Impact of the Accreditation of Medical Education in Mexico on National Exam for Applicants to Medical Residences

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Abstract: *24 years after initiating the accreditation of medical education in Mexico, it is necessary to ask: what is the impact of the accreditation of medical schools and faculties in Mexico? To explore this question, the study was conducted with the purpose of analyzing the relationship between the results of the National Exam for Applicants to Medical Residences (ENARM) and the accreditation status during the period from 2001 to 2017. The design was observational, analytical, longitudinal and retrospective. Public information was used from the official websites of the Inter-institutional Commission for the Training of Human Resources in Health and Mexican Council for the Accreditation of Medical Education (COMAEM). The results obtained show an increase in the number of accredited programs (from 29 in 2001 to 74 in 2017). The average score of medical knowledge differed significantly (p <0.05) when counting or not with accreditation in force since 2002; It is also noted that the possibility of being selected in 1.48 times is increased. The size of the observed effect significantly favors (p = 0.02) schools with current accreditation. It is concluded that the accreditation has a positive impact on the results of the ENARM.*
Key Word: *Quality of education, Medical Education, medical residencies, quality assessment.*

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I. Introduction

Talking about the quality of medical education in Mexico is not a new topic [1-3]. In response to the policy of educational modernization, universities and higher education institutions appropriated the challenge of promoting quality education [4]. For this purpose, the National Commission for the Evaluation of Higher Education (CONAEVA) was set up. As a result of their activities, the Inter-Institutional Committees for the Evaluation of Higher Education (CIEES) were formed [5,6].

In this context, the Mexican Association of Faculties and Schools of Medicine (AMFEM) developed in the decade of the 90s the National System of Accreditation of Schools of Medicine. In 1993, the sections to be evaluated were approved and in 1996 the first accreditation report was issued to a medical education program [7]. In the period from 1996 to 2001, the AMFEM issued the corresponding accreditation report to 29 Faculties and Schools of Medicine [8].

In 2002, the AMFEM delegates the accreditation function to the Mexican Council for the Accreditation of Medical Education (COMEM). From this date, the mission of COMAEM is limited to the accreditation of the medical study programs in all its modalities and to issue an opinion according to the process established for that purpose. Apply a program to dictate the quality of the educational process developed by a Higher Education Institution for the training of physicians in it's different modalities [9]. Currently, COMAEM reports the accreditation status of 158 Schools and Faculties of Medicine, of which 83 (52.53%) have current accreditation.

After 24 years of experience in the accreditation of medical education in Mexico, the following question arises: what is the impact of the accreditation of medical schools and faculties in Mexico? This question has different levels of approximation. The first is historical and resorts to the experience of the institution to narrate the experience of the accreditation processes [10]. The second corresponds to the analysis of indirect variables that are associated with the medical training process, as in the case of the National Exam for Applicants to Medical Residences (ENARM) and the General Egress Examination-Medicine (EGEL-Medicine) [11,12]. The third level corresponds to the analysis of the standards and indicators used to evaluate the quality of educational programs [13,14].

In Mexico, there are few studies that analyze the impact of accreditation in medical education. The efforts made are aimed at identifying the concordance between national exams that evaluate the performance of students who have graduated, such as EGEL-Medicine and ENARM. Recently a study has been published by Vázquez Martínez and Ortíz-León [11] in which the relationship between the accreditation status by COMAEM and CIEES with the results of the ENARM of 2016 is analyzed, finding that the graduates of accredited educational programs have better results. Similar results are reported in the study carried out by Gaxiola-García

et al. [12], in which the registry of 153,654 applicants who presented the ENARM during the 2014-2018 period was analyzed. Following this line of reflection, the study was conducted with the purpose of analyzing the relationship between the results of the ENARM and the accreditation status during the period from 2001 to 2017.

II. Material and Methods

An observational, analytical, longitudinal and retrospective study was carried out. The information was obtained from public sources of the official websites of the Inter-institutional Commission for the Training of Human Resources in Health (for ENARM) [15] and COMAEM (for the accreditation status of faculties and medical schools) [8].

The national results from the period 2001 to 2017 of the ENARM were retrieved, obtaining the following information: relation of the educational institutions of the supporting physicians that participated in each year; number of supporters and selected per year and educational institution; average score obtained by institution in the section in Spanish (year 2001 and 2002) and medical knowledge (years 2003 to 2017) [15].

From the information published by COMAEM, the list of 158 schools and medical schools was obtained, generating a database in which it was indicated: the name of the educational institution, the accreditation status of each institution per year, since 2001 until 2017 [8].

For the statistical analysis, the Student's t-test [16,17], odds ratio [18,19], magnitude of the effect [20-22], and construction of the forest plot [23-25] were used; using Excel, SPSS and OpenMeta [Analyst] [26,27].

III. Results and Discussion

The ENARM has become the official, academic and legal way for graduates of medical schools to join the medical specialty programs [28-30]. This has led to a constant increase in the number of medical schools that participate with supporters in the ENARM; in 2001, 63 medical schools participated and 111 in 2017 (Table 1), representing an increase of 76% in medical schools in the 17 years analyzed in the study. This increase is consistent with that reported by other analyzes of the ENARM in which the increase of both the medical schools participating in this examination, as well as the number of subjects and the number of selected physicians is exposed [18,31-33].

Table 1: Distribution of Schools and Faculties of Medicine participating in the ENARM during 2001-2017, by accreditation status

Year	With Accreditation		Without accreditation		Total
	No.	%	No.	%	
2001	29	46.03	34	52.96	63
2002	32	47.76	35	52.24	67
2003	39	57.35	29	42.65	68
2004	42	59.15	29	40.85	71
2005	47	66.20	26	33.80	73
2006	48	66.66	24	33.34	72
2007	52	70.27	22	29.73	74
2008	55	72.37	21	27.63	76
2009	57	70.08	21	26.92	78
2010	60	76.92	18	23.08	78
2011	61	75.31	20	24.69	81
2012	57	69.51	25	30.49	82
2013	61	69.32	27	30.68	88
2014	61	65.59	32	34.41	93
2015	69	66.99	34	33.01	103
2016	70	64.22	39	35.78	109
2017	74	66.67	37	33.33	111

Since 1996, when the first opinion were issued that accredited the quality of medical programs by the AMFEM, the concern for quality has been installed in medical schools [34]; so that the proportion of schools with current accreditation has increased over the course of the 17 year under study. Table 1 shows that in the period 2001-2010, the number of accredited programs increases; but from 2011 to 2017, the number of accredited academic programs is reduced, from 76.92% in 2010, to 66.67% in 2017. This is a relative decrease, since the number of medical schools in Mexico has increased in the last 5 years. However, the impact can be important, since during the period between 2007 and 2011, goal 20 on Human Resources in Health proposed by the Pan American Health Organization was being met, since it indicates that: "Seventy percent of schools of clinical health sciences and public health will be accredited by a recognized accreditation body" [35]. Therefore, this goal is not covered by Mexico since 2012.

The increase of medical schools in Mexico has generated two important effects in terms of accreditation. The first is related to the promotion of a culture of quality that allows educational institutions to request external evaluation to identify the quality of the educational process carried out for the training of physicians [36,37]. The second arises from the assumption that the accreditation is reflected in the professional and academic quality of the graduates [36,38], so it is limited to the impact of quality assessment processes in the operation of plans and programs of study [4,5,7]. In this line of reflection, an indicator to determine the impact of accreditation is the academic performance measured through the ENARM [11,12]; it's recognized that it evaluates the knowledge held by general practitioners [39-41].

The average of the score related to the knowledge of medical content obtained by those who apply the ENARM, has increased by 55.36% during the period between 2001 and 2017. The national average of the score was 39.94 in 2001, and gradually increases until reaching 62.05 in 2017 (Table 2). When comparing the results obtained by the doctors considering the accreditation or not of the school from which they graduated, it is observed that both show a tendency to increase; however, the magnitudes are different.

The score obtained by students graduated from accredited schools increased from 40.87 in 2001 to 63.19 in 2017, even above the national average, representing an increase of 54.61%. The score obtained by students graduated from schools without accreditation increased from 39.14 in 2001 to 54.75 in 2017, a value below the national average, representing an increase of 39.88%. The statistical analysis among graduates from schools with and without accreditation shows that the difference observed is statistically significant ($p < 0.05$) in all years, except in 2001 and 2016 (Table 2).

Table 2: Distribution of the average score of medical knowledge obtained by the physicians who applied the ENARM, considering the accreditation status of the school of origin.

Year	National Average	With Accreditation	Without Accreditation	p
2001	39.94	40.87	39.14	0.1180
2002	39.70	41.11	38.41	0.0092
2003	38.94	40.54	36.79	0.0004
2004	36.64	38.30	34.22	0.0001
2005	38.79	40.49	35.71	0.000022
2006	41.06	42.52	38.08	0.0012
2007	29.50	30.30	27.84	0.0001
2008	38.15	38.89	36.19	0.000015
2009	52.15	52.79	50.50	0.0029
2010	52.23	52.85	50.19	0.0014
2011	52.47	53.24	50.12	0.0010
2012	59.33	60.72	56.03	0.000006
2013	60.42	61.24	58.68	0.0056
2014	61.46	62.43	59.59	0.0004
2015	60.14	60.70	59.02	0.0544
2016	60.66	61.42	52.27	0.0100
2017	62.05	63.19	54.75	0.000036

Source: self made. p = value of p (Student's t).

These results show the relationship between the accreditation of the educational program and the performance of the graduated doctors who applied the ENARM; so that the number of accredited programs is increasing annually, as well as the difference observed in the score of medical knowledge between the schools with accreditation and without it. These results are consistent with what has been reported in the literature [29-31], as well as in the studies conducted by Vázquez Martínez and Ortíz-León [11], Gaxiola-García et al [12] and van Zanten et al [38].

When analyzing the number of supporters, it was observed that in 2001, 18,577 applicants presented the ENARM and only 18.16% (3,374 physicians) were selected. Of the selected physicians, 1,865 (55.28%) indicated having graduated from any of the 29 schools with accreditation and 1,509 (44.72%) of the 34 schools without accreditation. For 2017, the total number of applicants was 36,950; 89.65% graduated from the 74 accredited medical schools. In this year, 8,239 (22.30 %) applicants were selected, but only 8.00% (659 physicians) came from the 37 schools without accreditation. To analyze these results, the *odds ratio* [18,19] was used to calculate the probability of being or not accepting considering the accreditation or not of the school in which the medical studies were carried out. The data show that applicants to medical residences increase the probability of being selected from 1.09 to 2.22 times if they graduated from accredited academic programs (Table 3). In this context, the probability of being accepted when presenting the ENARM when the supporter is graduated from a school with accreditation of the study program is increased by more than 100%. Similar results were obtained by Vázquez Martínez and Ortíz-León [11], Gaxiola-García et al [12] and van Zanten's research group [38]. On the other hand, these studies open up the possibility of exploring accreditation towards outcomes-oriented models [34,38,42,43].

Table 3: Probability of being selected when presenting the ENARM and having graduated from accredited programs, 2001-2017.

Year	Selected Physicians		Odds Ratio	SE	95% CI	
	With Accreditation	Without Accreditation			Lower limit	Upper limit
2001	18.76	17.47	1.09	0.04	1.01	1.18
2002	24.65	19.61	1.41	0.03	1.32	1.51
2003	26.65	16.29	1.83	0.04	1.70	1.97
2004	22.52	11.58	2.22	0.04	2.04	2.40
2005	26.78	16.34	1.87	1.04	1.74	2.02
2006	25.36	19.23	1.43	0.04	1.33	1.53
2007	30.28	18.81	1.87	0.04	1.75	2.01
2008	31.47	20.21	1.81	0.04	1.67	1.97
2009	26.77	24.18	1.15	0.04	1.06	1.25
2010	29.07	23.16	1.10	0.06	0.98	1.23
2011	26.46	18.16	1.62	0.06	1.44	1.83
2012	20.50	21.83	1.42	0.04	1.31	1.55
2013	29.18	24.08	1.30	0.04	1.20	1.40
2014	27.38	22.04	1.33	0.05	1.22	1.46
2015	22.83	20.12	1.16	0.05	1.06	1.27
2016	22.51	20.16	1.15	0.05	1.05	1.26
2017	22.88	17.22	1.43	0.04	1.31	1.56

Source: self made. SE = Standard Error of odds ratio; 95% CI = 95% Confidence Interval

In order to determine the influence of the accreditation on the results obtained by the supporters of the ENARM, the magnitude of the effect was determined by the Hedges and Olkin method [20-22]. Due to the information available on the CIFRHS website, only the magnitude of the effect was determined by comparing the percentage of medical graduates who applied the ENARM and whether or not they were selected to perform medical residencies. The results obtained are presented in table 4.
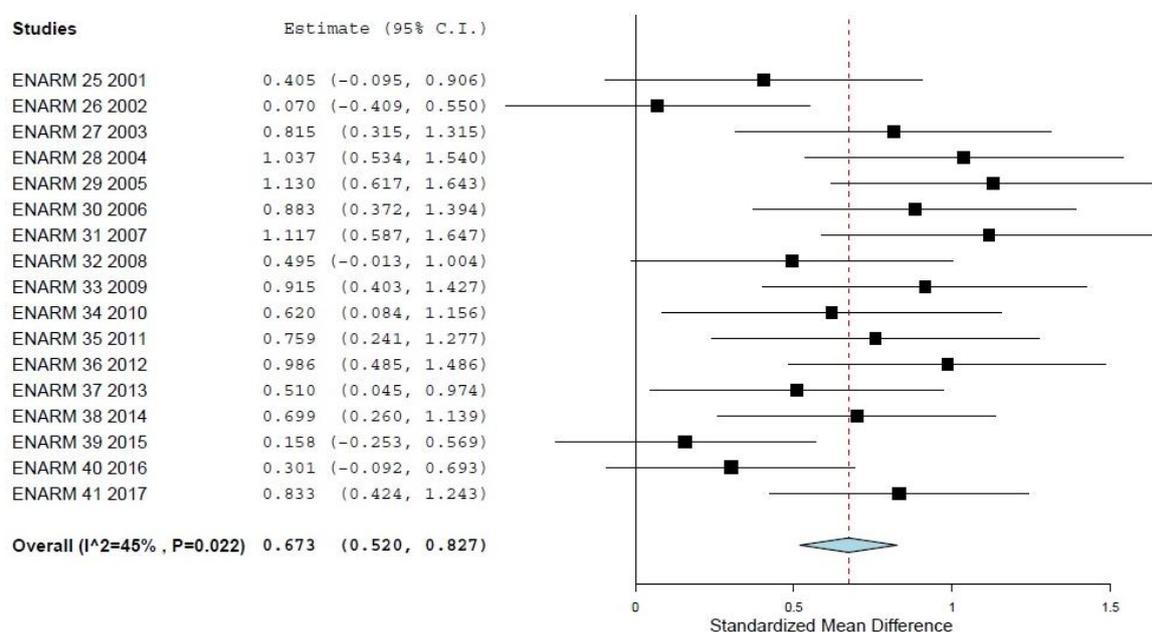
Table 4: Magnitude of the effect of being selected when presenting the ENARM and having graduated from programs with accreditation, 2001-2017.

Year	Difference of means	p	Hedges' g	95% CI	
				Lower limit	Upper limit
2001	7.62	0.11	0.41	-0.10	0.91
2002	12.28	0.01	0.67	0.18	1.17
2003	13.85	0.00	0.82	0.32	1.31
2004	15.58	0.00	1.04	0.53	1.54
2005	15.60	0.00	1.13	0.62	1.64
2006	11.76	0.00	0.88	0.37	1.39
2007	15.59	0.00	1.12	0.59	1.65
2008	8.89	0.05	0.50	-0.01	1.00
2009	14.78	0.00	0.91	0.40	1.43
2010	10.00	0.02	0.62	0.08	1.16
2011	11.85	0.00	0.76	0.24	1.28
2012	13.01	0.00	0.99	0.49	1.49
2013	7.02	0.03	0.51	0.05	0.97
2014	8.65	0.00	0.70	0.26	1.14
2015	2.57	0.45	0.16	-0.25	0.57
2016	3.45	0.13	0.30	-0.90	0.69
2017	9.02	0.00	0.83	0.42	1.24

Source: self made. p = Value of p for the difference of means (t of student of two tails); 95% CI = 95% Confidence Interval.

Measuring the magnitude of the effect explores the effectiveness of the quality of the academic programs in the selection to enter the training programs of medical specialties; that is, emphasis is placed on the accreditation of educational programs in the context of the ENARM. The graduated physicians who were selected through the ENARM were integrated into two groups: in group 1 the graduated physicians from programs with accreditation were included and in group 2 the graduated physicians from programs without accreditation. The difference of the means of the percentage of physicians selected through the ENARM was obtained for each year, observing that the values are distributed in a range from 2.57 to 15.59 (Table 4). The difference between the means was statistically significant in all years, except in 2001, 2008, 2015 and 2016.

On the other hand, the magnitude of the effect calculated by the *g* of Hedges ranges from 0.16 to 1.13. According to the Cohen classification [20-22], where no statistically significant differences were found between the difference in means, the magnitude of the effect was negligible (year 2015), small (years 2001 and 2016) or medium (year 2008). Even when the difference between is statistically significant, it is observed that during the years of 2002, 2010, 2011, 2013 and 2014 the magnitude of the effect is medium. For the period between the

years of 2003 and 2007, and the years of 2009, 2012 and 2017, the magnitude of the effect is large. This implies that only in 47% of the years included in the study, the influence of the accreditation of the accredited programs in the selection of physicians applying the ENARM is significantly large.

Finally, we explored the combined effect that can be attributed to accreditation in the academic performance of the physicians who present the ENARM measured through the proportion of physicians graduated who were selected. Following the methodological approach of Hedges and Olkin for meta-analysis [20-22], the magnitude of the effect of the 17 years analyzed was calculated. With the results obtained, the *forest plot* was constructed (figure 1) using the OpenMeta[Analyst] software [26,27]; so that the point and interval estimates of the size of the effect studied are presented.

Figure 1: *Forest plot* of the magnitude of the effect of being selected when presenting the ENARM and having graduated from programs with current accreditation. The blue diamond corresponds to the meta-analysis value of the 17 years included in the study.

For the analysis, the continuous random-effects model was used, through the measurement of the standardized means difference. The heterogeneity of the study yielded a value of *tau*^{2} of 0.050, a value Q (df = 16) of 29.349 and a p-value of 0.022; noting that the studies are different from those attributed to fixed-effect models, so that the variability explained by heterogeneity (I^2) and not randomly is 45%. In this context, the effect of the accreditation of programs by COMAEM has the same effect on the proportion of physicians selected through the ENARM during the period studied.

Figure 1 shows the individual estimate of the annual ENARM, calculating a point estimate of the 17 years of 0.673, with 95% confidence intervals of 0.520 (lower bound) and 0.827 (upper bound); the standard error was 0.080 and the p-value <0.001. These results show the positive impact of the accreditation of medical schools in the selection of doctors who applied the ENARM; they also complement the results presented in Table 3 related to the probability of selection and confirm what has been reported by other studies. However, they can't be compared with other studies because there are no meta-analysis applications to the object of study of this communication; so it contributes to the opening of new research routes for the analysis of the impact of accreditation on the academic performance of physicians.

IV. Conclusion

The evaluation of quality has become a mechanism of social responsibility and medical schools can't avoid it; therefore, it is necessary to look for instruments that allow evaluating the impact of the accreditation of their academic programs.

The study conducted offers an objective alternative to the analysis of the impact of having current accreditation. In this sense, the results are transferable to all medical schools, so that they can, in addition to assessing the effort to maintain a current accreditation, can obtain information that places each school in a national context. In addition, with the information provided by the CIFRHS to each school, the development and evaluation of the syllabus can be fed back.

The influence of 17 years of accreditation in Mexico can be identified in the proportion of applicants who are selected through the ENARM to obtain an effect of medium magnitude; so it will be important to apply the methodology of meta-analysis to other variables such as the average score obtained in medical knowledge.

The study presents limitations that derive from the accessibility of information, for example, the number of ENARM opportunities that applicants have made is unknown; or the number of years in professional practice. It is also not possible to identify the maximum and minimum values of the score obtained in medical knowledge obtained by each medical school; or the score obtained in each area in which the ENARM is integrated. It was also found that there is a statistical bias when calculating the number and proportion of selected applicants. Undoubtedly, being able to control these aspects would increase the power of the study carried out.

Finally, with the data obtained and the analysis carried out, it is concluded that the accreditation has a positive impact on the results of the ENARM, which contributes to consider the reported results as an indicator to evaluate the impact of accreditation in medical schools in Mexico.

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