methods**Data**

The main database is an archive of individual choices of residency training programs in the annual competitions from 2003 through 2011, provided by Spain's Ministry of Health, Social Services and Equality. The data were provided with the condition of not identifying medical schools, except for the medical school that obtained the best result. For each candidate in each year, the archive contains the candidate's national ranking (an ordinal number ranging from 1 up to the total number of candidates), the residency program chosen (including specialty and medical center), the candidate's residential postal code, sex, nationality, and medical school attended.

Methods

First, we focused on a descriptive analysis of the national rankings in relation to the candidate's medical school, according to the 2011 national competition. For each medical school, we computed the mean and standard deviation of graduates' national ranking, and then employed nonparametric tests to assess differences in the observed mean rankings between medical schools.

To analyze the temporal stability of the rankings during 2003–2011, we first standardized the rankings as percentiles in order adjust for differences in the number of candidates electing residency positions in each year, and then calculated the mean percentile ranking for each university in each year. We then examined the trends in the mean percentile rankings of the highest- and lowest-rank universities.

What do we know?

The results of the national MIR examination offer a unique opportunity to make a quantitative, objective comparison among Spanish medical schools. This study assessed for differences in the MIR exam results among Spanish medical schools and analyzes the school variability between the years 2003 and 2011.

What is new from this study?

Marked differences among medical schools were detected in the 2011 MIR examination. The median graduate from medical school #1 was 1477 and 5383 for medical school #29. These figures correspond to a standardized ranking of 21% and 70% for medical school #1 and #29, respectively (that is, half of #1 and #29 medical graduates obtained better [below position 21% and 70%] and half worse [over position 21% and 70%], respectively). The relative position of the 29 Spanish medical schools that graduated students applying to the MIR exam was very stable between the years 2003 and 2011. These results indicate that there are marked differences with respect to the MIR exam results between medical school graduates in Spain and that these differences are very consistent over the years 2003–2011.

The Editors.

Medical schools are only identified by a number, since we were given access to the data with the condition of maintain the names occult, except for medical school #1.

Results

In the year 2011 a total of 6873 residency positions nationwide were offered by the Spanish Ministry of Health, Social Services and Equality. These positions covered 47 specialties distributed over 231 training centers. Family & Community Medicine offered the higher number (1919) of residency positions. A total of 11,550 medical graduates (including 1997 foreign nationals) took the MIR exam to apply for the 6873 training positions. Of these candidates, 4677 withdrew without choosing a residency program.

University rankings

Table 1 shows the medical schools ranked by their MIR exam results and the corresponding percentage of graduates that chose Family & Community Medicine specialty. The median graduate from university #1 (that is, the numerical value from medical school #1 that separates the higher half from the lower half graduates according to the 2011 MIR exam results), occupied position 1477 out of 6873 in the national MIR ranking. This corresponds to a standardized ranking of 21 out of 100 (that is, 1477/6873). In other words, the median graduate from medical school #1 got the position 21 out

of 100 graduates from all Spanish medical school graduates that took the same exam (half of university #1 graduates got a better position that 21% in the MIR exam and the other half of university #1 graduates got a worse position).

Also shown in Table 1 are the standardized nationwide rankings of students in the 25th and 75th percentiles within their own medical school. For example, a student who ranked in the 75th percentile among graduates of the medical school of university #1 (that is, in the bottom quarter of his class), was nonetheless in the top 38% of all participants in the national MIR exam.

The percentage of each medical school graduates among the first 1000 and above position 5001 is shown in Table 2. Striking differences among the universities are evident. While university #1 had 41% of its graduates among the first 1000, the corresponding figure for medical school #29, at the bottom, was 10 times worse (4%). Marked differences were also evident between medical school #1 and #2. The first had 41% of its graduates among the first 1000, but university #2 had 10% less graduates among the first 1000 (31%). Medical school #1 had 81% of its graduates among the first 3000 and only 5% above position 5001. The corresponding figures for medical school #2 and #29 were 70% and 21% (among the first 3000), and 5% and 44% (above position 5001), respectively.

The cumulative distributions of the standardized rankings by medical school in the 2011 MIR examination results are shown in Fig. 1. A number of medical schools showed cumulative score distributions that closely adhere to the diagonal line from the origin to the vertex at the upper right. These medical schools produce graduates who are roughly representative of all candidates nationwide. Those medical schools whose curves are situated to the left of the diagonal produce graduates who perform better than the national average, while those whose curves are situated to the right perform worse.

Trends in medical school rankings 2003–2011

Fig. 2 shows the trend in the nationwide MIR rankings of the median graduate from the highest and lowest ranked medical schools for the period 2003–2011, as well as the corresponding trend for graduates of all foreign medical schools (medical school #28 in Table 1). Throughout this period, the same medical school – the Universidad Autónoma de Madrid (UAM) – held the top ranking, with its median graduate achieving between the 21st and the 26th percentile nationwide. The lowest ranked medical school, whose median graduate ranked between the 61st and 70th percentile, was always held by one of the same two universities. In recent competitions, the median foreign candidate obtained better results than those domestic institutions. Among 23 universities with rankings throughout 2003–2011, twelve remained in the same ranking quartile, while eleven moved up or down only one quartile. The Spearman correlation coefficients of the universities' percentile rankings between any pair of years ranged from 0.75 to 0.86.

Discussion

According to the yearly national MIR examination results this study shows marked differences between the Spanish

Table 1 Ranking of medical schools in Spain according to the performance of their graduates in the MIR examination, 2011.

Medical school number ^a	Median ranking of medical school graduates ^c	Ranking of medical school graduates within their own universities			% Graduates electing family medicine residencies
		25th percentile ^d	50th percentile – median ^e	75th percentile ^f	
1	1477	7	21	38	8
2	1879	11	27	47	11
3	2136	13	31	55	18
4	2229	12	32	64	15
5	2460	17	35	59	21
6	2738	18	39	66	23
7	2748	18	40	65	20
8	2809	15	40	61	17
9	2926	22	42	68	17
10	3107	27	45	76	27
11	3120	18	45	73	33
12	3128	22	45	77	25
13	3153	23	45	68	21
14	3266	23	47	79	28
15	3272	23	47	71	26
16	3273	28	47	60	12
17	3279	22	47	74	26
18	3312	28	47	71	33
19	3330	21	48	70	24
20	3404	24	49	70	28
21	3419	25	49	76	27
22	3583	26	51	69	30
23	3780	32	54	76	32
24	3958	30	56	77	30
25	4072	34	57	75	31
26	4193	30	59	82	33
27	4392	40	61	76	32
28 ^b	4434	37	61	83	35
29	5383	49	70	84	46

^a Universities are listed from number 1 (the medical school with its median graduate in the best position in the 2011 MIR examination, number 1477 out of 6873) to number 29 (the medical school with its median graduate in the worst position in the 2011 MIR examination, number 5383 out of 6873).

^b Foreign universities combined. All medical graduates from foreign medical schools have been grouped into medical school #28.

^c Median, the numerical value separating the higher half of the graduates in one medical school from the lower half according to the MIR exam results. The median graduate of medical school #2 obtained the position 1879 in the 2011 MIR examination. That is, half of medical school #2 graduates got better positions in the ranking and the other half of medical school #2 graduates got worse positions in the ranking.

^d The 25th percentile is the score below which 25 percent of the observations may be found. Medical school #4 had 25% of their graduates among the best 12% in the 2011 MIR examination.

^e The 50th percentile or median is the score below which 50% of the observations may be found. Medical school #5 had 50% of their graduates among the best 35% in the 2011 MIR examination.

^f The 75th percentile is the score below which 75% of the observations may be found. Medical school #1 had 75% of their graduates among the best 38% in the 2011 MIR examination.

medical school graduates. In addition, these differences are persistent over the period of 2003–2011. Thus, the differences in the results of the Spanish medical school graduates who take the yearly MIR examination are marked and persistent. In the last nine nationwide MIR exams, the Universidad Autónoma de Madrid has always occupied the top spot, while one of two specific medical schools have consistently occupied the bottom (Fig. 2). These results suggest that there are structural defects, rather than a good or a bad cohort

in a given year. In addition the results suggest that the performance of each medical school is very similar throughout the years.

While a candidate's score on the national MIR exam may not ultimately predict professional success, most Spanish medical school programs are influenced by this exam. This study allowed for the first time to measure the success of each Spanish medical school at the national MIR examination and provides a detailed map

Table 2 Percentage of each medical school graduates among the first 1000, from 1001 to 3000, from 3001 to 5000 and above 5001 according to the 2011 MIR examination results.

Medical school number ^a	Among the first 1000	From 1001 to 3000	From 3001 to 5000	Above 5001
1	41%	40%	14%	5%
2	31%	39%	25%	5%
3	28%	38%	19%	15%
4	29%	32%	23%	17%
5	23%	36%	24%	17%
6	18%	38%	27%	18%
7	18%	37%	28%	18%
8	25%	36%	23%	16%
9	16%	38%	26%	20%
10	15%	34%	26%	25%
11	20%	30%	24%	26%
12	15%	34%	23%	28%
13	11%	35%	32%	23%
14	15%	32%	24%	28%
15	17%	31%	29%	24%
16	6%	41%	47%	6%
17	15%	30%	29%	26%
18	11%	29%	40%	20%
19	14%	31%	33%	23%
20	15%	30%	33%	22%
21	15%	29%	27%	29%
22	9%	30%	37%	23%
23	11%	29%	32%	28%
24	10%	29%	31%	29%
25	11%	21%	40%	28%
26	8%	27%	27%	38%
27	11%	16%	46%	28%
28 ^b	7%	23%	32%	37%
29	4%	17%	35%	44%

^a Universities are listed from #1 (the medical school with its median graduate in the best position in the MIR competition) to #29 (the medical school with its median graduate in the worst position in the MIR competition).

^b Foreign universities combined. All medical graduates from foreign medical schools have been grouped into medical school #28.

of the differences. In contrast with the inequitable egalitarianism of public budget allotments, the MIR exam results provide a unique basis for rewarding performance.

The MIR exam has been criticized as unnecessarily dependent on rote learning as opposed to intellectual curiosity, with insufficient evaluation of clinical problem-solving skills. Nonetheless, the extreme disparity in the Spanish medical school results points to persistent pockets of mediocrity.

Improvements in public medical schools in Spain and possibly in other European countries require encouraging competition for students and for financing. One way that competition can be encouraged is through comparisons. Such comparisons could lead to more informed choices on the part of students (including foreign students, whose tuitions help to cover university costs). Such comparisons could also guide structural modifications within each medical school and financing. In an environment where public financing rewarded performance, other measures of excellence could be added, such as published articles, patents and innovative education.

Our study has a number of limitations. First, we studied the rankings of only those medical school graduates who made a residency selection. We excluded those who took the MIR exam but withdrew without making a selection, as we did not have data on their university of graduation. However, if we had included those candidates who withdrew from the competition, it is likely that differences among universities would have been even more exaggerated than reported here.

Second, we did not take into account each candidate's effort in preparing for the national exam. A candidate with a strong preference for a noncompetitive specialty with few applicants may have less incentive to study.

Third, our finding of wide and persistent differences among universities may be the result of student self-selection rather than the quality of education. Thus, the most talented students would seek to enroll in the UAM simply because of its reputation of training the best students. As a consequence, graduates of the UAM would obtain higher scores in the MIR not because of the quality of their medical education, but simply because the UAM had accepted them. One way to address this potential source of bias is

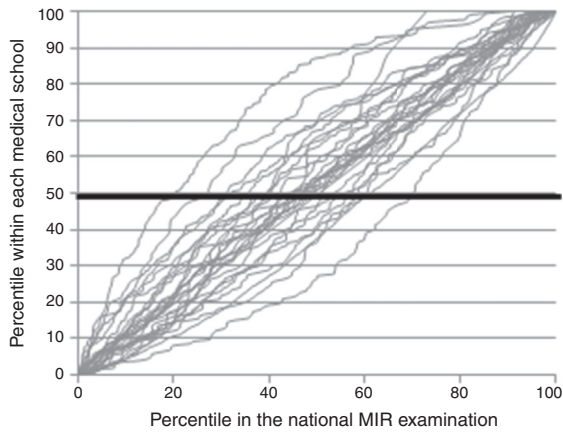


Figure 1 Distribution of national MIR rankings within each medical school,^a 2011. (a) The horizontal axis measures the standardized ranking among all candidates nationwide, while the vertical axis measures the standardized ranking within each medical school. Each curve corresponds to the cumulative distribution for a particular medical school. The leftmost curve corresponds to medical school #1, while the rightmost corresponds to medical school #29. The horizontal line drawn at the level 50 corresponds to the median student within each medical school. The points of intersection of this horizontal line with each curve correspond to the national ranking of the median student within each medical school (the numerical value separating the higher half of the graduates in one medical school from the lower half according to the 2011 MIR exam results). Thus, the last position 6873 becomes 100 and the median position 3437 becomes 50. The vertical axis measures the standardized ranking within each medical school. Thus, position 1477 out of 6873 (median for medical school # 1 with a standardized ranking of 21 out of 100) corresponds to the intersection of leftmost curve with the horizontal line drawn at the level 50. It signifies that 50% of the graduates from medical school # 1 were among the best 21% of all graduates taking the 2011 MIR examination. Position 4811 out of 6873 (standardized ranking of 70 out of 100) for medical school # 29 corresponds to the intersection of right most curve with the horizontal line drawn at the level 50. It signifies that 50% of the graduates from medical school # 29 obtained position numbers above 70% of all graduates taking the 2011 MIR examination.

to examine medical schools' admission criteria. Our preliminary results show no correlation between a university's cut-off score for admission to medicine on the nationwide college entrance exam for 2004–2005 (when the MIR cohort of 2010–2011 began their medical studies), and the medical school MIR ranking six years later.

Finally, not all the participants in the annual MIR competition are recent medical graduates. There is, in fact, considerable "recirculation" of candidates, not only among those who withdrew from a previous round, but also from candidates already in residencies who are dissatisfied with their current training program. In principle, the fact that the results for 2011 derive from a mixture of different cohorts of candidates could prevent us from drawing conclusive inferences about present-day medical schools. Nonetheless, the stability in the rankings over nine annual competitions suggests that this limitation is not serious.

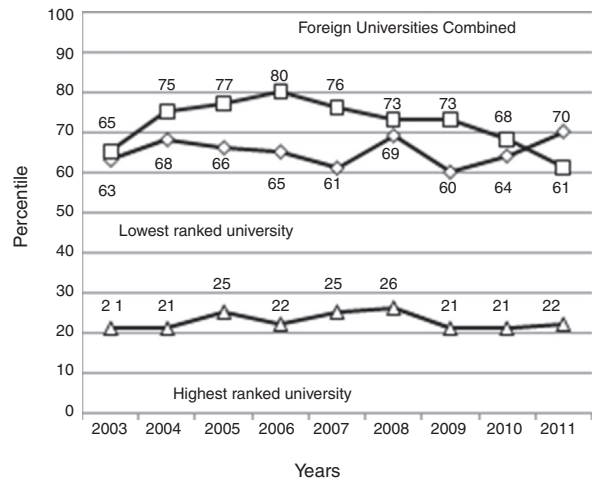


Figure 2 Trends in the national MIR examination results of the median graduate from the Highest and Lowest Ranked Spanish medical schools.

Conclusion

There are marked differences in medical schools in Spain and these differences are very consistent over the years 2003–2011. The MIR system provides an exceptional opportunity to compare the medical schools of an entire country in order to further educational and health policies. The important differences in the results of the MIR exam among the different medical schools of Spain may serve as a starting point for reallocation of public funds among universities. Such a reallocation should be based on responsible autonomy, competence measured by comparison, informed choice on the part of students and professors, and result-based financing.

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Conflicts of interest

The authors declare that they have no conflict of interest.

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