University of Groningen

Medical student selection

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CHAPTER

4

Effects of medical school admission based on GPA, voluntary multifaceted selection, or lottery on long-term study outcomes

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ABSTRACT

During the transition from a lottery-based admissions system to a selection-based system, multiple admissions processes were in use simultaneously in Dutch medical schools. This transition period offered the unique opportunity to explore performance differences between students who were admitted to the same medical school based on different criteria: a top pre-university GPA, selection-acceptance, lottery after selection-rejection, or lottery. In this study on long-term study results, the output measures were clinical clerkship grades, dropout, MD/ PhD trajectory rates and graduation rates after seven years. All medical students (N=352) admitted to the Bachelor's degree programme in Medicine at University of Groningen, the Netherlands in 2009 were included in the analyses. We used ANCOVA modelling, logistic regression, and Bonferroni post hoc multiple-comparison tests and corrected for gender effects. Our analyses showed that mean grade for first-year clinical clerkships differed between groups ($F_{(3, 317)}$= 3.61; $p<0.05$) and was higher in the top pre-university group than in the lottery-admitted group that had not participated in selection ($p<0.05$). Selection-accepted students did not outperform their rejected peers. Second-year clinical clerkship grades did not differ between groups ($F_{(3, 300)}$= 1.41; $p>0.05$). Group differences in dropout rates bordered statistical significance ($\chi^2_{(3)}$=7.59; $p=0.055$). MD/PhD rates differed between groups ($\chi^2_{(3)}$=10.15; $p<0.05$) and were higher in the top pre-university group than in the selection-rejected lottery group (OR=0.23; $p<0.05$). Graduation rates after seven years of training did not differ between groups ($\chi^2_{(3)}$=4.54; $p>0.05$). We conclude that there was little difference in long-term study outcomes between students who were admitted through the different processes. We found no differences between selection-accepted and selection-rejected students. The results of this study therefore do not solidly support the general preference for selection-based admissions over lottery or GPA-based admissions.

INTRODUCTION

After decades of admitting medical students based on a national weighted lottery, the medical school admissions system in the Netherlands now employs selection based on applicant characteristics.[1-7] This transfer between systems took place over several years, in which the percentages of lottery-based admissions decreased while selection-based admissions increased. The transition period offered a unique opportunity to compare study results of students who were admitted to the same medical school based on different admissions criteria. In this study, we focus on long-term study outcomes in order to determine whether selection-based admission is indeed related to better study outcomes than lottery-based admission over the course of medical training.

In the years of transferring to a selection-based admissions system, multiple admissions processes were in place simultaneously in Dutch medical schools. For several years, students were admitted through one of three processes: applicants with an excellent pre-university GPA had direct access and were admitted without further assessment, other applicants could participate in a voluntary selection process organized by the medical school of their choice (there are eight medical schools in the Netherlands), or enrol in the national weighted lottery. Selection-rejected applicants automatically enrolled in the lottery, which resulted in a fourth admissions pathway based on lottery after initial rejection. In a field where most studies on selection have to correct for range restriction due to the absence of performance data for rejected applicants,[8-11] this admissions system represented a unique natural experiment in which the effects of different admissions procedures on performance could be examined without restriction of range, or effects of institutional or time differences.

In a paper published in 2014,[2] we assessed pre-clinical performance of students who were admitted through the four pathways. We found that students who were admitted based on an excellent pre-university GPA performed well in the academic as well as the 'non-academic' courses in the curriculum. Selection-accepted students did not outperform selection-rejected students in the academic courses, but did score better in a non-academic course on professionalism. The most striking finding in this study, however, was that the lottery-admitted group that had not participated in selection showed the lowest performance on all outcome measures. We proposed that the selection process, despite not having large selection effects, might have a participation effect because of its time and labour intensive nature. Highly motivated applicants may be willing to invest large amounts of time and effort into a voluntary selection process in order to maximize their chances of admission, whereas less motivated students might choose to wait for the lottery, which did not require any additional effort.

In the previous study, we included only pre-clinical performance because the selection process had not been in effect long enough to also examine clinical performance. However, the literature on medical school selection suggests that the predictive validity of academic criteria such as pre-university GPA for medical school performance decreases with the transfer to the clinical phase, whereas the predictive validity of 'non-academic' assessments (as examined in the selection process) increases when these skills become a greater part of the assessment of performance.[12-14] Recent studies in the Dutch system indicated that selection-accepted students had a lower chance of dropping out of medical school than lottery-admitted students and perform better

in clinical clerkships.[5,14,15] However, in most of these studies the lottery-admitted group was not divided into selection-rejected students and students who had not participated in the selection process. It is therefore still unclear whether the selection process itself was effective in selecting more suitable applicants, or if the difference was (partly) attributable to a participation effect. We wondered whether the differences we found in the pre-clinical phase would also be visible in clinical performance and study progress data of the four groups we studied.

In this follow-up study, we study the first cohort in our medical school that was admitted through the multi-process admissions system, to examine whether previously found effects persist through the transition to clinical training. We focused on the following research questions:

1. Does performance in the clinical phase of medical training differ between selection-accepted and selection-rejected students, and how do these groups compare to lottery-admitted and excellent pre-university GPA admitted students?
2. Do dropout rates differ between the four admission groups?
3. Do MD/PhD trajectory rates differ between the four admission groups?
4. Do graduation rates differ between the four admission groups?

METHODS
Context

This study was conducted with data from University of Groningen, the Netherlands. This university offers a problem-based medical degree programme that consists of three years of pre-clinical training (the Bachelor's degree programme) followed by three years of clinical training (the Master's degree programme). All students who have successfully completed the Bachelor's degree programme are automatically accepted for the Master's degree programme. In the first year of the Master's degree programme, students follow four 10-week clinical clerkships and three courses that run through the whole academic year: professional development, clinical consultation, and knowledge progression. The four first-year clerkships each consist of 5 weeks of training in the Clinical Training Centre of the university, followed by a 5-week clinical clerkship in the hospital.

In the second year of the Master's degree programme, students follow ten 4-week clinical clerkships in the hospital, and two courses that run through the whole academic year: professional development and knowledge progression. The third year consists of a 20-week clinical semi-doctor internship, a 20-week scientific internship, and the course on knowledge progression.

Each course in the programme provides students with a fixed number of course credits under the European Credit transfer system. One course credit represents 28 hours of study. The annual number of course credits in the curriculum is 60.

Participants

We included all 352 students who were admitted to the Dutch Bachelor's degree programme in Medicine at University of Groningen in 2009 (71% females; mean age at the start of the first year= 18.5; mean pre-university GPA= 7.4). We distinguished between four groups of students: top pre-university GPA admissions (n=60; 81.7% females; mean age at the start of the first year= 17.9; mean pre-university GPA= 8.2), selection-accepted admissions (n=86; 73.3% females; mean age at the start of the first year= 18.5; mean pre-university GPA= 7.1), selection-rejected lottery admissions (n=118; 66.1% females; mean age at the start of the first year= 18.5; mean pre-university GPA= 7.3), and lottery admissions (n=88; 68.2% females; mean age at the start of the first year= 19.0; mean pre-university GPA= 7.2) (Table 1).

University of Groningen privacy policy allows the use of student records for research purposes, on the condition that data cannot be traced back to individual students.[16] In accordance with this policy, data were derived from the university administration and anonymised for analysis.

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	Mean age[i]	Pre-university GPA[ii]
	352	71	18.5	7.4
Top pre-university GPA	60	81.7	17.9	8.2
Multifaceted selection process	86	73.3	18.5	7.1
Selection-rejected lottery	118	66.1	18.5	7.3
Lottery	88	68.2	19.0	7.2

[i] Top pre-university GPA < other groups ($p<0.05$)
[ii] Top pre-university GPA > other groups ($p<0.05$)

Admissions system

All students in this study were admitted to University of Groningen medical school based on either a top pre-university GPA, acceptance in a multifaceted selection process, or the national weighted lottery. Chronologically, this system can be regarded as a three-step process. In the first step, students with a pre-university GPA of 8 or higher on a scale from 1 (poor) to 10 (excellent), are admitted without further assessment. Pre-university GPA is calculated as the average of high school examinations and national final examinations. Of all high school graduates, approximately 4% obtain a GPA of 8 or higher, and about 15% of medical school applicants qualify.[2] In the second step, medical schools offer a multifaceted selection process, in which participation is voluntary. The selection process is unique for each medical school, as they aim to select applicants who are suitable for their specific curriculum. In general, applicants' suitability is determined based on measures of both academic aptitude and behavioural and interpersonal qualities. The third step is the national lottery, which is weighted for pre-university GPA. Applicants are divided over four GPA-categories: 7.5≤ GPA <8; 7≤ GPA <7.5; 6.5≤ GPA < 7, and 6≤ GPA <6.5. The admission ratio for the categories is 9: 6: 4: 3, respectively. In 2009, 50% of the new students at University of Groningen were admitted through the weighted lottery.

Annually, around 8500 applicants register for a degree programme in Medicine. There are 2785 places available at eight different medical schools, of which 410 are at University of Groningen. In 2009, around 350 of these places were in the Dutch Bachelor of Medicine, and the other 60 places were in the International Bachelor of Medicine, the English-taught version of the programme. In this study, we included only students who started the Dutch Bachelor of Medicine.

The University of Groningen selection process

The voluntary multifaceted selection process consisted of two phases. In the first phase, applicants had to create and hand in a portfolio with sections on their pre-university education, extracurricular activities, and a number of reflection assignments. Evaluations of the first phase indicated that the completion of the portfolio required a time investment of 40 to 60 hours. The portfolios that were sent in were evaluated and the 225 highest-ranking applicants were invited to the second round phase of the selection process, whereas lower-ranking applicants were excluded. In the second phase, students came to the university for a day of assignments. The day was divided into four 90-minute blocks: a writing assignment, a scientific reasoning block, a patient lecture and an MMI-like[17] series of short interviews and role-plays. The second phase of the process focused on the assessment of academic aptitude, professional behaviour, communication skills and analytic/creative/practical skills. All participants were ranked based on their total score for the second phase and the highest-scoring applicants were offered a place in the University of Groningen Bachelor's degree programme in Medicine. For a more detailed description of the selection process and its scoring, see Schripsema et al. 2014.[2]

Outcome measures

First-year clinical clerkship scores were calculated to assess clinical performance in the first year of the Master's degree programme. The average of the grades on all successfully completed clinical clerkships out of the four first-year clerkships were used. Grades for successfully completed clerkships range from 6 (sufficient) to 10 (excellent). For students who had not yet completed all first-year clinical clerkships, the average of the clerkships they did successfully complete was calculated.

Second year clinical clerkship scores were calculated to assess clinical performance in the second year of the Master's degree programme. The average of the grades on all successfully completed clinical clerkships out of the ten second-year clerkships was used. Again, grades for successfully completed clerkships range from 6 (sufficient) to 10 (excellent). For students who had not yet completed all first-year clinical clerkships, the average of the clerkships they did successfully complete was calculated.

Dropout was coded 1 for students who had quit medical training between admission in 2009 and October 2016, and 0 for students who had either graduated or were still in training.

MD/PhD trajectory was coded 1 for students who had chosen to combine their Master's degree programme with a Ph.D. research project and 0 for students who had not. Students who choose this trajectory graduate two years later, with both an MD and Ph.D. diploma.

Graduation of the full programme was coded 1 for students who had obtained their Master's degree before October 2016 (seven years after admission to the 6-year programme) and 0 for

students who had not. We used graduation rates seven years after admission instead of six (the official duration of the full programme) because in some cases there was a waiting time between completion of the Bachelor's degree and the start of the first-year clinical internships, preventing students from graduation within six years. Students who were coded 1 for dropout or for MD/PhD trajectory were coded missing for this variable.

Statistical analysis

For the first-year and second-year clerkship scores, we conducted analysis of covariance (ANCOVA) with Bonferroni post hoc multiple-comparison tests to assess group differences in performance. Group differences in dropout and graduation rates were examined using binomial logistic regression with changing reference groups. P-values for odds ratios were corrected for multiple comparisons using the Bonferroni correction. All statistical analyses were performed using IBM-SPSS Statistics Software, version 23[18] and corrected for gender effects.

Ethical approval

This study was approved by the Ethical Review Board of the Dutch Association for Medical Education (NVMO case number 863).

RESULTS

Descriptives

Descriptive statistics for group percentages of females, mean age at the start of the programme, and pre-university GPA are displayed in Table 1. Group percentages of females did not differ significantly between groups ($\chi^2_{(3)}$ = 5.25; p>0.05). Mean age differed between groups ($F_{(3, 348)}$ = 7.82; p<0.001). Bonferroni post hoc multiple comparison tests showed that mean age in the top pre-university GPA group was significantly lower than in the other groups (Mean difference MD : 0.48-1.11; p<0.05). Pre-university GPA differed between groups as well ($F_{(3, 348)}$ = 56.6; p<0.001). This was due to the fact that by default, the mean pre-university GPA was higher in the top pre-university GPA group than in the other groups (MD: 0.90 – 1.08; p<0.001).

Clinical clerkship scores

The four groups differed in mean first-year clinical clerkship grades ($F_{(3, 317)}$= 3.61; p<0.05). Bonferroni post hoc multiple comparison tests showed that the mean grade for the first-year clinical clerkships in the top pre-university group was slightly, but significantly higher than in the lottery-admitted group that had not participated in selection. Second-year clinical clerkship grades did not differ between groups ($F_{(3, 300)}$= 1.41; p>0.05) (Table 2).

Dropout

29 of the 352 (8.2%) included students quit their medical studies before October 2016. Group differences in dropout rates bordered statistical significance ($\chi^2_{(3)}$ = 7.59; p=0.055) (Table 3).

Table 2. ANCOVA analyses for group differences in mean first-year and second-year clinical clerkship grades.

	N	Mean	SE Mean	F-value Group	P-value
First-year clinical clerkships[i]	322	7.74	0.02	$F_{(3, 317)} = 3.61^*$	p<0.05
Top pre-university GPA	54	7.84	0.05		
Multifaceted selection process	85	7.74	0.04		
Selection-rejected lottery	109	7.73	0.04		
Lottery	74	7.63	0.04		
Second-year clinical clerkships	305	7.94	0.02	$F_{(3, 300)} = 1.41$	p>0.05
Top pre-university GPA	51	7.98	0.05		
Multifaceted selection process	79	7.96	0.04		
Selection-rejected lottery	106	7.89	0.03		
Lottery	69	7.92	0.04		

[i]Top pre-university GPA >Lottery

Table 3. Dropout rates and odds ratios for pairwise comparisons corrected for gender.

Dropout	N	Dropout	%	Odds ratio 1	2	3	4
Reference group	352	29					
1 Top pre-university GPA	60	7	11.7	-			
2 Multifaceted selection process	86	2	2.3	0.17	-		
3 Selection-rejected lottery	118	8	6.8	0.49	2.92	-	
4 Lottery	88	12	13.6	1.09	6.47	2.22	-

MD/PhD trajectory

30 of the 352 (8.5%) included students were following an MD/PhD programme. MD/PhD rates differed between groups ($\chi^2_{(3)}$ = 10.15; p<0.05). After Bonferroni correction for multiple comparisons in post hoc analyses, the only statistically significant difference was between the top pre-university group and the selection-rejected lottery group (OR=0.23; p<0.008) (Table 4).

Graduation

After exclusion of all students who had dropped out or were enrolled in an MD/PhD trajectory, 293 students remained in the analyses of graduation rates. 209 of these 293 students graduated within seven years after admission. Graduation rates did not differ significantly between groups ($\chi^2_{(3)}$ = 4.54; p>0.05) (Table 5).

Table 4. MD/PhD trajectory rates and odds ratios for pairwise comparisons corrected for gender.

MD/PhD trajectory	N	MD/PhD	%	Odds ratio 1	2	3	4
Reference group	352	30					
1 Top pre-university GPA	60	10	16.7	-			
2 Multifaceted selection process	86	10	11.6	0.61	-		
3 Selection-rejected lottery	118	6	5.1	0.23*	0.38	-	
4 Lottery	88	4	4.5	0.21	0.34	0.90	-

* $p < 0.05$

Table 5. Graduation rates and odds ratios for pairwise comparisons corrected for gender.

Graduated full programme	N	Graduated	%	Odds ratio 1	2	3	4
Reference group	293	209					
1 Top pre-university GPA	43	30	69.8	-			
2 Multifaceted selection process	74	54	73.0	1.34	-		
3 Selection-rejected lottery	104	79	76.0	1.78	1.33	-	
4 Lottery	72	46	63.9	0.88	0.66	0.50	-

DISCUSSION

In this study, we examined medical school performance of four groups of students who were admitted through different admissions processes. Performance in clinical internships did not differ between selection-accepted and selection-rejected students, but we did find that first-year clinical clerkship performance was better among students who were admitted based on an excellent pre-university GPA than among students who were admitted based on lottery. Group differences in dropout rates bordered statistical significance, with the highest rates in the groups that had not participated in the selection process. For MD/PhD trajectory rates, only the difference between the excellent pre-university GPA admitted group and the selection-rejected lottery group reached statistical significance. The percentage of students who graduated the 6-year medical programme within seven years did not differ between groups.

We found little difference in clinical clerkship performance between the four student groups. The only statistically significant difference was that between first-year clerkship grades of students who were admitted based on a top pre-university GPA and lottery-admitted students. Selection-accepted students did not outperform selection-rejected students. For the clinical clerkships in the second year of the clinical phase, we did not find any group differences. Our data indicates that the selection process, though aimed at selecting students with good non-academic skills in addition to the required academic skills, did not result in better clinical performance among accepted students. They therefore do not seem to support the transition from a lottery-based system to a selection-based system. Yet, the lack of performance differences in the clinical

clerkships may partly be explained by a lack of differentiation. Students who show appropriate performance in the clinic most often receive a grade on the higher end of the scale (i.e. 7 or 8). Other grades are rarely obtained, which makes differentiation between students based on clinical clerkship grades problematic. However, all students have to be sufficiently prepared for clinical practice before they start their clinical clerkships.[19,20] The small differences might also indicate that the pre-clinical phase was a sufficient preparation for clinical training, regardless of the criteria on which admission was based.

Group differences in dropout rates bordered statistical significance. In the selection-accepted group the dropout rate was 2.3%, which was the lowest of all four groups. Dropout rates were more than five times higher in the top pre-university group and the lottery-admitted group than in the selection-accepted group, but this difference did not reach statistical significance. As was proposed in our previous article, it is possible that the time and labour intensive selection process induces self-selection of highly motivated applicants, resulting in better performance among students who had participated in the process than among non-participants. The selection process forces applicants to thoroughly familiarize themselves with the medical curriculum as offered by our university, as well as with the medical profession itself. Students who have done this might therefore also have a better understanding of their future career at and choose this career more consciously. This kind of well-informed decision to apply to medical school has been proposed by Benbassat and Baumal (2007) as a better selection instrument than measures of 'non-cognitive skills'.[21] This notion is in line with the results of a recent study on curriculum sample selection for medical school, in which students were selected in a selection process that resembled the medical school curriculum. Students who were accepted in this process showed better performance than their rejected peers.[22] Our findings indicate that students who made a well-informed decision for a career in medicine quit their training less often than students who were admitted based on lottery or previous academic performance. However, due to the small sample size this difference did not reach statistical significance, which might be explained by the relatively small sample size in this study and the low incidence of dropout. In total, less than 10% of students dropped out of medical school. However, our results raise the question whether it is a step forward to implement a selection process, along with numerous potential biases, when the returns of such a process are not statistically significant.

Students who were admitted based on a top pre-university GPA chose an MD/PhD trajectory significantly more often than selection-rejected lottery students. The other groups did not differ in MD/PhD rates, although the group rates indicated that selection-accepted students and top pre-university GPA students chose an MD/PhD trajectory more often than the lottery-admitted groups. Concerns have been expressed about the diminishing workforce in academic medicine[23,24] and the data in our study provide an indication that differences in admissions procedures might be related to the percentage of students who choose an academic career. An admission process that results in an increase of students who are interested in an academic career within medicine would be of high value. However, no firm conclusions can be drawn from the data in this study. The different admissions processes be studied in further detail and with larger samples in order to explore possible changes in medical school selection processes to stimulate growth of the workforce in academic medicine.

Graduation rates after seven years of training did not differ between groups. The percentage of graduated students seemed higher among selection-accepted and selection-rejected students than in the other two groups but this difference was not statistically significant. In addition, the lower graduation rates in the top pre-university group might partly be explained by the higher rates of MD/PhD trajectories in this group. We excluded those students from the graduation analysis.

Although this study provides unique insights into effects of different admissions processes on long term medical school performance, it has some limitations. Firstly, we conducted this study at a single medical school and it remains unclear whether the effects we found are generalizable to other universities in the multi-process admissions system. A multi-site study we recently conducted at different medical schools in the Netherlands indicated that the participation effect of the voluntary selection process might be applicable to the selection process at University of Groningen, but not to more academically focused selection processes.[4] It is therefore possible that also long-term effects of the different admissions processes differ between medical schools, depending on the criteria and demands in the selection process and institutional differences. Secondly, due to time restrictions, we only included one cohort of students in this study. This was the first cohort that was admitted through the multi-process admission system incorporating the top pre-university admissions criteria, selection, and lottery. In subsequent years, applicants might have been better informed about the different processes and the corresponding chances of admission, which might have influenced the proportion of students that, for example, applied for the voluntary selection process. Thirdly, the multi-process admissions system is not in effect anymore, and all medical schools in the Netherlands now admit all students based on a selection process. It is unclear whether effects of participation in the selection process persist now that participation is the only option. Effects related to participation might be smaller in this system, because some applicants who now belong to the 'lottery-without-participation-group' would now choose to participate in selection instead of choosing a different career path.

In conclusion, we found little difference in long-term study outcomes between students who were admitted through the different processes. Selection-accepted students did not outperform selection-rejected lottery students or top pre-university GPA and lottery-students. The results of this study therefore do not solidly support the general preference for selection-based admissions over lottery or GPA-based admissions.

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