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Predictive power of high school educational attainment and the medical aptitude test for performance during the Bachelor program in human medicine at the University of Bern: a cohort study

Krings Rabea, Huwendiek Sören, Walsh Nathalie, Stricker Daniel, Berendonk Christoph

Institute for Medical Education (IML), University of Bern, Bern, Switzerland

Summary

OBJECTIVE: Prior high school educational attainment and medical aptitude tests are two of the most frequently used selection procedures for admission to medical school. Both of these have been shown to correlate with future performance. However, there is a need for further analysis of the combined impact of these two admissions tools and comparison of their predictive value for future performance. At present, successful completion of high school (Matura) and an aptitude test (*Eignungstest Medizinstudium Schweiz*, EMS; Swiss Aptitude Test in Medicine) are used for admission to all medical schools in the German-speaking part of Switzerland. The purpose of this study was to explore the predictors that are most decisive for performance in undergraduate medical education. More precisely, we were interested in the contributions of the Matura grade and the EMS score to explanations of performance in the Bachelor program of Medicine at the University of Bern.

METHODS: Matura grades, EMS score and performance in the Bachelor program of Medicine were collected for 730 students from four cohorts. Of these, 277 graduated from high school with a biology-chemistry major. Hierarchical regression analysis was conducted for each study year and type of examination to determine which predictors affected performance during undergraduate medical education.

RESULTS: These data show that Matura grades are an important predictor for performance in undergraduate medical education. The EMS score had no impact when the Matura grades were part of the analysis. The biology-chemistry major grade was a predictor for performance in the first year of undergraduate study. From the second academic year onwards, past performance in the bachelor's program was the best predictor for future performance during undergraduate medical education.

CONCLUSIONS: Students' Matura grades predicted their subsequent performance in undergraduate medical education in the bachelor's program of the University of Bern. In contrast, EMS scores do not explain any additional variance in students' performance throughout the entire bachelor's program. These findings suggest a need for rethinking the admission process.

Key words: performance in studies of human medicine, high school educational attainment, Medical Aptitude Test

Correspondence:
Correspondence, Rabea Kings, Dr. phil., Institute for Medical Education, University of Bern, Mittelstrasse 43, CH-3012 Bern, rabea.krings[at]iml.unibe.ch

Introduction

For decades, admission to medical school has been based on successful prior educational attainment. Nowadays, admissions to medical studies are limited for many programs and in many countries, as the number of potentially eligible candidates far exceeds the number of places. Accordingly, selection must take place to decide who should be entitled to study medicine and who should not [1]. This brings with it considerations of the procedures and methods to be used for selection [2]. Selection procedures differ internationally. An overview of the methods used is presented in the 'Ottawa consensus statement: Selection and recruitment to the healthcare professions 2018' [1]. Prior educational attainment and aptitude tests are two of the most frequently used selection procedures [3].

Educational attainment is traditionally the primary basis for regulating entrance into medical schools. Prior grades are a robust predictor of future performance in undergraduate and postgraduate medical assessments [3] [4]. This so-called 'academic backbone' provides strong support for using measures of educational attainment for student selection [5]. However, admission based on high school grades alone has been challenged, and the comparability of high school grades is disputed. Moreover, there has been a continual increase in the average grades awarded at the maximum level in recent years in countries such as the UK and Germany [6] [7]. This development, with ever higher grade

averages, appears to be less pronounced in Switzerland, but the rising high school graduation rate (Maturaquote) is also leading to discussions about the value and significance of the certificate [8].

The growing number of applicants and the above-mentioned issues concerning the use of high school grades alone for selection have encouraged the development of aptitude tests as part of the admission process. A large number of different tests are used for this purpose, ranging from tests of general cognitive ability to tests that mainly cover scientific knowledge, as well as tests that include a blend of these two types. However, evidence of predictive validity for aptitude tests is equivocal [3]. Based on these findings, the 2018 Ottawa consensus statement on selection and recruitment to the healthcare professions stressed the importance of evaluating each aptitude test in its own right in order to draw conclusions on its quality and usefulness [1]. Moreover, there is a need for more analysis of the combined impact of multiple admissions tools and the inter-correlation of such tools [4].

Successful completion of high school (Matura) and an aptitude test form the basis for admission to the German-speaking medical schools in Switzerland. The aptitude test is known as the *Eignungstest für das Medizinstudium in der Schweiz* (EMS; Swiss Aptitude Test in Medicine). It assesses the general cognitive ability of the candidate rather than explicitly focusing on their scientific knowledge. The goal of the EMS is to demonstrate the potential of a candidate to successfully complete their medical studies, and the EMS's developers claim that the better the test value, the more likely it is that the candidate will successfully complete their medical studies [9]. These EMS results have been shown to be reliable, and their preliminary evaluation demonstrated a correlation with performance in the early years of medical studies [10].

The EMS has been used since 1998, although since its introduction controversy has remained as to whether or not this selection process allows the 'right' candidates to study medicine [11]. Indeed, additional measures which are not part of the admission process in Switzerland, such as communication skills, professional behavior and personality traits, are widely used in other countries like the Netherlands [12], Israel [13], and Canada and the USA [14].

In summary, little is known about the validity of the selection procedures that are used to control admission to medical studies in Switzerland. This situation is particularly unfortunate because admission to medical studies is of great relevance to the individual candidate, as well as to society as a whole [15] [16]. Accordingly, it is important that decisions on admission procedures are based on solid empirical evidence.

The purpose of this study was to explore the predictors that are most decisive for performance in undergraduate medical education. More precisely, we were interested in the contributions of the Matura grade and the EMS score to explanations of performance in the Bachelor program of Medicine at the University of Bern. We hypothesized that Matura grades (both the overall grade and the grades in biology and chemistry) would best predict performance, as prior educational attainment is known to be a robust predictor of future educational achievement. Secondly, we hypothesized that the EMS score, with its highly reliable measurement of candidates' characteristics under equal conditions for all, would add incremental validity for predicting subsequent performance in medical school. The answers to these research questions should provide relevant information for the further development of these admission procedures for medical studies.

Methods

Sample

This was a four-cohort, retrospective study of medical students who began their studies at the University of Bern (Switzerland) between 2010 and 2013. Of the 730 students who began their studies in these years, 390 (53.4%) were female and 340 (46.6%) were male; 172 started their studies in 2010, 184 in 2011, 191 in 2012 and 183 in 2013; and 277 graduated from high school with a biology-chemistry major.

The study was approved by the Ethics Commission of the Faculty of Human Sciences of the University of Bern (N°. 2018-10-00002) and was evaluated as exempt from registration by the Cantonal Ethics Commission (ID REQ-2018-00600).

Sample measures

Participants' sex, age at entry, number of years from the Matura to the start of medical studies, EMS score and Matura grades were provided by the Admissions Office of the University of Bern. The mean of all of a student's Matura grades was calculated as a predictor, referred to here as the 'Matura grade'. In addition, the grade attained in the biology-chemistry major was chosen as a further predictor, as the defined learning outcome of undergraduate medical studies is heavily based on bio-medical content. The EMS score at the first attempt at the EMS was used. The following performance measures of the undergraduate medical students, provided by the Faculty of Medicine, University of Bern, were used: correct answers in the first-, second- and third-year multiple choice (MC) examinations (%); performance in the first- and second-year oral examinations (%); and standardized value of the objective structured clinical examination (OSCE) in the third year.

Statistical analysis

All the statistical analyses were processed using SPSS software, version 25.0 (SPSS Inc, Chicago, IL, USA). The data were analyzed using hierarchical regression analyses. Differences were considered significant at $p < 0.05$. Before the hierarchical regression, correlation analysis was used to test whether the Matura grade and the EMS score differed in terms of the strength of their correlations to the other variables. The Matura grade was significantly more strongly corelated with all of the outcome variables, thus showing that it should be used before the EMS score in the hierarchical regression analyses. Furthermore, Matura grades and EMS score did not differ in terms of their variances ($F(669,695) = 0.003$, $p = 1.00$).

Results

Of the 730 students included in this study, 640 (87.7%) obtained their bachelor's degree in medicine, with 512

(70.1%) completing it within three years. Therefore, there was a 12.3% drop-out rate among the 730 students from the four cohorts. The statistical analysis, with the intercorrelations of the study variables, is presented in table 1.

To test our hypotheses, hierarchical regression analysis was conducted for each study year and each type of examination, which resulted in six different hierarchical regression analyses. The aim of the regression analyses was to find out if Matura grades and EMS correlate with 'success' in the Bachelor program of Medicine. The higher a student's score in the different examinations, the higher their success. Data was entered stepwise to analyze which predictors add value to the variable success. First, the control variables (e.g. age, sex) were added to the model, then Matura grades, followed by EMS score and, if applicable, performance in previous years.

The control variables number of years from the Matura to the start of medical studies and age at entry into the medical program showed no significant effects in any of these models. Only the control variable sex yielded one significant difference: women performed better than men in the third-year OSCE. In all the other analyses, sex was not significant.

In step 2 of the analysis, the Matura grade was entered. As expected, the Matura grade was positively and significantly corelated with performance in all the examinations (i.e., MC, oral, OSCE; for all three years of the bachelor's program). The explained variance in the performance declined with increased duration of study: the Matura grade explained more of the variance in performance in the first-year examinations (first-year MC examination, 36%; first-year oral examination, 42%) than in the second- and third-year examinations (second-year MC examination, 28%; second-year oral examination: 27%; third-year MC examination, 19%; third-year OSCE, 16%).

In step 3 of the analysis, the EMS score was entered. The EMS score yielded no significant results in any of the analyses. This shows that the EMS score did not explain any additional variance over the Matura grade in any of the three years of the bachelor's program, neither for the MC examinations, nor for the oral examinations or the OSCE. For the first-year examinations, the biology-chemistry major grade was entered in a fourth step. The biology-chemistry major score was positively and significantly corelated with performance in the MC and oral examinations in the first year of the bachelor's program (see tables 2, 3). All these analyses were also conducted for the whole sample of 730 students, without step 4. These data showed the same pattern as those for the reduced sample of 277 students with a biology-chemistry major.

For the second- and third-year examinations, the performances in the previous examinations were entered in step 4 (e.g., was the second-year MC examination result predicted by the first-year MC examination result?). In all the models, previous performance predicted subsequent performance positively and significantly. However, the additional amount of explained variance varied according to examination year and type of examination. Performance in the first-year MC examination explained 29% of the additional variance in performance in the second-year MC examination (see table 4). Performance in the first-year oral examination explained 13% of the additional variance in performance in the second-year oral examination (see table 5). Performance in the second-year MC examination explained 28% of the additional variance in performance in the third-year MC examination (see table 6). Performance in the second-year oral examination explained 5% of the

Table 1: Means, standard deviations and correlations across all variables.

Variable		Mean	*SD*	1	2	3	4	5	6	7	8	9	10	11
1	First-year MC examination (%)	67.28	10.61											
2	First-year oral examination (%)	69.77	15.81	**0.80****										
3	Second-year MC examination (%)	70.80	10.02	**0.74****	**0.60****									
4	Second-year oral examination (%)	69.39	15.50	**0.64****	**0.60****	**0.78****								
5	Third-year MC examination (%)	68.12	7.67	**0.58****	**0.54****	**0.70****	**0.57****							
6	Third-year OSCE	99.93	4.13	**0.29****	**0.30****	**0.34****	**0.38****	**0.35****						
7	Time from Matura to start of studies (years)	1.11	1.56	0.80	0.02	0	-0.30	0.02	0.01					
8	Age at entry (years)	20.12	1.81	0.02	-0.03	-0.06	**-0.09***	-0.03	-0.02	**0.90****				
9	Sex (0, female / 1, male)	0.47	0.50	-0.01	-0.01	0	-0.01	-0.01	**-0.28****	**0.14****	**0.15****			
10	Matura grade	4.94	.38	**0.54****	**0.55****	**0.47****	**0.44****	**0.42****	**0.34****	**-0.17****	**-0.20****	**-0.27****		
11	EMS score	108.69	6.60	**0.23****	**0.20****	**0.25****	**0.23****	**0.25****	**0.13****	-0.02	-0.07	0.01	**0.35****	
12	Biology-chemistry major	4.84	0.63	**0.57****	**0.61****	**0.48****	**0.50****	**0.38****	**0.24****	**-0.15***	**-0.13***	**-0.13***	**0.81****	**0.27****

* $p < 0.05$, ** $p < 0.01$

additional variance in performance in the third-year OSCE (see table 7).

In the analyses of performance in the second-year MC examination and the third-year OSCE, the Matura grade was no longer significant (see tables 4, 7). The Matura grade was, however, still a significant predictor of performance in the second-year oral examination and the third-year MC examination (see tables 5, 6).

In step 5 of the analysis of the second- and third-year performances, the biology-chemistry major score was entered

Table 2: Regression analysis: impact of Matura grade and EMS score on first-year MC examination.

Variable	Measure	Model 1			Model 2			Model 3			Model 4		
		B	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Time from Matura to start of studies	years	0.91	1.04	0.10	1.56	0.83	0.17	1.56	0.83	0.17	1.60	0.82	0.18
Age at entry	years	-0.33	0.81	-0.05	-0.10	0.64	-0.01	-0.10	0.65	-0.01	-0.14	0.63	-0.02
Sex	0, female / 1, male	-0.66	1.29	-0.03	1.80	1.05	0.09	1.82	1.05	0.09	1.48	1.04	0.07
Matura grade	-				16.45	1.32	0.63**	16.53	1.40	0.63**	11.03	2.23	0.42
EMS score	-							-0.01	0.08	-0.01	-0.01	0.08	-0.01**
Biology-chemistry major	grade										4.21	1.34	0.26**
Adjusted R^2	-	-0.01			0.36			0.36			0.38		
Change in R^2	-	0			0.37			0			0.02		
F	-	0.42			39.48**			31.47**			28.75**		
F for change in R^2	-	0.42			155.92**			0.03			9.86**		

** $p < 0.01$

Table 3: Regression analysis: impact of Matura grade and EMS score on first-year oral examination.

Variable	Measure	Model 1			Model 2			Model 3			Model 4		
		B	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Time from Matura to start of studies	years	1.39	1.79	0.11	1.86	1.36	0.15	1.86	1.36	0.15	1.87	1.34	0.15
Age at entry	years	-0.87	1.37	-0.09	-0.17	1.04	-0.02	-0.16	1.04	-0.02	-0.19	1.02	-0.02
Sex	0, female / 1, male	-0.95	2.15	-0.03	1.34	1.64	0.04	1.33	1.65	0.04	0.81	1.63	0.03
Matura grade	-				24.96	2.06	0.67**	24.91	2.18	0.67**	16.82	3.54	0.45**
EMS score	-							0.01	0.12	0.00	0.03	0.12	0.01
Biology-chemistry major	grade										5.97	2.09	0.26**
Adjusted R^2	-	-0.01			0.42			0.41			0.44		
Change in R^2	-	0			0.43			0			0.02		
F	-	0.27			36.89**			29.36**			26.74**		
F for change in R^2	-	0.27			146.16**			0			8.19**		

** $p < 0.01$

Table 4: Regression analysis: impact of Matura grade and EMS score on second-year MC examination.

Variable	Measure	Model 1			Model 2			Model 3			Model 4			Model 5		
		B	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Time from Matura to start of studies	years	0.98	1.07	0.11	1.33	0.90	0.15	1.35	0.90	0.15	0.23	0.71	0.03	0.24	0.71	0.03
Age at entry	years	-0.61	0.83	-0.09	-0.25	0.70	-0.04	-0.24	0.70	-0.03	-0.06	0.54	-0.01	-0.07	0.54	-0.01
Sex	0, female / 1, male	-0.73	1.31	-0.04	1.57	1.14	0.08	1.48	1.14	0.07	0.43	0.88	0.02	0.40	0.89	0.02
Matura grade	-				14.53	1.44	0.55**	13.98	1.53	0.53**	2.84	1.46	0.11	2.25	2.00	0.09
EMS score	-							0.09	0.08	0.06	0.06	0.06	0.04	0.06	0.06	0.04
First-year MC examination	%										0.71	0.05	0.68**	0.71	0.06	0.68**
Biology-chemistry major	grade													0.50	1.16	0.03
Adjusted R^2	-	-0.01			0.28			0.28			0.57			0.56		
Change in R^2	-	0			0.28			0			0.29			0		
F	-	0.36			25.80**			20.90**			57.60**			49.24**		
F for change in R^2	-	0.36			101.68**			1.22			171.31**			0.19		

** $p < 0.01$

Table 5: Regression analysis: impact of Matura grade and EMS score on second-year oral examination.

Variable	Measure	Model 1			Model 2			Model 3			Model 4			Model 5		
		B	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Time from Matura to start of studies	years	2.27	1.86	0.18	2.45	1.59	0.20	2.38	1.59	0.19	1.41	1.45	0.11	1.46	1.44	0.12
Age at entry	years	-2.11	1.43	-0.22	-1.36	1.22	-0.14	-1.28	1.22	-0.13	-1.09	1.10	-0.11	-1.11	1.10	-0.12
Sex	0, female / 1, male	-1.32	2.22	-0.04	0.64	1.91	0.02	0.45	1.92	0.01	-0.12	1.73	0.00	-0.41	1.73	-0.01
Matura grade	-				20.47	2.42	0.53**	19.41	2.55	0.51**	7.30	2.95	0.19*	2.80	3.99	0.07
EMS score	-							0.18	0.13	0.09	0.16	0.12	0.08	0.17	0.12	0.08
First-year oral/ practical examinations	%										0.52	0.08	0.48**	0.50	0.08	0.46**
Biology-chemistry major	grade													3.78	2.27	0.16
Adjusted R^2	-	0			0.27			0.27			0.41			0.41		
Change in R^2	-	0.01			0.27			0.01			0.13			0.01		
F	-	0.93			18.76**			15.41**			22.94**			20.25**		
F for change in R^2	-	0.93			71.23**			1.72			43.25**			2.78		

** $p < 0.01$

Table 6: Regression analysis: impact of Matura grade and EMS score on third-year MC examination.

Variable	Measure	Model 1			Model 2			Model 3			Model 4			Model 5		
		B	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Time from Matura to start of studies	years	1.47	0.82	0.23	1.65	0.74	0.26*	1.67	0.74	0.26*	1.27	0.59	0.20*	1.27	0.59	0.20*
Age at entry	years	-1.14	0.64	-0.23	-0.85	0.58	-0.17	-0.85	0.58	-0.17	-0.91	0.46	-0.18*	-0.91	0.46	-0.18
Sex	0, female / 1, male	-1.17	1.01	-0.08	0.38	0.94	0.02	0.30	0.94	0.02	-0.82	0.76	-0.05	-0.84	0.76	-0.05
Matura grade	-				9.07	1.23	0.46**	8.52	1.30	0.43**	2.50	1.17	0.13*	2.11	1.68	0.11
EMS score	-							0.09	0.07	0.08	0.05	0.06	0.04	0.05	0.06	0.04
Second-year MC examination	%										0.51	0.05	0.61**	0.51	0.05	0.61**
Biology-chemistry major	grade													0.32	0.99	0.03
Adjusted R^2	-	0.01			0.19			0.2			0.49			0.48		
Change in R^2	-	0.02			0.19			0.01			0.28			0		
F	-	1.61			14.99**			12.38**			37.55**			32.07**		
F for change in R^2	-	1.61			54.04**			1.75			128.59**			0.11		

* $p < 0.05$, ** $p < 0.01$

Table 7: Regression analysis: impact of Matura grade and EMS score on third-year OSCE.

Variable	Measure	Model 1			Model 2			Model 3			Model 4			Model 5		
		B	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*	*B*	*SE B*	*β*
Time from Matura to start of studies	years	0.10	0.42	0.03	0.17	0.41	0.05	0.18	0.41	0.05	0.05	0.40	0.01	0.05	0.40	0.01
Age at entry	years	-0.49	0.32	-0.18	-0.42	0.31	-0.15	-0.42	0.31	-0.15	-0.37	0.31	-0.14	-0.37	0.31	-0.14
Sex	0, female / 1, male	-2.33	0.50	-0.29**	-1.93	0.50	-0.24**	-1.94	0.51	-0.24**	-1.99	0.49	-0.25**	-1.98	0.49	-0.25**
Matura grade	-				2.36	0.66	0.23**	2.28	0.70	0.22**	1.17	0.75	0.11	1.52	1.09	0.15
EMS score	-							0.01	0.04	0.02	0.00	0.04	0.00	0.00	0.04	0.00
Second-year oral/practical examinations	%										0.07	0.02	0.24**	0.07	0.02	0.25**
Biology-chemistry major	grade													-0.29	0.65	-0.04
Adjusted R^2	-	0.11			0.16			0.15			0.2			0.19		
Change in R^2	-	0.12			0.05			0			0.05			0		
F	-	10.66**			11.59**			9.26**			10.29**			8.81**		
F for change in R^2	-	10.66**			12.72**			0.13			12.95**			0.2		

** $p < 0.01$

as a predictor. This predictor was not significant in any of the models (see tables 4-7). All these analyses were also conducted for the whole sample of 730 students, without step 5. These data showed the same pattern as those for the reduced sample of 277 students with a biology-chemistry major.

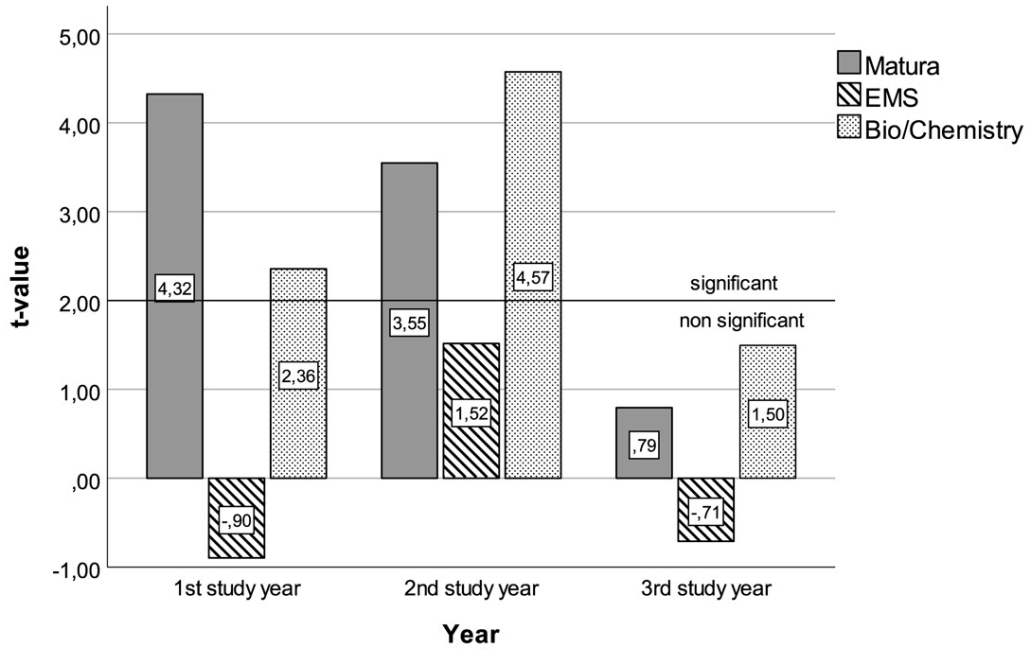
To check that the significance of the Matura grade and the non-significance of the EMS score in steps 2 and 3 were not affected by the order of the hierarchical regression, additional analyses were carried out with the EMS score entered first (i.e., in step 2), followed by the Matura grade (i.e., in step 3). With one exception, the EMS score was positively and significantly corelated with performance in the different examinations. The exception was the third-year OSCE, where the EMS score was not a significant predictor. However, for all the models, the EMS score was no longer significant when the Matura grade was incorporated in step 3, whereupon the Matura grade achieved significance instead. Furthermore, t-tests were carried out to determine whether the students who succeeded in the three years of study differed from those who failed. The t-values provide a standardized measurement of the difference between the means of the two samples. The high positive t-values in figure 1 show that the students who succeeded in their first two years of study had significantly higher Matura grades and higher grades in their biology-chemistry major. There was no difference, however, between students who succeeded and those who failed in terms of the EMS score (figure 1, negative or near-zero t-values for EMS score).

Discussion

The correlation between Matura grades and performance for undergraduate students of human medicine at the University of Bern was considerably higher than the correlation between EMS score and performance, supporting our first hypothesis. These correlations were strongest in the first year of medical study and decreased with increased duration of medical study. More interestingly, the regression analysis showed that up to 42% of the total variance in performance in the first year of these medical studies can be explained by the Matura grade. In contrast, the EMS score did not explain any additional variance in performance throughout the entire bachelor's program. Hence, our second hypothesis is not supported. Moreover, the EMS scores of the students who failed their examinations in the Bachelor program of Medicine at the University of Bern did not differ from the EMS scores of those students who passed these examinations.

These data resonate with the findings on admissions to medical schools in the literature. Prior educational attainment is regarded as a reliable predictor of future performance, while different opinions are held regarding the significance of aptitude tests [3]. Indeed, it is known that when aptitude tests do have predictive validity, it is often the knowledge parts, and especially those related to the natural sciences, that predict future performance in the early phase of medical studies [17] [18]. Aptitude tests also often have predictive validity when prior educational attainment is not available, not comparable or out of date (e.g. mature entrants) [19]. As indicated, the EMS score is an assessment of the general cognitive ability of a candidate and does not explicitly focus on prior scientific knowledge. Much to the contrary, we show here that solid knowledge of the natural sciences is a key factor for successful performance in medical studies. Students with higher grades in the high school biology-chemistry major performed better in the first year of medical studies than those who achieved lower grades in these disciplines.

Figure 1: Differences in Matura, EMS score and biology-chemistry major grade between the students who succeeded in one study year and those who failed (standardized t-values). Positive values show higher scores for students who succeeded, negative values show higher scores for students who failed.



With the EMS score apparently of limited use for predicting the future performance of undergraduate students of human medicine at the University of Bern, the question arises of whether there are alternative measures with which to regulate access to medical studies and to make the admission conditions as meaningful and as fair as possible [20]. Here, it is worth taking a closer look at how medical education has developed. Undergraduate medical education has evolved considerably in recent years. This can be seen by the development and implementation of PROFILES (**P**rincipal **R**elevant **O**bjectives and **F**ramework for **I**ntegrative **L**earning and **E**ducation in **S**witzerland), a national reference framework for undergraduate medial curricula which provides a set of competency- and outcome-based learning objectives for medical students and faculties throughout Switzerland [21]. This document acknowledges sound scientific knowledge as the foundation for medicine, but stresses characteristics such as communication skills, professionalism and the ability to collaborate within an interprofessional team.

Indeed, examination formats reflect this development, as seen in the OSCE, where not only knowledge, but also clinical skills, communication and interactions with patients are evaluated [22]. It is likely that with the introduction of PROFILES, such methods of performance assessment will be increasingly used in medical studies [23]. This evolution of undergraduate medical education resonates with calls for a holistic review of the admission and selection processes for medical studies [11, 15, 20, 24, 25]. One holistic review conceptualized this admission process as a strategic, mission-driven, evidence-based process that offers a flexible framework for selection by incorporating the stakes of the individual applicant, the institution that sponsors the education and societal needs [16]. This approach acknowledges that prior academic attainment must be considered as one of several important criteria, although other competencies that might be deemed necessary to function properly as a future physician should not be ignored. However, assessing abilities such as communication and collaboration is not straightforward in the context of such selection.

Despite this, there is now a growing number of methods which provide sound psychometric indices that can be used to capture these complex competencies. There is a good level of consensus among researchers that tools like multiple mini-interviews [26] or situational judgements tests [27] can complement pre-admission cognitive measures to predict performance outcomes during a clerkship and during postgraduate education [3]. Patterson and colleagues indicated that nonacademic attributes might be used as criteria to ‘select out’, while academic criteria might be used to ‘select in’ [25].

Along with evidence from the broader body of work in the area of admissions, our findings should now be used to start a dialogue that will lead to an admission process based on a strategic, evidence-based set of methodologies. Such an admission process would take into account the needs of the individual applicant, the medical faculties and society.

Limitations

Our study has a number of limitations. First, it was conducted at a single institution. Indeed, the correlation between EMS score and performance over the first three years of the three German-speaking medical programs reported in the 1998/99 preliminary study by Hänsgen and Spicher is higher than that in the present study [10]. However, our analysis covered four cohorts and not just two, as in this study. More importantly, at the time of the preliminary evaluation in 1998/99, the EMS score had shown little selective effect. Only about 20% of candidates were excluded from medical studies due to a low EMS score. The situation today is quite different. Currently, almost four candidates apply for every study place. The difference between the ratio of applicants to places in the late nineties and today’s ratio is a possible explanation for the different correlations observed between the EMS score and performance in medical studies at these two points in time. Therefore, there might be less variance in the EMS score now in comparison to in 1998/99. However, the variances of the EMS score and the Matura grade do not differ significantly between 1998/99 and now. Moreover, there was no difference between the EMS scores of students who succeeded in the different study years and those who failed, whereas students who succeeded had higher grades in their Matura and in their biology-chemistry major compared with students who failed.

Conclusions

Matura grades predict the subsequent performance of medical students in undergraduate medical education in the Bachelor program of the University of Bern. More than 40% of the total variance in performance in the first year of medical studies can be explained by prior educational attainment. In contrast, EMS scores do not explain any additional variance in performance across the entire bachelor’s program. These results call for a better understanding of the factors that predict performance in medical studies and suggest the need for a rethinking of the admission process.

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