

High school ranks and admission tests as predictors of first year medical students' performance

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Abstract. This article focuses on the predictive values of certain academic variables, high school ranks and admission tests, as related to grades at the end of the first year of the Licenciate in Medicine in Spain. Multiple regression equations were calculated for each first year subject. Multiple R values ranged from 0.41 to 0.61 which implies explained variance percentages of 16.5 and 37.5. The best predictor was found to be the high school grade point average in science courses, the global examination and the admission test average. The importance of taking into account these variables in the admission process is considered. Also the inclusion of some aptitudinal variables is discussed. Finally the need to establish prediction performance tables to be used in the counselling process of admitted students is considered.

Introduction

The gradual increase in the number of candidates seeking admission to university studies in recent years has underlined the need to devise effective selection procedures. Formerly, the admission problem was basically resolved through testing candidates' knowledge and aptitudes, in a word, their academic maturity. This is criteria reference testing. An individual was deemed suitable for the studies of his choice if testing results showed him to be in possession of the adequate prerequisites.

The current avalanche of applications has led to a certain change of strategy. Not only does the student need to demonstrate the expected academic maturity but must also compete with his fellow applicants who, like himself, are striving for university placement. Thus performance and academic maturity are competitively placed on the scale to determine access to higher studies. Thus, to criteria reference testing is added one of normative character. Only the "best" are admitted (at least in so far as their academic ratings go) even though many others fulfil standards of an acceptable academic level.

What should not be overlooked however is that in practice the reverse of the situation so far described can, and actually does, take place: that is candidates are admitted in numerical relation to openings available on the onedimensional basis of "best" academic grade point average, with total disregard for their having achieved adequate academic maturity.

That is to say, the danger exists in practice that a unidimensional normative selectivity procedure be carried out to the exclusion of the criterion aspect. In practical terms, a candidate's intellectual preparation may not be up to the demands of university studies. All of which necessarily produces more academic failures. In Spain, priority is given to academic factors in spite of all evidence pointing to the fact that our present system of selection is, to say the least, inadequate. The question immediately arises: What relevance have academic factors to success in university studies? To what degree can previous appraisal of intellectual preparation predict later performance?

In recent decades a great deal of research has been concerned with determining those specific qualities or factors related to academic success. Spanish studies worthy of mention would include Aguirre's longitudinal study (1980) in which the predictive value of a series of academic and aptitude variables of a cross-section of medical students are analyzed; the Cid Palacios study (1977) centered on the State "selectividad" exam and its characteristics; and Escudero's study (1984) featuring correlations of the order of 0.40-0.50 between secondary school and first year university performance. In our study on biology students (Touron, 1984), previous academic performance values related to first-year university performance in the order of 0.65 — 0.42.

The kinds of variables analyzed in the different studies centered on this problem can be grouped as follows:

- a) Academic variables
- b) Intelligence and differential aptitudes
- c) Personality
- d) Vocational interests

An interesting study which analyses the predictive value of each of the above variable groupings, along with those previously mentioned and which is related to the admission of medical students, is that of Gough (1977). Sheldrake (1975), on the basis of the results of other studies, refers to values of between 0.30-0.40 as regards academic and intellectual variables, although in combination with other factors, such as certain personality aspects, the correlation rises to 0.50-0.60. These personality factors by themselves appear to be less relevant, showing correlations between 0.20-0.30. Combinations of the various mentioned factors reach values (R-multiple) ranging between 0.60-0.90.

Schofield (1975) on the basis of a cross-section of University of Minnesota students, combining previous academic variables (GPA) and admission tests (MCAT) concludes that these are relevant to later success, along with additional factors such as personality, interests, extra-curricular activities, etc. included by faculty committees to determine the most promising candidates. In fact, performances obtained by students selected by either procedure were not significantly different.

Results of the various studies we have so far analyzed are fairly coincident. It can thus be affirmed that secondary-school academic variables, for science and humanity courses or both together correlate with later success, typically ranging from 0.30-0.40 (Arnold, 1983; Gough, 1978; Roessler, 1978; Murden, 1978; Cullen, 1980). However, Sarnacki (1982) warns of the need to proceed with caution in the use of GPA, owing to matters involving validity and reliability.

As regards admission tests, in a summary study recently carried out by Jones (1984) on the predictive validity of the new MCAT, this test's selective value is made manifest while it is pointed out at the same time that more reliable predictions were obtained systematically by combining it with prior performance (GPA).

What cannot be overlooked, however, is that the combination of academic variables along with aptitude type factors noticeably improves predictions. Thus, Roessler (1978) obtains values of the R-multiple ranging between 0.19 and 0.42 using only cognitive variables while other kinds of predictors show values of the R-multiple ascending to 0.45 — 0.64.

And though procedures and contexts may vary according to countries and schools the validity of academic variables as success barometers for university students, medical students in this instance, is unquestionable.

The present study is focused on this aspect: the predictive values of certain academic variables — to be specified later on — as related to grades at the end of the first year of the Licenciate in Medicine. By academic performance we refer, in this study, to the grade point average given by professors to students in the various course subjects.

Method

Data was gathered from final examination results in all courses taken by 184 students in June, 1984. Due to the impossibility of completing information on all students, the sample was reduced to 165.

Independent variables were divided into two groups:

group 1) those proceeding from secondary school grade point averages and selection tests;

group 2) those proceeding from Medical School admission tests.

The first group of variables was taken from grade point averages in Mathematics, Physics, Chemistry and Biology for the four years previous to university studies (in Spain the students enter Medical School directly from high school for a six year course) as well as the overall grade point average for these four subjects; likewise, the overall grade point average for all subjects including the four mentioned science studies. Likewise, the final grade of the State "selectividad" test was used. Information collected from the Medical School admission tests, included variables related to: Mathematics, Physics, Chemistry, Biology and Comprehension, and the overall grade for all of these. Tests were objective, multiple-choice types of between 20 and 40 items offering 5 options. Reliability was 0.80 according to the Kuder and Richardson 21 formula. The comprehension test was based on a test on a medical theme which the student was to read within a maximum time limit of 30 minutes followed by a set of 10 questions.

The dependent variables, the criteria to be predicted, consisted of the grades at the end of the first year courses: : iology, Biochemistry, Biophysics, Anatomy, Embryology and Biostatistics, as well as the grade point average for all of these over the first year.

Data were processed with programs 8D and 2R of the program package BMDP (Biomedical Computer Programs) (Dixon, 1979) at the University of Navarra Data Processing Center.

The 8D program was used for calculating the correlation between the different variables with respect to the grades at the end of the first year courses as well as between the secondary

school and admission test variables. Later, using the 2R program following the stepwise procedure, the equations of multiple regression of each of the first year courses as well as the variable "overall performance" were calculated.

Results and discussion

Table 1 shows correlations of grade points between secondary school, admission tests and first year courses. It can be seen that the correlation values of the different courses vary between 0.50 and 0.25, which suppose percentages of explained variances of between 25% and 6%. These are moderate values although they hover within the habitual range mentioned above.

Worthy of mention at this point is the fact that the variable grades in the State "selectividad" test has only minor relevance since its maximum prediction value accounts for 14% of the variance in Biophysics, and its minimum value is 3% of the explained variance for Anatomy.

It can be seen that the predictive value of grade point average is slightly superior to that of the courses when considered individually. However, it is not clear which is superior, as the greater predictive value related to Biology, Biochemistry and Embryology corresponds to the grade point average of all secondary school courses, while with respect to Biophysics, Anatomy and Biostatistics the greater predictive value corresponds to the grade point average of the science courses. At any rate, the range of values of one and the other is quite similar: 26% —11% and 27% —12%.

Table 1. Correlation of high school and admission test "grade points with first year courses.

	Performance Variables	Biology	Biochemistry	Biophysics	Anatomy	Embryology	Biostatistics
High school	Mathematics	0.4950	0.3838	0.4020	0.2778	0.3213	0.2993
	Physics	0.4891	0.4002	0.4671	0.3138	0.3548	0.2989
	Chemistry	0.4547	0.3687	0.4316	0.2870	0.3190	0.2510
	Biology	0.4311	0.2995	0.4325	0.2790	0.3479	0.2709
	Global	0.5138	0.4656	0.5121	0.3606	0.4454	0.3313
	Selectividad	0.3373	0.3650	0.3734	0.1826	0.3119	0.2307
	Glob. sciences	0.4440	0.4071	0.5252	0.3936	0.3738	0.3485
Admission	Mathematics	0.3303	0.3198	0.3308	0.2320	0.2619	0.3223
	Physics	0.3958	0.2927	0.3614	0.2834	0.3790	0.3075
	Chemistry	0.4858	0.3229	0.3628	0.2251	0.3941	0.3417
	Biology	0.5174	0.3008	0.3325	0.2997	0.3440	0.2820
	Compr. test	0.2878	0.0610	0.1539	0.2327	0.1274	0.2343
	Glob. admission	0.4805	0.4165	0.5099	0.2470	0.3888	0.3185

Table 2. Correlations of high school grade points with admission tests.

Admission	Mathematics	Physics	Chemistry	Biology	Global
High school					
Mathematics	0.4938	0.3193	0.4706	0.4181	0.4572
Physics	0.4408	0.3477	0.4466	0.4200	0.3917
Chemistry	0.4235	0.3074	0.4332	0.4055	0.3378
Biology	0.3556	0.3417	0.3782	0.4808	0.3021
Global-high school	0.4373	0.2737	0.3846	0.4170	0.3166
Global-sciences	0.3167	0.3040	0.2533	0.3277	0.4291
Selectividad	0.3306	0.2278	0.2692	0.2818	0.2138

In the second part of Table 1 the relative values of the correlation coefficients of the admission tests variables are shown taking unto consideration the variables individually; the highest value corresponds to Biology (ADM), 0.51 in the same area and the lowest value to Chemistry (ADM), 0.23 with respect to Anatomy. Again we find ourselves with an habitual range in this type of values 0.51— 0.23.

The comprehension test has noticeably lower predictive value although, as will be seen further on when prediction equations are referred to, its value is complementary.

If the four variables are considered together, a slight increase in their predictive capacity is to be seen, as can be observed in Table 1. In terms of explained variance, values ranged between 60% for Anatomy and 26% for Biophysics.

As to the results appearing in Table 2 we will refer only to the more relevant aspects.

All values are moderate and within normal ranges. If we consider the overall variables (High School Sciences and "Selectividad") as compared to the global admission test grade points, it can be seen that the highest value corresponds to the science courses (0.43) which in terms of explained variance supposes 18.5% while the "selectividad" test grade point average explains only 4.69%, a notably lower value.

In the light of this data and taking into account that high school grade point averages account for 27.6% (in the most favorable case) while that of "selectividad" does not pass 14%, its minor relevance as a selection criterium is once again emphasized. This becomes even clearer when it is considered that this value did not discount the effect exercised by the average high school grade, and if it had, its value would have been even lower. It might still be expected to have complementary effect in the calculation of the prediction equations, but as we shall see it does not.

In Tables 3 and 4, the values relative to the prediction equations of the various courses as well as to overall performance are summarized.

This type of multiple regression analysis permits an evaluation of the total relevance of the different variables to the criteria to be predicted, when the procedure followed chooses the variables in the order optimized by the value of R-multiple, since overlapping phenomena, the elimination of useless van-anee, etc, are to be expected (cf. Kerlinger, 1975). Thus for example, the comprehension test variable, which showed a quite moderate correlation with the criteria, now appears in two equations, Anatomy and Biology.

In Table 3 some of the equation parameters are indicated, the multiple correlation coefficient, the coefficient of multiple determination, the increase of this, as well as the evolution of estimated error on introducing each variable.

It can be seen that the R-multiple values ranged between 0.41 and 0.61. In terms of accountable variance this supposes percentages of 16.5% and 37.5%. These values are much higher than those indicated previously (Roessler et al., 1978).

Table 3. Prediction equation parameters of first year medical courses (predictors: grade points of high school and admission tests)

Parameters	R multiple	R ² multiple	Increase R ²	Error estimate	Criterium
Variable					
Global admission	0.4805	0.2309	0.2309	1.8927	
Chemistry-high school	0.5611	0.3148	0.0839	1.7912	Biology
Comp. test (admission)	0.5765	0.3324	0.0176	1.7729	
Global admission	0.4165	0.1735	0.1735	2.4386	
Global-high school	0.5045	0.2545	0.0810	2.3322	Biochemistry
Global sciences	0.5252	0.2759	0.2759	1.9910	
Global-admission	0.6124	0.3751	0.0922	1.8546	Biophysics
Global-high school sciences	0.3936	0.1549	0.1549	1.8297	
Comp. test	0.4270	0.1823	0.0274	1.8046	Anatomy
Mathematics-high school	0.4475	0.2003	0.0180	1.7895	
Global-admission	0.3888	0.1511	0.1511	1.9336	
Global-high school	0.4690	0.2199	0.0688	1.8586	Embryology
Physics-high school	0.3527	0.1244	0.1244	2.1478	
Physics-admission	0.4055	0.1645	0.0401	2.1037	Biostatistics
Global-high school sciences	0.5160	0.2662	0.2662	1.5625	
Global-admission	0.5967	0.3561	0.0898	1.4776	Global-1st year performance

The best predictors, it should be pointed out, are the high school grade point averages in science courses, the global examination and over all the admission test average, all of which are shown in Table 4. Courses considered individually are of minor relevance.

The State "selectividad" test does not qualify as a predictor in any of the calculated equations.

However, using first year global performance as the criterium, the two best predictors are: high school grade point averages (sciences) and the admission test average. In the majority of equations both indicate a complementary relationship.

On the basis of these data can be concluded that grade point average of both high school and admission tests are reliable predictors of academic success for students finishing their first year. Thus, their inclusion as aspects to be taken into consideration in the selection process seems appropriate.

In the future, however, certain instrumental aspects need to be improved upon. With respect to admission tests we would recommend broadening the scope of each of the tests for purposes of greater reliability and, consequently, validity.

Likewise, it would be desirable to measure entena by means of objective instruments (in the technical sense) so that a pattern of common reference could be established for all students. This would favour longer term planning in longitudinal studies.

The inclusion into the selection process of other variables related to aptitude should also be taken seriously into consideration not only for improving prediction reliability but the selection process as well.

Finally, performance prediction tables should be constructed which would constitute a positive factor for better counselling newly admitted students and to establish timely corrective measures for the purpose of off-setting previous knowledge gaps so often discovered in new students.

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