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Correlation of high school exam grades with study success at a German medical school

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ABSTRACT

To evaluate the association between high school leaving exam grade and achieved grades in the first medical state exam among medicine students in a major southern German medical school.

An anonymous questionnaire-based cross sectional examination was performed among all medicine students of the 3rd to 5th year in a major medical school in the German federal state Bavaria. Associations between grades of the high school leaving exam and grades achieved in both written and oral parts of the first medical exam were analyzed using Spearman's rank correlation coefficients. 432 students answered the questionnaire. Spearman's rank correlation analysis showed that there is only a weak association between high school leaving exam and medical state exam grades. Our finding that high school leaving exam degrees and medical state exam grades are not strongly linked to each other support the trend seen in the past years in Germany that more and more medicine study places are distributed also considering other factors than high school leaving exam degrees.

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INTRODUCTION

The predictive value of different factors on medical school performance has continuously being discussed intensively throughout the past decades [1-12]. There is a legitimate interest on finding valid test mechanisms, as in many countries the number of applicants to medical schools is several times higher than the available places.

In Germany, university places are distributed by and under supervision of a central institution called "Stiftung für Hochschulzulassung" (formerly: ZVS; now: hochschulstart.de) [13]. Twenty percent of the available places are distributed solely considering the grade of the high school leaving exam (the so-called "Abitur") and 20% of the places by consideration of the

time the students are waiting for their university place since leaving high school. The remaining 60% of the places are distributed, after application at hochschulstart.de, using special screening methods by the individual universities, in which the grade of the high school leaving exam is playing a more or less important role, depending on each university (AdH, Auswahlverfahren der Hochschulen) [14].

When applying for a university place, students also have the opportunity to improve their selection chances by undertaking an additional exam which can be allocated with the high school exam grade (HSG) - however, this is not possible at all universities [15]. It is of prime interest whether the methods of distribution

used are predictive for a successful completion of the studies.

Remarkably, in Germany the predictive value of the HSG on study performance, which can be and is most often measured by the grades of the first medical examination after 2 years of study (the so-called “Physikum”, M1n, first “Staatsexamen”), was investigated only twice until today. Once in the year 1990 [16] as well as in 1998 and in this case based on the results of the medical state examinations in the years 1986-1987 [17]. Although the last mentioned elaborated and detailed study was performed among a huge number of students, it is reasonable to ask whether the results still are representative and valid after more than 20 years, as modalities of both high school leaving exam and medical state exam have changed, partly substantially, over time.

To address this question we performed a questionnaire-based cross-sectional study using an anonymous questionnaire among human medicine students in the semesters 5-10 (3rd to 5th year), which have already undertaken their first medical exam, and asked their HSG and also grades achieved in the written and oral part of their first medical state examination.

METHODS

Achieved results in the written and oral parts of the first medical state exam as well as the HSG were enquired using an anonymous questionnaire which was handed out to students, who were willing to participate, at the end of required courses during the summer study period 2012 at the medical school of the Friedrich-Alexander-University of Erlangen-Nuremberg. The grades of the German high school leaving exam can range between 0.9 (best achievable grade) and 4.0 (worst grade enabling university entry). They are calculated and given with one decimal place. The single parts of the first medical state exam are graded from 1 (best achievable grade) to 6 (worst achievable grade) and do not feature a decimal place. A grade equal to or higher than 5 in one part of the exam leads to the fail of the test.

Students were asked to give information about their age, gender and progress in study (explicitly the semester in which they are). Moreover, students were asked whether they have ever failed the first medical state exam. Since only the first attempt was considered for evaluation, reported grades of the second or third attempt were withdrawn and were imputed with grade “5”.

Statistical methods

In a first step, we graphically analyzed the correlation between grades in the first medical state exam and

HSG via scatterplots. To visualize the direction of a possible effect, we included a trend line calculated by a nonparametric locally weighted scatterplot smoothing estimator in the scatterplots.

In a second step, the correlation between HSG and both written and oral part of the first medical state exam, respectively, was analyzed using Spearman’s rank correlation coefficient and corresponding correlation tests.

All statistical tests were two-tailed with a significance level of $p = 0.05$. Data were analyzed using the statistical software package R version 2.14.2 [18].

RESULTS

Altogether, 432 students filled in the questionnaire. 7 questionnaires were sorted out due to fragmentary infilling, so that 425 (98.4%) of the questionnaires could be evaluated. From these students 258 (60.7%) were female and 167 (39.3%) were male.

High school leaving exam grades

36% of the students had a grade ≤ 1.4 , 54.8% a grade between 1.5 and 2.4, 8.7% a grade between 2.5 and 3.4 and 0.5% a grade ≥ 3.5 (Table 1). Distinct differences were seen when this aspect was regarded gender-distributed: More female students (39.9%) had achieved grades ≤ 1.4 when compared to male students (29.9%) (Table 1). In contrast, more male than female students had HSGs between 1.5 and 2.4 (58.1% to 52.7%, respectively) and 2.5 and 3.4 (10.8% to 7.4%, respectively) (Table 1). Students with HSGs > 3.5 were all male (Table 1).

Table 1. Distribution of the high school leaving exam grades among the students.

High school grade	frequency		
	Total	female	male
≤ 1.4	153 (36%)	103 (39.9%)	50 (29.9%)
1.5 - 2.4	233 (54.8%)	136 (52.7%)	97 (58.1%)
2.5 - 3.4	37 (8.7%)	19 (7.4%)	18 (10.8%)
> 3.5	2 (0.5%)	0 (0%)	2 (1.2%)

Written part of the first medical state exam

3.8% of the students achieved the best grade “1”, 28.7% the grade “2”, 38.6% the grade “3” and 17.6% the grade “4” whereas 11.3% of the asked students failed the written part of the first medical state exam (Table 2). In the written part of the exam more male than female students achieved the grades “1” and “2”

Table 2. Distribution of the grades of the written part of the medical state exam among the students.

State exam (written)	frequency		
	Total	female	male
1	16 (3.8%)	3 (1.2%)	13 (7.8%)
2	122 (28.7%)	61 (23.6%)	61 (36.5%)
3	164 (38.6%)	108 (41.9%)	56 (33.5%)
4	75 (17.6%)	56 (21.7%)	19 (11.4%)
failed	48 (11.3%)	30 (11.6%)	18 (10.8%)

(7.8% to 1.2% and 36.5% to 23.6%, respectively) (Table 2). The grades “3” and “4” were underrepresented among male students when compared to female students (33.5% to 41.9% and 11.4% to 21.7%, respectively) (Table 2). The number of students having failed the exam was nearly the same among male and female students (10.8% to 11.6%) (Table 2).

Oral part of the first medical state exam

8.2% of the students achieved the grade “1”, 32.9% the grade “2”, 31.8% the grade “3” and 15.8% the grade “4” (Table 3). 11.3% of the students failed the oral part of the exam at the first attempt (Table 3). Slightly more male than female students achieved the grade “1” (9% to 7.8%) and also, a little more often the grade “2” (36.5% to 30.6%) (Table 3). In the consequence, male students were underrepresented regarding the grades “3” and “4” (30.5% to 32.6% and 13.2% to 17.4%, respectively) (Table 3). Regarding the number of students having failed this part of the exam there were no noteworthy differences between male and female students (10.8% to 11.6%) (Table 3).

Table 3. Distribution of the grades of the oral part of the medical state exam among the students.

State exam (oral)	frequency		
	Total	female	male
1	35 (8.2%)	20 (7.8%)	15 (9%)
2	140 (32.9%)	79 (30.6%)	61 (36.5%)
3	135 (31.8%)	84 (32.6%)	51 (30.5%)
4	67 (15.8%)	45 (17.4%)	22 (13.2%)
failed	48 (11.3%)	30 (11.6%)	18 (10.8%)

Correlation of the high school leaving exam grade with results of the medical state exam

The Spearman correlation analysis showed that there is only a weak association between the grades of HSG and the grades achieved in the written and oral part of the first medical state exam ($r=0.23$ and 0.16 , respectively) (Table 4, Figure 1, 2). This is also true when this issue is regarded gender-separated, however, there is a tendency that the correlation is slightly stronger among male students if the written part of the state examination is regarded ($r=0.28$ vs. 0.25 among female students) (Table 4). Also, there is a slightly stronger correlation among female students regarding the oral part of the examination ($r=0.19$ vs. 0.14 among male students) (Table 4).

Different results could be seen when the students were separated by their achieved results in the HSG. Students which had achieved a grade ≤ 1.4 showed a higher correlation in both written and oral parts of the state exam if compared to students which had a grade >1.5 ($r=0.36$ vs. 0.22 and 0.36 vs. 0.10 , respectively) (Table 5).

Trend analyses showed that there is a tendency of achieving better results when starting medical school with higher HSGs and this is more distinct among students with a HSG ≤ 1.4 (Figure 1, 2).

Table 4. Correlation analysis according to Spearman between grades of high school leaving exam and the grades of the written and oral parts of the medical state exam among all, female and male students.

High school grade and:	correlation					
	All students	p	female	p	male	p
state exam, written part	0.23	<0.001	0.25	<0.001	0.28	<0.001
state exam, oral part	0.16	0.001	0.19	0.003	0.14	0.076

Table 5. Correlation analysis according to Spearman between grades of high school leaving exam and the grades of the written and oral parts of the medical state exam among students which achieved high school leaving grades <1.4 and >1.5. HSG = high school leaving exam grade.

High school grade (HSG) and:	correlation			
	HSG ≤ 1.4	p	HSG ≥ 1.5	p
state exam, written part	0.36	<0.001	0.22	<0.001
state exam, oral part	0.36	<0.001	0.10	0.096

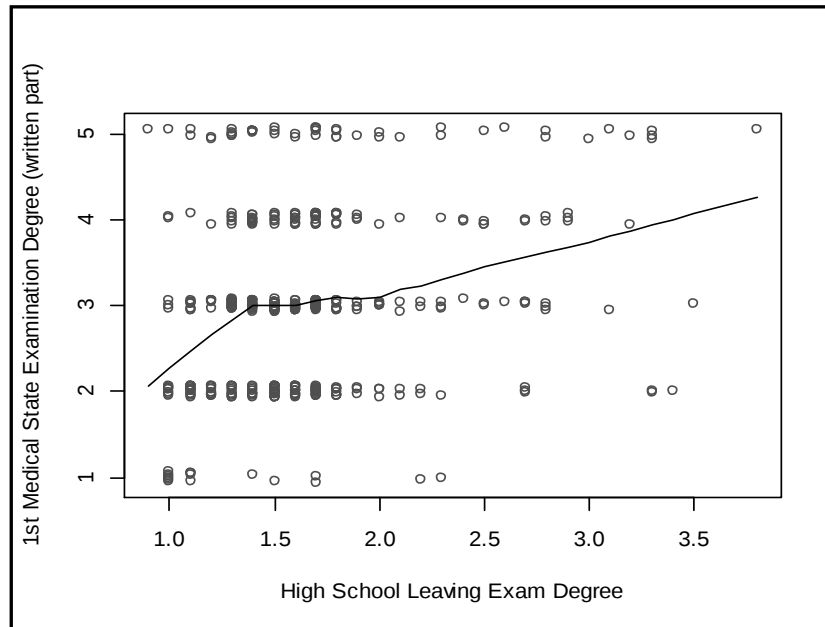


Figure 1. Diagram showing the trend analysis between high school leaving exam grade and grade of the written part of the first medical state exam.

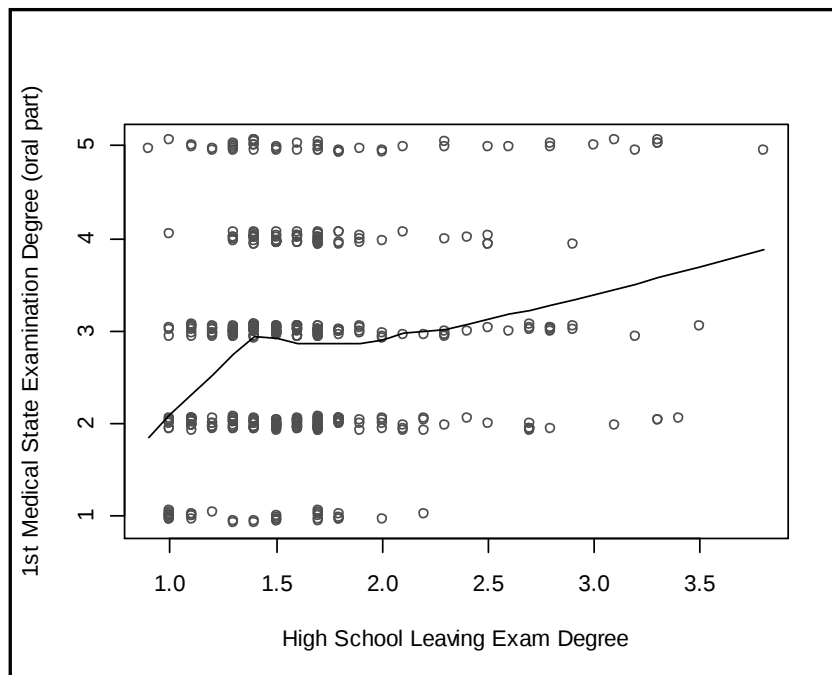


Figure 2. Diagram showing the trend analysis between high school leaving exam grade and grade of the oral part of the first medical state exam.

DISCUSSION

The evaluation of predictive criteria for academic performance in medical schools is a topic of high interest and is being performed in many countries worldwide as study places usually are less than applicants and there is the attempt to distribute these places equitably but also in an effective manner. 1988, Wallace et al. could show in a cohort of British students that there is a weak but still significant correlation between HSG and preclinical and clinical study performances [12]. However, they could also demonstrate that these findings are not at all stable but partly differ distinctly between different cohorts. In medical schools in Croatia and Saudi-Arabia it could be shown that high school grades are significant predictors for university graduation and in in-course academic performance data [2,3], whereas another recent Saudi-Arabian study did not show a significant predictive value [4]. Regarding medical students in Amsterdam (Netherlands), Hulsman et al. could show in a recent study that academic achievement but not motivation is significantly higher among students which had been allowed to entry the medical school due to their excellent high school grades when compared to students which gained a study place via a special selection procedure based on medical comprehension, social and ethical understanding of health care as well as communication and interpersonal skills [5].

However, the assessment of the predictivity of factors to academic performance has to be undertaken specifically in each country as the modalities of high school and medical school education and also most important, social and cultural behavior can be distinctly different between countries and populations. The rationale for the present study was the fact that the most recent study investigating this issue in Germany was performed in the year 1996 considering medical state exam grades of the years 1986 and 1987 [17]. Although this classical study relied on the grades of a huge amount of students (>30,000) and showed, compared to other study disciplines a relatively high correlation between HSG and study performance in Germany [19], the question arose whether the results still are valid nowadays as modalities of both, high school exams and medical state examination and last but not least also the modalities of the medical curricula have remarkably changed over time.

In our study we could show that there is only a weak correlation between high school leaving exam grade and the achieved grades in both, written and oral parts of the first medical state exam. This correlation is stronger among students with very good HSGs and this finding is similar to the findings of Hulsman et al. among Dutch medical students, where it could be

shown that students with excellent HSGs are also overrepresented among very successful students [5].

Our findings led us to conclude that the consideration-only of the HSG sorts out potential students who could be successful in their study despite their “worse” HSGs. More and a wider-spread consideration of other student selection methods seems urgently to be advisable. These other methods, already applied at some universities, include among others 1) an additional and facultative exam being considered from some faculties and offering potential medical students the possibility to improve their HSG (TMS), 2) the consideration of former apprenticeships in (mostly) medical branches and 3) the results of an interview [20].

However, our study has also limitations: Although we had used a representative number of students, more factors have to be considered in forthcoming investigations. As the high school education and also high school leaving exam underlies, partly distinct, different modalities in the different federal states of Germany, one have to address this issue in following studies to evaluate the influence of these variables. Also, further research has to be performed to evaluate the impact of socioeconomic and educational circumstances as well as of the origin of the HSG in terms of the federal state the HSG was achieved, as Germany has a federal and therefore diverging educational system between the federal states.

Nevertheless, our findings support the trend that more and more places in German medical schools are distributed considering other factors than high school leaving exam grades alone, as they show that the association between HSG and medical state exam grades is no longer as strong as it was found some 20 years ago. It can't be denied that there is still a connection of HSG and medical school performance, however, the fact that this relation is not really distinct should encourage performing further research to support the constant efforts which had been made in the past years to enable more equitable distribution of medical school study places.

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