On Academics

ADMISSIONS CRITERIA AS PREDICTORS OF STUDENTS' ACADEMIC SUCCESS IN MASTER'S DEGREE PROGRAMS AT THE NATIONAL INSTITUTE OF PUBLIC HEALTH OF MEXICO

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A competent public health workforce is a key element to ensure the advancement of research and the successful implementation of public health policy and programs, which, in turn, help ensure the health and wellness of the population. A century after the creation of the professional schools of medicine, public health, and nursing in Mexico, following the reports of Flexner,[1] Welch and Rose,[2] and Goldmark,[3] an effort is under way to modernize the education of health professionals. We need to reexamine the quality of the programs and institutions responsible for training leaders, practitioners, and researchers, all of whom are much needed to advance the public health agenda.

In this context, all of the schools and programs have admissions criteria to select the best candidates for their public health programs; however, we do not have enough evidence to support that each requisite or criteria specific for the programs is a predictor of academic success. Moreover, although some of the criteria are objective, much subjectivity is present during the admissions process.

The use of admissions criteria makes the implicit assumption that these indicators are predictive of a student's eventual good academic performance. Surprisingly, no widely known statistical evidence supports this assumption; as of August 31, 2011, a PubMed search yielded no scientific articles studying admissions processes in schools of public health (SPHs), and few articles dealt with the issue in other health-related professions such as medicine, pharmacy, and dentistry.[4–17]

The need for having a more objective evidence-based selection process has already been identified in undergraduate education. The National Association for College Admission Counseling[18] recommended that each educational institution perform research on the validity of the admissions tests and share its results with other universities. In light of this recommendation, it is striking that the field of public health, which tries to base its progress on rigorous scientific studies, does not apply this same rigorous approach to the selection of its students. The use of terms such as "evidence-based medicine" and even "evidence-based public health" is widespread, reflecting a positive trend to leave subjectivism behind. Why, then, don't SPHs have evidence-based admissions criteria?

The students in the National Institute of Public Health of Mexico (INSP [*Instituto Nacional de Salud Pública*]) come not only from Mexico, but from many other Latin American and Caribbean countries, as well as from the United States, Africa, and Europe. INSP offers primarily the 1.5-year-long Master of Public Health (MPH) and the two-year-long Master of Science (MSc) degrees, with diverse areas of concentration such as epidemiology, biostatistics, environmental health, behavioral and social sciences, health services administration, reproductive health, and nutrition. It also offers doctorate degrees and other diverse academic programs related to public health. Every year, approximately 150 students are admitted to the MPH and MSc programs at INSP.

INSP aspires to have an 80% graduation rate in its master's degree programs, which allows the school to maintain its certification from the U.S. Council on Education for Public Health (CEPH) and the Mexican government's National Council of Science and Technology (CONACYT), the latter of which offers scholarships to students in its certified programs. INSP has struggled to meet this 80% graduation rate, and although it eventually succeeded, students take overly long to graduate. It could take students up to four years or even longer to graduate, whereas the established

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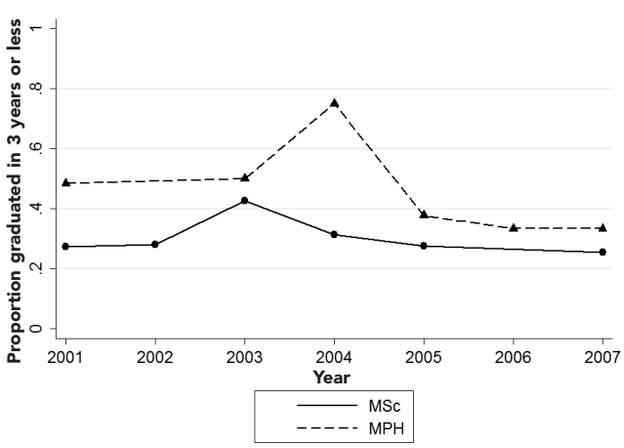
time for graduation is two years, with an extension possibility of one year if the thesis or project requires more time to conclude. To graduate, students must complete either a thesis or a scientific article in the MSc program, and a thesis or a Terminal Professional Project (which describes an intervention in the community and presents its results) in the MPH program. In all cases, students have an advising committee and, upon completing their thesis/project, must present an oral exam before a jury (different from the advising committee) comprising researchers from inside and outside INSP. In the case of an article/thesis, a research protocol must be first written and approved by the student's advising committee, as well as the INSP human subjects, biosafety, and research committees; only after this approval can the student begin to perform research activities, analyze data, and write the article/thesis.

Although INSP's goal is that students graduate in 2.5 years, actual rates of graduation in this amount of time or less have been low (Figure 1), with an average of 30% for the MSc program and 40% for the MPH program. Graduation rates greatly improve with time and eventually reach the desired goal years later.

As part of the effort to find strategies that will improve graduation rates, we decided to perform a rigorous statistical analysis of the admissions criteria as predictors of academic success of INSP students in terms of not only graduation itself, but also the time it takes to obtain the degree, as well as students' academic performance as measured by average grades (or grade point average [GPA]).

Figure 1. Proportion of students graduating in three years or less after admission to the National Institute of Public Health of Mexico master's degree programs (MSc or MPH), according to year of admission



MSc = Master of Science
MPH = Master of Public Health

METHODS

Description of the current admissions selection process

One admissions criterion for prospective INSP students is a general knowledge test known as CENEVAL EXANI-III, which is used throughout the country for applicants to graduate programs. The test consists of three main components: verbal reasoning, mathematical reasoning, and English proficiency. Additional criteria for INSP admissions include a mathematics test covering themes in algebra, logarithms, and exponents; a curriculum evaluation; and an interview with two INSP professors. For the interview, a questionnaire is used that assigns points according to the perceived desirability of the applicant's answers. The final result is then expressed as a numeric index equal to the simple sum of these points. INSP only accepts applicants whose GPA from their bachelor's degree studies is at least 8.0 (on a scale of 0.0 to 10.0, which is the scale most widely used in Mexico). Information on other variables such as gender, age, place of residence, place of bachelor's studies, and marital status is also collected in forms completed by the applicant. A faculty committee in each area of concentration then gathers and votes on acceptance based loosely on the results of these criteria.

Study population

Our study population included enrolled students from the years 2001 through 2008 who entered the MPH or MSc program. The study design was a retrospective cohort. We obtained information from school records, which was entered into a Microsoft® Excel database and then transferred to STATA® for analysis.[19] The information gathered included date of admission; date of egress (defined as the conclusion of all mandatory courses); date of graduation or dismissal; grades in the CENEVAL EXANI-III global index as well as English, verbal, and mathematical reasoning indices; result of the interview (in a numeric index); and GPA of bachelor studies. Information was also retrieved on gender, age, type of bachelor studies, and number of children. Data identifying subjects were not included in the database to protect students' privacy. The original sample size was 579. However, due to large numbers of missing data, we excluded years 2001 and 2002 from further analysis, leaving us with a sample of 428 students; 54 additional students admitted in the year 2006 were excluded from regression models because the mathematics test was not applied that year, and

129 subjects were excluded because of missing values on covariates, leaving us with an analytical sample of 245 students.

Statistical analysis

Outcome variables were GPA (as a continuous variable) and an indicator variable for status of graduation (1 = graduated, 0 = otherwise); ordinary least squares (OLS) regression with robust standard errors and logistic regression models were fitted accordingly. All models were adjusted for age, gender, number of children, type of program (MPH or MSc), and year of admission as a second-degree polynomial. Numerical independent variables were standardized to make the magnitude of the coefficients comparable; the estimated beta coefficients represent the mean change in average grades for an increase of one standard deviation of the independent variable in the case of OLS regression and the proportional change in the odds of graduating in the logistic regression models.

We analyzed time from egress (credit completion) to actual graduation (in days), with the event being defined as graduation. We defined day 0 to be two years after admission to the school in the case of MSc students and 1.5 years after admission in the case of MPH students. Students who had not graduated on the day we collected the information, as well as those who were dismissed (expelled) from school, were defined as censored observations (end of follow-up time). In the case of students who had graduated or were dismissed before two years or 1.5 years from egress had passed for MSc and MPH students, respectively, we specified that the event had taken place at day 1 of the follow-up time. We obtained Kaplan-Meier survival estimates for MPH and MSc students, and Cox-proportional hazards models were fitted, adjusting for the same covariates as the linear and logistic models. In each modeling strategy, we tested for interactions between the numerical indices and the type of program (MPH or MSc).

RESULTS

Results from descriptive statistics are shown in Table 1. The average age of the applicants was 30 years, and a majority of them (67%) were female. All test results were consistently better, although by a small margin, for MSc students compared with MPH students. Conversely, MPH students scored better in the interview index.

Table 2 shows results from the GPA model. The general test result, the mathematics test, and the bachelor's studies GPA were all highly significantly predictive of the master's program GPA. Conversely, the interview did not show a significant association. The results of the model, which included the three components of the CENEVAL EXANI-III test as separate variables, showed that only mathematical reasoning was significantly predictive of average grades (p=0.04), whereas verbal reasoning and English were not (p=0.71 and p=0.40, respectively). Neither age nor gender was significantly associated with performance. Both models explained approximately 27% of the total variance of GPAs. Results of the logistic regression model of the odds of graduation are shown in Table 3; none of the admissions criteria was a significant predictor of graduation, and only gender was marginally associated, suggesting that women were 1.8 times as likely to graduate as men. The model featuring the three components of the CENEVAL EXANI-III did not show a significant association of any of the components with the odds of graduation (p=0.80 for English, p=0.92 for verbal reasoning, and p=0.68 for mathematical reasoning).

The Kaplan-Meier survival estimates for the MPH and MSc programs are shown in Figure 2. From these estimates, it is clear that MPH students graduate at a much faster rate than MSc students in the first few months after concluding their academic credits; however, approximately 1.5 years after this time, the rate stabilizes and graduation occurs very slowly from that point. The MSc survival curve shows a steadier rate of graduation until approximately 2.5 years after concluding academic credits, after which we observe the same phenomenon as in the MPH students, with graduations becoming extremely slow. The Cox proportional hazards models showed no evidence that any of the admissions criteria are predictive of the time to graduation, with, once again, only gender being marginally associated, suggesting that women are 50% more likely to graduate at any particular time than men (p=0.086), all other factors being equal.

There were no statistically significant interactions between the type of program (MSc vs. MPH) and any of the variables included in the model, so we decided to present a single model encompassing students from both programs.

DISCUSSION

The most intriguing finding of the study was the fact that admissions criteria are strong predictors of academic grades but not of graduation, which suggests that factors delaying graduation are not directly related to entry academic skills. A natural question was whether GPAs obtained in the MPH or MSc programs are related at all to the odds of graduation. To address this question, we fitted an additional OLS model using

Table 1. Descriptive statistics of a sample of students in the National Institute of Public Health of Mexico master's degree programs, 2003–2008

	Total			*Master of Science program*			*Master of Public Health program*		
Characteristic	N	*Mean*	*SD*	N	*Mean*	*SD*	N	*Mean*	*SD*
Age (in years)	426	30.2	7.0	234	29.0	6.6	192	31.8	7.2
Gender (percent of males)	428	33.2	NA	234	35.5	NA	194	30.4	NA
Number of children	423	0.3	0.7	234	0.3	0.7	189	0.4	0.7
CENEVAL index[a]									
Global	391	1,013.7	63.5	219	1,029.4	60.9	172	993.8	61.3
English	391	1,002.5	117.6	219	1,018.5	110.0	172	982.2	124.0
Verbal reasoning	391	1,015.7	86.3	219	1,031.7	82.7	172	995.3	86.8
Mathematical reasoning	391	1,024.2	98.4	219	1,053.1	88.7	172	987.5	98.1
Mathematics test[b]	332	64.8	18.8	198	69.0	16.3	134	58.6	20.5
Bachelor's studies GPA[c]	403	8.7	0.6	224	8.7	0.5	179	8.6	0.6
Interview index[b]	335	57.7	11.7	170	56.4	7.4	165	59.0	14.8
Master's studies GPA[c]	422	8.9	0.5	232	8.9	0.5	190	9.0	0.4

[a]On a scale of 700.0 to 1,300.0

[b]On a scale of 0.0 to 100.0

[c]On a scale of 0.0 to 10.0

SD = standard deviation

NA = not applicable

CENEVAL = CENEVAL EXANI-III test

GPA = grade point average

Table 2. Ordinary least squares regression model with robust standard errors of average grade at time of egress of the National Institute of Public Health of Mexico master's degree programs, 2003–2008

Variable	*β*	P-*value*	*95% CI*
CENEVAL index[a]	0.0929	0.005	0.0283, 0.1576
Bachelor's studies GPA[a]	0.1130	<0.001	0.0565, 0.1696
Mathematics test[a]	0.1168	0.001	0.0469, 0.1867
Interview index[a]	0.0282	0.223	–0.0172, 0.0736
Age (in years)[a]	0.0030	0.917	–0.0527, 0.0586
Gender (0 = female, 1 = male)	–0.0800	0.161	–0.1920, 0.0321
Number of children	0.0123	0.577	–0.0319, 0.0572
Program (0 = MSc, 1 = MPH)	0.2845	<0.001	0.1713, 0.3980
Time	0.6143	<0.001	0.3429, 0.8860
Time^2	–0.0607	<0.001	–0.0845, –0.0370

[a]Beta coefficients per increase of one standard deviation of independent variable

CI = confidence interval

CENEVAL = CENEVAL EXANI-III test

GPA = grade point average

MSc = Master of Science

MPH = Master of Public Health

the dummy for graduation as the outcome and GPAs as the independent variable. To our surprise, we found a very significant association ($p<0.001$) showing that students with higher grades were indeed much more likely to graduate. This apparent contradiction was explained when we took the percentage of variance explained by average grades (9%). The roughly 91% unexplained variability in the odds of graduation is likely due to factors related to the long process of writing the protocol/thesis/article and having it reviewed and approved by multiple committees, in a time when most students need to find a job.

The fact that the mathematical reasoning component of the CENEVAL EXANI-III test and the mathematics INSP test are the more predictive factors of average grades may reflect the fact that competencies in biostatistical analysis are among the most important competencies in the area of public health. The results of the survival analysis suggest that there are critical thresholds for graduation in terms of time after

Table 3. Logistic regression model of the odds of graduating from the National Institute of Public Health of Mexico master's degree programs, 2003–2008

Variable	*Odds ratio (95% CI)*	P-*value*
CENEVAL index[a]	1.191 (0.787, 1.805)	0.41
Bachelor's studies GPA[a]	1.189 (0.844, 1.673)	0.32
Mathematics test[a]	1.182 (0.745. 1.033)	0.48
Interview index[a]	0.882 (0.597, 1.304)	0.53
Age (in years)[a]	0.986 (0.658, 1.477)	0.95
Gender (0 = female, 1 = male)	0.541 (0.273, 1.070)	0.08
Number of children[a]	0.893 (0.612, 1.305)	0.56
Program (0 = MSc, 1 = MPH)	1.089 (0.527, 2.249)	0.82
Time	3.985 (0.659, 24.102)	0.13
Time^2	0.813 (0.688, 0.961)	0.02

[a]Odds ratios per increase of one standard deviation of the independent variable

CI = confidence interval

CENEVAL = CENEVAL EXANI-III test

GPA = grade point average

MSc = Master of Science

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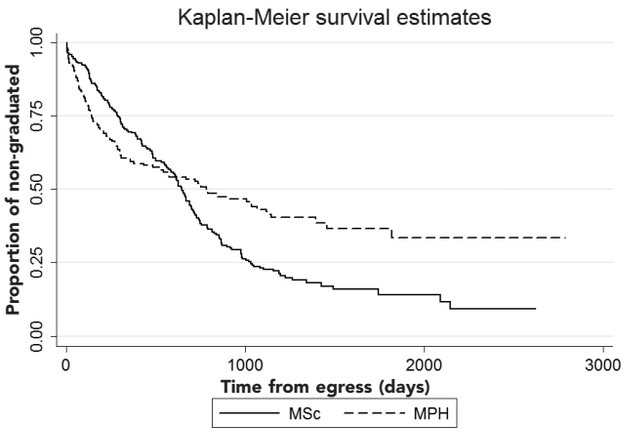
Figure 2. Time to graduation from the National Institute of Public Health of Mexico master's degree programs (MSc or MPH), 2003–2007



MSc = Master of Science
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concluding academic credits, so INSP should focus its efforts on this critical period to identify obstacles that delay students' graduation. Because stipends provided to students by CONACYT end after two years of admission to the school, we believe these critical windows reflect the fact that students begin to seek and eventually find jobs, which reduces the time available for work on their thesis, causing many of them to abandon all efforts toward finishing their degree. It is important to note that gender and age were not important predictors of grades, odds of graduation, or time to graduation. This finding emphasizes the importance of not taking these variables into account in the student selection process. The interview seems to have no relation to average grades, odds of graduation, or time to graduation. We cannot rule out that the interview is important for the selection process; however, it means that once a student is accepted, having had a good interview does not by any means guarantee that the student will have a favorable result at the end.

Although no similar studies in SPHs are published, some similarities were found in a study of a professional program in pharmacy. Houglum et al. found that the overall American College Test score and previous grades in mathematics were significantly related to academic success.[10] Similarly, in a study of time to graduation in a pharmacy PhD program, no variables were found to be predictive of the time to graduation with the exception of having previously taken advanced courses in biology.[12]

Limitations

The main limitation of our study was that rejected students were not contributing information to the estimation process. This limitation could cause a selection bias if unknown factors are associated both with the probability of admission and with the outcome, either average grades or graduation, as long as observed variables are correlated to these unknowns. Heckman selection models could be a solution, although the usual problem with this strategy is that an instrument is needed (in this case, a variable that is related only to the probability of selection, but not to average grades or to the probability of graduating), which is hard to find.[20] Because of the probability of selection bias, we recommend caution in using the results of this study to guide a modification of the selection process for the moment. However, even if selection bias is present, we could argue that the results we found are valid for those who are already admitted into the school, and they still convey valuable information.

CONCLUSION

Our findings suggest that although admissions variables are good predictors of GPAs, factors delaying graduation may instead be due to difficulties in the development of a student's thesis or final projects, or other related causes such as going back to work. This study constitutes our first attempt to scientifically investigate the factors behind academic success in an SPH. We plan to conduct future studies that will focus on the graduation process, which, according to our results, should be the most important measure. We hope that this study motivates other SPHs to scientifically delve into their admissions and graduation processes; such studies will surely promote advancements in the generation of educational knowledge that will contribute to evidence-based administrative decision-making and have a long-term impact on the education of health professionals and their competencies in the field.

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