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The Change in Entrance Exam Requirements for Medical School: Impact on Prior Performance, Entrance Exam Success, and Study Achievement

Minna Hallia [1,*], Petri Kulmala [1,2], Jouni Pursiainen [3] and Pentti Nieminen [4]

[1] Education Development and Service Unit, Faculty of Medicine, University of Oulu, 90014 Oulu, Finland
[2] Medical Research Center Oulu, Oulu University Hospital, 90014 Oulu, Finland
[3] Faculty of Technology, University of Oulu, 90014 Oulu, Finland
[4] Faculty of Medicine, Medical Informatics and Data Analysis Research Group, University of Oulu, 90014 Oulu, Finland; pentti.nieminen@oulu.fi
* Correspondence: minna.hallia@tuni.fi

Abstract: The medical profession is a prestigious position that requires very extensive higher education, to which only a small proportion of applicants are accepted. Changes in selection criteria can profoundly impact applicants' pre-educational choices, early medical studies, and the characteristics of future medical professionals. This study assesses the impact of changing the admission requirements of medical schools in Finland. We examined two cohorts of students admitted to the University of Oulu's medical school: 2009–2011 (n = 316) and 2013–2015 (n = 339). The first cohort prepared for the entrance exam with a field-specific book, while the second cohort focused on secondary school subjects such as biology, chemistry, and physics. We analysed the effects of the changes on accepted students' profiles and the relationship between their prior performance, entrance exam success, and performance in medical studies. Changing the entrance exam content did not significantly alter accepted students' profiles or ease access for recent matriculants. However, minor changes in correlations between prior performance, entrance exam performance, and medical study success were observed. The entrance exam's predictive power for academic success was weak in both admission periods. This comparative study found that changing the entrance exam material did not notably influence the characteristics of accepted students. The changes to the selection criteria appear to have a minor impact on the actual success of students studying medicine. Regardless of the selection criteria, those who are accepted typically demonstrate strong learning capabilities. Despite modifications in the required entry-level knowledge, students with strong skills are admitted.

Keywords: medical school selection; entrance exam; prior performance; selection criteria; study success

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1. Introduction

Selection procedures for admission to medical schools play an important role in medical education. It is therefore important to continually evaluate these processes and consider their impact. Not only do they affect the decisions of those wishing to study in the field, but they also influence the delivery and societal impact of medical education (Cleland, 2018; Fielding et al., 2018; Kelly et al., 2018; Patterson et al., 2016; Razack et al., 2015). Changes in selection criteria can shape the pre-training choices of applicants, influence the content of the initial phase of medical training, and determine the characteristics of future

medical professionals (Hashimoto & Johnson, 2023). Changes to the selection process are not made very often (Greatrix & Dowell, 2020; Patterson et al., 2016). In addition, it takes time to assess their impact, as the potential effects may not become apparent for years.

Admission and selection criteria for medical schools are expected to be fair, transparent, evidence-based, and legally defensible, while recognising the complexity of medical practice and the diversity of the working environment of future doctors (Benbassat & Baumal, 2007; O'Flynn, 2010; Wilson et al., 2012). Ideally, the selection process should be able to reliably identify the key characteristics of the applicants' performance in their studies and predict their qualifications to serve in a future medical position (Hughes, 2002; Patterson et al., 2016; Razack et al., 2015). The selection process must effectively discriminate between applicants, identifying those with the strongest motivation, the requisite basic knowledge for completing the studies, and the personal qualities essential for the medical profession (Wilson et al., 2012). It is also expected to ensure that those selected have a diverse range of skills and personalities (Hughes, 2002). Furthermore, this process should be considered in the context of the medical curriculum and the desired outcomes of education.

Defining the attributes and skills required for the medical profession and reliably assessing the potential of medical school applicants are topics of ongoing debate in the literature and research (Evans et al., 2020; Patterson et al., 2016). Universities aim to accurately predict the learning abilities of applicants and select the most suitable students from a pool of talented candidates. These selected students are expected to perform successfully in their studies and achieve the learning objectives set for the medical programme.

The selection process for medical students has been examined from a variety of perspectives, with a focus on individual selection methods and comparisons between different methods (Kelly et al., 2018; Patterson et al., 2016; Tsikas & Fischer, 2025). Some studies suggest that a science-focused entrance test may be a good predictor of student success (Meyer et al., 2019), while others show a strong correlation or predictive value between prior academic performance and student success (McManus et al., 2011; Mercer & Puddey, 2011; Sladek et al., 2016). Interview-based methods are often considered the best way to assess an applicant's values and personal characteristics (Patterson et al., 2016; Pau et al., 2013). In addition, the assessment of personal competencies, which are considered critical to an applicant's success in medical school and future performance as a physician, is recommended as part of the selection process (Koenig et al., 2013). Tsikas and Fischer (2025) recently demonstrated that shifting the focus away from upper secondary school grades towards aptitude tests and even explicitly non-cognitive criteria does not jeopardise success in medical studies. Interestingly, the use of a lottery as a selection method is also considered to be as effective as any other method (Powis, 2015; Wouters, 2017). However, there is no consensus on the effectiveness of different selection methods (Calles Santoyo et al., 2025; Hefny et al., 2024; Kleemola & Hyytinen, 2019). According to Wilson et al. (2012), a clear answer is unlikely to be found, as the context in which selection takes place has a significant impact on the results.

The Finnish education system is known for its equal opportunities and for being free of charge and widely available at all levels of education. While admission to higher education institutions is highly competitive, the process is designed to uphold principles of equality and fairness. Tests like entrance exams (EE) have a long-standing history as the primary tool for selecting students at Finnish universities. Traditionally, these exams heavily relied on field-specific literature, enabling applicants to demonstrate their familiarity with their chosen field of study and their commitment to academic pursuits within that domain. Students preparing for medical school entrance exams used a field-specific book called "Galenos", which covered anatomy; physiology; and the biological, physical, and chemical foundations of the human body. This approach aimed to underscore the importance of

natural sciences in understanding the body's structures, functions, and the multidisciplinary nature of medicine and medical research (Wähälä et al., 2010).

In Finland, changes to medical EE requirements were implemented in 2012. Departing from the reliance on field-specific entrance exam materials, medical schools decided to base their entrance exams on the Finnish upper secondary school syllabi in biology, chemistry, and physics. The field of medicine is highly competitive, and gaining admission to medical school is a high-stakes process, often requiring applicants to apply multiple times. The revision in EE material was aimed at favouring applicants who had recently completed their upper secondary education and demonstrated proficiency in the relevant subjects of Matriculation Examination (ME) tests. The ME examination is a national standardised final exam at the end of upper secondary school. Successful completion of the ME provides eligibility for university studies. The aim was to speed up and streamline access to medical studies, in line with wider higher education policy objectives.

The selection criteria in medical school admissions reflect both the goals and the needs they are designed to meet. It is important to remember that any changes to these selection criteria should be well justified and based on a clearly defined need. Such changes are expected to lead to the intended outcomes. Moreover, their broader consequences must be considered—not only the immediate effects on current applicants but also how these changes influence the decisions applicants make in their previous upper secondary education, as well as the overall landscape of secondary education. Impact analysis cannot be done at the same time as the changes come into force. The consequences will only be visible years later (Greatrix & Dowell, 2020; Patterson et al., 2016).

Previous studies have paid less attention to the effects of changing admission criteria (Fielding et al., 2018). Little is known about the potential consequences of changing the entrance examination material in medical school admission. We focused on evaluating the impact of these changes on the profiles of accepted students and their influence on the association between prior (admission process) performance, success in the entrance exam, and performance in actual medical studies. Our primary objective was to compare two groups of accepted medical students: (1) students accepted based on field-specific knowledge acquired before the admission process (2009–2011) and (2) students accepted by knowledge in subjects included in upper secondary school curriculum (2013–2015). The research questions addressed were:

1. Does the profile of accepted individuals change?
2. What is the association between the success in the national Matriculation Examination (ME) tests and the entrance exam (EE) in these two groups?
3. Is there an associated effect of ME test success on the academic performance of individuals accepted into medical studies within these two groups?
4. How does success in the EE relate to the academic performance of the accepted students in their medical studies in these two groups?

2. Materials and Methods

2.1. Participants

This study was conducted at the University of Oulu, Finland. The study sample comprised newly accepted medical students at the University of Oulu from 2009 to 2011 (n = 316) and from 2013 to 2015 (n = 339). All students had attended the EE, which was a mandatory requirement for all medical school applicants to be considered for selection. The EE is a five-hour written exam integrating assignments and reading material. The EE also assessed applicants' motivation and general skills necessary for medical studies. All participating students had also completed Finnish ME.

2.2. Admission Periods

The students were categorised based on the year they attended the EE and gained admission. The first group included those accepted from 2009 to 2011 (n = 316). They prepared for the EE using a field-specific book "Galenos", covering anatomy; physiology; and the biological, physical, and chemical foundations of the human body (Wähälä et al., 2010). The second group of participants included students accepted between the years from 2013 to 2015 (n = 339). During those years, the EE was aligned with upper secondary school curriculum subjects: biology, chemistry, and physics. These enabled students preparing for their national Matriculation Examination (ME) to simultaneously gear up for the EE, potentially enhancing their success. As the change in exam material in 2011 was announced in late autumn of 2011, many applicants had already prepared for next year's entrance exam using the field-specific book, leading to the exclusion of students accepted in 2012 from this study.

2.3. Measures

ME test grades were used to assess prior performance. Data collection involved ME results from the Matriculation Examination Board via the University of Oulu. Six subjects, commonly chosen by applicants for their ME, were selected for this analysis: mother tongue (Finnish, Swedish, or Sami language); mathematics (advanced level); English language; chemistry; physics; and biology. Notably, chemistry, physics, and biology were also relevant for the EE from 2013 to 2015. The seven-point Latin grade scale of the ME test was converted into numeric grades following the Matriculation Examination Board's statistical recording. Grades ranged from laudatur (highest, grade 7) to approbatur (lowest, grade 2) and improbatur (failed, grade 0). However, failed subjects were not included in our data. ME completion years were grouped into five categories, with ME conducted each fall and spring. Each group included students who took the ME in the preceding fall and/or in the spring of a specific year.

The University of Oulu administration provided information on EE performance and academic success. EE success was gauged using standardised z-value transformed scores to account for yearly variations in maximum points and test difficulty. Success in academic studies was based on five key courses during the first two study years (preclinical stage), comprising lectures, tutorials, and laboratory work. These courses, critical for clinical stage internship allocation, were anatomy and medical cell and developmental biology (21–22 ECTS); medical biochemistry and molecular biology (14–15 ECTS) in the first year; and microbiology (9.5–10 ECTS), pharmacology and toxicology (10 ECTS), and physiology (15 ECTS) in the second year of medical studies. Courses were graded on a 1–5 scale, with 5 as the highest. Study success was measured by the total score of these five courses.

Students' sex and year of completion of upper secondary education were also recorded.

2.4. Statistical Analysis

Data analysis was performed using IBM SPSS Statistics (version 28). Basic characteristics (sex, year of approval, and selected subjects in ME) of the students were presented using frequency and percentage distributions by admission periods. The chi-square test was used to evaluate the statistical significance of associations between basic characteristics and admission periods. The independent samples t-test was used to analyse the mean differences in ME grades and medical course scores between admission periods. Pearson correlation coefficients were used to assess the relationships between ME grades, EE scores (z-scores), and overall success by total course scores. Fisher's z-test was used to evaluate the statistical significance of the difference between correlation coefficients estimated from the two admission periods. We also conducted a series of linear regression analyses to

identify the predictive power of sex, year of approval, ME grades, and EE scores (z-scores) on study success. We report the estimated regression coefficients with their standard errors (SEs) and the coefficient of determination R^2 for each estimated model. The data conformed to the assumptions and preconditions of the linear regression analyses.

3. Results

3.1. Impact of Entrance Exam Changes on the Profile of Accepted Students

Table 1 shows the distribution of sex, access to studies, and ME subjects written in by the admission periods.

Table 1. The frequency and percentage distribution of the basic characteristics among the admitted students in 2009–2011 (n = 316) and 2013–2015 (n = 339) by study period.

	Admission Period		***p*-Value of Chi-Square Test**
	Years 2009–2011	**Years 2013–2015**	
Characteristics	***n* (%)**	***n* (%)**	
Sex			0.571
▪ Male	158 (50.0)	177 (52.2)	
▪ Female	158 (50.0)	162 (47.8)	
Year of admission			<0.001
▪ Graduation year	76 (21.1)	69 (20.4)	
▪ Next year	76 (24.1)	57 (16.8)	
▪ 2 years after graduation	86 (27.2)	76 (22.4)	
▪ 3 years after graduation	45 (14.2)	52 (15.3)	
▪ More than 3 years	33 (10.4)	85 (25.1)	
Selected subject in Matriculation examination (ME)			
▪ Biology	172 (54.4)	228 (67.3)	<0.001
▪ Chemistry	231 (73.1)	252 (74.3)	0.720
▪ Physics	188 (59.5)	204 (60.2)	0.859
▪ Mathematics (advanced)	291 (92.1)	301 (88.8)	0.153
▪ Mother tongue	314 (99.4)	336 (99.1)	n.a.
▪ English (advanced)	309 (97.8)	327 (96.5)	0.358

No change in sex distribution was observed. The year of admission analysed the acceleration of the transition from upper secondary school to medical school, i.e., it measured how long after completing the ME the applicants were accepted as students. In 2009–2011, applicants were admitted more swiftly post-graduation, with 45.2% gaining admission in the year of or the year following graduation. Conversely, in 2013–2015, this figure dropped to 37.2%. Additionally, the percentage of those accepted over three years after graduation rose from 10.4% in 2009–2011 to 25.1% in 2013–2015. Thus, after the shift to upper secondary school subjects in the EE, a lower proportion of new medical students had recently graduated from upper secondary school.

Table 1 also presents the distribution of the subjects chosen by accepted applicants for their ME, and a statistically significant change was observed only in biology ($p < 0.001$). In 2009–2011, 54.4% of accepted applicants had completed biology tests, increasing to 67.3% in 2013–2015. Although advanced mathematics was not part of the EE material, its contribution to the EE performance is considered relevant as mathematical competence supports the completion of test tasks.

We also compared students' performance on the ME grades across admission periods (Table 2). No significant changes were observed between the student groups.

Table 2. The mean and standard deviation (SD) of the ME test grades of the admitted students by study period.

	Admission Period				*p*-Value of *t*-Test
	Years 2009–2011		Years 2013–2015		
ME Subject	**Mean (SD)**	***n***	**Mean (SD)**	***n***	
▪ Biology	5.7 (1.1)	172	5.7 (1.0)	228	0.853
▪ Chemistry	5.5 (1.1)	231	5.4 (1.1)	252	0.543
▪ Physics	5.4 (1.2)	188	5.4 (1.1)	204	0.797
▪ Mathematics (advanced)	5.6 (1.1)	291	5.4 (1.2)	301	0.067
▪ Mother tongue	5.4 (1.2)	314	5.3 (1.1)	336	0.235
▪ English (advanced)	5.2 (1.3)	309	5.2 (1.3)	327	0.910

3.2. Correlation Between Matriculation Exam Grades and Entrance Exam Performance

We further analysed the correlation between ME grades and EE scores in both student groups. The correlation coefficients during the 2009–2011 and 2013–2015 admission periods were as follows: biology 0.04 vs. 0.16, chemistry 0.07 vs. 0.09, physics 0.04 vs. 0.10, advanced mathematics 0.03 vs. 0.15, mother tongue < 0.01 vs. 0.17, and English 0.07 vs. 0.05. In both admission groups, the correlations were weak and grades from the ME subjects did not correlate with the EE z-scores. Although the corresponding correlations were slightly higher in 2013–2015, the z-test on the Fisher z-transformed correlation coefficients showed that there were no statistically significant changes in the coefficients, except for mother tongue ($p = 0.040$).

3.3. The Association of Matriculation Exam Grades on Academic Achievement in Medical Studies

We used the total scores from the five medical courses (anatomy, medical biochemistry, pharmacology, physiology, and microbiology) as a measure of study success in medical courses. There was no significant difference in the study success between the admission periods. The mean (SD) value of the total score was 14.6 (4.2) in 2009–2011 and 14.8 (4.0) in 2013–2015 (*p*-value of the *t*-test was 0.573).

Table 3 presents the correlation coefficients between ME subject grades and the study success in medical courses. Correlations between ME grades and further study success in medical studies were either very weak (<0.20) or, at most, moderate (0.20 to 0.40), although some were statistically significant. In the second period, 2013–2015, all correlations (except English) had strengthened slightly, showing a stronger link to academic performance. However, the differences in correlations between admission periods were not statistically significant in any ME subject. The correlation coefficient between Matriculation examination grades and study success in medical courses could be found at Table S1.

Table 3. Correlation coefficients with sample sizes between matriculation examination grades and the total score of study success in medical courses (anatomy, medical biochemistry, pharmacology, physiology, and microbiology) by admission period. Correlations that are statistically significant at the 0.01 level are shown in bold. The *p*-value of Fisher's z-test to assess the significance of the difference between the two correlation coefficients is given for each ME subject.

ME Subject	Admission Period		*p*-Value of Fisher's z-Test
	2009–2011	2013–2015	
Mother tongue	**0.18** (n = 314)	**0.25** (n = 336)	0.352
Biology	**0.28** (n = 172)	**0.33** (n = 228)	0.588
English	**0.15** (n = 309)	0.13 (n = 327)	0.256
Physics	0.16 (n = 188)	**0.29** (n = 204)	0.178
Chemistry	0.16 (n = 231)	**0.26** (n = 252)	0.253
Mathematics	0.15 (n = 291)	**0.23** (n = 301)	0.315

3.4. The Impact of Entrance Exam (EE) Scores on Academic Achievement in Medical Courses

We also analysed the relationship between success in EE and performance in medical studies. In the period 2009–2011 (n = 316), the Pearson correlation coefficient between the standardised z-EE score and the total score of the five medical courses was 0.18 (p = 0.001). In the 2013–2015 period (n = 339), the correlation had increased to 0.28 ($p < 0.001$). These associations can be considered weak, and the change between the correlations was not statistically significant (p-value of Fisher's z-test was 0.178).

3.5. Regression Analysis of Factors Contributing to Academic Success in Medical Courses

Multivariable linear regression models were used to test which selected variables explained the variability in study success for both groups. Four linear regression models were constructed for each admission period, with the total score of five medical courses as the dependent variable. Each model included sex and year of admission as categorical independent background variables. All models also included mother tongue; EE scores (z-scores); and one of the ME subjects (biology, chemistry, physics, or advanced mathematics). Separate analyses were conducted for each subject as the number of applicants taking these ME subjects varied.

Table 4 shows the results of the linear regression model analysis for the 2009–2011 admission period. Models 1–4 show that student sex and success in EE are statistically significantly associated with academic success. The year of admission does not seem to improve the predictive power of the models. The ME subjects also did not make a significant contribution to the models, except that biology was associated with the outcome variable. In 2009–2011, the models explained only a small part (from 11.4% to 13.5%) of the variation in academic success.

Table 5 shows the four models formulated in the multivariable analysis for the 2013–2015 admission period. In all models, the EE scores had a statistically significant association with the outcome variable. In this admission period, ME subjects had a more pronounced association with academic success. The models also suggested a stronger effect of the year of admission. The explanatory power of models 5–8 (of 17.6% and 20.1%) was slightly better than in the 2009–2011 period. The differences in the regression coefficients between the admission periods were not statistically significant.

Table 4. Regression models for predicting study success among newly accepted medical students in the admission period 2009–2011.

	Model 1 (*n* = 168)		**Model 2 (*n* = 228)**		**Model 3 (*n* = 186)**		**Model 4 (*n* = 288)**	
	b (SE)	***p*-Value**	**b (SE)**	***p*-Value**	**b (SE)**	***p*-Value**	**b (SE)**	***p*-Value**
Sex	1.52 (0.64)	**0.018**	1.52 (0.56)	**0.008**	1.37 (0.65)	**0.036**	1.31 (0.49)	**0.007**
Year of admission	−0.93 (0.68)	0.171	−1.21 (0.65)	0.064	−0.79 (0.69)	0.258	−1.01 (0.52)	0.055
Mother tongue	0.11 (0.30)	0.728	0.45 (0.26)	0.078	0.43 (0.27)	0.110	0.33 (0.22)	0.138
Biology	0.68 (0.32)	**0.038**						
Chemistry			0.18 (0.28)	0.527				
Physics					0.33 (0.30)	0.277		
Mathematics (adv)							0.33 (0.24)	0.176
z-score of EE	0.63 (0.30)	**0.035**	0.61 (0.27)	**0.026**	0.84 (0.30)	**0.006**	0.77 (0.23)	**0.001**
R^2	0.135		0.126		0.125		0.114	

Sex: 0 = male, 1 = female; Year of admission: 0 = graduation year and next year, 1 = 2 years or more after graduation. Statistically significant *p*-values at the 0.05 level are shown in bold.

Table 5. Regression models for predicting study success among newly accepted medical students in the admission period 2013–2015.

	Model 5 (*n* = 220)		**Model 6 (*n* = 241)**		**Model 7 (*n* = 197)**		**Model 8 (*n* = 291)**	
	b (SE)	***p*-Value**	**b (SE)**	***p*-Value**	**b (SE)**	***p*-Value**	**b (SE)**	***p*-Value**
Sex	0.25 (0.52)	0.633	0.75 (0.50)	0.136	0.11 (0.57)	0.848	0.26 (0.44)	0.566
Year of admission	−1.44 (0.52)	**0.006**	−0.91 (0.54)	0.096	−1.37 (0.60)	**0.024**	−1.51 (0.46)	**0.001**
Mother tongue	0.14 (0.29)	0.633	0.50 (0.25)	**0.046**	0.27 (0.27)	0.316	0.59 (0.22)	**0.007**
Biology	0.92 (0.29)	**0.002**						
Chemistry			0.67 (0.25)	**0.008**				
Physics					0.62 (0.28)	**0.029**		
Mathematics (adv)							0.29 (0.20)	0.150
z-score of EE	0.71 (0.26)	**0.006**	0.97 (0.24)	**<0.001**	1.00 (0.25)	**<0.001**	1.02 (0.21)	**<0.001**
R^2	0.176		0.196		0.196		0.201	

Sex: 0 = male, 1 = female; Year of admission: 0 = graduation year and next year, 1 = 2 years or more after graduation. Statistically significant *p*-values at the 0.05 level are shown in bold.

4. Discussion

In this study, we examined the impact of changes in selection criteria by comparing students accepted to medical school between 2009–2011 and 2013–2015. Our research focused on how these changes affected the profile of accepted students and the relationships between their prior achievement, their success at the entrance exam, and their performance in medical school. The results of this study showed that, compared to an earlier period when the field-specific book was used in the EE, the proportion of students who were accepted three years or more after leaving upper secondary school was higher when the EE material focused on secondary school subjects. The proportion of applicants who included subjects from the entrance exam in their ME programme did not change significantly. The associations of ME grades and EE test scores with academic outcomes at medical school were weak. However, the associations increased slightly in the later entry period. Irrespective of the selection criteria, those who were accepted tended to have strong study skills. One notable finding was that students who started medical school soon after leaving upper secondary school were more likely to perform better in medical school. This supports the aim of accelerating and simplifying the transition from secondary education to university studies.

4.1. Impact of EE Changes on the Profile of Accepted Students

Our results challenge the expectation (Kupiainen et al., 2023) that changing the EE material to upper secondary school subjects would offer added value in the medical school student selection. This scenario assumes that more new students would have grades in EE-related subjects, their grades would be better, and recently matriculated applicants would obtain a place in medical school more quickly. However, our results suggest that applicants interested in studying medicine are already inclined towards natural science from the early stages of upper secondary school. They tend to choose subjects such as biology, chemistry, and physics, regardless of their direct application in EE. The only significant change in the profile of students accepted as a result of the change in the EE material was an increase in the number of students who had passed the biology ME exam. Given the highly selective nature of medicine, which traditionally attracts applicants with high grades in previous studies, it is not surprising that there was no significant change in the average ME test grades.

4.2. Correlation Between Matriculation Exam Grades and Entrance Exam Performance

Our study also aimed to assess whether the correlations between EE performance and previous ME test scores differed between groups of students. When EE was based on a field-specific book, there was no observed relationship between individual ME test grades and success in the EE. In the second admission period, the EE was based on the upper secondary subjects of biology, chemistry, and physics, and a slightly stronger correlation between the ME test grades and the EE results might have been expected, as both tests were expected to assess the same knowledge acquired during the upper secondary school. Contrary to this assumption, no significant correlation was found between ME grades and EE success in the second period either. The weak correlations could be explained by the selective nature of the students accepted. They are already doing well in upper secondary school and mainly obtain the highest grade in the ME subjects and EE tests. Thus, the whole variability of the ME grades and EE tests does not appear in the calculation of the correlation coefficients. The lack of variation in ME grades makes these variables indistinguishable from a constant. The concept of a correlation coefficient could be problematic when one of the variables is close to a constant, i.e., has mainly identical values.

There are reports that contradict our findings. A study of student selection for dental programmes found correlations between secondary school grades in biology and chemistry and corresponding sections of the German natural science examination (Arnold et al., 2011). A previous study of medical student selection also found significant, albeit weak, correlations between ME test scores and natural science entrance tests in biology, chemistry, and physics (Lindblom-Ylänne et al., 1996). Had we separated the scores on EE questions related to biology, chemistry, and physics, we might have obtained more precise information about the correlations between grades in these subjects and exam performance.

4.3. The Associations of ME and EE Test Scores with Medical School Academic Outcomes

In our assessment of study success using the total score of the scores from five pre-clinical courses, we found no statistically significant difference between the two groups. Our correlation analysis revealed that the correlation between ME test grades and the total scores of the first two years of medical courses was slightly stronger after the change in EE material. This finding suggests that prior success in ME tests contributes positively to performance in later studies. Our study is in line with an earlier study on medical students which showed that entry-level skills had some potential to predict preclinical success, even though their predictive power was quite limited (Lindblom-Ylänne et al., 1999). While some studies report a high predictive value of prior performance for study

success (Patterson et al., 2016; Schreurs et al., 2020; Simpson et al., 2014), others note that its impact diminishes as medical studies progress (Puddey et al., 2014).

Previous studies have compared the performance of medical students according to their admission pathway (entrance test, university-specific selection quota, pre-university grade point average quota, waiting time quota, ex-ante quota, and foreign students). These studies showed that students admitted through the entrance test or the quota for excellent pre-university educational attainment performed markedly better during than students admitted in other quota (Meyer et al., 2019; Mommert et al., 2020; Tamimi et al., 2023; Tsikas & Fischer, 2025).

We observed a weak correlation between entrance exam and study success scores among the students from the admission period 2009–2011. EE success had a stronger connection to academic outcomes in the 2013–2015 student group whose entrance exam was based on specific subjects from the upper secondary school curriculum. However, the difference was not statistically significant. This suggests that, while field-specific knowledge provided a solid foundation for certain subjects, proficiency in biology, chemistry, and biology could offer a broader capability for overall academic success during the first two study years. Previous research on admission tests as predictors of study success has shown mixed results due to variations in the tests themselves (Kreiter et al., 2018; Patterson et al., 2016). As Patterson et al. (2016) noted, each test requires its own empirical support. An earlier Finnish study on medical student selection found that three natural science tests in biology, chemistry, and physics predicted medical course scores (Lindblom-Ylänne et al., 1999). In their study, Wilkinson et al. (2011) concluded that, although statistically significant relationships between test scores and study success was found, the correlations were weak and generally persisted only during the first year of medical studies. In other studies, tests have shown limited or no predictive value for academic performance (Simpson et al., 2014).

Admission tests are most closely associated with early (preclinical) performance, with prior performance being the strongest predictor across the curriculum (Sladek et al., 2016). In different contexts, admission tests have been found to provide additional predictive information for student success beyond that available from previous performance (Meyer et al., 2019).

Our study is on the first two years of mainly knowledge-oriented studies, and it does not provide insight into potential correlations in clinical studies at medical school. It is important to note that factors other than prior achievement or success in EE influence students' success. This influence increases as students progress through their studies. Other factors that could influence the implementation of the change in selection criteria include whether the test content has been adapted to the new requirements and whether the course content has been successfully adapted to the level of knowledge of new students.

Admission tests that assess knowledge similar to that demonstrated by prior educational attainment have been criticised (Mwandigha et al., 2018). Future research should look more closely at the relationship between grades in the subjects on which the EE is based and the EE itself. This raises a question: Would relying solely on these factors as the basis for student selection yield consistent results?

4.4. Multivariable Analysis of Factors Contributing to Academic Success in Medical Courses

We used multivariable linear regression models to investigate the influence of basic student characteristics, prior performance, and entrance exam scores simultaneously on success during the first two years of study. Different approaches to learning and studying contribute to success in medical school. We found that female sex and EE scores were most strongly associated with success when the entrance exam was based on a field–specific book in 2009–2011. The strong performance of female students is partly anticipated given

that girls tend to achieve higher grades at school overall in Finland (Hautala & Kallio, 2020; Torppa et al., 2018). It is claimed that the Finnish educational system does not treat girls and boys equally. Our results confirm previous findings that sex-based differences exist in the learning and study strategies of medical students and that these differences affect performance in the preclinical curriculum (McManus et al., 2013; Saxena et al., 2024). These differences could be explained by females' higher achievement motivation. Demonstrating greater compensatory effort, self-control, and pride in their productivity may enable female students to achieve higher scores in medical courses. However, the impact of sex on student performance in medical schools appears to be a controversial topic (Meyer et al., 2019; Tamimi et al., 2023).

The change in the EE material between 2013 and 2015 reduced the predictive effect of sex on study success in multivariable models. Instead, the timing of postgraduate admission became a more significant predictor of academic success: students who were accepted two years or more after leaving upper secondary school performed worse than those who were accepted more quickly after graduation. Starting medical studies later after graduation may mean that the foundations in biology, chemistry, and physics provided by upper secondary school are no longer as strong as they once were for preclinical medical studies. To put it another way, a faster transition to medical studies would indicate success in academic studies and would therefore be desirable.

The overall predictive power explained almost one-fifth of the variation in study success. The low predictive power suggests that factors other than prior performance in ME or success in EE play a significant role in determining study success. Previous research has highlighted the importance of non-cognitive factors, such as personality traits, motivational factors, learning strategies, and psychological factors, in university study success, especially in the first year (Richardson et al., 2012; Saxena et al., 2024). The inclusion of completed vocational training in a relevant medical field as a selection criterion for medical studies, in addition to cognitive criteria, appears to be justified by a study conducted by two German medical schools (Amelung et al., 2022). Furthermore, contextual elements such as the teaching and learning environment are also influential in determining academic success (Koster & Verhoeven, 2017).

4.5. Limitations of the Study

Our study was conducted in a local setting at a medical faculty in Finland, and every educational setting is unique. Nevertheless, despite the limited scope and the timing of the change in entrance exam requirements, which occurred more than a decade ago, our findings may be helpful in considering possible interventions regarding selection criteria in medical schools that require changes in entrance examination material or the introduction of new admission routes.

In 2012–2015, the University of Oulu implemented a separate admission track for graduates. This track reserved ten study places exclusively for individuals who had completed first-degree university studies in any discipline. This approach might have affected the age group analysis. However, for these participants, several years had passed since their secondary school studies, requiring them to reacquaint themselves with the content to prepare for the EE.

Medical students have good study skills, which can be considered a minimum requirement for admission to medical school and successful medical studies (Lindblom-Ylänne et al., 1999). Previous research (McManus et al., 2005; Meyer et al., 2019; Wilkinson et al., 2011) has found that applicants accepted to medical school tend to have high grades in their previous studies, resulting in minimal variance within the target group and leading to weak correlations between the analysed explanatory and outcome variables. The limited

variance may limit the range of our data. In addition, many of the accepted applicants have previous university studies in the natural sciences. These applicants may have a solid understanding of science at university level, regardless of their ME test scores. Consequently, these applicants may excel in EE and are likely to continue to perform well in medical studies.

5. Conclusions

The changes in the selection process did not significantly impact the profiles of the selected students, nor did they expedite and streamline the access of newly matriculated applicants to medical studies, as expected in line with the broader goals of higher education policy. However, altering the EE material did affect applicants, particularly regarding the required knowledge base. This influence extends to the initial stages of their studies, suggesting a need to carefully examine the content of these studies. In fields like medicine, where there is high application pressure, the effects of changes in the selection process should be comprehensively evaluated from a broader perspective, extending beyond the accepted students. Regardless of the selection criteria, those who are accepted typically demonstrate strong learning capabilities. Despite modifications in the required entry-level knowledge, students with strong skills are admitted, and their learning and integration into the curriculum can be enhanced during their studies. Student selection is just beginning; the responsibility then shifts to the medical education providers to achieve the stated learning outcomes through their educational programs.

This study sheds light on the relevance of a candidate's performance in upper secondary school, their success in the entrance exam, and their subsequent performance in medical studies. With reforms in Finnish university student selection processes, the Matriculation Examination, which is the final test in upper secondary school, has gained increased importance. This holds true not only for candidates participating in the ME tests but also for the institutions organising these tests and those using the test results for admission purposes. Our research contributes valuable insights into the effects of the required knowledge base and enhances our understanding of the connection between student admissions and the initial stages of medical studies.

Supplementary Materials: The following supporting information can be downloaded at https://www.mdpi.com/article/10.3390/educsci15060683/s1: Table S1: Correlation coefficient between Matriculation examination grades and study success in medical courses. Correlations that are statistically significant at the 0.01 level are shown in bold.

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Abbreviations

The following abbreviations are used in this manuscript:

EE	Entrance exam
ME	Matriculation Examination
ECTS	European Credit Transfer and Accumulation System
SE	Standard error
SD	Standard deviation

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