Medical student selection

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CHAPTER 2

Selection and study performance: comparing three admission processes within one medical school

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ABSTRACT

Objectives

(1) To analyse whether students admitted to one medical school based on top pre-university grades, a voluntary multifaceted selection process, or lottery, differed in study performance. (2) To examine whether students who were accepted in the multifaceted selection process outperformed their rejected peers. (3) To analyse whether participation in the multifaceted selection procedure was related to performance.

Methods

We examined knowledge test and professionalism scores, study progress and dropout in three cohorts of medical students admitted to University of Groningen, the Netherlands in 2009, 2010 and 2011 (N=1055). We divided the lottery-admitted group in students who had not participated and students who had been rejected in the multifaceted selection process. We used ANCOVA modelling, logistic regression, and Bonferroni post hoc multiple-comparison tests and controlled for gender and cohort.

Results

The top pre-university group had higher knowledge test scores and more first-year course credits than all other groups ($p<0.05$). This group received the highest possible professionalism score more often than the lottery-admitted group that had not participated in the multifaceted selection process ($p<0.05$). The group that was accepted in the multifaceted selection process had higher written test scores than the lottery-admitted group that had not participated ($p<0.05$) and received the highest possible professionalism score more often than both lottery-groups. The lottery-admitted group that had not participated in the multifaceted selection process earned fewer first-year course credits than all other groups ($p<0.05$). Dropout rates differed between groups ($p<0.05$), but correction for multiple comparisons rendered all pairwise differences non-significant.

Conclusions

A top pre-university GPA was the best predictor of performance. For so-called non-academic performance, the multifaceted selection process was efficient in identifying applicants with suitable skills. Participation in the multifaceted selection procedure seems predictive of higher performance. Further research is needed to assess whether our results are generalizable to other medical schools.

INTRODUCTION

Medical schools aim to identify and admit applicants who will perform best. One of the best pre-admission predictors of academic success is pre-university Grade Point Average (GPA).[1,2] Additionally, scores on the Medical College Admission Test (MCAT), in which problem-solving skills in physical and biological science, writing skills and verbal reasoning abilities are examined, correlate with subsequent performance.[1,3,4] Furthermore, scores on the multiple mini-interview (MMI) correlate with the ethical/communication skills components of licensing examination scores, interpersonal understanding and clerkship performance. [5-7] In the MMI, variables such as interpersonal skills and professionalism are assessed in a series of short interviews. Many medical schools use a combination of selection tools to base their admission decisions on.

Studies on the relation between admission scores and later performance, however, are characterised by two limitations. First, most studies have a restriction of range, as performance data are only available for applicants who were accepted in the selection process. It remains unclear how rejected applicants would have performed, had they been admitted. Second, in most medical schools, all students are admitted through the same admission process with a single set of criteria, which limits opportunities to compare different admission processes.

In the literature, few studies investigating performance differences between accepted and rejected students have been reported.[8, 9] A study from Canada showed no differences in national licensing examination scores between accepted students and rejected students who had matriculated at another medical school.[9] Admission was based on undergraduate GPA and scores on an autobiographical submission, a simulated tutorial and a personal interview. In a second study at the same medical school, accepted students showed higher national licensing examinations scores than their rejected peers.[8] The difference between the two studies was that the simulated tutorial and the personal interview had been replaced by a multiple mini-interview (MMI). The MMI, as such, seemed to be a better predictor of performance than the previously used interview methods. However, the authors acknowledge that absolute causal conclusions could not be drawn, because the comparison was based on groups of students admitted in different time periods.

A few studies addressed the effects of different admission processes on student performance within one medical school. A study from Denmark showed higher dropout rates among students who were admitted on the basis of high pre-university GPA than among students who were admitted through a non-grades-based admission test. The authors therefore concluded that admission based on previous academic achievement alone might not be sufficient in preventing dropout.[10] A study from the Netherlands compared medical school performance of students who were admitted based on either a multifaceted selection process or lottery. The authors found that dropout rates were lower for selected students than for their lottery-admitted peers.[11] They found no differences in study progress per year or test grades. A subsequent study indicated that students who were accepted in the selection process outperformed lottery-admitted students in clerkships.[12] However, the lottery-admitted group consisted of students who had been rejected at first in the selection process and students who had not participated in this process. Therefore, the effects of the selection process could not fully be explored. Additionally, we wondered

whether these effects are generalizable to other medical schools that use lottery next to other admission processes.

The Netherlands has a three-step admission system. In the first step, applicants with a top pre-university Grade Point Average (GPA) are offered admission. Participation in the second step is voluntary. In this step, students participate in a multifaceted selection process that is organised by each medical school separately. The third step is a national weighted lottery, in which applicants who were rejected in the second step as well as applicants who have not participated in the second step can enrol. This unique system provided us with the opportunity to add to the literature in several ways. First, we could compare performance of students who were admitted to one medical school through three different processes. Second, we could examine the effects of the multifaceted selection process without restriction of range, as we had performance data of both students who were accepted and students who were rejected in this process. Third, we had a unique control group, consisting of lottery-admitted students who had not participated in the multifaceted selection process. We know little of the latter group, except that they chose not to participate in the multifaceted selection process. We expected them to perform less well than the other groups because participation was shown to be an important predictor of academic success,[13] and because we expect students who participated in the multifaceted selection process to be more motivated, which has been shown to be related to clinical performance.[30] We focused on the following research questions:

1. Does medical school performance differ between students who were admitted through different admission processes?
2. Do students who were accepted in a voluntary multifaceted selection process outperform students who were rejected in this process?
3. Do students who have participated in a voluntary multifaceted selection process outperform students who have not?

METHODS

Context

This study was performed at University of Groningen, the Netherlands. The problem-based curriculum consists of a three-year pre-clinical Bachelor's and a three-year clinical Master's programme. The first year of the Bachelor's programme includes four ten-week blocks, a year-long professionalism course, and the interuniversity progress test.[14,15] Each part provides students with a fixed number of course credits under the European Credit Transfer System. One course credit equals 28 hours of study. The maximum number of course credits per year is 60.

Admission processes in the Netherlands

The Netherlands has a national policy for medical school admissions, in which applicants can be admitted through one of three steps. In the first step, students with a pre-university Grade Point Average (GPA) ≥ 8 (on a scale ranging from 1=poor to 10=excellent) gain admission to the medical school of their choice without further assessment. This grade average is calculated

by averaging applicants' mean grade on pre-university school examinations and mean grade on national final examinations. As only approximately the top 4% of all pre-university graduates achieve a GPA ≥ 8, this grade indicates excellent achievement. In the second step, applicants can be accepted in a multifaceted selection process. Each medical school organises its own selection process, in which participation is voluntary. Selection processes differ between medical schools but they usually consist of two rounds, in which various knowledge-based and behavioural variables are measured. In the third step, applicants are admitted through the national weighted lottery. In the lottery, applicants are categorized based on their pre-university Grade Point Average (GPA). Four categories are distinguished: 7.5≤ GPA <8; 7≤ GPA <7.5; 6.5≤ GPA < 7, and 6≤ GPA <6.5. Admission ratio for each category is respectively 9: 6: 4: 3.[11,16] Applicants who were rejected in the multifaceted selection process can still get admitted through the lottery. Up until 2011, approximately 50% of the available places at each medical school were assigned through the national weighted lottery.

Every year, around 8500 applicants subscribe to medical school in the Netherlands. There are 2780 places available, 410 of which at University of Groningen. Approximately 60 of these places are allocated to the International Bachelor of Medicine. The remaining 350 are allocated to the Dutch Bachelor. In the current study, we only included students who were enrolled in the Dutch Bachelor of Medicine.

Participants

We included all 1055 students who were admitted to the Dutch Bachelor of Medicine at University of Groningen in 2009, 2010 and 2011 (69% females; mean age at the start of the first year= 18.6; mean pre-university GPA= 7.3). We defined four groups of students: students who were admitted based on a pre-university GPA ≥ 8 out of 10 (n=143; 71% females; mean age at the start of the first year= 18.0; mean pre-university GPA= 8.2); students who were accepted in the multifaceted selection process (n=295; 74% females; mean age at the start of the first year= 18.5; mean pre-university GPA= 7.1); lottery-admitted students who had been rejected at first in the multifaceted selection process (n=315; 69% females; mean age at the start of the first year= 18.5; mean pre-university GPA= 7.1); and lottery-students who had not participated in the selection process (n=302; 63% females; mean age at the start of the first year= 19.1; mean pre-university GPA= 7.0). Descriptive statistics on percentages of females, mean age and pre-university GPA within the four groups are depicted in Table 1.

The privacy policy of the University of Groningen states that student records can be used for research purposes, as long as reports cannot be traced back to individual students.[17] In accordance with this privacy policy, anonymised data were derived from the university administration.

Multifaceted selection process

In 2009, 2010 and 2011, the University of Groningen selection process consisted of two rounds. In the first round, applicants were asked to send in a pre-structured written portfolio, based on the procedure developed by Erasmus MC medical school,[11] with an additional section on reflection. As such, the portfolio contained three sections: pre-university education, extracurricular activities and reflection. In the section on extracurricular activities, points were

granted when applicants could show their ability to be involved in multiple activities at the same time (i.e. combine pre-university education with additional activities). Extracurricular activities yielded points if they met fixed criteria on total duration and the amount of time spent on the activities per week. Only activities that were carried out in the last 1.5 years, for at least 5 months in a row, for more than 3.5 hours per week, yielded points.

In the section on reflection, applicants had to carry out a number of reflection assignments. For example, applicants had to ask three people in their network to give two reasons why the medical profession would fit them and one reason why they might be better off not practising medicine. Applicants were asked to reflect on these statements in a short essay. In the evaluation process, only the reflection was assessed. Evaluations of the selection process indicated that applicants needed 40 to 60 hours to complete their first-round portfolio.

The 225 highest-scoring applicants of the first round were invited to participate in the second round of the multifaceted selection process, which lasted an entire day and took place at University of Groningen medical school. The day was divided in four blocks: a writing assignment, a patient-lecture with subsequent assignments, a scientific reasoning block and a series of short interviews and role-plays. For the writing assignment, applicants had to write an essay about a societal problem where ethical decision-making was key. For example, applicants had to write an essay on China's one-child policy. To prepare for this assignment, applicants received a package with information about the subject a week before the second round. The lecture was focused on medical knowledge, ethical dilemmas and professional behaviour, and consisted of a presentation with integrated videos, similar to a video-based situational judgment test (SJT).[18,19] Applicants had to answer questions about the content of the lecture, describe and analyse the presented ethical issues and recognize (un)professional behaviour. In the scientific reasoning block, applicants were asked to read a scientific article about which they had to answer questions that tested analytic, creative and practical skills.[20,21] The fourth block consisted of an MMI-like[5,22] series of short assignments in which applicants had to reflect on the assignments in their first-round portfolio, carry out a role-play that focused on communication skills, and a three-phased role-play in which applicants had to collaborate with two fellow applicants. In this scenario, three applicants first had to prepare a problematic interaction with an actor, then they had the actual conversation, and afterwards they had to reflect on the course of the conversation.

The scores on the four blocks were calculated and the applicants were ranked based on their total score. The fourth block was weighted double. The highest ranking applicants were offered a place at University of Groningen medical school.

Outcome measures

Written test scores were assessed by average grades on knowledge tests. Grades are given on a ten-point scale, ranging from 1=poor to 10=excellent. We collected students' grades for the four block tests in the first year and calculated their average grade. We only included grades at the first test date.

Study progress was assessed by the number of course credits students earned in their first three years of medical school. The maximum number of credits that can be earned per year is

60. For the cohort that started in 2009, we assessed the earned course credits after students' first, second and third year of medical training. For the cohort that started in 2010, we assessed the earned credits after students' first and second year. For the cohort that started in 2011, we assessed the earned course credits after the first year.

Professionalism scores were assessed by the percentage of students who received the highest possible score (i.e. 'good') in the professionalism course. In the year-long professionalism course, students are judged on professional behaviour regarding tasks, others, and oneself. Students are trained to reflect on these dimensions of behaviour and make concrete plans for improvement. Supervisors score students' professional behaviour as either insufficient, sufficient, or good.

Dropout was defined as leaving University of Groningen medical school in the academic years that were analysed.

Statistical analysis

We performed analysis of covariance (ANCOVA) to examine group differences in written test grades and in the number of course credits that students earned in their first, second and third year. To determine which groups differed, we performed Bonferroni post hoc multiple-comparison tests for the corrected means. We conducted logistic regression analysis with changing reference groups to examine group differences in the percentage of students who received the highest possible score in the professionalism course. Students who dropped out of medical school in the first half of each year were excluded from the abovementioned analyses, as they were not able to earn course credits in the entire analysed period and including them might overestimate effects on study progress. To assess group differences in dropout rates, we conducted logistic regression analysis including the entire group (N=1055). All analyses were performed using IBM-SPSS Statistics Software, Version 20 [23] and controlled for gender, age and cohort. After initial analyses, age was eliminated as a covariate, as in all models age was not a significant predictor. We did not correct for pre-university GPA, as the group of students who were admitted based on a top pre-university GPA was defined by this variable and the other groups did not differ significantly.

RESULTS

Descriptives

The group that was accepted in the multifaceted selection process had a higher percentage of females than the lottery-admitted group that had not participated in the selection process ($p<0.05$). The top pre-university group had a lower mean age than the other groups ($p<0.01$), whereas the lottery-admitted group that had not participated in the selection process had a higher mean age than the other groups ($p<0.001$). The top pre-university group had a higher mean pre-university GPA than the other groups ($p<0.001$), whereas the other groups did not differ (Table 1).

Table 1. Descriptive statistics for percentages of females, mean age at the start of the first year, and mean pre-university GPA for the four student groups.

	N	%females[i]	Mean age[ii]	Pre-university GPA[iii]
	1055	69	18.6	7.3
Top pre-university GPA	143	71	18.0	8.2
Multifaceted selection process	295	74	18.5	7.1
Selection-rejected lottery	315	69	18.5	7.1
Lottery	302	63	19.1	7.0

[i] Multifaceted selection process > Lottery ($p<0.05$)
[ii] Top pre-university GPA < other groups ($p<0.01$); Lottery > other groups ($p<0.001$)
[iii] Top pre-university GPA > other groups ($p<0.001$)

Written test scores

Average written test scores differed between groups ($F_{(3, 1025)}= 63.20$; $p<0.001$). Bonferroni post hoc multiple-comparison tests showed that the top pre-university group had a higher mean than all other groups (Mean difference MD: 1.0 to 1.3; SE=0.10; $p<0.05$) (Table 2). The group that was accepted in the multifaceted selection process scored higher than the lottery-admitted group that had not participated in this process (MD=0.30; SE=0.08; $p<0.05$).

Course credits

The number of course credits earned in the first year differed between groups ($F_{(3, 1025)}= 17.50$; $p<0.001$). The top pre-university group earned more credits in the first year than all other groups (MD: 3.9 to 8.5; SE:1.20 to 1.22; $p<0.05$) (Table 2). The lottery-admitted group that had not participated in the multifaceted selection process earned less course credits in the first year than the group that was accepted in this process and the lottery-admitted group that had been rejected at first in the multifaceted selection process (MD: 2.7 to 4.6; SE: 0.97 to 0.99; $p<0.05$). The number of course credits earned in the second year also differed between groups ($F_{(3, 656)}= 10.30$; $p<0.001$). The lottery-admitted group that had not participated in the multifaceted selection process earned less credits than all other groups (MD:4.7 to 8.0; SE:1.26 to 1.55; $p<0.05$), whereas the other groups did not differ significantly. The number of credits students earned in the third year did not differ between groups ($F_{(3, 346)}= 2.26$; $p>0.05$).

Professionalism scores

The percentage of students who received the highest possible score in the professionalism course differed between groups ($\chi^2_{(3)}= 21.35$; $p<0.001$).The top pre-university group received the highest possible score most often, followed by the group that was accepted in the multifaceted selection process. The differences between the latter group and both lottery-groups were significant, as well as the difference between the top pre-university group and the lottery-group that had not participated in the multifaceted selection process (Odds Ratio OR:1.59 to 2.05; $p<0.05$) (Table 3). The difference between the top pre-university group and the lottery-group that was

rejected in the multifaceted selection process did not reach significance due to the smaller size of the top pre-university group.

Table 2. ANCOVA analyses of mean differences in year-one written test grades and course credits gained in the first, second and third year of medical training between the four student groups.

	N	Corrected Mean	SE Mean	F-value Group	P-value
Written test grades	1031			$F_{(3, 1025)} = 63.20$[i]	p<0.001
Top pre-university GPA	142	7.53	0.07		
Multifaceted selection process	285	6.50	0.06		
Selection-rejected lottery	312	6.37	0.06		
Lottery	292	6.20	0.06		
Course credits 1st year	1031			$F_{(3, 1025)} = 17.50$[ii]	p<0.001
Top pre-university GPA	142	59.0	0.11		
Multifaceted selection process	285	55.1	0.08		
Selection-rejected lottery	312	53.2	0.08		
Lottery	293	50.5	0.09		
Course credits 2nd year	662			$F_{(3, 656)} = 10.30$[iii]	p<0.001
Top pre-university GPA	101	55.6	0.23		
Multifaceted selection process	173	53.7	0.20		
Selection-rejected lottery	218	52.4	0.18		
Lottery	170	47.7	0.20		
Course credits 3rd year	352			$F_{(3, 346)} = 2.26$	p>0.05
Top pre-university GPA	54	55.7	0.22		
Multifaceted selection process	85	56.8	0.20		
Selection-rejected lottery	113	57.2	0.19		
Lottery	79	52.8	0.22		

[i] Top pre-university GPA > other groups (p<.05); Multifaceted selection process > Lottery (p<.05)
[ii] Top pre-university GPA > other groups (p<.05); Multifaceted selection process > Lottery (p<.05); Selection-rejected lottery > Lottery
[iii] Lottery < other groups (p<.05)

Table 3. Numbers of students with the optimal score in the professionalism course and odds ratios corrected for gender and cohort.

	Optimal Score Professionalism			Odds ratio			
	N	Optimal score	%	1	2	3	4
Reference group	1031						
1 Top pre-university GPA	142	78	54.9	-			
2 Multifaceted selection process	285	152	53.3	1.06	-		
3 Selection-rejected lottery	312	130	41.7	1.68	1.59*	-	
4 Lottery	292	105	36.0	2.05*	1.94*	1.22	-

*p<.05

Dropout

Dropout rates differed between groups ($\chi^2_{(3)}$= 9.32; p<0.05). Bonferroni correction for multiple comparisons rendered all pairwise differences non-significant (Table 4).

Table 4. Dropout rates and odds ratios for pairwise comparisons corrected for gender and cohort.

	Dropout			Odds ratio			
	N	**Dropout**	**%**	**1**	**2**	**3**	**4**
Reference group	1055						
1 Top pre-university GPA	143	6	4.2	-			
2 Multifaceted selection process	295	17	5.8	0.73	-		
3 Selection-rejected lottery	315	20	6.3	0.66	0.90	-	
4 Lottery	302	34	11.3	0.36	0.49	0.54	-

DISCUSSION

We found that different admission processes relate to differences in study performance. Students who were admitted based on a top pre-university GPA performed best on all measures. Students who were accepted in the multifaceted selection process and their rejected peers differed significantly on professionalism scores, but not on the other outcome measures. Lottery-admitted students who had not participated in the multifaceted selection process showed the lowest performance.

Our finding that students admitted based on a top pre-university GPA performed best was in line with earlier findings showing that previous academic performance is one of the strongest predictors of medical school performance.[1,24-26] However, top pre-university GPA students also received the highest possible score in the professionalism course most often. In this course, non-academic variables such as interpersonal and communication skills, ethical decision making, reflection and professional behaviour are assessed. The overall high performance of the top pre-university group suggests that applicants who perform well academically might have an advantage in the so called non-academic domain as well. Indeed some argue that academic skills might facilitate behavioural competencies.[5] For example, a study on academic performance of adolescents showed that self-discipline was more predictive of grades than IQ, suggesting that grades might be a better indicator of self-discipline or work ethic –so-called non-academic attributes– than of intelligence.[5,27] Applicants with strong skills in all domains of the medical profession might therefore be identified using previous academic performance as an important determinant in medical school admissions.

We found that students who were accepted in the multifaceted selection process scored higher in the professionalism course than both groups of lottery-students. We did not find any other performance differences between students who were accepted or rejected in the selection process. Consequently, it seems that the multifaceted selection process was effective in identifying applicants who perform well on the variables that are assessed in the professionalism course,

but did not differentiate between the applicants on in terms of knowledge test scores and study progress. This might be explained by the large focus on ethical and interpersonal components in the multifaceted selection process. Understanding the difference in this type of performance between accepted and rejected students is important, as the focus of medical training gradually shifts from mostly acquiring basic medical knowledge to practising clinical skills. Ethical and interpersonal variables are increasingly important in medical training. Our results therefore indicate that, in addition to measuring academic variables, measuring ethical and interpersonal attributes might be helpful in the selection of applicants with the greatest potential to succeed in medical training.

Lottery-admitted students who had not participated in the multifaceted selection process performed less well than all other groups. For lottery-admitted students who had participated in this selection process but were rejected, we did not find this effect. The lower performance of non-participants might indicate that previously reported differences in dropout rates,[11] test grades[28] and clerkship grades[12] between selected and lottery-admitted students in the Dutch admission system can be attributed to the lottery-admitted group that had not participated in the selection process, rather than to the lottery-group as a whole. Our results in fact indicate that for knowledge test scores and study progress, *participation* in the multifaceted selection process may more predictive than *acceptance* in this process. As such, it might be profitable for medical schools to admit only applicants who have put time and effort into their application. The lower performance of non-participants may be explained by the voluntary nature of the multifaceted selection process (i.e. a mechanism of self-selection that is induced by the Dutch admission system).[29] Highly motivated students might use every opportunity to achieve admission into medical school, whereas less motivated students might choose to wait for the lottery. Motivation indeed may be an important factor in predicting future performance.[30] In previous studies, students who were accepted in a multifaceted selection process were found to be more motivated than lottery-admitted students and students who were admitted based on a top pre-university GPA.[28,31] A possible explanation for this difference in motivation is that participation in the selection process requires 40 to 60 hours of work. Highly motivated students might have easily invested this kind of time and effort, whereas for less motivated students this threshold might have been too high. We propose that the system of voluntary participation in the multifaceted selection process facilitates self-selection of highly motivated students through the amount of time that is spent on the application. Therefore, it may be beneficial for medical schools to assign large amounts of homework in the application process. Further research is needed to examine the effects of the amount of homework in selection processes.

In our study, differences in dropout rates were non-significant, which is not in line with findings from Denmark showing that students who were admitted based on high pre-university GPA alone had higher dropout rates than students who were admitted through a non-grades-based admission test.[10] It is possible, however, given that the odds ratios in our analysis of dropout rates, was highest among lottery-admitted students who had not participated in the multifaceted selection process, that this analysis suffers from insufficient power due to the low number of dropouts observed. More research is needed to explore possible moderating effects of medical school characteristics on the relation between admission processes and study performance.

From our results, we conclude that the best of the three admission processes in the Dutch system is admission based on a top pre-university GPA. This type of admission was related to high performance on all outcomes we examined. However, in the Netherlands, there are not enough applicants with a pre-university GPA ≥ 8 to fill the available places in all medical schools. Therefore, we need an alternative. Since 1975, we have had a national weighted lottery system.[32] As lottery-students who did not put time and effort into applying for medical school performed less well than students who did, a multifaceted selection process seems a better option as this selection process yielded benefits in terms of performance in the professionalism course. Future research in this field needs to add to the theoretical basis for reliable, valid, and fair selection tools.

A limitation of our study is that we only included first-year study results in the analyses of written test grades and professionalism scores. We decided to do so because the students in our sample progressed differently after the first study year. Some students had to re-sit exams and were therefore not able to sit exams in the following year. Consequently, including results from later study years was problematic. The only performance measure we could examine in later study years was the number of course credits students earned per year. A second limitation of our study is that we only had data from two cohorts to calculate the number of course credits students earned in the second year, and data from only one cohort to calculate students' total number of course credits in the third year. It is possible that effects change over time. However, the multifaceted selection process at University of Groningen was implemented in 2009 and therefore, long-term performance data are not yet available. We aim to investigate long-term effects of the different admission processes in future research. A third limitation may be that we examined three cohorts in the same medical school and it is unclear whether our results are generalizable to other universities. As the results of studies at different universities are inconsistent, it seems that differences between medical schools moderate the relation between admission processes and study performance. Multi-site studies are needed to assess whether similar results can be found in other medical schools, with different curricula.

Conclusions

Different admission processes relate to performance differences in medical school. Pre-university GPA is the best predictor of later performance in medical school. Lottery-students who had not participated in the voluntary multifaceted selection process showed the lowest performance. Students who were accepted in this selection process outperformed their rejected peers in terms of interpersonal, collaboration and communication skills, reflection, ethical decision making and professional behaviour.

For academic performance, *participation* in a time-consuming voluntary selection process seems to be more predictive than *acceptance* in this process. This might be due self-selection of highly motivated applicants, who make the effort and take the time to participate in the selection process. For so-called non-academic performance, a multifaceted selection process seems to be beneficial. This might be explained by the strong focus on ethical and interpersonal variables in this process. Further research is needed to assess whether similar results can be found at other medical schools that use lottery next to other admission processes.

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